No. 22-1228

In the United States Court of Appeals for the Federal Circuit

PANDUIT CORP., FS.COM INC., THE SIEMON COMPANY,
APPELLANTS

v.

INTERNATIONAL TRADE COMMISSION,
APPELLEE

CORNING OPTICAL COMMUNICATIONS LLC,
INTERVENOR

APPEAL FROM THE UNITED STATES INTERNATIONAL TRADE COMMISSION IN NO. 337-TA-1194

CORRECTED NON-CONFIDENTIAL CONSOLIDATED OPENING BRIEF OF APPELLANTS PANDUIT CORP., FS.COM INC., AND THE SIEMON COMPANY

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LANGUAGE OF THE PATENT CLAIMS AT ISSUE

Claims 1 and 3 of U.S Patent No. 9,020,320 (the "'320 patent") provide:

1. A fiber optic apparatus, comprising:

a chassis; and

a fiber optic connection equipment provided in the chassis;

the fiber optic connection equipment configured to support a fiber optic connection density of at least ninety-eight (98) fiber optic connections per U space, based on using at least one simplex fiber optic component or at least one duplex fiber optic component.

3. The fiber optic apparatus of claim 1, wherein the fiber optic connection equipment is configured to support· a fiber optic connection density of at least one hundred forty-four (144) fiber optic connections per U space.

Claim 11 of the U.S. Patent No. 10,444,456 (the "'456 patent") provides:

11. A fiber optic apparatus, comprising:

a chassis configured to be disposed in an equipment rack, the chassis comprising front and rear ends that are spaced apart from one another in a longitudinal direction, and comprising opposite first and second ends that are spaced apart from one another in a lateral direction that extends crosswise to the longitudinal direction;

a plurality of fiber optic equipment trays supported by the chassis and extendable relative to the chassis in the longitudinal direction; and

a plurality of fiber optic modules configured to be installed in the plurality of fiber optic equipment trays, wherein each fiber optic module of the plurality of fiber optic modules comprises a front side, a rear side, an internal chamber, a plurality of first fiber optic adapters disposed through the front side, at least one second fiber optic adapter disposed through the rear side, and a plurality of optical fibers disposed within the internal chamber and extending from the at least one second fiber optic adapter to the plurality of first fiber optic adapters;

> wherein each fiber optic equipment tray of the plurality of fiber optic equjpment trays is configured to receive multiple fiber optic modules of the plurality of fiber optic modules;
>
> wherein the plurality of fiber optic equipment trays and the plurality of fiber optic modules are configured to support a fiber optic connection density of at least ninety-eight (98) fiber optic connections per U space of the chassis, based on using a simplex fiber optic adapter or a duplex fiber optic adapter as each fiber optic adapter of the plurality of first fiber optic adapters; and·
>
> wherein a U space comprises a height of 1.75 inches and comprises a width of 19 inches or 23 inches.

Claim 1 of U.S. Patent No. 10,120,153 (the "'153 patent"), from which claims 9 and 16 depend, provides:

> 1. A fiber optic apparatus, comprising:
>
> a chassis configured to be disposed in an equipment rack, the chassis comprising opposite front and rear ends that are spaced apart from one another in a longitudinal direction, and comprising opposite first and second ends that are spaced apart from one another in a lateral direction that extends crosswise to the longitudinal direction;
>
> a guide system configured to be disposed within the chassis;
>
> at least one fiber optic equipment tray configured to slidably engage within the guide system, the at least one fiber optic equipment tray comprising a front end with at least one fiber optic routing element that comprises successive material sections extending frontward, upward, and rearward, respectively, to permit optical fibers to be routed to either left or right portions of the at least one fiber optic equipment tray toward the first and second ends of the chassis; and
>
> a plurality of fiber optic modules configured to be received by the at least one fiber optic equipment tray, wherein each fiber optic module of the plurality of fiber optic modules is independently movable in the longitudinal direction relative to the at least one fiber optic equipment tray, and wherein each fiber optic module of the plurality of fiber optic modules comprises a

front end, a rear end, an interior, a plurality of first fiber optic adapters disposed through the front end, at least one second fiber optic adapter disposed through the rear end, and at least one optical fiber disposed within the interior and establishing at least one optical connection between the at least one second fiber optic adapter and at least one first fiber optic adapter of the plurality of first fiber optic adapters.

Claims 14, 22, and 23 of the U.S. Patent No. 8,712,206 (the "'206 patent") provide:

14. A fiber optic module, comprising:

a main body defining an internal chamber disposed between a front side and a rear side;

a plurality of optical fibers disposed in the internal chamber;

a front opening disposed along a longitudinal axis in the front side;

a first plurality of fiber optic components optically connected to the plurality of optical fibers, the first plurality of fiber optic components disposed through the front opening providing a fiber optic connection density of at least one fiber optic connection per 7 .0 millimeters {mm) of width of the front opening; and

at least one second fiber optic component optically connected to at least one of the plurality of optical fibers to provide optical connection between the at least one second fiber optic component and at least one of the first plurality of fiber optic components

22. The fiber optic module of claim 14, further comprising at least one rail disposed on the main body.

23. The fiber optic module of claim 22, further comprising at least one latch attached to the at least one rail and configured to engage the at least one rail.

PANDUIT CORP.'S CERTIFICATE OF INTEREST

Pursuant to Federal Circuit Rule 47.4, undersigned counsel for Appellant certifies the following:

1. The full name of the party represented by me is Panduit Corp.

2. There are no additional real parties in interest.

3. There are not any parent corporations or and publicly held companies that own 10 percent or more of the stock of the party represented by me.

4. The following attorneys appeared for Appellants in proceedings in the International Trade Commission or are expected to appear in this Court:

(a) Of Steptoe & Johnson LLP: John Caracappa, Li Guo, and Benjamin Holt

(b) Of DLA Piper: Robert B. Groselak

5. There are no other cases or case numbers of cases will directly affect or be directly affected by this court's decision in this appeal include, other than the originating case and case number being appealed from.

6. There are no applicable organizational victims in criminal cases or bankruptcy case debtors or trustees related to this proceeding.

/S/KELLY J. EBERSPECHER
KELLY J. EBERSPECHER

THE SIEMON COMPANY'S CERTIFICATE OF INTEREST

Pursuant to Federal Circuit Rule 47.4, undersigned counsel for Appellant certifies the following:

1. The full name of the party represented by me is The Siemon Company.

2. There are no additional real parties in interest.

3. There are not any parent corporations or and publicly held companies that own 10 percent or more of the stock of the party represented by me.

4. The following attorneys appeared for Appellants in proceedings in the International Trade Commission or are expected to appear in this Court:

   (a) Of Cantor Colburn LLP: Nicholas A. Geiger

5. There are no other cases or case numbers of cases will directly affect or be directly affected by this court's decision in this appeal include, other than the originating case and case number being appealed from.

6. There are no applicable organizational victims in criminal cases or bankruptcy case debtors or trustees related to this proceeding.

/S/MICHAEL J. RYE
MICHAEL J. RYE

FS.COM, INC.'S CERTIFICATE OF INTEREST

Pursuant to Federal Circuit Rule 47.4, undersigned counsel for Appellant certifies the following:

1. The full name of the party represented by me is FS.com Inc.

2. There are no additional real parties in interest.

3. FS.com, Ltd. is the parent corporation that owns 10 percent or more of the stock of the party represented by me.

4. The following attorneys appeared for Appellants in proceedings in the International Trade Commission or are expected to appear in this Court:

   (a) Of K&L Gates LLP: Benjamin E. Weed, Yonglin Liu

5. There are no other cases or case numbers of cases will directly affect or be directly affected by this court's decision in this appeal include, other than the originating case and case number being appealed from.

6. There are no applicable organizational victims in criminal cases or bankruptcy case debtors or trustees related to this proceeding.

/S/GEORGE C. SUMMERFIELD
GEORGE C. SUMMERFIELD

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STATEMENT OF RELATED CASES

Counsel for Appellants certify that no other appeal from the same proceeding at the United States International Trade Commission ("ITC" or "Commission") is or was previously before this Court or any other appellate court, whether under the same or a similar title. Fed. Cir. R. 47.5(a).

Under Fed. Cir. R. 47.5(b), counsel for Appellants state that the Court's decision in this appeal will not affect other judicial or administrative matters.

STATEMENT OF JURISDICTION

The ITC issued a final determination under 19 U.S.C. § 1337 ("Section 337") on August 3, 2021, with the presidential review period ending on October 2, 2021. Appellants Panduit Corp. ("Panduit"), The Siemon Company ("Siemon"), and FS.com, Inc. ("FS") filed their timely Notice of Appeal within 60 days, on November 29, 2021. *See* 19 U.S.C. § 1337(c). This Court therefore has jurisdiction pursuant to 28 U.S.C. § 1295(a)(6).

STATEMENT OF THE ISSUES

I. Whether the Commission legally erred in holding that Panduit and Siemon imported "articles that . . . infringe" under the importation requirement of 19 U.S.C. § 1337(a)(1)(B) based on its findings of induced infringement of apparatus claims of the '320, '456, and '153 patents when (1) Panduit and Siemon only imported modules and not chassis or other components; (2) modules are not required elements of the ’320 patent and are but one component out of several in the ’456 and ’153 patents; (3) modules did not directly infringe any of the ’320, ’456, and ’153 patents; (4) the Commission did not require any nexus between the modules and the claims of the ’320, ’456, and ’153 patents; and (5) the Commission found that the modules did not contributorily infringe because they were capable of substantial noninfringing uses.

II. Whether the Commission legally erred in finding asserted claims of the ’320 and ’456 patents enabled when (1) the claims of those patents recite a broad, open-ended range of fiber optic connection densities per U space of “at least” 98 and 144; (2) the Commission excluded post-priority-date evidence of new, smaller form factor components within the scope of the claims that can achieve far higher connection densities in a U space (such as 432 connections); and (3) the ’320 and ’456 patents do not disclose teachings that would enable the POSA to exceed densities significantly greater than 144 connections per U-space.

III. Whether the Commission legally erred in finding that Panduit’s and Siemon’s accused products infringed the ’153 patent when (1) Corning amended the claims during prosecution to limit the recited “fiber optic routing elements” to those with a distinct configuration; (2) the ALJ agreed that the claims were limited to that configuration; but (3) the Commission declined to address Appellants' non-infringement arguments showing that their products lacked the configuration.

IV. Whether the Commission's findings that Siemon's and FS's module products infringed the '206 patent were legally incorrect because they were premised on an improper construction of "front opening" that includes modules with multiple front openings, rather than a single front opening.

PRELIMINARY STATEMENT

The Commission opinion departs from longstanding legal precedent in two important ways. *First*, since its inception, the Commission's jurisdiction has been statutorily limited through the importation requirement. Congress well-understood that Federal Courts were empowered to adjudicate intellectual property disputes in the United States. The Commission, which has powerful injunctive remedies not available in Federal Court, was not intended to supersede this jurisdiction for all domestic products, but instead to handle international trade matters. For decades, the Commission adhered to this requirement through a "nexus" test that required the imported "article" have a sufficient "nexus" to the infringing act. Here, the Commission has discarded the nexus test, seemingly reserving the right to claim jurisdiction over any domestically produced product so long as a component of that product is imported. The Commission found it irrelevant whether the component is significant; whether the component is necessary to infringement; or whether the component is even expressly recited in the claims. This holding improperly expands the Commission's jurisdiction beyond what Congress intended and should be reversed.

Second, the Commission misapplied Federal Circuit precedent to find broad, open-ended range claims to be enabled. Two patents-in-suit (the '320 and '456 patents) include claims that require a connection density of "***at least 144*** connections per U space" using simplex and duplex components, while the specification undisputedly describes only a density ***up to 144*** – nothing more. The Commission ignored that the open-ended claims broadly permit the use of new advances using smaller form-factor components that can achieve greater connection densities than those achievable as of the priority date; and it foreclosed reliance on post-priority-date evidence that demonstrated that new advances within the scope of the claims could achieve densities of ***432*** connections or more. The Commission's ruling effectively permits Corning to claim future-developed technology that achieves densities in excess of 144 connections per U space—precisely what the enablement requirement was designed to prohibit.

Finally, the Commission committed two other legal errors that justify reversal or remand. For the '153 patent, the Appellants presented non-infringement arguments to both the Commission and the ALJ, but neither addressed the argument.

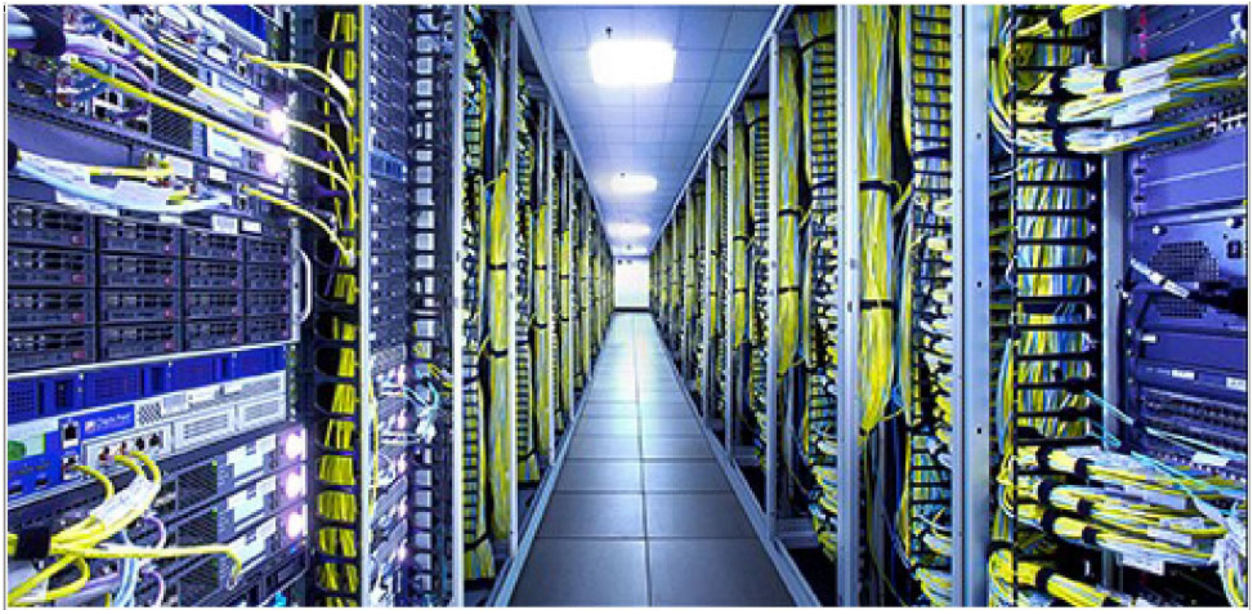
Panduit's and Siemon's products do not infringe the '153 patent because the orientation of the accused product does not meet the specific directional limitations in the claim. Also, for the '206 patent, the Commission misapplied principles of claim differentiation and arrived at an erroneous claim construction. This error is determinative of infringement for both Siemon and FS and should similarly be reversed.

STATEMENT OF THE CASE

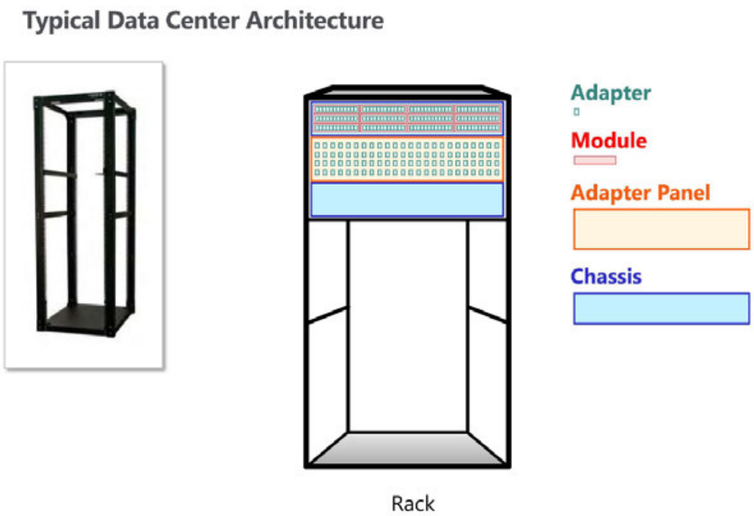
I. Background of Relevant Fiber Optic Technology

This is a case about fiber optic technology. Fiber optics involve the use of fiber optic cables and related components to transmit data. Appx136032 (Q/A 20). Fiber optic cables have been used since the 1970s to transmit signals over long distances. Appx28264 (Q/A 24); Appx136033 (Q/A 21). Since the 1980s, rack mounted chassis have been used to support fiber optic components and increasing needs for higher-bandwidth communications. Appx136033 (Q/A 22); Appx28268 (Q/A 43). With increased bandwidths that tracked Moore's law, increasing transistor densities on electronic chips permitted faster communications, spurring demand for increasing densities of fiber optic components. Appx136033 (Q/A 23).

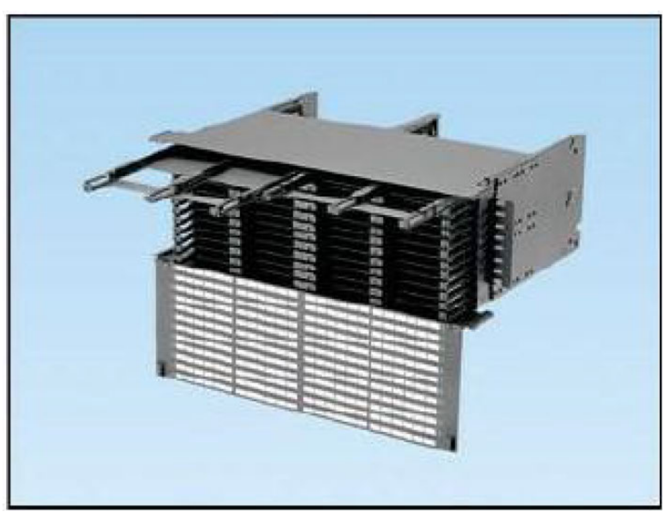
As demand has increased, companies have reduced the size and increased the power of fiber optic communications components. Appx136034 (Q/A 24). The modern data center took shape, which may include millions of optical fibers connecting thousands of devices, as shown below. Appx27386; Appx28268 (Q/A 40); Appx136034 (Q/A 27); Appx9.



In the modern data center, multiple servers, chassis, trays, modules, adapter plates, connectors, adapters, and other fiber optic communication equipment sits on racks in an effort to achieve high densities. Appx136034 (Q/A 27); Appx136036 (Q/A 31-32) Appx136041-136042 (Q/A 59-67). The image below shows a typical data center architecture, which illustrates just some of these components. Appx134515 (RDX-001.8).



Fiber-optic components are further subdivided within the racks and chassis shown above. For example, the chassis on a data center rack can in turn be organized using trays. The image on the left shows a fiber optic chassis and trays that house a single fiber optic module (shown in blue), and the image on the right shows another example of such a chassis and its protruding trays without any modules inserted.



Appx26742; Appx84724. The chassis are manufactured in standardized sizes and heights—thus, the chassis shown on the left is a "1U" chassis,[1] while the chassis on the right is a "4U" chassis. A fiber optic module that can optionally be inserted into the chassis is shown below.

Appx26871.

Fiber optic connectors and adapters can be used with modules or adapter plates to further subdivide fiber optic connections. Appx136036-136037 (Q/A 34-36). Adapters are the sockets or receptacles into which fiber optic connectors are inserted, and they can be of a simplex or duplex type. Appx28264-28265 (Q/A 25). Simplex and duplex adapters support single-fiber and two-fiber connections. Appx136037-136038 (Q/A 37-45); Appx28624-28625 (Q/A 25-29). They can be of various types, with one well-known type known as the priority date being called an *LC-type* adapter. Appx136038 (Q/A 43). LC adapters were small form-factor

[1] A "1U" space is alternatively referred to as a "1RU" space or a "U space." Appx9.

simplex and duplex components developed by Lucent technologies in the 1990s, and examples are shown below. Appx28265 (Q/A 29); Appx134219; Appx148435; Appx27683.

Another class of adapters were known as multi-fiber adapters—these involve either 8 or 12 fibers per connection (rather than 1 or 2) and are outside the scope of this appeal. Appx136038-136039 (Q/A 47-49); Appx27683; Appx28265-28266 (Q/A 26, 34). Simplex/duplex adapters and multi-fiber adapters can be thought of as two distinct *species* of adapters. Appx27686.

II. The Fiber Optic Equipment Patents and Proceedings Below

The asserted patents relate to the fiber optic technologies and connection equipment described above. The ’320 patent, ’456 patent, and ’153 patent are from the same family and are generically directed toward fiber optic apparatuses and related components, including the chassis that house fiber optic components.

Appx9. The ’206 patent is from a different family and is directed solely to fiber optic modules. Appx9, Appx12.

A. The Fiber Optic Connection Equipment Patents

1. The ’320 Patent

The ’320 patent is directed toward a chassis with generic “fiber optic connection equipment” that is configured to support particular fiber optic connection densities of “at least” 98 or 144 connections using “at least one simplex fiber optic component or at least one duplex fiber optic component.” Claim 1 recites:

> 1. A fiber optic apparatus, comprising:
> a chassis; and
> a fiber optic connection equipment provided in the chassis;
> the fiber optic connection equipment configured to support a fiber optic connection density of at least ninety-eight (98) fiber optic connections per U space, based on using at least one simplex fiber optic component or at least one duplex fiber optic component.

Appx609 (Claims 1, 3). The claim language does not restrict the sizes or types of the configured equipment to achieve the claimed densities, other than the use of a chassis and the use of “at least one” simplex or duplex fiber optic component.

2. The ’456 Patent

The ’456 patent is also directed toward fiber optic apparatuses that achieve “at least” 98 fiber optic connections per 1U space. Corning asserted claims 11, 12, 14-16, 19, 21, 27, and 28 of the ’456 patent. Relative to the ’320 patent, the claims of the ‘456 patent more specifically recite specific required components of the apparatus, including a chassis in an equipment rack, fiber optic trays, modules, simplex and duplex adapters, and other components. Claim 11 recites:

> 11. A fiber optic apparatus, comprising:
> a chassis configured to be disposed in an equipment rack,
> the chassis comprising front and rear ends that are spaced apart from one another in a longitudinal direction, and comprising opposite first and second ends that are spaced apart from one another in a lateral direction that extends crosswise to the longitudinal direction;
> a plurality of fiber optic equipment trays supported by the chassis and extendable relative to the chassis in the longitudinal direction; and
> a plurality of fiber optic modules configured to be installed in the plurality of fiber optic trays, wherein each fiber optic module of the plurality of fiber optic modules comprises a front side, a rear side, an internal chamber, a plurality of first fiber optic adapters disposed through the front side, at least one second fiber optic adapter disposed through the rear side, and a plurality of optical fibers disposed within the internal chamber and extending from the at least one second fiber optic adapter to the plurality of first fiber optic adapters;
> wherein each fiber optic equipment tray of the plurality of fiber optic equipment trays is configured to receive multiple fiber optic modules of the plurality of fiber optic modules;
> wherein the plurality of fiber optic equipment trays and the plurality of fiber optic modules are configured to support a fiber optic connection density of at least ninety-eight (98) fiber optic connections per U space of the chassis, based on a simplex fiber optic adapter or a duplex fiber optic adapter as each fiber optic adapter of the plurality of first fiber optic adapters; and
> wherein a U space comprises a height of 1.75 inches and comprises a width of 19 inches or 23 inches.

Appx842. The adapters recited in the claims of the ’456 patent are simplex or duplex, but claims 11, 12, 15-16, 19, and 21 do not restrict the simplex or duplex connectors to those of any particular size or type.

3. The ’153 Patent

The ’153 Patent is also directed to fiber optic equipment, but does not recite particular fiber optic connection densities. Appx664. Corning asserted claims 9, 16, 23, and 26. Appx6. The claims require additional features, such as that the fiber optic equipment include guide systems and trays that are configured in a particular manner. Appx722, Appx724. Independent claim 1, from which claims 9 and 16 depend, recites:

> 1. A fiber optic apparatus, comprising:
> a chassis configured to be disposed in an equipment rack, the chassis comprising opposite front and rear ends that are spaced apart from one another in a longitudinal direction, and comprising opposite first and second ends that are spaced apart from one another in a lateral direction that extends crosswise to the longitudinal direction;
> a guide system configured to be disposed within the chassis;
> at least one fiber optic equipment tray configured to slidably engage within the guide system, ***the at least one fiber optic equipment tray comprising a front end with at least one fiber optic routing element that comprises successive material sections extending frontward, upward, and rearward, respectively,*** to permit optical fibers to be routed to either left or right portions of the at least one fiber optic equipment tray toward the first and second ends of the chassis; and
> a plurality of fiber optic modules configured to be received by the at least one fiber optic equipment tray, wherein each fiber optic module of the plurality of fiber optic modules is independently movable in the longitudinal direction relative to the at least one fiber optic equipment tray, and wherein each fiber optic module of the plurality of fiber optic modules comprises a front end, a rear end, an interior, a plurality of first fiber optic adapters disposed through the front end, at least one second fiber optic adapter disposed through the rear end, and at least one optical fiber disposed within

> the interior and establishing at least one optical connection between the at least one second fiber optic adapter and at least one first fiber optic adapter of the plurality of first fiber optic adapters.

Appx722-723 (emphasis added). Independent Claim 23 contains substantially similar limitations. Appx724. Each of the claimed trays thus have a front end with "at least one fiber optic routing element that comprises successive material sections extending frontward, upward, and rearward, respectively . . ." that is used to route optical fibers towards the sides of the chassis. Appx722-723 (Claims 1, 9, 16), Appx724 (Claims 23, 26).

B. Relevant Proceedings Before the ALJ and the Commission Related To The '320, '456, and '153 Patents

1. Infringement and Importation Issues Pertaining to the '320, '456, and '153 Patents That Apply To Panduit and Siemon

The ALJ and Commission held that neither of Panduit nor Siemon directly infringed any of the '320, '456, or '153 patents because none of them sell all of the required components recited in the claims in combination. Appx171-172, Appx320, Appx374-375 (ALJ); Appx23.

Nonetheless, Appellants Panduit and Siemon import modules that can optionally be used in the ***chassis*** that is recited in each the asserted claims of the '320, '456, and '153 patents. Appx167; Appx22; Appx170; Appx218-219. Unlike the modules, Panduit produces the chassis and relevant subassemblies domestically, in Illinois. *See, e.g.,* Appx167; Appx133864 (42:5-43:7) (tray assembly), Appx133873 (79:6-21) (enclosures). The ALJ and Commission made no factual findings that Panduit or Siemon imported any other fiber optic components within the scope of the ’320, ’456, or ’153 patents.

The Commission considered whether Panduit’s and Siemon’s importation of modules constituted contributory infringement, i.e., liability for “***imports into the United States [of] a component***” of a patented invention. *See* 35 U.S.C. § 271(c) (emphasis added). The ALJ found that neither party contributorily infringed because the modules have “substantial noninfringing uses.” Appx218-220. For Panduit, the ALJ held that the accused modules can be used with unaccused HD Flex Zero RU Bracket and Cassette holders, and adapters that can be used with other non-infringing systems known as the SFQ and Opticom systems. Appx219 (citing Appx20877; Appx20531; Appx150534-150535 (Q/A 48-52); *see also* Appx136672-136673 (Q/A 251); Appx145390-145401; Appx170 n.16; Appx150535 (Q/A 52)). Siemon has similar non-infringing uses. Appx219 (citing Appx20788-20787; Appx20546; Appx149928 (Q/A 20-21); Appx170 n.16). The Commission affirmed the findings of no contributory infringement. Appx51-52.

The ALJ and Commission, however, found that Panduit and Siemon induced infringement of the ’320, ’456, and ’153 patents. Appx48.[2] The ALJ held that Siemon and Panduit induced customers to infringe by encouraging, teaching, and aiding them to use their products in an infringing device. Appx207-209; Appx212-214; Appx331; Appx336; Appx402; Appx404. The ID held that Panduit and Siemon induced infringement based on generic specification documents, ordering and installation guides, and marketing documents pertaining to Panduit’s FLEX products and Siemon’s LightStack products. Appx208-209, Appx212-214. There were no factual findings that any of these documents were included or referenced on packaging of imported modules or that these written materials were imported. *See* Appx207-209; Appx212-214. In fact, certain of the cited documents promoted non-infringing uses. Appx214 (Siemon’s documents reference the use of non-infringing adapter plates).

Panduit and Siemon separately challenged both before the ALJ and the Commission whether the imported modules could be deemed “articles that infringe” pursuant to 19 U.S.C. § 1337(a)(3)(A)—i.e., the importation requirement.

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[2] Both Panduit and Siemon were found by both the ALJ and Commission to induce infringement of claims 1 and 3 of the ’320 patent, claims 11-12, 14-16, 19, 21, and 27-28 of the ’456 patent, and claims 9 and 23 of the ’153 patent. *Id.* Panduit was additionally found to infringe claims 16 and 26 of the ’153 patent.

(continued...)

On appeal, there is no dispute that Panduit and Siemon neither directly nor contributorily infringe any of the ’320, ’456, or ’153 patents; nor is there any dispute that Panduit does not infringe the only patent-in-suit directed squarely to modules—the ’206 patent.[3] Appx524.

The ALJ noted that “[e]arly Commission precedent established that there must be a nexus between the importation . . . and the alleged unfair acts” at issue. Appx164. It acknowledged that, in this case, “there are some combinations that do not infringe the asserted patents,” but held that Panduit and Siemon imported “articles that infringe” because it deemed their “import activity” to be “sufficiently tied to the alleged infringement to qualify as an unfair act under 19 U.S.C. § 1337(a)(1)(B).” Appx170-171.

The Commission affirmed the ALJ’s holding that the imported modules were “articles that infringe.” Appx17-23. It held that because Panduit and Siemon import components of accused apparatuses, “[t]hat is sufficient to establish” importation under Section 337. Appx17. The Commission vacated the ALJ’s discussion of any “nexus” test it might have applied, holding that “[w]hether imported components meet any claim limitations or have a nexus to the asserted claims is irrelevant

[3] Unlike Panduit, Siemon was found to infringe claim 22 of the ’206 patent, which Siemon is separately appealing before this court. If reversed, the facts of both Panduit and Siemon are generally similar for both parties’ appeal of satisfaction of the importation requirement.

to the issue of whether there is an 'importation into the United States' of those components." Appx22. It held that "an 'article supplied' to induce infringement can be an 'article that infringes,'" and that there is no requirement that an "article that infringes" be a "primary" or "quintessential" article. Appx30. It concluded that "'the statutory phrase 'articles that . . . infringe' covers chassis and module combinations that, after importation of the modules, were used by Panduit's and Siemon's customers to directly infringe as a result of Panduit's and Siemon's inducement.'" Appx32 (quoting Appx169).

Chair Kearns submitted "Additional Views" regarding "articles that infringe" under the importation requirement. Appx98-104. He noted that "[a] nexus test has never been rejected by our reviewing court," acknowledged that "section 271(c), addressing contributory infringement, is the only relevant part of the section that speaks to the standard for infringement by components of an invention," and proposed a four-factor test that is largely based on the contributory infringement standard and akin to another nexus test. Appx102-103.

2. Proceedings Pertaining To Lack of Enablement of the '320 and '456 Patents

Appellants argued below that claims 1 and 3 of the '320 patent and claim 11 and various dependent claims of the '456 patent are invalid for lack of enablement based on the open-ended, range limitations that cover connection densities of "at least" 96 or 144 fiber optic connections. The ALJ held that the claims were enabled based on Corning's arguments and assertions that no one had achieved more than approximately 144 connections per U space using fiber optic components available in the prior art. Appx279-289. Without addressing the claims' breadth, the ALJ agreed with Corning that there was an inherent upper limit to the claims and that the teachings in the specification allowed the POSA to approach that limit.

Appellants Petitioned to the Commission, noting that the ALJ erred in limiting the analysis of the "inherent upper limit," ignored the broad claim scope of the claims at issue, and improperly excluded relevant post-priority-date evidence about new MDC adapters that can be used to achieve densities of at least 432 connections per U-space. Appx22899-22906. Because the Commission declined to review the ALJ's findings, the ALJ's decision on this issue became the Commission's decision for purposes of this appeal.[4]

3. Additional Relevant Proceedings Pertaining To Non-Infringement of The '153 Patent

The parties agreed on, and the ALJ adopted, the construction for the term "at least one fiber optic routing element that comprises successive material sections extending frontward, upward, and rearward, respectively . . ." of "a front end of the

[4] Because the Commission adopted the ALJ's findings and did not address enablement in a separate opinion, this brief sometimes refers to the Commission when discussing the ALJ's initial determination regarding enablement.

fiber optic equipment tray having at least one flange comprising successive sections extending frontward, upward, and rearward that guides optical fibers to either the left or the right." Appx380.

Panduit and Siemon argued, and the experts agreed, that this limitation required that the fiber optic equipment have a specific structure—a flange—that progresses in a specific way—***extending from*** the main body of the tray and comprising successive sections extending frontward, upward, and rearward, without intervening sections. Appx20658-20661; Appx151858:11-19; Appx28386 (Q/A438). Panduit and Siemon argued that their products did not include this structure because their trays' routing elements were located on ***top*** of the tray and did not extend forwards from the front of the tray. Appx12068; Appx20660-20661; Appx21724. Instead, at best they extended upwards then rearwards. *Id*.

The ALJ failed to address Panduit's and Siemon's non-infringement argument. While the ID acknowledged and reproduced the argument (Appx382-384), the ID did not address the configuration of routing elements. Appx384-388.

Panduit and Siemon petitioned to the Commission on this issue. Appx22932-22936. The Commission stated that it was reviewing the ID's findings on indirect infringement of the asserted claims of the '153 Patent. Appx24087. The Commission, however, also failed to consider Appellants' non-infringement argument. *See* Appx26-32 (addressing other arguments).

III. The Fiber Optic Module Patent and Related Proceedings

A. The ’206 Patent

The ’206 patent is the only patent-in-suit that is expressly directed to fiber optic modules. Corning asserted claims 22 and 23 of this patent against Panduit, and only claim 22 against Siemon. Claims 22 and 23 both depend from claim 14. Claim 14 reads as follows:

> 14. A fiber optic module, comprising:
> a main body defining an internal chamber disposed between a front side and a rear side;
> a plurality of optical fibers disposed I the internal chamber;
> a front opening disposed along a longitudinal axis in the front side;
> a first plurality of fiber optic components optically connected to the plurality of optical fibers, the first plurality of fiber optic components disposed through the front opening providing a fiber optic connection density of at least one fiber optic connection per 7.0 millimeters (mm) of width of the front opening; and
> at least one second fiber optic component optically connected to at least one of the plurality of optical fibers to provide optical connection between the at least one second fiber optic component and at least one of the first plurality of fiber optic components.

Appx660. Dependent claim 22 further requires that “at least one rail [is] disposed on the main body” of the module, and dependent claim 23 further requires “at least one latch attached to the at least one rail” that is “configured to engage the at least one rail.” Appx661.

B. Relevant Proceedings Related To The Module Patent

1. Panduit's Non-Infringement of the Module Patent

Panduit argued that its modules do not infringe either of asserted claims 22 and 23 of the '206 patent. The Commission agreed. Appx456-459; Appx52. Panduit's modules have "triangular lumps or protrusions on the sides of the modules," not rails as claim 22 requires. Appx458. And Panduit did not infringe claim 23 either because "[i]nasmuch as the Panduit accused modules do not have a rail, there can be no latch 'attached to the at least one rail.'" Appx459. Corning did not Petition these findings and they are binding here. Appx52 n.31.

2. FS and Siemon's Alleged Infringement of the Module Patent

The Commission found that Siemon and FS.com infringed the '206 patent based on its construction of "front opening," which the Commission found could encompass multiple front openings. Appx52-59. It was not disputed that Siemon's and FS.com's accused products had multiple smaller front openings, as opposed to a large single front opening. Appx26670; Appx28426-28427 (Q/A 536), Appx22813; Appx136655.

SUMMARY OF ARGUMENT

I. For a violation to exist in the ITC, Complainants must be found to have imported "***articles that—infringe***" a valid United States patent. 19 U.S.C. § 1337(a)(1)(B) (emphasis added). The Commission legally erred because Panduit and Siemon did not did not import any such articles that infringed the ’320, ’456, and ’153 patents, which are directed toward chassis assemblies. They only imported modules—a component that is not even required by the ’320 patent, and is but one component out of several in the ’456 and ’153 patents. The Commission held that Panduit’s and Siemon’s modules did not contributorily infringe because the imported modules were “commodit[ies] of commerce suitable for substantial noninfringing use[s].” 35 U.S.C. § 271(c). The Commission also found that Panduit’s modules do not directly infringe the ’206 patent—the sole Corning patent that is squarely directed to modules.

The Commission also found that Panduit and Siemon did not directly infringe any of the ’320, ’456, and ’153 patents—it solely found induced infringement based on infringement by their ***customers***, based almost exclusively on Panduit’s and Siemon’s ***domestic production*** of racks, chassis, trays, adapters, and other components.

Suprema, Inc. v. International Trade Commission, 796 F.3d 1338 (Fed. Cir. 2015) is distinguishable because the claims at issue here are apparatus claims, not method claims. For apparatus claims, it is possible to have an unambiguous “article that infringes”—whether a fully assembled product or a component of that product—at the time of importation under either Section 271(a) or 271(c). For method claims, by contrast, certain steps must necessarily be performed after importation, creating ambiguities as to whether components—***even substantial ones***—might be "articles that infringe." In *Suprema*, the substantiality of the imported article—fingerprint scanners—was not in dispute, and was fundamental to the steps of the method claims. In that unique context, this Court deferred to the Commission's interpretation of "articles that infringe."

Here, no such deference is warranted, and the Commission erred in extending *Suprema* to apparatus claims. Moreover, even if induced infringement is relevant to the "articles that infringe" apparatus claims, the Commission further erred by applying a standard that required ***no nexus*** between the imported modules and the induced infringement of the '320, '456, and '153 patents. Under this test, it did not matter whether and to what extent Panduit's and Siemon's modules were actually used in any infringement, or whether the modules had substantial noninfringing uses under Section 271(c). Such a "no nexus" test is unreasonable even under *Chevron* principles. All parties agreed that, at minimum, ***some*** nexus test should be required. Under a proper nexus test, Panduit's and Siemon's modules would not be deemed "articles that infringe" because the accused ***system*** is not the modules but the chassis, trays, and enclosures that Panduit and Siemon do not import.

II. The Commission also legally erred by holding that expansive, open-ended range claims of the '320 and '456 patents that recite connection densities of "***at least***" 98 or 144 connections were enabled. Specifically, it erred in applying the legal standard set forth in *Andersen Corp. v. Fiber Composites, LLC*, 474 F.3d 1361, 1376-77 (Fed. Cir. 2007), which permits open-ended claims "if there is an inherent, albeit not precisely known, upper limit and the specification enables one of skill in the art to approach that limit."

First, the Commission erred in holding that an upper limit existed. Because the claim language places ***no restrictions*** on the sizes or types of the chassis, trays, adapters, adapters, or other fiber optic components that can be used to achieve larger fiber optic connection densities per U space, it ignored the possibility of future technological innovations with smaller form factors that made it possible to achieve higher connection densities far in excess of the approximately 144 enabled by the claims. Relatedly, it ignored that an "inherent" limit is not dynamic, but instead a static value that must stand the test of time. It then compounded its error by refusing to consider concrete, post-priority date evidence that confirmed the possibility of achieving 432 connections or more in a U-space using a new technology that fell within the scope of the claims. It did so despite this Court's precedent, which establishes that such post-priority date evidence can be "relevant to determining if the claims were enabled as of the priority date." *Amgen v. Sanofi*, 872 F.3d 1367, 1375 (Fed. Cir. 2017); *MagSil Corp. v. Hitachi Global Storage Techs., Inc.,* 687 F.3d 1377, 1382 (Fed. Cir. 2012). These errors demonstrate that the

Commission's finding of an existence of an inherent upper limit was fundamentally flawed, and that no upper limit existed.

Second, the evidence established that the specification only enabled connection densities of up to approximately 144 connections using simplex or duplex components. Thus, it strains credulity to suggest that ***any*** invention that exceeds a connection density of 144 connections in a U-space was enabled by the claims, let alone that the specification enabled the ***full scope*** of the unbounded, open-ended range as the law requires. This Court should thus reverse because Corning "cho[se] broad claim language at the peril of losing any claim that cannot be enabled across its full scope of coverage." *MagSil*, 687 F.3d at 1381.

III. The Commission also erred holding that Panduit and Siemon infringed the claims of the '153 patent because it did not address its construction of "fiber optic routing element," which is limited to a precise configuration as confirmed by Corning's own prosecution history disclaimer. Neither the ALJ or Commission addressed the fact that the Appellants' products have "fiber optic routing elements" that are disposed in a precise configuration, constituting reversible error.

IV. Finally, the Commission erred in holding that Siemon and FS infringed the '206 patent because it applied an improper construction of "front opening" that allowed modules with ***multiple*** front openings to fall within the scope of the claims. The asserted claims recite a "a front ***opening***," while other non-asserted claims recite "front ***openings***." The specification lends further support to a construction that limits the asserted claims to ***a single front opening***. Because Siemon and FS's accused modules only contain multiple openings, the Commission's finding of infringement should be reversed under the corrected construction.

ARGUMENT

I. STANDARD OF REVIEW

This Court reviews the Commission's final determinations under the standards of the Administrative Procedure Act ("APA"). Pub.L. 79–404, 60 Stat. 237 (1946) (codified as 5 U.S.C. § 500 et seq.). Under the APA, this Court reviews legal determinations *de novo* and findings of fact for substantial evidence. *Ajinomoto Co., Inc. v. Int'l Trade Comm'n*, 597 F.3d 1267, 1272 (Fed. Cir. 2010). Issues of statutory interpretation and claim construction are reviewed under the *de novo* standard. *Teva Pharm. USA, Inc. v. Sandoz, Inc.*, 574 U.S. 318, 332-33 (2015); *Volkswagen of Am., Inc. v. United States*, 532 F.3d 1365, 1369 (Fed. Cir. 2008). "Whether a patent satisfied the enablement requirement is a question of law based on underlying factual findings." *Pacific Biosciences of California, Inc. v. Oxford Nanapore Techs., Inc.*, 996 F.3d 1342, 1350 (Fed. Cir. 2021).

II. THE IMPORTATION REQUIREMENT WAS NOT MET AS TO PANDUIT AND SIEMON BECAUSE THEIR IMPORTED MODULES ARE NOT "ARTICLES THAT INFRINGE" THE '320, '456, AND '153 PATENTS, REQUIRING REVERSAL

The importation requirement is an important jurisdictional hurdle that ensures that the ITC is limited to its proper role as an arbiter of the trade laws, rather than as a tribunal for all patent infringement. Section 337 only prohibits "[t]he importation into the United States, the sale for importation, or sale within the United States after importation . . . ***articles that—[i]nfringe*** a valid and enforceable United States patent." 19 U.S.C. § 1337(a)(1)(B)(i) (emphasis added). The statute's focus on articles that infringe is intentional, because the ITC only has ***in rem*** jurisdiction over certain imported articles. Here, Panduit and Siemon did not import any "articles that infringe" the '320, '456, and '153 patents. Indeed, the only thing they do import—modules—have at most an attenuated connection to the other patents-in-suit, and were found to have substantial non-infringing uses post-importation. They cannot be an "articles that infringe" under any interpretation.

Nonetheless, rather than recognize the component's tenuous relationship to the claim language, the Commission simply held that it does not matter. Overturning decades of precedent that its jurisdiction hinges on a nexus between the imported article and the infringing act, the Commission held a nexus is no longer required. With that, the "no nexus" test was born. In doing so, the Commission eviscerated the importation requirement and expanded its jurisdiction to cover virtually all U.S. manufactured products. So long as an imported component is somehow used in an otherwise domestically manufactured product accused of infringement, the Commission claims jurisdiction over each and every component, no matter how attenuated the connection. This opinion is contrary to statute, expands into Federal District Court jurisdiction, and should be reversed.

A. Panduit's Imported Modules Are Not An "Article That Infringes" Because They Were Expressly Found Not To Infringe The Only Patent-In-Suit Directed to Modules—The '206 Patent

The only product that Panduit and Siemon import *are* modules. Panduit and Siemon do not import chassis; and do not import trays, or any other relevant subenclosures that are housed on trays such as cassettes, adapter plates, or patch panels. Appx9; Appx23. As to Panduit specifically, the ALJ expressly held that Panduit's accused modules "do not infringe" asserted claims 22 and 23 of the '206 patent, which are specifically directed toward modules, and the Commission did not disturb that finding. Appx660-661; Appx459; Appx52 & n.31. This underscores that Panduit's modules are not "articles that infringe." As it stands, the Commission retains jurisdiction over Panduit's domestically-developed chassis based solely on importation of a component expressly found not to infringe.

B. Panduit's and Siemon's Modules Are Not An "Article That Infringes" The '320, '456, or '153 Patents Because They Neither Directly Infringe Nor Contributorily Infringe *Any* Of The Apparatus Claims of Those Patents

Panduit's and Siemon's modules also are not "articles that infringe" because they never directly or contributorily infringe the '320, '153, and '456 patents.

The ALJ correctly found that neither Panduit nor Siemon directly infringe. Appx23. The imported modules do not—and cannot—directly infringe any of the '320, '153, and '456 patents, which are directed to fiber optic chassis assemblies. The '320 patent does not even recite a module—instead, asserted claims 1 and 3 recite "a chassis" and generic "fiber optic connection equipment" that is "configured to support" certain fiber optic connection densities. Appx609 (claims 1, 3). The '153 and '456 patents, for their part, recite numerous components aside from modules. For example, independent claim 23 of the '153 patent recited "a chassis," a "guide system" within the chassis, "a plurality of fiber optic equipment trays," and "fiber optic adapters."[5] Claim 11 of the '456 patent similarly recites "a chassis," "a plurality of fiber equipment trays," and "fiber optic adapters." Appx842.[6] In sum, the imported modules are not even recited or required in the

[5] The other asserted claims of the '153 patent—claims 9, 16, and 26—reflect similar requirements. Appx723-724.

[6] The other asserted claims of the '456 patent—claims 12, 14-16, 19, 21, 27, and 28—reflect similar requirements. Appx842-843.

’320 patent, and are at most a minor *subcomponent* of the larger fiber optic apparatuses claimed in the ’153 and ’456 patents, making direct infringement of the apparatus claim impossible both *pre*- and *post*- importation.

The Commission also correctly found that neither Panduit nor Siemon contributorily infringe any of the ’320, ’153, and ’456 patents because the imported modules are “commodit[ies] of commerce suitable for substantial noninfringing use.” 35 U.S.C. § 271(c). As it held, Panduit’s modules are used in connection with several non-infringing Panduit products. Appx23 (affirming “the ID’s finding of no contributory infringement with respect to . . . Panduit”); Appx51-52 (citing Appx219); Appx218-219 (noting that the modules could be used with non-infringing Panduit products other than the Panduit accused chassis (such as the HD Flex Zero RU Bracket and Cassette Holders) and other systems that used alternative adapters (such as the SFQ and Opticom systems)); Appx219 (citing Appx20788-20787; Appx20546; Appx149928 (Q/A 20-21); Appx170 n.16). Siemon’s are likewise used for numerous non-infringing purposes. Appx51-52; Appx214; Appx149928 (Q/A 20-21).

Because the imported modules are commodities of commerce suitable for substantial non-infringing uses of the apparatus claims at issue, they cannot be “articles that infringe” consistent with the importation requirement. Indeed, Sections 271(a) and Section 271(c) are the only statutes that are squarely directed to the making, using, or selling of imported *articles* that might infringe a patent, as opposed to *actors*, as in the induced infringement statute, Section 271(b). *See* 35 U.S.C. § 271(b) ("Whoever actively induces infringement of a patent shall be liable as an infringer."). Thus, under the plain text of Section 337, only 271(a) and 271(c) are relevant to the "articles that infringe" under 19 U.S.C. § 1337(a).

While this Court considered induced infringement relevant to an assessment of "articles that infringe" in *Suprema*, it did so in the context of a method claim about scanning fingerprints that recited steps, rather than an apparatus claim that recited specific *articles* or *components* of articles, as here. The key issue in *Suprema* was that, because a method claim was at issue, it was not possible to have direct infringement at the time of importation. 796 F.3d at 1349.

The fingerprint-scanning steps of the method claim in *Suprema* were performed post-importation after software was loaded onto fingerprint scanner hardware. *Id.* at 1341-43. The focus of the Court's analysis was whether post-importation performance of method steps by an induced infringer under 271(b) could be the basis for finding that the fingerprint scanners were "articles that infringe." *Id.* at 1347-1351. But the substantiality of the "article that infringed" (the fingerprint scanner) used to perform the method steps was not in dispute.[7] *Id.* at 1353.

Here, because an apparatus claim is at issue, direct infringement by an *article* under 271(a) can occur at the point of importation. Similarly, under 271(c), contributory infringement of a *component* can occur at the point of importation if that component lacks substantial non-infringing uses and is used for infringing purposes. Thus, the Patent Act unambiguously accounts for articles that infringe apparatus claims at the time of importation under Section 337 through Sections 271(a) and 271(c), and one need not consider Section 271(b) here.

For this reason, no deference should be provided to the Commission's interpretation. While the majority in *Suprema* found ambiguity to warrant *Chevron* deference, it did so in context of *method claims*. 796 F.3d at 1347 (Suprema has not shown that "articles that infringe . . . excludes induced infringement of a method claim"). No such ambiguity exists for *apparatus claims*.[8]

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[7] Notably, in *ClearCorrect Operating v. ITC*, 810 F.3d 1283, 1286 (Fed. Cir. 2015), this Court held that imported "articles" under Section 337 are limited to tangible, "material things," and do not include electronic data transmissions. *See also id.* at 1290-99.

[8] *Comcast Corp. v. Int'l Trade Commission*, 951 F.3d 1301 (Fed. Cir. 2020) involved an apparatus claim and affirmed a violation based on a finding of induced infringement. However, *Comcast*'s very short discussion of "articles that infringe" did not address the difference between method and apparatus claims argued here, nor did the sufficiency of a nexus between the imported set-top boxes and the asserted claim appear to be in dispute. *Id.* at 1307-08.

Further, certain legislative history from Section 337 confirms that it creates a remedy for ***infringing imported articles*** – not for domestic infringement incidentally related to a noninfringing imported product. *See, e.g.*, S. Rep. No. 100-71, at 128-29 (1987) ("The importation of ***any infringing merchandise*** derogates from the [patent holder's] statutory right . . . ." (emphasis added)); S. Rep. No. 93-1298 at 196 (1974), reprinted in 1974 U.S.C.C.A.N. 7186, 7329 ("For example, in patent-based cases, the [ITC] considers, for its own purposes under section 337, ***the status of imports with respect to the claims of U.S. patents***." (emphasis added)). As this Court recognized in *Suprema*, "domestic" patent infringement is dealt with under a separate "statutory regime[]" in the District Courts. 796 F.3d at 1345.

In sum, the Commission's effort to expand the holding of *Suprema* to importation of a component with substantial non-infringing uses is not supported by statute, particularly in the context of the apparatus claims at issue here. The Commission's decision amounts to a strained effort to apply induced infringement to the *in rem* "articles that—infringe" importation requirement and should be reversed.

C. Panduit's and Siemon's Modules Are Not "Articles That Infringe" The '320, '456, and '153 Patents Even If One Considers Induced Infringement To Be Relevant To The Importation Requirement For Apparatus Claims

Even if Section 271(b) were applicable to "articles that infringe" apparatus claims, the importation requirement still would not be satisfied. If applying the

Chevron framework (as *Suprema* did), the Commission's interpretation of the statute must still be *reasonable.* 796 F.3d at 1349 ("Because Section 337 does not answer the precise question before us, we consider whether the Commission's interpretation of Section 337 is reasonable."); *Holder v. Martinez Gutierrez*, 566 U.S. 583, 584, 132. S.Ct. 2011, 2017 (2012).

Here, the Commission applied a "no nexus" text that did not require an analysis of whether there was *any* nexus whatsoever between the imported component (here, Panduit's and Siemon's modules) and the '320, '153, and '456 patents for which induced infringement was at issue. This new, unprecedented standard is unreasonable even under *Chevron*. Apart from the fact that Panduit's modules did not infringe the only module patent at issue in the case, the Commission's analysis ignored that the claimed apparatuses of the '320, '153, and '456 patents included other components aside from modules, such as the chassis and tray assemblies. Moreover, the '320 patent does not even recite or necessarily require a module. Thus, Panduit's modules were thus either unnecessary for infringement to the claimed inventions (for the '320 patent), and were otherwise one of several components of the invention ('153 and '456 patents). By declining to require a meaningful nexus, the Commission unreasonably erred in improperly expanding its jurisdictional reach to Panduit regardless of its findings of induced infringement.

1. The Commission's "No Nexus Test" Is Unreasonable Under Any Standard, And Underscores The Error That Permeates The Commission's Analysis of "Articles That Infringe" Under The Importation Requirement

By adopting a rule that there need not necessarily be any nexus between the imported component and the "articles that infringe" the actual patents in suit, the Commission was able to ignore the relative insignificance of the component being imported. Critically, the Commission "affirmed, ***with modifications***, the ID's findings" and specifically ***d[id] not adopt the ID's analysis and findings regarding a 'nexus' between the imported components and the 'articles that infringe.***'" Appx17; Appx22 (emphasis added). A nexus "is irrelevant," according to the Commission. *Id.* It instead suggested that the question of whether there are "articles that infringe" is based on an analysis of infringement divorced from any analysis of the imported articles. It thus concluded without analysis that Panduit and Siemon met the importation requirement simply because it "import[ed] their accused modules." Appx23.

The Commission's discussion of induced infringement continued to ignore the need for a "nexus" between the imported modules and the alleged infringement by Panduit's and Siemon's customers. *See* Appx28-32; Appx45-48. In that discussion, the Commission simply held that Panduit's modules were "articles that infringe" under the importation requirement because, "[i]n this case, the imported articles are components of the accused apparatuses." Appx29. Consistent with that finding, it further suggested that any generic "article supplied" in connection with an induced infringement finding could be sufficient under the importation requirement, regardless of the degree of nexus to the asserted claims or to the patented invention. *See* Appx30. And it also suggested that the modules' "substantial noninfringing uses" were irrelevant, even though the Panduit modules ***did not infringe the only module patent***, were but one minor component of the remaining patents, and could be used as a ***non-infringing article*** of those patents in several ways.

The "no nexus" test established by the Commission to ascertain "articles that infringe" is both arbitrary and unreasonable. Citing precedents from the Commission beginning in 1978, the Commission noted that "[i]t is appropriate for the Commission to consider whether there is a sufficient nexus between the accused imported articles and the alleged unfair acts before determining whether a violation of section 337 has been shown," and that "[e]arly Commission precedent established that if an imported component does not satisfy all elements of an asserted patent claim by itself, then such a ***nexus must exist for there to be a violation of Section 337***. Appx24526-24527 (emphasis added).

Numerous decisions from the ITC continued to adopt a nexus requirement over the course of the following 40 years. Appx101 (Additional Views of Chair Kearns); Appx24527-24530 & n.1 (citing numerous ITC precedents from 1978 through 2020).[9] That the Commission arbitrarily chose to completely abandon any such nexus requirement here and failed to "offer[] a reasoned explanation" for its decision underscores that its decision is unreasonable and is "owed no deference." *ClearCorrect,* 810 F.3d at 1302.

The arbitrary and unreasonable nature of the Commission's "no nexus" rule is further demonstrated by the fact that the Commission contemplated enforcing such a test here, but chose not to. The Commission asked all parties below whether a "sufficient nexus between the imported article and the alleged unfair acts" should be required. Appx24087. In response, the ITC staff noted that "in investigations such as this one, the Commission ***should continue to consider whether there is a sufficient nexus*** between the imported article and the alleged unfair acts to justify a finding that ***actionable importation*** has occurred." Appx24530 (emphasis added). The Appellants likewise noted that "the Commission should consider whether a 'nexus' exists between the imported article and the unfair acts" and that doing so is consistent with this Court's precedent. Appx24471 (citing *ClearCorrect*, 810 F.3d at 1290-99; *TianRui Group Co. v. ITC*,

[9] The Court also identified recent decisions where Commissioners Kearns and Schmidtlein identified multifactor tests examining the relationship between imported components and alleged post-importation infringement, and concluded that these tests are "essentially a nexus test" as well. Appx24529-24530.

661 F.3d 1322, 1325 (Fed. Cir. 2011) ("[S]ection 337 focuses . . . on the nexus between the imported articles and the unfair methods of competition"). And even Corning agreed that "[w]here an imported article does not infringe at the time of importation, the Commission ***should require a nexus*** between the imported article and the infringement." Appx24111 (emphasis added).

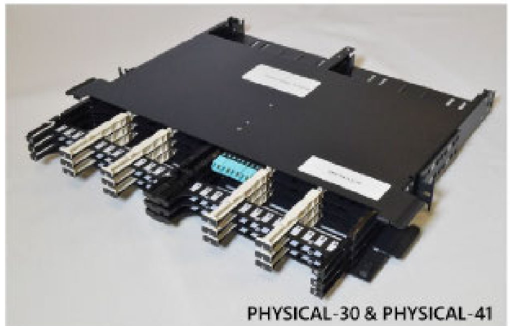
2. Under A Proper "Nexus" Analysis, Panduit's and Siemon's Modules Cannot Be Deemed "Articles That Infringe" The '320, '456, and '153 Patents

When one requires there to be a "sufficient nexus" between the imported article and the alleged infringement, Panduit's and Siemon's articles cannot be deemed "articles that infringe" the '320, '456, and '153 patents.

First, the modules are, at best, one of several recited components of the claims. As noted above, the '320 patent does not even require a module. The Commission attempts to suggest otherwise (*see* Appx31), but it is wrong. The plain language of claim 1 does not recite a module, but instead recites "fiber optic connection equipment provided in the chassis." The suggestion that this claim phrase requires modules is belied by the '320 patent's specification—the "single best guide to the meaning of a disputed term." *Phillips v. AWH Corp.*, 415 F.3d 1303, 1315 (Fed. Cir. 2005). The '320 patent's specification does reference modules, but the Commission selectively ignores that the specification repeatedly and consistently refers to the fiber optic connection equipment recited in the ’320 patent as including equipment other than modules, including patch panels, trays, adapters, and other types of fiber optic equipment. Appx561 (Abstract); Appx600 (1:50-51); Appx601 (4:51-57) (noting that fiber optic connection equipment can “support one or more fiber optic modules,” but that “***the fiber optic equipment 10 could also be adapted to support one or more fiber optic patch panels or other fiber optic equipment that supports the fiber optic components and connectivity***” (emphasis added)). The modules are thus not even required by the ’320 patent.

Additionally, the ID held that, to the extent modules are relevant to the ’320 patent, the focus of the claim is the fact that the ***chassis*** must be “***configured to support***” 98 or 144 fiber optic connections per U-space. Appx173 (emphasis added). The ALJ held that the limitation is met “when a single accused module is inserted into the chassis.” Appx173. Thus—Corning argued that a chassis shown below housing a single module (shown in blue) would infringe.

Representative Panduit
Base-8 Combination



Appx26742; Appx21224. Consistent with this theory, the ID noted that the patented system "***is designed to allow customers to add connections as demand warrants***," and that the "configured to support" language is directed to "***describe the fiber optic equipment's design***, not its use at any given point in time." Appx172, Appx175 (emphasis added); *see also* Appx21225. In other words, the claims as interpreted are agnostic how many modules are inserted into the chassis. This is because the accused ***system*** is not the modules themselves, but rather the chassis, trays, and other components of the enclosure that Panduit and Siemon do not import. This again reinforces the lack of nexus between the modules and infringement of the '320 patent.

The Commission also declined to undertake any independent analysis of the claims of the '456 and '153 patents, simply asserting that modules are "one of just two custom components" of their claims. Appx31.[10] But the Commission is again wrong because it ignored that the claims of the '456 and '153 patents recite numerous other components than modules, including a chassis, trays, guide systems, and fiber optic adapters. *See supra*, pp. 10-17. The Commission's attempt to oversimplify the claims as being devoted to solely a chassis and a module is therefore misleading and convenient in light of its "no nexus" requirement.

Second, the lack of nexus is reinforced by Panduit and Siemon modules' substantial non-infringing uses. The Commission "adopt[ed] this finding" of the administrative judge, along with the ID's finding of no contributory infringement. Appx47; Appx51-52. The substantial non-infringing uses include, for example, using the modules with non-infringing chassis, such as Panduit's HD Flex Zero RU Bracket and Cassette Holders; using adapters that are compatible with non-infringing fiber optic connection systems, such as Panduit's SFQ and Opticom system; and using the chassis with Panduit's non-infringing floor mounted enclosures. Appx170 & n.16 (citing Appx150534-150535 (Q/A 48-52); Appx136672-136673 (Q/A 251); Appx145390-145401; Appx150534-150535 (Q/A 50-52); Appx149928 (Q/A 21)); *see supra*, pp. 14, 30. Panduit's and Siemon's modules therefore are each a "commodity of commerce suitable for substantial noninfringing use," could

[10] The same statement is made in the ID in a conclusory manner and without citation. *See* Appx170.

be used interchangeably in numerous non-infringing products. 35 U.S.C. § 271(c). This information is relevant to a nexus test, as confirmed by the proposed test for "articles that infringe" endorsed by Chair Kearns in his Additional Views, which would consider "the extent to which [the imported component] has non-infringing uses." Appx102-103.

Finally, *Suprema, Comcast*, and *Digital Receivers II* do not support the Commission's flawed analysis. The Commission ignored the facts of those cases, which each reinforce the importance of a nexus requirement. In each case, there was plainly a substantial nexus between the imported articles and the alleged infringement such that the imported articles were the primary, tangible articles used in connection with the infringement. In *Suprema*, the imported articles were the fingerprint scanners used to scan fingerprints and collect data in accordance with the claimed method, and these were eventually combined with intangible software that was used with the scanners post-importation. 796 F.3d at 1341. In both *Comcast* and *Digital Video Receivers*, the imported articles were Comcast's X1 set-top-box systems, which were fundamental to patent claims that used "television program guide equipment" (i.e., those same set-top boxes) to facilitate recordings of tv shows on customers' mobile devices. *Comcast*, 951 F.3d at 1304-05; *In The Matter of Certain Digital Video Receivers* (*Digital Receivers II*), 2019 WL 2953269, No. 337-TA-1103, Commission Opinion (June 4, 2019) at *17-18. The existence of "substantial nexus" was not in doubt or in dispute for those three cases.

The Commission also asserts that Federal Circuit and Commission precedent does not set forth a "primary" or "quintessential" legal requirement for imported articles. Appx30. But the Commission does not dispute that the fingerprint scanners and set-top-boxes *were* the primary articles in *Suprema*, *Comcast*, and *Digital Receivers II*, making those cases readily distinguishable from this one. The Commission's conclusory reliance on these irrelevant does not justify the Commission's improper application of the "no nexus" test.

III. THE COMMISSION'S ENABLEMENT DETERMINATION SHOULD BE REVERSED AS TO THE ASSERTED CLAIMS OF THE '320 AND '456 PATENTS

Enablement "serves the dual function in the patent system of ensuring adequate disclosure of the claimed invention and of preventing claims broader than the disclosed invention." *MagSil, Inc.*, 687 F.3d at 1380-81. "[T]he specification of a patent must teach those how to make and use the ***full scope*** of the claimed invention without undue experimentation." *Id.* at 1380 (emphasis added); *Pacific Biosciences*, 996 F.3d at 1350 (citing *MagSil*, 687 F.3d at 1381); *Idenix Pharms. LLC v. Gilead Sciences Inc.*, 941 F.3d 1149, 1154 (Fed. Cir. 2019).

Claims 1 and 3 of the '320 patent and claims 11, 12, 15, 16, and 21 of the '456 patent recite a fiber optic connection density with no upper limit. These claims recite fiber optic connection equipment apparatuses, including a chassis, that can be configured to achieve "at least" 98 or "at least" 144 fiber optic connections per-U space using simplex or duplex connections.[11] Appx21589; Appx171. Despite this, the specification only discloses a ***single embodiment*** of a chassis that supports only "up to" 144 fiber optic connections per U-space using ***LC-type*** simplex or duplex connectors, and no embodiments that support more than 144 fiber optic connections per U-space using such connectors. Appx575 (Fig. 1); Appx602 (5:33-49), Appx604 (10:25-37), Appx606 (14:5-34), Appx607 (15:29-26); Appx151972 (972:10-14).

Nonetheless, in finding enablement, the Commission relied on precedent from this Court stating that claims "may be supported if there is an inherent, albeit not precisely known, upper limit and the specification enables one of skill in the art to approach that limit." *Andersen*, 474 F.3d at 1376-77; Appx281. The Commission erred as a matter of law in applying this precedent. *First*, it legally erred in concluding that the claims had an inherent upper limit at all by ignoring the claims' scope and disregarding crucial post-priority date evidence. *Second*, it legally erred to the extent that it suggested that the specification would have enabled the POSA

[11] Appellants do not challenge claim 19 of the '456 patent as invalid for lack of enablement because it recites a connection density of exactly 144 connections per 1U space.

to achieve fiber optic connection density significantly above 144 connections per U-space.

A. The Commission Legally Erred In Concluding That The Claims Had An Inherent Upper Limit At All By Ignoring The Claims' Scope and Disregarding Crucial Post-Priority-Date Evidence

The asserted claims, on their face, recite no upper limit. Claims 1 and 3 of the '320 patent require "fiber optic connection equipment" that can support "***at least***" 98 and 144 fiber optic connections per U-space, respectively. Appx609 (emphasis added). Claim 11 of the '456 patent similarly requires fiber optic components that can support a fiber optic connection density of "***at least***" 98 fiber optic connections per U-space. Appx842 (emphasis added).

Beyond reciting no upper limit, both claims 1 and 3 of the '320 patent and claim 11 of the '456 patent place few restrictions on the "fiber optic components" that can be used to achieve the unbounded range of densities in a 1U space. Claims 1 and 3 of the '320 patent require a "chassis," but otherwise permit the use of any fiber optic components to achieve the claimed density so long as they employ "at least one simplex fiber optic component or at least one duplex fiber optic component." Appx609. Similarly, claim 11 of the '456 patent recites a "chassis," "trays," "modules," and "adapters," but does not restrict those components so long as the connection density is achieved "using a simplex fiber optic adapter or a duplex fiber optic adapter as each fiber optic adapter." Appx842. Thus, the claims do not restrict the sizes or types of ***any*** fiber optic connection components used to achieve fiber optic connection densities within a 1U space, whether connectors, adapters, trays, cables, or any other components, other than the requirement that the adapters be "simplex" or "duplex." The experts agreed on this point, including that later-developed components of smaller sizes fall within the claim scope. Appx136078, Appx136081 (Q/A 199, 210) (Dr. Blumenthal); Appx151989-151990 (989:20-990:4) (Dr. Prucnal).

The specification further reinforces the fact that the invention could include components of different sizes and types. It states that "[m]any modifications and other embodiments of the invention set forth herein will come to mind to one skilled in the art." Appx609 (19:1-2); Appx841 (19:34-35). These modifications "are not limited to the type of fiber optic equipment tray or the means or device to support fiber optic modules installed in the fiber optic equipment trays," and include the "fiber optic adapter type, including but not limited to fiber optic connectors and adapters, and number of fiber optic connections, density, etc." Appx609 (19:22-29); Appx841 (19:39-51; Appx136078 (Q/A 197); *see also* Appx609 (19:41-49), Appx841 (19:66-20:5).

A claim with an open-ended range must enable the full scope of the range to any alleged inherent upper limit. *Andersen*, 474 F.3d at 1376-77. In its decision that an "inherent upper limit" existed, the Commission focused almost exclusively on generic "constraints" that would, of course, place certain limits on what might fit within a 1U space. Appx282-284. But while focusing on "constraints," it ignored technological advancements that were relevant to the scope of the claims, such as modern fiber optic adapters, that make it possible to further increase density despite the constraints. *See id.* These technological innovations were put before the Commission by both Corning and Appellants, but were simply ignored or disregarded by the Commission. Appx20552-20553; Appx22904-22906.

One such innovation, ***MDC-type*** duplex adapters, is relevant to claim scope and enablement. Such adapters, launched in 2019 by non-party US-Conec, have a much smaller form factor than the duplex (LC or otherwise) described or contemplated in the '320 and '456 patents. Appx838 (14:36-55); Appx136080 (Q/A 210); Appx21594. With these modern adapters, it suddenly became possible for the POSA to achieve up to 432 fiber optic connections per U-Space—i.e., a density *three times* that which was described as the maximum achievable density in the '320 and '456 patents using LC-type simplex and duplex adapters. Appx136081 (Q/A 212); Appx139691; Appx139688; Appx21594 (emphasis added). Nonetheless, a chassis populated with MDC adapters falls within the claim scope of "at least" 98 or "at least" 144 fiber optic connections per U space. Neither Dr. Prucnal nor Corning disputed or rebutted that MDC-type adapters, or that the use of MDC adapters within the standardized 1U space, fall within the scope of the claims.

Appx151299-151301 (299:14-25, 300:16-301:12); Appx151301 (301:20-22); Appx151420 (420:11-19); Appx151977 (977:13-21); Appx151979 (979:7-16); Appx28639 (Q/A 45). Nor is there a dispute that other later-developed components placed within a chassis might unlock yet more possibilities, as Dr. Prucnal recognized. *See* Appx988-990 (988:1-990:4).

Nonetheless, the Commission legally erred in refusing to consider post-priority-date evidence of the MDC-type adapters that demonstrated the claims' lack of an inherent limit—or that the limit was, at a minimum, 432 connections per U space. Appx286-287. It held that a 45-year-old precedent from this Court's predecessor "prohibits" consideration of "post-priority evidence" in the context of enablement. Appx287 (citing *In re Hogan*, 559 F.2d 595, 605 (C.C.P.A. 1974)). But more recent precedent from this Court expressly holds that post-priority date evidence can "be relevant to determining if the claims were enabled as of the priority date and ***should not have been excluded simply because it post-dated the claims' priority date***." *Amgen*, 872 F.3d at 1375 (emphasis added) (citing *White Consol. Indus., Inc. v. Vega Servo-Control, Inc.*, 713 F.2d 788, 791 (Fed. Cir. 1983)); *Mag-Sil*, 687 F.3d at 1382 (holding open-ended range claims invalid for lack of enablement where post-priority-date evidence showed "resistive change of 604% has now been achieved by others," and "[t]he '922 patent specification does not disclose working examples of tunnel junctions with resistive changes of 20%, 120%, 604%, or 1000%”).

Corning’s reliance on evidence of Investments in the context of its arguments in support of a domestic industry underscores that the evidence should have been considered in this Court’s assessment of enablement. Appx28639-28640 (Q/A 44-47); Appx21409, Appx21411. By advancing those arguments, Corning represents that its investments are “with respect to articles protected by the patent,” as the statute requires. 19 U.S.C. § 1337(a)(3); *Interdigital Commc’ns, LLC v. Int’l Trade Comm’n*, 707 F.3d 1295, 1298 (Fed. Cir. 2013) (investments to establish domestic industry “must pertain to products covered by the [asserted] patent”)).[12] Corning thus believes that the Investments are relevant to the scope of the ’320 and ’456 patents, and thus relevant to the “full scope” of the claims that should be considered for purposes of enablement.

Ultimately, the Commission disregarded the post-priority-date evidence because it asserted that “the state of the art for enablement purposes is assessed as of the priority date of the patent – here, August 2008 – and no later.” Appx286-287 (citing *Hogan*, 559 F.2d at 605; *Chiron Corp. v. Genentech, Inc.*, 363 F.3d 1247, 1254 (Fed. Cir. 2004); *Amgen*, 872 F.3d at 1374-75). But while the Commission is

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[12] Cases cited by Corning below are also consistent with this legal proposition. *See* Appx21709.

correct that the "*state of the art*" for assessing whether the full scope of the claims are enabled is that state as of the priority date, it erred because it ignored that post-priority-date evidence is relevant for understanding the full scope of the claim that needed to be enabled as of the priority date.

The Commission's failure and unwillingness to grapple with the full scope of future possibilities that fall within the claims underscores the error in its finding of an inherent upper limit. An "inherent" limit plainly means a theoretical maximum that cannot change over time, lest the scope of a claim would be rendered a moving target with technological advances. Indeed, if the inherent upper limit can change over time, three-fold in the instance of LC versus MDC adapters, what about the upper limit found by the Commission was inherent? The opinion below provides no guidance, only stating that "some inherent limit exists," while declining to expressly state "what the limit is."[13] Appx285; *see also* Appx151972 (972:19-23); Appx21590. This reinforces that no upper limit exists, and that reversal is required for this reason alone. Appx21338; *Andersen*, 474 F.3d at 1376-77. "[A] patentee chooses broad claim language at the peril of losing any claim that

[13] Relatedly, the ID found that "persons of ordinary skill . . . may disagree about exactly what the limit is." Appx285. This would seem to also suggest that the scope of the claim does not "inform those skilled in the art about the scope of the invention with reasonable certainty" under the indefiniteness standard. *Nautilus v. Biosig*, 572 U.S. 898, 910 (2014).

cannot be enabled across its full scope of coverage." *MagSil*, 687 F.3d at 1381. That is the case here.

B. The Commission Legally Erred To The Extent That It Suggested That the Specification Would Have Enabled the POSA To Achieve Fiber Optic Connection Density Significantly Above 144 Connections per U-space

The only potential finding by the Commission of an inherent upper limit to the open-ended claims is approximately 144 connections per 1U space. *See* Appx285-286 (bulleted list citing Appx95848-95849 (Q/A 214-217); Appx29500; Appx134192 (p. 181)); Appx151973 (973:7-12); Appx151974 (974:2-3); *see also* Appx136079 (Q/A 202); Appx151974-151975 (974:23-975:5). The Commission credited testimony that at the time of patenting, the highest density that could be achieved was approximately 144 connections per 1U space. It then determined that the claims of "at least 144" fiber optic connections were enabled – presumably up to approximately 144 connections per 1U space. In other words, the Commission relied upon what was achievable in the art at the time of patenting (approximately 144 connections) and determined that to be the inherent upper limit.

If this ***was*** the Commission's finding, its analysis was backward and legally flawed because the claims lack an upper limit for the reasons discussed above. *See supra*, Argument Section III.A. Moreover, the Commission's flawed analysis confirms that if ***anything*** was enabled as of the priority date, it was only connection density of approximately 144 connections—nothing more. Thus, the Commission erred to the extent that it suggested that the specification would have enabled the POSA to achieve higher densities, such as those that can be realized today with MDC-type adapters and other small form factor components.

As the specification confirmed, the maximum density that could be achieved using the *LC-type* simplex and duplex adapters available as of the priority date was 144 connections per U-space. Appx838 (14:36-55). The only examples involving simplex or duplex adapters employ the LC-type and do not address any new or smaller types of adapters, whether MDC-type adapters or any others. *Id.* The specification expressly teaches in the table below that the "Max Fibers per 1RU" using "Duplexed LC" adapters is no greater than 144 connections.

Connector Type	Max Fibers per 1RU	Max Fibers per 4RU	Number of Connectors per 1 RU Space	Number of Connectors per 4 RU Space	Bandwidth per 1U using 10 Gigabit Transceivers (duplex)	Bandwidth per 1U using 40 Gigabit Transceivers (duplex)	Bandwidth per 1U using 100 Gigabit Transceivers (duplex)
Duplexed LC	144	576	72	288	1,440 Gigabits/s.	960 Gigabits/s.	1,200 Gigabits/s.
12-F MPO	576	2,304	48	192	5,760 Gigabits/s.	3,840 Gigabits/s.	4,800 Gigabits/s.
24-F MPO	1,152	4,608	48	192	11,520 Gigabits/s.	7,680 Gigabits/s.	9,600 Gigabits/s.

Appx609.

That the specification only supports enablement of up to a maximum of 144 connections using LC-type adapters is reinforced by the evidence from Dr. Prucnal, Panduit, and Mr. Rhoney the Commission cited in its analysis in support of its alleged upper limit. *See* Appx285-286 (bulleted list citing Appx95848-95849 (Q/A 214-217); Appx29500; Appx134192 (p. 181)). Dr. Prucnal's testimony was about an achievable upper limit "*using LC connectors and adapters*"; the Panduit document addressed "*Duplex LC*" adapters;[14] and Mr. Rhoney discussed a "theoretical limit *with LC connectivity* of 144 fiber connections." Appx95848-95849 (Q/A 216), Appx29500, Appx134192 (181:1-8) (emphases added). The ITC also noted that Panduit and its expert made calculations using prior art (Appx284), but ignores that those calculations also pertained to prior art that used LC-type adapters. *See* Appx95841 (Q/A 184); Appx95912 (Q/A 435). The reliance on this evidence reinforces that the maximum possible density using the LC-type adapters known and disclosed in the specification was to 144 connections per U-space.

Furthermore, Corning and its expert confirmed that the maximum density is approximately 144 connections per U-space based on simplex or duplex components. On cross examination, Corning's expert admitted that "the '320 patent discloses a maximum of 144 fiber optic connections per 1RU space using simplex or duplex components." Appx151971 (971:7-10). He also testified that, using the components available as of the priority date, he believed that "in a 1RU space 144 is what has been achieved ***as the highest density that will work after a lot of design and effort.***" Appx151974 (974:14-25) (emphasis added). At most, he testified that you might be able to get slightly higher by "adding another adapter on

[14] The ID acknowledges that Panduit's calculation was based on the number of "***duplex LC adapters per U space***." Appx284 (emphasis added).

there." Appx151974-151975 (974:22-975:5). Corning also argued in its post-hearing reply brief that none of the Appellants "exceed[ed] EDGE's density [of 144 connections per U-space] in 12 years." Appx21593; Appx95848 (Q/A 215). Extensive experimentation would therefore have been required at the priority date to increase—let alone triple—the density significantly beyond 144 connections.

The Commission references the multi-part standard for enablement *In re Wands*, 858 F.2d 731, 737 (Fed. Cir. 1988), and suggests that Appellants' expert needed to undertake an analysis of the *Wands* factors.[15] Appx288-289. Not so. The *Wands* "factors while illustrative are not mandatory," and lack of enablement can be shown without them. *Cephalon, Inc. v. Watson Pharms., Inc.*, 707 F.3d 1330, 1336 (Fed. Cir. 2013). But even when considered, the *Wands* factors uniformly point to a lack of enablement of any connection densities significantly above 144: the excessive quantity of experimentation to even slightly exceed a connection density of 144 connections per U-space using the prior art LC-type adapters is confirmed by the Commission's findings and testimony referenced above, and by the fact that the MDC adapters that made it possible to achieve a

[15] The *Wands* factors are: "(1) the quantity of experimentation necessary, (2) the amount of direction or guidance presented, (3) the presence or absence of working examples, (4) the nature of the invention, (5) the state of the prior art, (6) the relative skill of those in the art, (7) the predictability or unpredictability of the art, and (8) the breadth of the claims." 858 F.2d at 737.

density of 432 connections per U-space were not invented until 2019—*eleven years* after the priority date. *See* Appx139687-139690; Appx139691. Meanwhile, the specification provides no guidance (let alone working examples) for achieving densities greater than 144 using simplex or duplex components.

This Court's finding of no enablement in *MagSil* reinforces the lack of enablement of densities beyond 144 connections here. In *MagSil*, the claims recited the attainment of levels of resistance of "at least 10%" and the specification disclosed examples that achieved up to 11.8% resistance. Achieving the even higher levels of resistance "***took some twelve years after the '922 application was filed to achieve***." 687 F.3d at 1382 (emphasis added). This Court emphasized that "[t]he '922 patent specification only enables an ordinarily skilled artisan *to achieve a small subset* of the claimed range," and there was "no showing that the knowledge of that artisan would permit, at the time of filing, *achievement of the modern values* above 600% without undue experimentation." *Id.* (emphases added).

Other recent case law is consistent and refuses to find enablement where only "narrow" portions of a broad range are enabled. *Pacific Biosciences*, 996 F.3d at 1352 (finding lack of enablement because "before the 2009 priority date . . . , relevant artisans did not know how to perform nanopore sequencing for more than a ***narrow range*** of the full scope of nucleic acids covered by the asserted claims") (emphasis added); *Idenix*, 941 F.3d at 1161 (finding lack of enablement where "working examples are present but are ***very narrow***, despite the breadth of the claims at issue") (emphasis added). Here, at most, what is enabled is a narrow range of approximately 0 to 144 connections, plus perhaps an added adapter. Appx151973-151975 (973:21-975:5).

Finally, the Commission relied on *McRO, Inc. v. Bandai Namco Games Am. Inc.*, 959 F.3d 1091 (Fed. Cir. 2020) as allegedly supporting its enablement determination. Appx288-289. Not so. *McRO* only reinforces the Commission's error. *McRO* cited *MagSil* with approval, explaining the concern that the claim in that case "covered all changes in resistance of 10% or more (*e.g.*, 100% or 100%) in a particular process, and it was the lack of any teaching of how to achieve the resistance change even a little above 10% that was not enabled (and was concededly unknown at the time)." *McRO,* 959 F.3d at 1101 (citing *MagSil*, 687 F.3d at 1381-83).

Ultimately, here, the claim covers all fiber optic connection densities above 144 for simplex and duplex connectors. There are no teachings of densities in excess of 144. Certainly, there are no teachings about how to make and use MDC adapters (or any other adapters) that would have made such densities possible. The example of using MDC-adapters, moreover, *was* a "concrete," not abstract, identification of an "embodiment or embodiments asserted not to be enabled," consistent with *McRO.* 959 F.3d at 1100. Thus, reversal on enablement is required.

IV. PANDUIT'S AND SIEMON'S ACCUSED PRODUCTS DO NOT INFRINGE THE '153 PATENT AS THEY DO NOT INCLUDE THE CLAIMED "FIBER OPTIC ROUTING ELEMENT"

There is no dispute that the '153 Patent's recited "fiber optic routing element" requires a flange extending forward from the front side of the tray and then successively proceeding upwards and rearwards without any intervening sections. During the hearing, the parties' experts agreed as much. Appx20658-20661; Appx151858:11-19; Appx28386 (Q/A438). That is because amendments made during prosecution established that Corning intended to claim only fiber optic routing elements having a distinct configuration. Appx384-388.

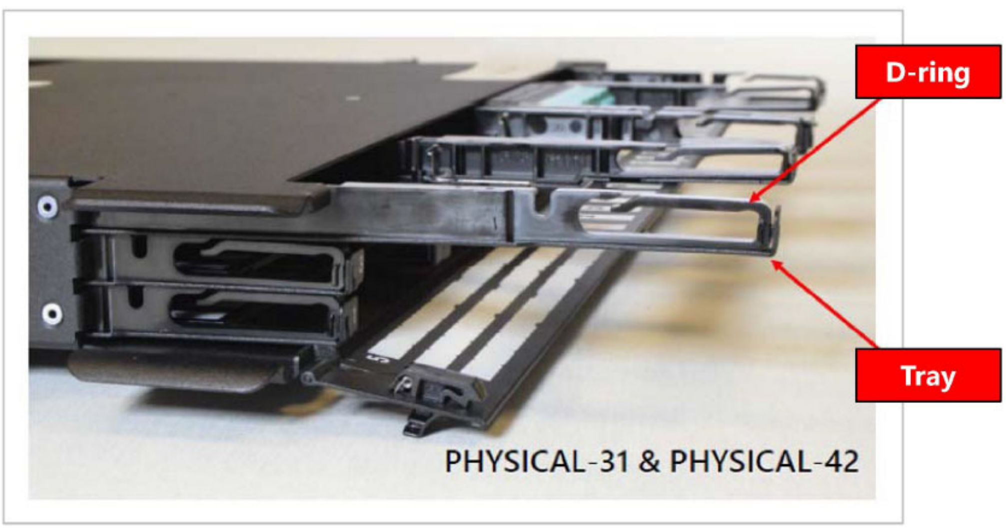
Specifically, during prosecution Corning amended the independent claims of the '153 Patent to add in the "successive" and "respectively" limitations. Appx12066-12070; Appx20659-20660. This was done to overcome a rejection where the purported fiber optic routing elements were disposed on ***top*** of the tray. Appx12066-12067; Appx20659; Appx110104-110108. In doing so, Corning cited to four figures, all of which, as the experts agreed, show a fiber optic routing element that is a flange ***extending from*** the front of the tray forward, then upward, and then rearward. Appx12066-12067; Appx20659; Appx151360 (360:2-8); Appx151360-151362 (360:23-362:2); *see also* Appx136624-136625 (Q/A 91).

In view of this Appellants argued that only routing elements ***extending from*** the front of the tray could infringe the '153 Patent. Thus, Appellants argued that the Accused Products did not infringe. Appx20659-20660; Appx21723-21725; Appx12067-12072. Despite the ID finding that the prosecution history required the specific configuration at the crux of Panduit's non-infringement argument, the ID failed to consider the non-infringement argument itself. *See* Appx384-390. Recognizing that the ID had overlooked this essential non-infringement argument, Appellants petitioned the issue to the Commission. Appx22932-22936. But while the Commission elected to review the finding that Appellants indirectly infringed the '153 Patent, the Commission still ignored Appellants' non-infringement argument directed to the specific structure of the fiber optic routing element.

This is legal error. It is the ALJ's obligation to rule on all issues presented during the Violation phase of the proceeding. *See, e.g.*, 19 C.F.R. § 210.42(d); *Apple Inc. v. ITC*, 725 F.3d 1356, 1366-67 (Fed. Cir. 2013) (faulting the ITC for failing to consider evidence related to secondary considerations and remanding for consideration); *Apps. In Internet Time, LLC V. RPX Corp.*, 897 F.3d 1336, 1353 (Fed. Cir. 2018) (finding that the PTAB's selective weighing of the evidence did not pass muster under the APA); *Princeton Vanguard, LLC v. Frito-Lay N. Am., Inc.*, 786 F.3d 960, 970 (Fed. Cir. 2015) (faulting the Board for short-cutting its consideration of the factual record). Specifically, the ALJ's initial determination must include "an opinion stating findings . . . and conclusions and the reasons or bases therefor necessary ***for the disposition of all material issues of fact, law, or***

discretion presented in the record." 19 C.F.R. § 210.42(d) (emphasis added). Similarly, it is the Commission's obligation to fully address the issues that it chooses to review. *See, e.g.*, 19 C.F.R. § 210.45(b) ("Only the issues set forth in the notice of review, ***and all subsidiary issues therein***, will be considered by the Commission."). Neither of those rules was followed here.

Had either the ID or the Commission properly considered the evidence, it is clear that the Accused Products do not infringe the '153 Patent. With respect to Panduit, Panduit's routing element is on top of the tray, and does not at any point extend frontward from the tray. Appx22932-22936; Appx20659-20664; Appx21723-21725. Specifically, as was made clear during the below proceeding and as can be seen from the below figure, Panduit's D-ring component is disposed on, and either snapped or screwed into, the top of the tray. Appx20660-20661; Appx136631 (Q/A103-105); Appx134597.



Siemon's products similarly had routing elements that do not extend frontward from their trays in the manner claimed. Appx20661-20664; Appx136634-136635 (Q/A120-122).

Thus, the Accused Products cannot infringe the '153 Patent because they do not have successive sections that ***first*** extend forward ***and then*** extend upward and rearward. Accordingly, the Commission's Order finding the '153 Patent infringed should be reversed. At minimum, the Commission's findings as to the '153 Patent should be vacated and the issue remanded to the ITC.

V. THE COMMISSION'S INFRINGEMENT FINDINGS AGAINST SIEMON AND FS ON THE '206 PATENT SHOULD BE REVERSED BECAUSE IT APPLIED AN IMPROPER CLAIM CONSTRUCTION OF "A FRONT OPENING"

As noted above, Panduit does not infringe the '206 patent. For Siemon and FS, the dispute over infringement of the '206 patent hinges on whether the term "a front opening" of Claim 14, from which both asserted claims depend, was limited ***to a single front opening*** (as both Respondents and the OUII proposed) or rather could encompass multiple front openings on the front side of the claimed module (as proposed by Corning). Appx54. It was undisputed that neither Siemon's nor FS's Accused Products had a single uninterrupted front opening, but rather multiple openings separated by material or dividers. Thus, claim construction was determinative of infringement. Appx26670; Appx28426-28427 (Q/A 534-537); Appx136890 (Q/A 15-16); Appx22813; Appx136655; Appx21300-21301. The

Commission adopted Corning's proposed construction that required "an opening" rather than "a single opening." Appx54-58. It thus found that the multiple front openings on FS and Siemon's Accused Products infringed. The Commission's opinion is flawed and should be reversed.

The Commission's first legal error concerns its application of the doctrine of claim differentiation. Respondents and the OUII both noted that ***unasserted*** claims 63 through 70 explicitly claimed ***multiple*** front openings. Appx23846; Appx23245-247; Appx23851. They recite "front openings," while the asserted claims recite "a front opening." *Compare* Appx662 (24:21-23), *with* Appx660 (20:53-54). The language of these claims provides evidence of a clear intent to limit "'a' or 'an' in prior claims to 'one opening,'" which is the exception to the general rule that the words 'a' or 'an' in a patent claim carry the meaning of "one or more." *Harari v. Lee,* 656 F.3d 1331, 1341 (Fed. Cir. 2011) (citing *Insituform Techs., Inc. v. Cat Contracting, Inc.*, 99 F.3d 1098, 1105–06 (Fed.Cir.1996)).

The Commission reasoned that since claim 63 does not depend from claim 14, only a weak inference could be drawn by their contrast. Appx26669-26670. This Court has set out that claim differentiation can be relevant "in the context of a claim construction that would render additional, or different, language in another independent claim superfluous." *Curtiss-Wright Flow Control Corp. v. Velan, Inc.*, 438 F.3d 1374, 1381 (Fed. Cir. 2006); *Fantasy Sports Props. v.*

Sportsline.com, 287 F.3d 1108, 1115-16 (Fed. Cir. 2002). This is indeed the case here.

The ’206 patent has eight independent claims, and only independent claims 14 and 63 were considered by the Commission. *Phillips*, 415 F.3d at 1312. (“Other claims of the patent in question, both asserted and unasserted, can also be valuable sources of enlightenment as to the meaning of a claim term.”). Of these eight independent claims, six claim “a front opening”, one is silent as to an opening at all, and only one—claim 63—claims “front openings.” Appx660-662. Moreover, unasserted claim 41 is largely identical in terms of its recited claim elements to claim 63, with the only substantive difference being that claim 63 claims “front openings” and claim 41 claims “a front opening.” Appx600; Appx662. Due to this, construing “a front opening” to include multiple openings in claim 41 would render superfluous “the exacting language chosen by the patentee” in claim 63. *Creative Integrated Sys. v. Nintendo of Am., Inc.*, 526 F.App’x 927, 935 (Fed. Cir. 2013). To the extent that “a front opening” in claim 41 cannot be construed to include multiple openings, it follows that the same construction must be applied to claim 14. *Inverness Med. Switzerland GmbH v. Princeton Biomeditech Corp.*, 309 F.3d 1365, 1371 (Fed. Cir. 2002) (a claim term that appears in more than one claim must be construed consistently).

The Commission also erred in analysis of the intrinsic record. Nothing in the specification or in the figures show the single front opening, 126, further subdivided into multiple openings. The Commission incorporated Figure 13 into its construction, Appx54, but Figure 13 only shows a single opening with a single width, W_1. Appx639. Figure 11 shows an exploded isometric view of the same embodiment, with the added detail of adapters being fitted into the module, and again shows no dividers or spacers in the space the adapters are intended to occupy. Appx636, Appx639. Figures 16 through 18 (with the front view shown in Figure 18) show multiple front openings in a single module, but each of these multiple front openings have separate W_1 dimensions. Appx643 (showing separate dimensions); Appx652 (3:14-20). This shows that when the patentee wanted to describe multiple openings, it identified them, which the patentee did not do in Figure 13—the purported reference point for the Commission's construction.

Finally, Figures 14 and 15, which the Commission found persuasive, also show no dividers or spacers within the opening. In both figures, a front opening 126 points to a single open space with adapters. Appx640. Nothing in the specification describes or suggests the front opening is "filled with material" to support the adapters as Corning alleged or the Commission concluded. Notably, while the Commission focuses on the portion of 126 ***between*** the MPO adapters, it did not consider the portions of 126 outside the adapters. None of the figures show opening 126, and W_1, to encompass material on the front side of the module between the opening and the sidewall of the modules. Therefore, the portion of the opening 126 to which the arrows in the Figures are directed that are between the adapters and the sidewalls in these figures must be open, or else they would not be considered part of the "front opening" even under the Commission's construction.

Given that the Commission's applied an incorrect construction which is determinative of infringement, its finding that Siemon and FS infringed the '206 patent should be reversed.

CONCLUSION

For the foregoing reasons, the judgment of the ITC should be reversed, or at minimum, vacated.

Date: April 25, 2022

Respectfully submitted,

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ADDENDUM

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PUBLIC VERSION

UNITED STATES INTERNATIONAL TRADE COMMISSION
Washington, D.C.

In the Matter of

CERTAIN HIGH-DENSITY FIBER OPTIC EQUIPMENT AND COMPONENTS THEREOF

Investigation No. 337-TA-1194

COMMISSION OPINION

Table of Contents

I. INTRODUCTION

On May 24, 2021, the Commission determined to review in part the final initial determination ("ID") issued by the presiding administrative law judge ("ALJ") on March 23, 2021. Notice at 3-6 (May 24, 2021) ("Notice of Review"), *published at* 86 Fed. Reg. 28890-893 (May 28, 2021). On review, the Commission has determined that there has been a violation of section 337 of the Tariff Act of 1930, as amended, 19 U.S.C. § 1337, with respect to claims 1 and 3 of U.S. Patent No. 9,020,320 ("the '320 patent"); claims 11, 12, 14-16, 19, 21, 27, and 28 of U.S. Patent No. 10,444,456 ("the '456 patent"); claims 9, 16, 23, and 26 of U.S. Patent No. 10,120,153 ("the '153 patent"); and claims 22 and 23 of U.S. Patent No. 8,712,206 ("the '206 patent"). The Commission has also determined to issue a general exclusion order ("GEO") prohibiting the importation of infringing high-density fiber optic equipment and components thereof and cease and desist orders ("CDO") directed to three respondents. This opinion sets forth the Commission's reasoning in support of its determination.

II. BACKGROUND

A. Procedural History

The Commission instituted this investigation on March 24, 2020, based on a complaint filed on behalf of Corning Optical Communications LLC ("Corning") of Charlotte, North Carolina. 85 Fed. Reg. 16653-54 (Mar. 24, 2020). The complaint, as supplemented, alleged violations of section 337 in the importation into the United States, the sale for importation, or the sale within the United States after importation of certain high-density fiber optic equipment and components thereof by reason of infringement of certain claims of the '153, '206, '320, and '456 patents and U.S. Patent No. 10,094,996 ("the '996 patent"). *Id*.

The Commission's notice of investigation named thirteen respondents:

1. Total Cable Solutions, Inc. ("TCS") of Springboro, Ohio;

2. Legrand North America, LLC ("Legrand") of West Hartford, Connecticut;

3. AFL Telecommunications Holdings LLC ("AFL Holdings") of Duncan, South Carolina;

4. Huber+Suhner AG of Herisau, Switzerland;

5. Huber + Suhner, Inc. of Charlotte, North Carolina;

6. Shenzhen Anfkom Telecom Co., Ltd. d/b/a Anfkom Telecom ("Anfkom") of Shenzhen, China;

7. Shanghai TARLUZ Telecom Tech. Co., Ltd. d/b/a TARLUZ ("TARLUZ") of Shanghai, China;

8. Wulei Technology Co., Ltd. d/b/a Bonelinks ("Wulei Bonelinks") of Shenzhen, China;

9. FS.com Inc. ("FS") of New Castle, Delaware;

10. Leviton Manufacturing Co., Inc. ("Leviton") of Melville, New York;

11. Panduit Corporation ("Panduit") of Tinley, Illinois;

12. The LAN Wirewerks Research Laboratories Inc. d/b/a Wirewerks ("Wirewerks") of Quebec, Canada; and

13. The Siemon Company ("Siemon") of Watertown, Connecticut.

Id. at 16653-54. *Id*. The notice of investigation also named the Office of Unfair Import Investigations ("OUII") as a party. *Id.* at 16654.

Respondent Legrand was terminated from the investigation based on withdrawal of the allegations in the complaint pursuant to Commission Rule 210.21(a), 19 C.F.R. § 210.21(a). *See* Order No. 5 (Apr. 16, 2020); *unreviewed by* Comm'n Notice (May 7, 2020). The complaint and notice of investigation were amended to substitute AFL Telecommunications LLC for respondent AFL Holdings. 85 Fed. Reg. 44923 (July 24, 2020). Thereafter, Respondent AFL Telecommunications LLC was terminated from the investigation based on a settlement agreement. *See* Order No. 27 (Oct. 20, 2020), *unreviewed by* Comm'n Notice (Nov. 2, 2020).

Respondents Huber+Suhner AG, Huber + Suhner, Inc., Anfkom, TARLUZ, and Wulei Bonelinks (collectively, "Defaulting Respondents") were found in default pursuant to Commission Rule 210.16, 19 C.F.R. § 210.16. *See* Order Nos. 7 & 8 (June 9, 2020), *unreviewed by* Comm'n Notice (June 22, 2020); Order No. 13 (Aug. 21, 2020), *unreviewed by* Comm'n Notice (Sept. 15, 2020). Respondent TCS was terminated from the investigation based on a consent order. *See* Comm'n Notice (Sept. 28, 2020). Accordingly, Respondents Panduit, Leviton, Siemon, FS, and Wirewerks (collectively, "Active Respondents") remain active in the investigation.

As a result of the termination of all asserted claims of the '996 patent and certain other asserted claims, *see* Order No. 11 (July 29, 2020), *unreviewed by* Comm'n Notice (Aug. 13, 2020); Order No. 18 (Sept. 14, 2020), *unreviewed by* Comm'n Notice (Oct. 14, 2020); Order No. 19 (Oct. 2, 2020), *unreviewed by* Comm'n Notice (Oct. 27, 2020), the following table identifies the claims asserted against each Active and Defaulting Respondent and for satisfying the domestic industry requirement.

Table 1. Asserted Claims

Active Respondents	'320	'456	'153	'206
Panduit	1*, 3	11*, 12, 14-16, 19, 21, 27*, 28	9, 16, 23*, 26	22, 23
Leviton	1*, 3	11*, 14-16, 19, 27*		
Siemon	1*, 3	11*, 12, 14-16, 19, 21, 27*, 28	9, 23*	22
FS	1*, 3	11*, 12, 14-16, 19, 21	9, 16, 23*, 26	22, 23
Wirewerks				22, 23

Defaulting Respondents	’320	’456	’153	’206
Anfkom	1*, 3	11*, 12, 14-16, 19, 21	9, 16, 23*, 26	22, 23
Huber+Suhner AG and Huber + Suhner, Inc.	1*, 3	11*, 14-16, 19, 21, 27*	9, 16, 23*, 26	
TARLUZ	1*, 3	11*, 12, 14-16, 19, 21		22, 23
Wulei Bonelinks	1*, 3	11*, 12, 14-16, 19, 21		22, 23
Complainant	**’320**	**’456**	**’153**	**’206**
Corning	1*, 3	11*, 12, 14-16, 19, 21, 27*, 28	9, 16, 23*, 26	22, 23

* denotes an independent claim

A prehearing conference and evidentiary hearing were held in this investigation from October 21-26, 2020.

On March 23, 2021, the ALJ issued a final ID finding that certain accused products infringed the asserted claims and those claims had not been shown to be invalid. The ID also found that the economic prong of the domestic industry requirement was satisfied with respect to all the asserted patents under section 337(a)(3)(B) and (C). Accordingly, the ID found a violation of section 337 with respect to claims 1 and 3 of the ’320 patent; claims 11, 12, 14-16, 19, 21, 27, and 28 of the ’456 patent; claims 9, 16, 23, and 26 of the ’153 patent; and claims 22 and 23 of the ’206 patent.

On April 5, 2021, OUII and Respondent Leviton each filed a petition for review of the ID.[1] That same day, Respondents FS, Panduit, Wirewerks, and Siemon (collectively, “Joint

[1] *See* Office of Unfair Import Investigations’ Petition for Review (Apr. 5, 2021) (“OUII Pet.”); Respondent Leviton’s Petition for Review of Initial Determination (Apr. 5, 2021) (“Leviton Pet.”).

Respondents") also filed a joint petition for review.[2] Complainant Corning did not file a petition for review. On April 13, 2021, OUII, Leviton, and Corning each filed a response to the petitions.[3] On April 22, 2021, Leviton and Corning each filed comments regarding the public interest pursuant to Rule 210.50(a)(4).[4]

On May 24, 2021, the Commission determined to review the ID in part. Notice of Review at 3-6, *published at* 86 Fed. Reg. 28890-93 (May 28, 2021). Specifically, the Commission determined to review: (1) the ID's finding that the importation requirement of section 337 is met with respect to the accused products of Respondents Leviton, Panduit, and Siemon; (2) the ID's interpretation of the "width of the front side of [the] fiber optic module" limitation in the asserted claims of the '456 patent, and the associated infringement findings; (3) the ID's construction of "a front opening" in the asserted claims of the '206 patent, and the associated infringement findings; (4) the ID's finding that Leviton directly infringes the asserted claims of the '320 and '456 patents; (5) the ID's findings on indirect infringement of the asserted claims of the '320, '456, and/or '153 patents by Respondents Leviton, Panduit, FS, and Siemon; and (6) the ID's finding that Corning has satisfied the economic prong of the domestic industry requirement under section 337(a)(3)(B) and (C). The Commission did not review any other issues, including the ID's determination that the Active Respondents failed to show the asserted

[2] *See* Respondent FS.com Inc.'s, Panduit Corp.'s, The LAN Wirewerks Research Laboratories, Inc. d/b/a Wirewerks', and The Siemon Company's Joint Petition for Commission Review (Apr. 5, 2021) ("Joint Pet.").

[3] *See* Office of Unfair Import Investigations' Combined Response to Respondents' Petitions for Review (Apr. 13, 2021) ("OUII Resp."); Leviton's Response to Petitions for Review (Apr. 13, 2021) ("Leviton Resp."); Complainant's Response to Petitions for Review of the Initial Determination (Apr. 13, 2021) ("Compl. Resp.").

[4] *See* Leviton Manufacturing Co., Inc.'s Public Interest Statement (Apr. 22, 2021) ("Leviton Stmt"); Complainant's Public Interest Statement (Apr. 22, 2021) ("Compl. Stmt").

claims were invalid. In connection with its review, the Commission requested that the parties brief certain issues under review and requested the parties, interested government agencies, and other interested persons to submit briefing on the issues of remedy, the public interest, and bonding. *Id.*

On June 7, 2021, the parties filed initial submissions in response to the Notice of Review.[5] On June 14, 2021, the parties filed replies to each other's submissions.[6] Defaulting Respondents, Huber+Suhner AG and Huber + Suhner, Inc., filed a comment in response to the Commission's Notice of Request for Submissions on the Public Interest.[7] 86 Fed. Reg. 22067-68 (Apr. 26, 2021).

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[5] *See* Complainant's Initial Submission in Response to Commission Determination to Review in Part a Final Initial Determination Finding a Violation of Section 337 and the Request for Written Submissions on the Issues Under Review and on Remedy, the Public Interest, and Bonding (June 7, 2021) ("Compl. Sub."); Respondent Leviton Manufacturing Co. Inc.'s Brief to the Commission on Issues Under Review, Remedy, and Bonding (June 7, 2021) ("Leviton Sub."); Respondent FS.com Inc.'s, Panduit Corp.'s, The Siemon Company's, and The LAN Wirewerks Research Laboratories, Inc. d/b/a Wirewerks' Joint Responses to Commission Questions (June 7, 2021) ("Joint Sub."); Brief of the Office of Unfair Import Investigations on the Issues Under Review and on Remedy, the Public Interest, and Bonding (June 7, 2021) ("OUII Sub.").

[6] *See* Complainant's Reply Submission in Response to Commission Determination to Review in Part a Final Initial Determination Finding a Violation of Section 337 and the Request for Written Submissions on the Issues Under Review and on Remedy, the Public Interest, and Bonding (June 14, 2021) ("Compl. Reply"); Respondent Leviton Manufacturing Co. Inc.'s Reply Brief to the Commission on Issues Under Review, Remedy, and Bonding (June 14, 2021) ("Leviton Reply"); Respondent FS.com Inc.'s, Panduit Corp.'s, The Siemon Company's, and The LAN Wirewerks Research Laboratories, Inc. d/b/a Wirewerks' Reply to Complainant's and Staff's Responses to Commission Notice (June 14, 2021) ("Joint Reply"); Reply Brief of the Office of Unfair Import Investigations on the Issues Under Review and on Remedy, the Public Interest, and Bonding (June 14, 2021) ("OUII Reply").

[7] *See* Submission on the Issue of the Public Interest, EDIS DOC ID 744156 (June 7, 2021) ("H+S Stmt").

B. The Asserted Patents

The ’320, ’456, ’153, and ’206 patents are related. The ’320 and ’456 patents share a specification, and the ’153 patent is in the same family as the ’320 and ’456 patents. The ’206 patent is from a different family but shares the same 25 figures with the ’320 and ’456 patents.

The technology at issue in this investigation is high-density fiber optic equipment and components thereof, of the kind commonly used in data centers. A data center is a facility that houses communication equipment. CX-2041 (J. Technology Stip.) at 2. Data centers typically contain multiple racks for mounting electronic equipment, which is attached to the racks using mounting holes on the sides of each rack. *Id*. at 3. The racks are typically either 19 or 23 inches wide. *Id*. A “rack unit” is a measurement of vertical space within a rack. A standard rack unit is 1.75 inches tall. *Id*. at 4. One 1.75-inch rack unit is referred to as a “U space,” which is abbreviated as “1U” or “1RU.” *Id.* at 4-5; Blumenthal Tr. 671:5-13. Two such spaces, totaling 3.5 inches in height, are known as “2U.” Four such spaces, totaling seven inches in height, are known as “4U.” The purpose of the racks in fiber optic data centers is to house chassis (also referred to as “enclosures”) that can be configured to connect fiber optic cables. These chassis may contain trays that carry subenclosures such as “modules,” “cassettes,” “adapter plates,” and “patch panels.” CX-2041 at 6.

Figure 7 of the ’320 patent (reproduced below) illustrates a front perspective view of fiber optic equipment trays supporting fiber optic modules with one fiber optic equipment tray extended out from the chassis. JX-4 (’320 patent) at 3:16-18.

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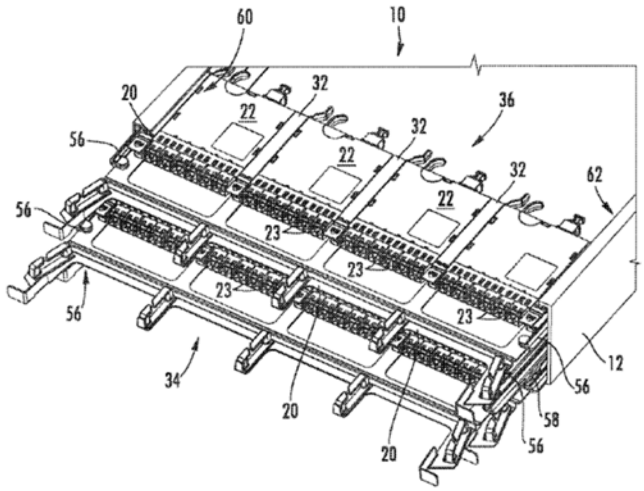

FIG. 7

JX-4 ('320 patent), Fig. 7

As shown in Figure 7, "the fiber optic equipment **10** includes a plurality of extendable fiber optic equipment trays **20** that each carries one or more fiber optic modules **22**." *Id.* at 5:9-12. "The chassis **12** and fiber optic equipment trays **20** support fiber optic modules **22** that support high-density fiber optic modules and a fiber optic connection density and bandwidth connections in a given space, including in a 1-U space." *Id.* at 5:12-16. The fiber optic equipment in this embodiment can support a high fiber optic connection density, as described below:

> The fiber optic equipment trays **20** in this embodiment support up to four (4) of the fiber optic modules **22** in approximately the width of a 1-U space, and three (3) fiber optic equipment trays **20** in the height of a 1-U space for a total of twelve (12) fiber optic modules **22** in a 1-U space. Thus, for example, if six (6) duplex fiber optic components were disposed in each of the twelve (12) fiber optic modules **22** installed in fiber optic equipment trays **20** of the chassis **12** as illustrated in FIG. 1, a total of one hundred forty-four (144) fiber optic connections, or seventy-two (72) duplex channels (i.e., transmit and receive channels), would be supported by the chassis **12** in a 1-U space. If five (5) duplex fiber optic adapters are disposed in each of the twelve (12) fiber optic modules **22** installed in fiber optic equipment trays **20** of the chassis **12**, a total of one hundred twenty (120) fiber optic connections, or sixty (60) duplex channels, would be supported by

> the chassis **12** in a 1-U space. The chassis **12** also supports at least ninety-eight (98) fiber optic components in a 1-U space wherein at least one of the fiber optic components is a simplex or duplex fiber optic component.

Id. at 5:33-52.

Figure 10A below illustrates an exemplary fiber optic module **22** that can be inserted in the fiber optic equipment trays **20** to provide fiber optic connections in the chassis **12**. *Id.* at 8:52-56. Fiber optic components **23** can be disposed through the front side **96** of the main body **90** and are connected to a fiber optic component **100** disposed through the rear side **98** of the main body **90**. *Id.* at 8:61-9:10. In one embodiment, the fiber optic components **23** on the front side **96** are duplex Lucent Connector (LC) fiber topic adapters and the fiber optic component **100** on the rear side **98** is a multi-fiber push-on/pull (MPO) fiber optic adapter. *See id.*; CX-0001C (Prucnal WS) Q/A 29-31, 34-35.

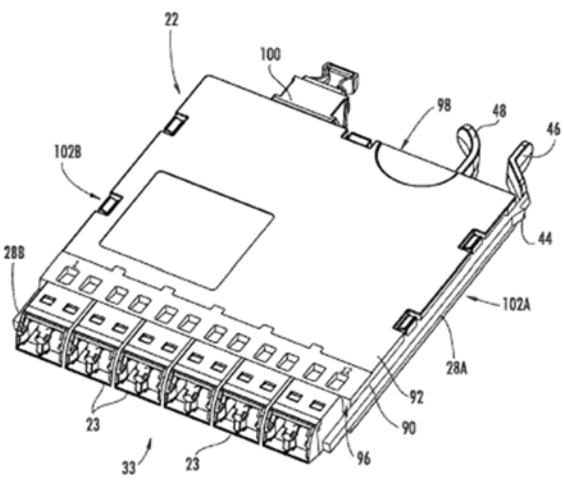

FIG. 10A

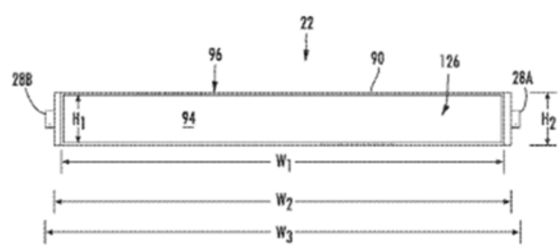

FIG. 13

Figure 13 above "illustrates a front view of the fiber optic module **22** without loaded fiber optic components **23** in the front side **96** to further illustrate the form factor of the fiber optic module **22**." JX-4 ('320 patent) at 9:64-67. "[T]he front opening **126** is disposed through the front side **96** of the main body **90** to receive the fiber optic components **23**." *Id.* at 9:67-10:2. In one embodiment, "the width W_1 of the front opening **126** is design[ed] to be at least eighty-five percent (85%) of the width W_2 of the front side **96**." *Id.* at 10:10-13. "The greater the percentage of the width W_1 to width W_2, the larger the area provided in the front opening **126** to receive fiber optic components **23** without increasing width W_2." *Id.* at 10:13-16. Width W_3 is "the overall width of the fiber optic module **22**," and "may be 86.6 mm or 3.5 inches in this embodiment." *Id.* at 10:16-18.

The asserted claims of the '320, '456, and '153 patents ("Apparatus Claims") are directed to fiber optic apparatuses that include at least a chassis and one or more fiber optic modules, whereas the asserted claims of the '206 patents ("Module Claims") are directed to fiber optic modules only. *Compare, e.g.*, JX-4 ('320 patent) at 19:52-59; JX-10 ('456 patent) at 21:43-22:9; JX-7 ('153 patent) at 19:8-20:10 *with* JX-1 ('206 patent) at 20:48-65, 21:27-31. Claims 1 and 3 of the '320 patent and claims 11, 19 and 27 of the '456 patent are directed to fiber optic apparatuses that achieve a certain number of fiber optic connections per U space. *See, e.g.*, JX-4 ('320 patent) at 19:52-59; JX-10 ('456 patent) at 21:43-22:9; CX-0001C (Prucnal WS) Q/A 570. Claims 21 and 28 of the '456 patent and the asserted claims of the '153 patent read on features that improve accessibility, such as sliding trays holding modules and features that guide tray and module movement. *See, e.g.*, JX-10 ('456 patent) at 22:63-23:3, 24:39-43; JX-7 ('153 patent) at 19:8-20:10; CX-0001C (Prucnal WS) Q/A 571. Claims 11 and 27 of the '456 patent and the asserted claims of the '206 patent read on features of modules and features guiding and allowing their installation and movement, which help to protect fibers from damage or excessive bending. *See, e.g.*, JX-10 ('456 patent) at 24:3-38; JX-1 ('206 patent) at 20:48-65, 21:27-31; CX-0001C (Prucnal WS) Q/A 572.

C. The Accused Products

The accused products consist of chassis (or enclosures), modules (or cassettes), and combinations thereof. ID at 10. There are three categories of accused products: Base-8, Base-12, and Base-24, which are defined by the number of fiber connections available per module. A Base-8 module supports eight fiber connections, and a Base-8 chassis supports eighteen Base-8 modules per 1U space. CX-0001C (Prucnal WS) Q/A 63. A Base-12 module supports twelve fiber connections, and a Base-12 chassis supports twelve Base-12 modules per 1U space. *Id*. A Base-24 module supports twenty-four fiber connections, and a Base-24 chassis supports six Base-24 modules per 1U space. *Id*. In each case, there are a total of 144 connections available in a 1U space; the difference in the three categories is in the number of modules needed to fill that space. Within each category, there are three chassis sizes: 1U, 2U, and 4U, which refer to the chassis height. *Id*. Apart from the total height, these types are materially the same for each Respondent. *Id*. The accused modules provide LC fiber optic connections on the front and at least one MPO or MTP (a proprietary version of an MPO) connection on the rear. *Id.* Q/A 27-29, 33.

The following table describes the accused products allegedly imported and/or sold in the United States by each Active Respondent:

Table 2. Summary of Accused Products

Respondent	Brand	Chassis			Module		
		Base-8	Base-12	Base-24	Base-8	Base-12	Base-24
FS	FHX	1U	1U		X	X	
Leviton	OPT-X		1U/2U/4U			X	X
Panduit	HD FLEX	1U/2U/4U	1U/2U/4U	1U/2U/4U	X	X	X
Siemon	LightStack	1U/2U/4U	1U/2U/4U		X	X	
Wirewerks	NextSTEP					X	

See ID at 12-14.

FS' Accused Products are marketed under the name FHX Series and FHXFCP/ FHX-C Series and include both chassis and modules. CX-0001C at Q/A 117.

Leviton's Accused Products are marketed under the name OPT-X UHDX Enclosures (chassis) and HDX Enterprise Cassettes (modules). *Id.* at Q/A 98.

Panduit's Accused Products are marketed as HD FLEX Fiber Enclosures and HD Flex Fiber Cassettes. *Id.* at Q/A 85. The parties agree that Panduit's FHCZA-12-10U, FH3CZA-08H-10B, and FHCZO-23-10BN cassettes are representative Base-12, Base-8, and Base-24 modules. RX-0006C (Min WS) Q/A 36; RX-1672C (Kuffel WS) Q/A 20-21.

Siemon's Accused Products are marketed under the name LightStack Ultra High-Density Fiber Plug and Play system and include LightStack and LightStack 8 Ultra High Density Fiber Enclosures (chassis) and LightStack and LightStack8 Ultra High Density Plug & Play Modules. CX-0001C at Q/A 106. Siemon's accused chassis underwent a relatively recent design change. *Id.* Effective August 26, 2019, Siemon modified its Siemon Base-12 and Base-8 Chassis to remove the front module latches that enabled Siemon Base-12 and Base-8 Modules, respectively, to be removed from the front of the chassis. *Id.* Siemon did not change any of the model numbers of its products following this change. *Id.* As a result of disabling the functionality of removing modules from the front of the chassis, there is no dispute that the post-August 2019 versions do not infringe the asserted claims that require front removability – namely claims 9 and 23 of the '153 patent. *Id.* at Q/A 107.

Wirewerks' Accused Products are modules marketed under the name NextSTEP. *Id.* at Q/A 126. In addition to Wirewerks' accused NextSTEP module, Wirewerks seeks adjudication of an additional Wirewerks product identified as the "Wirewerks First Alternative Design." ID at 14 (citing Order No. 23 at 5 (Oct. 14, 2020); RPX-0078C (First Alternative Design module)).

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The Wirewerks First Alternative Design includes a new adapter, which is used in the same housing as the accused NextSTEP module. *Id.* (citing RX-0006C (Min RWS) Q/A 227-28). The adapter includes additional material on the front side that, according to Wirewerks, increases the "connection density" of the total product when using the method for measuring density that was used in the complaint. *Id.*; RX-1673C (Tabet WS) Q/A 41-53.

D. The Domestic Industry Products

For purposes of domestic industry, Corning relies on its "EDGE" system consisting of equipment for providing high-density connections in data centers. *See* ID at 14 (citing CX-0002C (Ralph WS) Q/A 23). As with the accused products, Corning submits that the 1U versions of the chassis are representative of the other available heights. Corning asserts that the following representative products, and the groups of Corning products that they represent, practice at least one claim of an asserted patent:

Table 3. Summary of Domestic Industry Products

Asserted Patents	Representative Product	Model Nos.
'320 Patent '153 Patent '456 Patent (claims 11-12, 14-16, 19, 21)	Representative EDGE Base-12 combination (EDGE Base-12 chassis with EDGE Base-12 modules)	Chassis: EDGE-01U-SP Module: ECM-UM12-05-93T
	Representative EDGE Base-8 combination (EDGE Base-8 chassis with EDGE Base-8 modules)	Chassis: EDGE8-01U-SP Module: ECM8-UM08-05-E6Q-ULL
'456 Patent (claims 27-28)	Representative EDGE 4U Base-12 chassis with Representative EDGE Base-12 module	Chassis: LS-4U-01 Module: ECM-UM12-05-93T
	Representative EDGE 4U Base-8 chassis with Representative EDGE Base-8 module	Chassis: LS8-4U-01 Module: ECM8-UM08-05-E6Q-ULL
'206 Patent	Representative EDGE Base-12 module	Module: ECM-UM12-05-93T
	Representative EDGE Base-8 module	Module: ECM8-UM08-05-E6Q-ULL

See ID at 15-16.

III. COMMISSION REVIEW OF THE FINAL ID

When the Commission reviews an initial determination, in whole or in part, it reviews the determination *de novo*. *Certain Soft-Edged Trampolines and Components Thereof*, Inv. No. 337-TA-908, Comm'n Op. at 4 (May 1, 2015). With respect to the issues under review, "the Commission may affirm, reverse, modify, set aside or remand for further proceedings, in whole or in part, the initial determination of the administrative law judge." 19 C.F.R. § 210.45(c). The Commission also "may take no position on specific issues or portions of the initial determination," and "may make any finding or conclusions that in its judgment are proper based on the record in the proceeding." *Id.*

IV. ANALYSIS

The Commission has determined that Corning established a violation of section 337 with respect to claims 1 and 3 of the '320 patent; claims 11, 12, 14-16, 19, 21, 27, and 28 of the '456 patent; claims 9, 16, 23, and 26 of the '153 patent; and claims 22 and 23 of the '206 patent. Specifically, the Commission affirms with modified reasoning the ID's finding that Respondents Leviton, Panduit, and Siemon satisfy the importation requirement. Respondents FS and Wirewerks did not contest the ID's findings that the importation requirement was met as to their products. With regard to claim construction, the Commission has determined to: (1) adopt OUII's proposed construction for the "width of the front side of [the] fiber optic module" limitation in claims 12 and 28 of the '456 patent and find that the accused products meet this limitation under the proper construction; and (2) adopt Corning's proposed construction for the "front opening" limitation in the asserted claims of the '206 patent and find that the accused modules meet this limitation under the proper construction. The Commission also affirms with modifications the ID's finding that Respondents Panduit, Siemon, and FS induced infringement of the asserted claims of the '320, '456, and '153 patents, and that Respondent Leviton induced infringement of the asserted claims of the ’320 and ’456 patents. Further, the Commission affirms the ID’s finding of no contributory infringement by Respondents Leviton, Panduit, and Siemon, and takes no position on the ID’s finding of no contributory infringement by FS. The Commission takes no position on the ID’s finding that Leviton directly infringes the asserted claims of the ’320 and ’456 patents. Finally, the Commission affirms with modifications the ID’s finding that Corning has satisfied the economic prong of the domestic industry requirement under subparagraphs (B) and (C) of section 337(a)(3). The Commission affirms and adopts the ID’s findings, conclusions, and supporting analysis that are not inconsistent with the Commission’s opinion.

A. Satisfaction of the Importation Requirement for the ’320, ’456, and ’153 Patents by Respondents Leviton, Panduit, and Siemon

The Commission affirms, with modifications, the ID’s finding that the importation requirement of section 337 is satisfied with respect to Respondents Leviton, Panduit, and Siemon. *See* ID at 51 (Leviton), 60-61 (Panduit and Siemon). Respondents FS and Wirewerks did not challenge the ID’s finding that the importation requirement was met as to them, and the Commission did not review those findings. *Id.* at 61 (FS and Wirewerks).

The importation requirement as set forth in section 337(a)(1)(B) requires that there be an “importation into the United States, the sale for importation, or the sale within the United States after importation . . . of articles[.]” 19 U.S.C. § 1337(a)(1)(B). As explained below, the record shows that Respondents Leviton, Panduit, and Siemon each import components of their accused fiber optic apparatuses into the United States. That is sufficient to establish the requirement that there be an “importation into the United States” as provided in section 337(a)(1)(B).

Leviton challenges the ID’s finding that the importation requirement is satisfied by asserting that it does not import its accused modules, its accused chassis, or the accused chassis and modules in combination. Leviton Pet. at 8-14. It is undisputed that Leviton does not import its accused modules. *See* ID at 52 (finding that "Leviton manufactures all of its HDX Enterprise Cassettes [(modules)] in Bloomingdale, Illinois."). As shown in the chart below, Leviton manufactures its accused modules in its manufacturing plant in the United States.

RDX-0005C

[redacted]

RDX-0005C; *see also* RDX-0019C.0005.

As to the accused chassis,[8] Leviton submits that it has not imported a complete chassis but, rather, it imported "certain materials used to make components of the enclosures." Leviton Pet. at 14. The fact that a complete chassis is assembled in the United States is irrelevant to the question of whether the chassis subcomponents were imported into the United States. The Commission finds Leviton's admission of its importation of "materials" used to assemble the

[8] Leviton's "accused chassis" are the accused products marketed under the name OPT-X UHDX Enclosures. CX-0001C at Q/A 98. As shown in RDX-0005C, [redacted] are both components of Leviton's accused chassis. However, we note that the asserted apparatus claims do not include "trays" as part of the claimed "chassis." *See, e.g.*, JX-10 ('456 patent) at 21:50-51 (claim 11: "a plurality of fiber optic equipment trays supported by the chassis"). Rather, the claimed "chassis," trays," and "modules" are separate components of the claimed fiber optic apparatus. *See, e.g.*, *id.* at 21:43-54.

accused chassis is sufficient to establish that those materials were imported into the United States.

The record evidence shows that Leviton imported from Mexico its [redacted], as shown below, until July 31, 2020, when Leviton asserts that it began sourcing them from the United States. Accordingly, Leviton imported its [redacted] prior to, as well as after, the complaint was filed on February 21, 2020.

[redacted]

Compl. Sub. at 6. Leviton's Vice President of Engineering, Frank Kim,[9] testified that until July 31, 2020, just before the evidentiary hearing, other than the [redacted] included in the accused chassis were manufactured and assembled in Mexico.[10]

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[9] Frank Kim is Vice President of Engineering in Leviton's Network Solutions division. RX-0005C at Q/A 2.

[10] Shortly before the evidentiary hearing, Mr. Kim amended his testimony to state that the [redacted] formerly imported from Mexico are now sourced in the United States. RX-0005.1C (Errata to Kim WS). Leviton stopped importing the [redacted] from Mexico on July 31, 2020 (after the complaint was filed). Kim Tr. 534. Before this change, Mr. Kim confirmed that the country of origin for the completed chassis was listed as Mexico. *Id.*; CX-0055 (packaging labels for Leviton 1U and 4U chassis); JX-0013C at 50:1-51:17.

Kim Tr. 487-89. Specifically, the [redacted] included the manufacture and assembly in Mexico of [redacted] parts for the 1U enclosure, [redacted] parts for the 2U, and [redacted] parts for the 4U enclosures in Mexico. Kim Tr. 487:23-488:4, 490:23-491:7, 494:8-25; CX-0095C (Leviton UHD-W2 1RU Sub Drawing); CX-0062C (Leviton UHD-W2 2RU Sub Assembly Drawing) at 1; CX-0063C (Leviton UHD-W2 4RU Sub Assembly Drawing) at 1. Each [redacted] included the manufacture and assembly of [redacted] parts in Mexico. Kim Tr. 503:8-17; CX-0091C at 1. The [redacted] were manufactured in the United States and shipped to Mexico to be assembled with the [redacted] that were manufactured in Mexico. CX-0095C (Leviton UHD-W2 1RU Sub Drawing) (showing the [redacted] as imported, including the tray guides (item 6)); JX-0013C (Byquist Dep. Tr.) 139:15-140:13; Kim Tr. 489:3-25; JX-0016C (Kim Dep. Tr.) 233:20-234:6. The [redacted] manufactured in Mexico were then shipped as one piece to Leviton's assembly plant in the United States for final assembly. ID at 52-53 (citing JX-0013C (Byquist Dep. Tr.) at 130-38; CX-0059C (Leviton UHD-W2 1RU sub drawing)). Other parts for the chassis such as the [redacted] were also manufactured in Mexico and imported for assembly with the [redacted] in the United States. *See* RDX-0005C; CX-0054C (Leviton BOMs) at 2, Rows 27-29 (showing that these parts are all imported); CX-0060C (Leviton 001-5R1UD-S12 Assembly Instructions) at 10-11. Indeed, the labels on Leviton's imported [redacted] say "Country of Origin: Mexico."[11] *See, e.g.*, CX-0055 (packaging labels for Leviton 1U and 4U chassis); JX-0013C (Byquist Dep. Tr.) at 50:1-51:17; Kim Tr. 534:11-20. Based on these facts, the

[11] The labels on Leviton's imported [redacted] say, "Country of Origin: Mexico," not "Made in Mexico" as stated in the ID. ID at 53.

Commission concludes that the importation requirement of section 337 has been satisfied as to Leviton.[12]

Leviton also submits that its "imported materials are not the enclosures sold to or used by customers." Leviton Sub. at 22. To the extent Leviton is arguing that the components that it is importing into the United States are not "articles" because they are [redacted] or noncommercial items, we find that that argument lacks merit. *See Certain Non-Volatile Memory Devices & Prods. Containing the Same*, Inv. No. 337-TA-1046 ("*Non-Volatile Memory Devices*"), Comm'n Op. at 41-42 (Oct. 26, 2018) ("The term 'article' on its own is sufficiently capacious to embrace pre-commercial or noncommercial items.") (citing *Certain Computers and Computer Peripheral Devices, and Components Thereof, and Products Containing Same*, Inv. No. 337-TA-841, Comm'n Op. at 37, 39 (Jan. 9, 2014)).

After finding "Leviton's accused chassis were actually 'manufactured' in Mexico, with the exception of certain minor and insignificant assembly steps performed after importation," the ID also analyzed whether "[t]here was a sufficient nexus between the imported [redacted] and the 'articles that infringe' sold after importation." ID at 53-54. Leviton argues that the importation requirement is not met because its imported [redacted] "do not meet any claim limitations, and do not have any nexus to those claims." Leviton Sub. at 26. Both the ID and

[12] The ID found the "imported components represented over [redacted] percent of the value of Leviton's chassis, in terms of materials costs." ID at 53. The ID also found "[w]hen the cost of labor in Mexico is added, the percentage rises to [redacted] percent." *Id.* Leviton contends this latter finding is a misrepresentation of the evidence and that the percentage value of Mexico materials decreases to only [redacted] when the total cost of labor is considered. Leviton Pet. at 11. The Commission notes these considerations are not relevant to the importation analysis. The Commission does not adopt the ID's finding that when "the cost of labor in Mexico is added, the percentage rises to [redacted] percent" because it was based on including in the percentage calculation a unit cost for labor in the U.S., not in Mexico. *See* OUII Resp. at 48 n.16.

Leviton conflate the importation requirement with the separate inquiry of whether the imported components constitute "articles that infringe" within the meaning of section 337(a)(1)(B).

The Commission does not adopt the ID's analysis and findings regarding a "nexus" between the imported components and the "articles that infringe." *See* ID at 54-57 (Leviton), 58-61 (Panduit and Siemon). Whether imported components meet any claim limitations or have a nexus to the asserted claims is irrelevant to the issue of whether there is an "importation into the United States" of those components. Here, the evidence shows that Leviton's importation of its [redacted] from Mexico for assembly in its accused chassis satisfies the importation requirement under section 337(a)(1)(B). The question of whether Leviton's imported components may be considered "articles that infringe" is analyzed below in connection with infringement.

Regarding importation by Panduit and Siemon, the ID found that they import their accused modules, which are components of their accused fiber optic apparatuses. Panduit and Siemon do not dispute that they import their accused modules, but they argue that the ID improperly applied Federal Circuit and Commission precedent to importation of a noninfringing component with substantial noninfringing uses with respect to an apparatus claim. *See* Joint Pet. at 20-21. Again, these arguments do not address whether there is an "importation in the United States" of accused modules. Rather, these arguments are directed to whether the accused modules that are imported in the United States constitute "articles that infringe." Those arguments are addressed in connection with infringement below.

Based on the foregoing, the Commission finds that the importation requirement of section 337(a)(1)(B) is satisfied as to Respondents Leviton, Panduit, and Siemon. In the case of Leviton,

Leviton imported chassis components, which include the [redacted]. Panduit and Siemon import their accused modules.

B. Infringement of the Asserted Apparatus Claims (the ’320, ’456, and ’153 Patents), Articles That Infringe, and the Scope of Section 337

The ID found that Leviton and its customers directly infringe the asserted claims of the ’320 and ’456 patents and that, while Panduit, FS, and Siemon do not directly infringe, their customers directly infringe the asserted claims of the ’320, ’456, and ’153 patents. The ID also found that Leviton, Panduit, FS, and Siemon actively induce their customers to infringe the asserted apparatus claims, but they do not contributorily infringe those claims. The Commission determined to review these infringement findings and the ID’s construction of the “width of the front side of [the] fiber optic module” limitation in claims 12 and 28 of the ’456 patent.

As discussed below, the Commission has determined to: (1) adopt OUII’s proposed construction for the “width of the front side of [the] fiber optic module” limitation in claims 12 and 28 of the ’456 patent and find that the accused products meet this limitation as construed;[13] (2) affirm with modifications the ID’s finding of induced infringement of the asserted apparatus claims by Leviton, Panduit, Siemon, and FS; (3) affirm the ID’s finding of no contributory infringement with respect to Leviton, Panduit, and Siemon; (4) take no position on the ID’s finding of no contributory infringement with respect to FS; and (5) take no position on the ID’s findings concerning Leviton’s direct infringement.

[13] The Commission’s adoption of OUII’s proposal for the “width of the front side of [the] fiber optic module” limitation does not affect the ID’s findings as to the technical prong of the domestic industry requirement and validity of claims 12 and 28 of the ’456 patent.

PUBLIC VERSION

1. Limitation "width of the front side of [the] fiber optic module" (claims 12 and 28 of the '456 patent)

Claims 12 and 28 of the '456 patent recite "wherein the plurality of first fiber optic adapters is disposed through at least eighty-five percent (85%) of a width of the front side of at least one fiber optic module of the plurality of fiber optic modules." JX-10 ('456 patent) at 22:10-15, 24:39-43.

Before the ALJ, the parties proposed the following constructions for the "width of the front side of [the] fiber optic module" limitation.

Complainant	Respondents	OUII
"the width of the side of the module that when inserted faces the front of the chassis, excluding any module rail guides or protrusions **that are used to insert the module into the chassis or remove it from the chassis**"	"width of the front side of the fiber optic module including areas dedicated to latches, sidewalls, flanges, and other nonadapter functions" Otherwise indefinite.	"the width of the side of the module that when inserted faces the front of the chassis, excluding any module rail guides or protrusions***, e.g.*****, the dimension identified as 'W2' in Figure 13 of the '456 and '206 Patents"**

ID at 202 (emphasis added). The ID adopted Corning's proposal, but effectively applied OUII's construction in its infringement analysis because OUII's construction is "not materially different" from Corning's. *Id.* at 203. The Commission agrees with the Joint Respondents and OUII that OUII's proposed construction actually differed from Complainant's in one material respect: OUII's construction excluded all module rail guides or protrusions, while Complainant's construction only excluded protrusions that are used to insert or remove the module from the chassis. Joint Pet. at 71; OUII Resp. at 30. For this reason, the Commission *sua sponte* reviewed the ID's construction of this limitation.

On review, the Commission finds OUII's proposal, which adds a reference to "the dimension identified as 'W2' in Figure 13 of the '456 and '206 Patents," is better supported by the intrinsic record. As an initial matter, the ID's rationale for adopting Corning's construction applies equally to OUII's. *See* ID at 203 (comparing Corning's and OUII's proposals, which are "similar" as they exclude "any module rail guides or protrusions" with Respondents' proposal, which would not exclude rails or rail guides and would add the phrase "including areas dedicated to latches, sidewalls, flanges, and other nonadapter functions"), 203-05 (finding the specification and the function of measuring the width of the front side supports excluding rails), 205 (finding no prosecution history estoppel). Moreover, the '456 patent specification clearly defines the "width of the front side of [the] fiber optic module" to be equivalent to the width "W2," as shown in Figure 13. JX-10 ('456 patent) at 10:35-36 ("the width W2 of the front side **96** of the main body **90** of the fiber optic module **22**"). The patent specification also compares the width "W2" to other widths such as the narrower "width W1 of the front opening **126**," *id.* at 10:31, and the wider "[w]idth W3, the overall width of the fiber optic module **22**," *id.* at 10:39-40. Nowhere does the specification teach excluding only module rail guides or protrusions that are used to insert the module into, or remove it from, the chassis, as Corning's construction requires. Accordingly, the Commission adopts OUII's proposal and construes the "width of the front side of [the] fiber optic module" limitation in claims 12 and 28 of the '456 patent to mean "the width of the side of the module that when inserted faces the front of the chassis, excluding any module rail guides or protrusions, *e.g.*, the dimension identified as 'W2' in Figure 13 of the '456 and '206 Patents."

Adopting OUII's proposal does not affect the ID's infringement analysis with respect to Panduit's and FS' accused products because Panduit infringes claims 12 and 28 and FS infringes claim 12 under both Corning's and OUII's proposed constructions. ID at 216-218, 221, 226-27; *see*, *e.g.*, CDX-0001C at 168-69; CX-0001C (Prucnal WS) Q/A 303-07, 312-15. Accordingly, the Commission adopts the ID's analysis. With regard to Siemon, Corning's expert admits that

Siemon's Base-12 accused modules do not infringe claim 12 under Corning's construction. CX-0001C Q/A 310 ("These modules do not infringe under Corning's proposed construction, which excludes the protrusions on the top of the front side of the module, because according to Siemon these protrusions are not used to guide the module in and out of the chassis, as Corning's construction requires"); *see also id.* Q/A 311 (Siemon's Base-8 accused modules). The evidence shows, however, that Siemon's accused modules meet this limitation under OUII's construction. *See* CX-0001C (Prucnal WS) Q/A 310-11; JX-0010 ('456 patent) at 22:10-14. The Commission did not review the ID's finding that Siemon's accused combinations meet the other limitations of the asserted claims of the '456 patent. *See* ID at 223, 225. Thus, the Commission finds that Siemon's accused combinations infringe claims 12 and 28 of the '456 patent.

2. Induced Infringement

a. Scope of Section 337

The ID found that Leviton, Panduit, FS and Siemon's induced infringement constituted a violation of section 337. Leviton, Panduit, and Siemon argue that to the extent they are found to induce infringement under 35 U.S.C. § 271(b), their induced infringement does not constitute a section 337 violation because they do not import any "articles that infringe" within the meaning of section 337(a)(1)(B). According to their argument, the ID improperly extended *Suprema, Inc. v. Int'l Trade Comm'n*, 796 F.3d 1338 (Fed. Cir. 2015) (en banc), and Commission precedent to find a violation based on the importation of non-infringing components. *See* Leviton Pet. at 15-16; Joint Pet. at 20-21. As explained more fully below, we find that Leviton, Panduit, and Siemon's argument lacks merit.

In both *Suprema* and *Comcast Corp. v. International Trade Commission*, 951 F.3d 1301, 1308 (Fed. Cir. 2020), the Federal Circuit opined on the meaning of "articles that infringe" in the context of induced infringement under section 271(b). The Court concluded in *Suprema* that "articles that infringe" can encompass a respondent's induced infringement in the context of selling an imported article that is used by another to directly infringe. *Suprema*, 796 F.3d at 1352-53 ("We hold that the Commission's interpretation that the phrase 'articles that infringe' covers goods that were used by an importer to directly infringe post-importation as a result of the seller's inducement is reasonable."); *id.* at 1349 ("Induced infringement is one kind of infringement, and when it is accomplished by supplying an article, the article supplied can be an 'article that infringes' if the other requirements of inducement are met."). The use of the imported scanner at issue in *Suprema* by itself did not practice the asserted method claim. *Id.* at 1341-42. But because the imported scanner was used with domestically developed software after importation to directly infringe the fingerprint image processing claim, and the requirements of induced infringement were otherwise satisfied, it was sufficient to establish that the imported scanners constituted "articles that infringe." *Id.* at 1349, 1352-53.

Similarly, the Federal Circuit in *Comcast* upheld the Commission's determination that section 337 liability applies to a respondent's induced infringement in the context of products that were imported on behalf of the respondent and supplied to its customers with instructions to use the imported products to directly infringe. *See Comcast Corp. v. Int'l Trade Comm'n*, 951 F.3d 1301, 1308 (Fed. Cir. 2020) ("It is undisputed that direct infringement of the '263 and '413 patents occurs when the imported X1 set-top boxes are fitted by or on behalf of Comcast and used with Comcast's customers' mobile devices. Reversible error has not been shown in the Commission's determinations that the X1 set-top boxes imported by and for Comcast for use by Comcast's customers are 'articles that infringe' in terms of Section 337."); *see also Certain Digital Video Receivers and Related Hardware and Software Components*, Inv. No. 337-TA-1103 ("*Digital Video Receivers II*"), Comm'n Op. at 9, 12, 18-20. The use of the imported set-top boxes at issue in *Comcast* by themselves did not practice the system claims. But similar to *Suprema*, because the imported set-top boxes were used with domestic servers and customer's mobile devices after importation to directly infringe the claimed interactive television program guide system, and the other requirements of induced infringement were met, the Court found the imported set-top boxes are "articles that infringe." Thus, consistent with *Suprema*, *Comcast*, and subsequent Commission precedent, the ID properly found a section 337 violation based on the Respondents' induced infringement in connection with importation of the accused components, even though the imported components do not satisfy the claim limitations.[14]

In this case, Corning seeks to establish a violation of section 337 by the Active Respondents based on a theory of induced infringement of apparatus claims of the '320, '456, and/or '153 patents. Corning accuses Leviton of inducing infringement of apparatus claims in the '320 and '456 patents through importation of [redacted], assembling them with other materials to complete the accused chassis, selling the chassis to customers in the United States, and encouraging, teaching, or otherwise aiding its customers to use the accused chassis, at least some of the time, in combination with one or more domestically-produced accused modules. *See, e.g.*, ID at 51-57, 99-102. Corning accuses Respondents Panduit and Siemon of inducing infringement of claims in the '320, '456, and '153 patents through

[14] *Suprema* explained that "[b]y using the word 'infringe,' Section 337 refers to 35 U.S.C. § 271, the statutory provision defining patent infringement." 796 F.3d at 1346. The Federal Circuit confirmed that the word "infringe" does not narrow section 337's scope to any particular subsections of section 271, and explained that the term encompasses direct infringement, induced infringement, and contributory infringement. *Id.* Accordingly, the phrase "articles that infringe" under section 337(a)(1)(B)(i) is analyzed based on the particular facts of the investigation and the complainant's theory of infringement (*i.e.*, direct, induced, or contributory infringement) asserted against the respondent as the basis of the violation. Here the theory is inducement, and the Court has already clarified that under an inducement theory, the fact that the imported articles do not by themselves satisfy the claims does not preclude a finding of a violation of section 337.

importation of the accused modules, selling those modules to customers in the United States, and encouraging, teaching, or otherwise aiding its customers to use one or more accused modules, at least some of the time, in combination with domestically-produced accused chassis. *See, e.g.*, *id.* at 57-61, 97-99, 102-104.

Consistent with *Suprema*, *Comcast*, and *Digital Video Receivers II*, the Commission finds that section 337 applies to the facts pertaining to Corning's allegations of induced infringement by Leviton, Panduit, and Siemon. Specifically, the Commission finds that Leviton's imported [redacted] and Panduit's and Siemon's imported modules constitute "articles that infringe" for purposes of induced infringement when they are used by third-parties to directly infringe in the United States and the requirements of induced infringement under § 271(b) are established. In this case, the imported articles are components of the accused apparatuses similar to the set-top boxes at issue in *Comcast* and *Digital Video Receivers II*. Respondents' attempts to distinguish these authorities are without merit. Thus, the Commission affirms with the modified reasoning herein the ID's finding that Leviton's, Panduit's, and Siemon's imported articles meet the "articles that infringe" clause of section 337(a)(1)(B)(i) when these Respondents induce their customers to use the imported articles in combination with other components in the United States after importation to directly infringe the asserted apparatus claims.[15]

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[15] Corning also seeks to establish a violation of section 337 by Leviton based on a theory of Leviton's own post-importation direct infringement of the asserted apparatus claims of the '320 and '456 patents. Having found Leviton liable for violating section 337 under a theory of indirect infringement, the Commission takes no position on Corning's direct infringement claim against Leviton. *See Beloit Corp. v. Valmet Oy*, 742 F.2d 1421, 1423 (Fed. Cir. 1984). While Chair Kearns takes no position on Corning's direct infringement claim against Leviton, he offers, below, Additional Views Regarding "Articles that Infringe".

Panduit and Siemon also argue the ID erred in addressing the "factors in *Blood Cholesterol Testing Strips*" because it purportedly did not give weight to the fact that the ID found the modules have substantial non-infringing uses and the chassis includes "features key to infringing." Joint Pet. at 21, 22. They also attempt to distinguish this case from Commission precedent by arguing that the imported articles in *Suprema* and *Blood Cholesterol Testing Strips* were "the primary article" used in the method claims or must be "quintessential articles that infringe an apparatus claim." Joint Pet. at 20, 21. We find these arguments lack merit.

As discussed above, the Federal Circuit and the Commission have recognized an "article supplied" to induce infringement can be an "article that infringes." *See Suprema*, 796 F.3d at 1349. In applying the Federal Circuit's *Suprema* and *Comcast* decisions in *Digital Video Receivers II*, for example, the Commission acknowledged that the imported set-top box was a component article that was found to have a substantial non-infringing use. Nevertheless, the Commission determined that Comcast was liable for induced infringement of the system claim at issue when its customers used the imported set-top box with Comcast's domestic servers and its customers' mobile devices to directly infringe the asserted claims. *Digital Video Receivers II*, Comm'n Op. at 12, 18-20. Panduit and Siemon also misconstrue Federal Circuit and Commission precedent, none of which sets forth a "primary" or "quintessential" legal requirement for imported articles.[16]

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[16] We consider *Suprema* the more relevant precedent in relation to our analysis of induced infringement here as *Suprema* specifically addressed induced infringement whereas *Blood Cholesterol Test Strips* concerned an infringement theory based on respondent's own direct infringement. Moreover, as the Commission noted in *Blood Cholesterol Test Strips*, its analysis and findings were specific to the facts in that investigation. *Blood Cholesterol Testing Strips*, Comm'n Op. at 32.

Panduit and Siemon further submit that the claims of the ’320 patent are solely directed to a “chassis” and fiber optic connection equipment within that chassis, but no module is recited in the claims. Joint Pet. at 22. On the contrary, as the specification makes clear, the “fiber optic connection equipment provided in the chassis” in claim 1 of the ’320 patent is a reference to module(s) inserted in the claimed chassis.[17] *See, e.g.*, JX-4 (’320 patent) at 2:66-3:3 (describing Figure 1 as showing a rack with an installed “chassis supporting high-density fiber optic modules to provide a given fiber optic connection density and bandwidth capability”), 4:44-47 (describing the “fiber optic equipment **10** supports high-density fiber optic modules that support a high fiber optic connection density and bandwidth in a 1-U space”); CX-0001C (Prucnal WS) Q/A 144 (stating the “plain meaning of ‘fiber optic connection equipment’ to a person of ordinary skill in the art of the ’320 patent is equipment used to make or facilitate connections between or among fiber optic cables.”), 148 (testifying that fiber optic connection equipment includes Panduit’s accused modules), 152 (Siemon’s accused modules). The record evidence supports the ID’s finding that Panduit’s and Siemon’s accused modules are “one of just two custom components that together make up infringing combinations of chassis and modules.” ID at 60. The evidence also supports the ID’s finding that the imported modules “are not modified in any way before installation” and the “only remaining activity needed to form the infringing combination is to insert the modules into the chassis.” *Id.* at 60-61. There is no dispute that it is the combination of module(s) and chassis that infringes the asserted claims of the ’320, ’456, and ’153 patents.

Finally, Panduit and Siemon argue that “the ID erred in expanding the reach of Section 337 beyond circumstances where intent can be ascertained based on the imported article.” Joint Pet. at 22. They note that in “every case pre-*Suprema* the Commission only banned staple

[17] The asserted claims of the ’456 and ’153 patents recite “fiber optic modules.”

articles for importation on an inducement theory in circumstances where inducing instructions were imported alongside the article." *Id.* at 23. Respondents' argument is unpersuasive. There is no legal requirement that "inducing instructions" be included in the same package as the component used to induce infringement. Respondents rely on Judge Dyk's dissent in *Suprema*, *id.*, but Respondents' timing argument was rejected by the Federal Circuit in *Suprema* (en banc) and *Comcast* and by the Commission in *Digital Video Receivers II*. The respondent in *Comcast* "argue[d] that *Suprema* should be limited to its facts, whereby the inducement liability must be attached to the imported article at the time of the article's importation[,]" and that "any inducing conduct of articles that infringe occurs entirely after the boxes' importation." 951 F.3d at 1308. But the Federal Circuit upheld the Commission's contrary determination "that Section 337 applies to articles that infringe after importation," including the Commission's reasoning — which the Federal Circuit quoted with approval — that "the location of Comcast's inducing conduct" is not "legally relevant." *Id.* In other words, the inducing activities can occur before, during, or after importation. Thus, *Suprema*, *Comcast*, and Commission precedent support the ID's finding that "the statutory phrase 'articles that . . . infringe' covers chassis and module combinations that, after importation of the modules, were used by Panduit's and Siemon's customers to directly infringe as a result of Panduit's and Siemon's inducement." ID at 59.

b. Leviton's Induced Infringement

On review, the Commission affirms, with the modifications set forth below, the ID's finding that Leviton induced its customers to infringe claims 1 and 3 of the '320 patent and claims 11, 14-16, 19, and 27 of the '456 patent.[18]

[18] The ID's reasoning for finding indirect infringement of the asserted claims of the '320 patent also applies to the '456 and '153 patents. *See* ID at 221, 223, 226, 227, 292, 294, 300.

As an initial matter, Leviton does not challenge the ID's finding that Leviton's accused combinations, which include both imported and domestically produced components, satisfy each element of claims 1 and 3 of the '320 patent and claims 11, 14-16, 19, and 27 of the '456 patent under the ID's claim constructions.[19] ID at 80-81 (citing CX-0001C (Prucnal WS) Q/A 134, 141, 150-51, 172-76), 221-223 (citations omitted).

Corning relies on circumstantial evidence to show that Leviton's customers used the accused chassis and accused modules together in an infringing way. The direct infringement requirement for induced infringement can be proven by circumstantial evidence. *See Vita-Mix Corp. v. Basic Holding, Inc.*, 581 F.3d 1317, 1326 (Fed. Cir. 2009). The Federal Circuit has held that "where an alleged infringer designs a product for use in an infringing way and instructs users to use the product in an infringing way, there is sufficient evidence for a jury to find direct infringement." *Toshiba Corp. v. Imation Corp.*, 681 F.3d 1358, 1365 (Fed. Cir. 2012). This type of circumstantial evidence is sufficient for the fact-finder to "reasonably conclude that, sometime during the relevant period[,] more likely than not one [entity] somewhere in the United States" performed each of the claim steps, even when there is no direct evidence of a specific person doing so. *C. R. Bard Inc. v. AngioDynamics, Inc.*, 979 F.3d 1372, 1379 (Fed. Cir. 2020) (quoting *Toshiba*, 681 F.3d at 1366) (ellipsis omitted, alterations added)); *see*, *e.g.*, *GlaxoSmithKline LLC v. Teva Pharms. USA, Inc.*, 976 F.3d 1347, 1352-53 (Fed. Cir. 2020); *Lucent Techs., Inc. v.*

[19] The ID found an accused chassis "fully loaded" with accused modules to infringe. The Commission notes that under the ID's claim constructions infringement requires only one ('320 patent) or two ('456 patent) modules to be inserted into the chassis. *See* ID at 99 ("[T]here is sufficient circumstantial evidence that Leviton, and at least some of its customers, have fully loaded at least one accused chassis with accused modules."), 85 ("the record demonstrates that Leviton itself has fully loaded its accused chassis with accused modules"), 86-87 (Leviton "created videos further showing that it fully loads chassis and encourages customers to do so."). Thus, while a "fully loaded" chassis infringes the asserted claims of the '320 and '456 patents, infringement does not require a chassis to be "fully loaded." *See*, *e.g.*, ID at 215.

Gateway, Inc., 580 F.3d 1301, 1318 (Fed. Cir. 2009) ("Microsoft not only designed the accused products to practice the claimed invention, but also instructed its customers to use the accused products in an infringing way.").

Here, Leviton's witness, Mr. Kim, testified that Leviton designed the accused chassis and modules to be used together. *See* JX-0016C (Kim Dep.) at 69:1-70:1; *see also id.* at 203:3-14 (When asked "[Y]our intent in designing this was for the Leviton cassettes to be used with the Leviton enclosures; correct?," Mr. Kim replied "Correct. Intent of the design is only to be used with a Leviton-designed cassette with a Leviton-designed tray.").

The evidence also shows that Leviton offered to sell the accused chassis preassembled with modules and Mr. Kim testified that customers have ordered these combinations. ID at 100 (citing Prucnal Tr. 368-69 (testifying that Leviton ordering guide CX-0150 (Leviton Fiber Systems Prod. Literature) instructs customers to purchase accused chassis preassembled with accused modules)), 81-82 (citing CX-0152 (Leviton OPT-X enclosure product specifications) ("Enclosures shall be pre-configured or ma[d]e to order with respective adapter plates and MTP cassettes, for easy ordering with one part number."); CX-0150 (Leviton *Fiber Systems* product literature) at 12-15 (Ordering Guide: "(1) Select Enclosures & Panels . . . (2) Select Enclosure Accessories . . . (3) Select Adapter Plates OR Select MTP Cassettes . . . (4) Select Splice Trays/Modules . . . (5) Select Connectors")); JX-0016C (Kim Dep.) 135 (naming customers who have purchased the combination), 140 ("[W]e have had customer order HDX enclosure with cassettes — cassettes inserted into the enclosure.").

Leviton asserts the ID erred in its assessment of Mr. Kim's testimony. *See* Leviton Pet. at 24; Leviton Reply at 26-28. According to Leviton, "Mr. Kim merely named three customers who had 'purchased the final product,' *i.e.*, the *Leviton enclosure* by itself, as described in the presentation that he was testifying about."[20] Leviton Pet. at 24 (citing JX-0016C (Kim Dep.) 135 (discussing CX-0083C.55)). However, as indicated above, Mr. Kim also testified that customers have ordered the accused chassis with cassettes. JX-0016C (Kim Dep.) 140. Nevertheless, as Leviton points out, Mr. Kim did not specify which cassettes were inserted into the purchased enclosure and the front of the accused modules and some noninfringing adapter plates and modules look identical. *See* Leviton Reply at 28; Leviton Sub. at 18-19. Still, Mr. Kim testified extensively as to the use of the accused modules with the accused chassis. *See, e.g.*, JX-0016C (Kim Dep.) at 22-24, 47-48, 85, 100, 121, 123:3-11, 129:13-130:8 (identifying CX-0083C), 135:4-22 (discussing "page 39," which is CX-0083C.61), 177. Moreover, the documents that he testified about mention not only the accused chassis but also its use with the accused modules and non-accused adapter plates and MTP cassettes. *See* CX-0083 at 79 (showing accused combination), 123 (same). Thus, when Mr. Kim's testimony is considered along with the other evidence of record discussed below, it is sufficient circumstantial evidence that at least some customers purchased and assembled the accused combination in the United States according to Leviton's instructions.

Leviton instructed its customers how to assemble the accused chassis and modules into infringing configurations, which is further circumstantial evidence that customers have used such combinations. *See*, *e.g.*, ID at 100[21] (citing CX-0087C (Leviton Enclosure Instructions)); JX-

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[20] Emphasis in original unless otherwise specified.

[21] Leviton submits that the ID made several factual errors at pages 100 and 101. First, Leviton asserts that the ID erred in citing to Dr. Min to support its finding that Leviton acted with specific intent because Dr. Min was not retained by Leviton. Leviton Pet. at 27 (citing ID at 100). Second, Leviton asserts that the ID relied on marketing documents that were not admitted into evidence. *Id*. at 27-28 (citing ID at 101 (citing RX-0198, RX-0212)). We find these to be harmless errors because the ID relied on other evidence to support its findings. *See* ID at 100

0016C (Kim Dep.) at 199-200 (confirming installation instructions are sent to customers who purchase the accused chassis); CPX-0025 (How to Install the Opt-X UHDX Enclosure Video) at 0:28-1:02; CX-0086C (Leviton email dated Mar. 20, 2020) (showing Leviton customer using infringing combination). The Supreme Court in *Metro-Goldwyn-Mayer Studios, Inc. v. Grokster, Ltd.,* recognized that providing instruction on how to engage in an infringing use "show[s] an affirmative intent that the product be used to infringe." 545 U.S. 913, 936 (2005).

The record shows that [redacted]. Leviton Sub. at 37. Leviton did not provide sales data for its accused modules, but it is undisputed that Leviton's accused modules are manufactured in the United States. The importation and sale of Leviton's accused products in the United States together with Mr. Kim's testimony that Leviton designed the accused chassis and modules for use together is circumstantial evidence that Leviton induced at least some customers to purchase and assemble the accused combination in the United States according to Leviton's instructions.

Evidence that Leviton markets the accused chassis and modules for use together is also circumstantial evidence supporting Corning's claim of induced infringement. *See* ID at 95; *Chiuminatta Concrete Concepts, Inc. v. Cardinal Indus., Inc.*, 145 F.3d 1303, 1311 (Fed. Cir. 1998). Specifically, the ID found that Leviton's advertisements and product literature promoted the use of the accused combinations and touted the high-density capabilities to their customers. *See* ID at 82 (citing Prucnal Tr. 306-307 ("I've seen Leviton marketing material with preloaded chassis. And I don't know if that means offering to sell legally, but I have seen them configured

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(citing Prucnal Tr. 368-69; CX-0150; CX-0087C), 101 (citing Prucnal Tr. 370; Mulhern Tr. 956).

that way.”)), 85 (citing CX-0150 (Leviton Fiber Systems Prod. Literature) at 3-4 (stating Leviton’s new system offers “144 LC Fibers (1 RU),” describing this as “[u]ltra high density to help meet increasing network demands in data centers,” and promoting the “maximum capacity” of the Leviton accused chassis and showing that it is reached when filled with 12 Leviton accused modules); CX-1602C (Leviton HDX Cassette Presentation) at 3 (Leviton presentation made to a customer ([redacted]) highlighting the “144 fibers per RU” for its accused combination and contrasting it with Leviton’s prior 72 and 96 fiber products.)); CX-0093 (Leviton HDX MTP cassette specifications) (promoting accused modules as fitting in “UHDX 1RU, 2RU, and 4RU enclosures for 144 LC fibers per RU”); JX-0016C (Kim Dep.) at 216-23 (confirming CX-0093 is shown to customers and shows accused chassis and modules). Leviton also encouraged its salespeople to promote the use of the accused combination providing 144 fiber connections per rack unit. *See* JX-0016C (Kim Dep.) at 99:12-100:17, 146:19-147:8 (Leviton provided salespeople with comparisons of Leviton’s products to other competitors’ products).

Leviton argues that “the sale of a product that has substantial non-infringing uses along with instructions disclosing uses that might, but need not, infringe is insufficient as a matter of law to prove a predicate act of infringement.” Leviton Sub. at 48. Leviton also argues that, “[w]here, as here, a product has substantial non-infringing uses, ‘intent to induce cannot be inferred even when the defendant has actual knowledge that some users of its product may be infringing the patent.’” Leviton Pet. at 25 (citations omitted).

Leviton's accused modules all contain LC adapters on the front side and either MPO or MTP adapters on the rear side.[22] CX-0001C at Q/A 28, 33. While the ID found that Leviton's accused products have substantial noninfringing uses and, thus, Corning did not establish contributory infringement by Leviton, ID at 109, the ID also determined that the substantial noninfringing uses did not preclude a finding of induced infringement by Leviton, *id.* at 102. With one exception, the other non-accused Leviton modules do not have the LC-MPO configuration.[23] *See id.*; Compl. Sub. at 26. The ID thus concluded that "none of the [non-accused modules] are designed for the customer application that was the primary driver in developing and marketing the Leviton accused products – the need for 144 fiber optic simplex or duplex connections in a single U space[.]" ID at 102.

The ID's finding is consistent with Supreme Court and Federal Circuit precedent. The Supreme Court has explained "the Patent Act's exemption from liability for those who distribute a staple article of commerce, 35 U.S.C. § 271(c)," does not extend "to those who induce patent infringement, § 271(b)." *Grokster*, 545 U.S. at 935 n.10; *see also Toshiba.,* 681 F.3d at 1364 ("The existence of a substantial non-infringing use does not preclude a finding of inducement."). Rather, when faced with a substantial noninfringing use, the Federal Circuit has explained that a patentee must present evidence that "goes beyond a product's characteristics or the knowledge

[22] Independent claims 11 and 27 of the '456 patent require "a plurality of first fiber optic adapters disposed through the front side, at least one second fiber optic adapter disposed through the rear side." JX-0010 ('456 patent) at 21:57-59, 24:17-19. Claim 14 of the '456 patent requires the first fiber optic adapters to be "a simplex LC fiber optic adapter or a duplex LC fiber optic adapter" and the second fiber optic adapter to be a "multi-fiber push-on (MPO) fiber optic adapter." *Id.* at 22:21-27.

[23] Specifically, the ID noted that Leviton's expert "identifies only one such product with LC adapters on the front and multiple fiber MPO/MTP adapters on the rear, that product is for an unusual case of adapting a base-8 system to a base-12 enclosure." ID at 102 (citing RX-0008C (Lebby RWS) Q/A 207).

that it may be put to infringing uses, and shows statements or actions directed to promoting infringement." *Ricoh Co. v. Quanta Computer Inc.*, 550 F.3d 1325, 1341 (Fed. Cir. 2008) (quoting *Grokster, Ltd*., 545 U.S. at 935 & n. 10). The Commission finds the evidence discussed herein evidences Leviton's intent to induce infringement of the asserted apparatus claims.

The record evidence supports the ID's finding that Leviton designed its accused products "for use in an infringing way" to match EDGE's 144 connections. *Toshiba*, 681 F.3d at 1365. The ID found Leviton developed its accused products to match EDGE's 144 connections using LC adapters, even though they already had existing products that provided 72 or 96 LC connections and other products that provided a much greater number of connections using non-LC adapters. ID at 100-01 & n.21 ("In developing the Leviton accused products, Mr. Kim admitted that Leviton had obtained copies of the EDGE products and analyzed them."); *see* CX-0083C (6/16/15 Leviton Email) at 135 (Business Proposal for the new Leviton enclosure to match EDGE), 137 ([redacted])); CX-2060C (Prucnal Rebuttal) at Q/A 313 (discussing CX-0083C and the development timeline for Leviton's accused products). Evidence that Leviton set out to develop its accused products to support the same high fiber density as Corning's EDGE to capture Corning's customers and that segment of the market shows "purposeful, culpable expression and conduct" with an "intent . . . to bring about infringement." *Grokster*, 545 U.S. at 937-39.

The record evidence also supports the ID's finding that the LC-MPO configuration found in all of Leviton's accused modules is the most common application in data centers. Dr. Prucnal testified regarding the importance and dominance of the LC-MPO modules. CX-2060C (Prucnal

Rebuttal WS) at Q/A 379 (noting that Respondents' engineers[24] recognized the LC interface is "the industry's most popular interface" and "all the—the fiber interface of the equipment, server and switches, they were all LC); *id.* at Q/A 374 (during the development of the EDGE products, the EDGE inventors recognized that "LC connections were becoming the most popular types of connections in data centers"); CX-0001C at Q/A 29 (testifying that LC connectors are "the most popular type of connector in [high-density] networks today, particularly in data centers"); Prucnal Tr. 430:8-12 ("[T]he Base-12 modules on front are a very important application."); CX-0006C (Staber WS) at Q/A 12. He explained that it is common for data centers to fill chassis with modules having LC and MPO connectors:

> The Accused Products are often used to provide connections between [active equipment such as small form-factor pluggable] SFP transceivers and other network components. One principal type of connection required in data centers is connection between two fiber cables with LC duplex connectors and multi-fiber cables with MPO connectors. That is because the opto-electronics used to transmit over fiber primarily rely on the LC duplex standard, while the multi-fiber trunks used in data centers primarily rely on the MPO standard. Within a data center, it is typically necessary to transmit data over distances of as much as several hundred meters for distribution to individual terminal equipment such as servers. It would be impractical and complicated to route individual optical fibers for this purpose, so the fibers are typically grouped together and bound into trunk cables, which can be routed under the sub-floor or on ceiling tracks to traverse long spans. Trunk cables typically contain bundles of fibers in either 12-fiber increments (or subunits) or 8-fiber increments (or subunits). The ends of these subunits typically contain a multi-fiber connector, such as MPO or MTP connector.

CX-0001C at Q/A 38; *see id.* at Q/A 34 (testifying the "12-fiber MPO has gained widespread use in high-density networks and data centers"); CX-0152 at 1 (stating the "application" of Leviton's accused chassis to "provide an inter-connect or cross-connect between backbone horizontal cable

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[24] Dr. Prucnal referenced statements made by Wirewerks' and Siemon's engineers.

and active equipment"); CX-2060C (Prucnal Rebuttal WS) at Q/A 256 ("[A]t the time of the inventions, growing demand for bandwidth in data centers was driving the need for fiber optic connection equipment that could provide connections between duplex LC jumper cables on the front side of an equipment rack and MPO trunk cables on the rear side of an equipment rack."); CX-0006C (Staber WS) at Q/A 9, 27. The Commission finds no error in the ID's finding that the LC-MPO module usage in data centers is the customer application that was the primary driver in developing and marketing the Leviton accused products. *See* ID at 101-102.

Leviton argues that its product literature and instructions "merely describe the capabilities of the product and are insufficient as a matter of law to prove that Leviton acted with the specific intent to induce infringement." Leviton Pet. at 26-27 (citing *Vita-Mix Corp.*, 581 F.3d at 1329). While some of Leviton's instruction manuals and marketing materials show both infringing and non-infringing combinations, the Commission finds Leviton induced its customers to use the accused products in an infringing way by promoting the popular LC-MPO configuration in its marketing materials. For example, Leviton's fiber systems product literature promotes the infringing combination before all other configurations. CX-0150 at 2 (listing "Ultra high density (144F per RU)" as the first system feature of its fiber systems), 4 (highlighting infringing combination before all other configurations). Leviton's product specifications for its accused chassis and its accused modules also promote the infringing combination as the stated "application" for these products. CX-0152 at 1 (describing the "application" for Leviton's accused chassis is to "provide an inter-connect or cross-connect between backbone horizontal cable and active equipment.");[25] CX-0093 at 1 (describing

[25] Dr. Prucnal explained, "the 'backbone horizontal cable' involves the trunk or rear side, which typically uses multi-fiber connectors; the 'active equipment' is equipment 'to generate and receive the light pulses used to send and receive information over fiber optic cables.'" Compl.

Leviton's accused modules "come with 12-fiber MTP connectors on the back that break out to single or array connectors on the front," and are "[a]vailable with LC connectors.").

Leviton submits that it "offers *non-accused* cassettes, adapter plates, and splice modules that offer density *equivalent to or greater than* the [accused] modules."[26] Leviton Pet. at 27. For example, a Leviton chassis filled with 12 LC adapter plates (*see, e.g.*, RX-0225.007) or 12 LC splice modules (*see, e.g.*, RX-0225.015) can support up to 144 LC fiber connections/1RU. Leviton Sub. at 40-42. As another example, Leviton submits that its chassis filled with MTP adapter plates, splice modules, or cassettes that can also support fiber densities equivalent to or greater than the accused modules. *Id.* at 43-44. Leviton argues that both its and Corning's experts testified that a chassis filled with LC adapter plates, LC splice modules, or MTP adapter plates, splice modules, or cassettes do not infringe. *Id.* at 41-44 (citations omitted). The Commission finds these noninfringing uses that do not apply to the most common application in data centers do not absolve Leviton of liability for induced infringement. As discussed above, the evidence supports the ID's finding that it is the infringing combination of the accused Leviton chassis and modules that satisfies the need for connecting LC jumper cables with MPO trunk cables in data centers, and the ID properly concluded, based on the evidence, that Leviton encourages its users to make and use that infringing combination. *See* ID at 100-102.

Reply at 25 (quoting CX-0001C (Prucnal WS) Q/A 38). Dr. Prucnal also explained that "[a]ctive equipment 'primarily rel[ies] on the LC duplex standard.'" *Id.* (quoting CX-0001C (Prucnal WS) Q/A 38).

[26] As Corning explains, "adapter plates are designed for LC cables to pass through the rear, while splice modules are designed for cables that end in bare fibers to pass through the rear." Compl. Sub. at 22-23 (citing RX-0008C (Lebby RWS) Q/A 38, 53-54; RDX-0008C (Lebby Demonstratives) at 16-17; RPX-0009 (Leviton 5FUHD-SQL Adapter Plate)).

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Moreover, there is no evidence that Leviton intends its users to engage only in noninfringing uses of its products, or that the infringing combination is an unauthorized, "off-label" use. *Cf. Warner-Lambert Co. v. Apotex Corp.*, 316 F.3d 1348, 1365 (Fed. Cir. 2003) (holding that where it was shown that 97.9% of end uses of a prescription drug were noninfringing, in a summary determination context the court was "not in a position to infer or not infer intent . . . without any direct evidence"). On the contrary, Corning's witnesses testified that it was "common" for its customers to use the patented combination and "fully load EDGE chassis with EDGE modules," CX-0004C (Hicks WS) Q/A 25; that Corning "markets EDGE as enabling 144 single-fiber connections per 1U space precisely because data centers typically want to make as many connections as possible," *id.*; that Corning's "competitors do the same thing," *id.*; and that "[c]ustomers with large data centers typically have bay after bay, row after row, of fiber optic connection equipment, which is why high-density equipment is so important," CX-0006C (Staber WS) Q/A 12. Steve Polidan of former respondent AFL confirmed that, based on his 21 years of experience, he has seen chassis "completely loaded," and that he has personally seen AFL, Panduit, and Corning EDGE chassis fully loaded at customer sites.[27] Polidan Tr. 192-194.

Finally, regarding knowledge of the asserted patents, Leviton does not dispute the ID's finding that "Leviton knew of each asserted patent at least as of February 2020, when the complaint was filed." ID at 99. Leviton, however, contends that Corning failed to prove that Leviton was aware of the asserted patents before the Complaint was filed and failed to prove that

[27] The Commission gives Steve Polidan's testimony less weight because, as Leviton argues, the "front of the accused modules incorporate the very same adapters and look the *same* as the front of the non-accused LC adapter plates and non-accused LC splice modules." *See* Leviton Sub. at 18-19.

Leviton took any acts to induce infringement after the Complaint was filed. Leviton Pet. at 29. However, as the ID found, the record shows that Leviton obtained copies of the EDGE products and examined them in developing the Leviton accused products and "the EDGE products bear labels indicating patent protection and directing users to Corning's website, which contains virtual patent marking—including all four asserted patents—regarding the EDGE products." ID at 99 (citing CPX-0043); 100-01 & n.21 ("In developing the Leviton accused products, Mr. Kim admitted that Leviton had obtained copies of the EDGE products and analyzed them."); *see also* CX-0083C (6/16/15 Leviton Email) at 135 (Business Proposal for the new Leviton enclosure to match EDGE), 140 (photos of the EDGE products); CX-0081C at 8 (Leviton email dated Apr. 17, 2013) (noting the proprietary nature of Corning's products). As such, the Commission finds the ID did not err in finding that "Leviton was aware of the 'proprietary' nature of EDGE's patented features" before the filing of the complaint. ID at 100.

Based on the evidence discussed above, the Commission finds the ID reasonably concluded that Respondents' claims that "they are unaware of how their customers use their products" was "somewhat implausibl[e.]"[28] *Id.* at 96. Mr. Kim's testimony along with circumstantial evidence that Leviton designed the accused chassis to work together with the accused modules to meet the growing demand for LC-MPO connections in data centers, that Leviton markets and promotes the accused combination as a high fiber density offering, and that it instructs customers how to purchase and assemble the accused combination, all support the

[28] Leviton asserts that the "ID does not find that any customer ever used a 4RU Leviton Enclosure loaded with modules." Leviton Pet. at 25. The circumstantial evidence discussed above references not only the accused 1RU and 2RU chassis but also the 4RU chassis. *See, e.g.*, JX-0016C at 100-102, 127, 144, 175-77, 199-200; CX-0150 at 12 (showing the accused 4RU chassis can be preinstalled with 48 accused modules); CX-0087C; CX-0093.

ID's finding that Leviton induced its customers to use the accused combinations to infringe claims 1 and 3 of the '320 patent and claims 11, 14-16, 19, and 27 of the '456 patent.

c. Panduit's and Siemon's Induced Infringement

On review, the Commission affirms, with the supplemental analysis set forth below, the ID's finding that Panduit and Siemon induced their customers to infringe claims 1 and 3 of the '320 patent, claims 11-12, 14-16, 19, 21, and 27-28 of the '456 patent, and claims 9 and 23 of the '153 patent and the ID's finding that Panduit also induced its customers to infringe claims 16 and 26 of the '153 patent.

As an initial matter, Panduit and Siemon did not challenge the ID's finding of knowledge of the asserted patents. *See* Joint Pet. at 47-50. The ID found Panduit knew of each asserted patent when it was first issued. ID at 97. The ID found that Siemon admitted knowledge of the '320 patent by October 30, 2019 and modified its products in mid-2019 in view of Corning's patents covering EDGE. *Id.* at 103.

The ID found that Panduit and Siemon sell their accused products to customers in the United States. *See id.* at 97; CX-1839C; CX-1998C; CX-1835C; CX-0320C; CX-0176C; JX-0026C (Veatch Dep.) at 13-14. In particular, the evidence shows that Panduit sold 13,946 accused chassis and 121,116 accused modules between January 2018 and July 2020. CX-1839C. Siemon sold 1,215 accused chassis and 14,550 accused modules between January 2018 and March 2020. CX-1835C. Significant sales data for the accused product support an inference of direct infringement. *See, e.g.*, *Lucent Techs*., 580 F.3d at 1318; *see also Moleculon Research Corp. v. CBS, Inc*., 793 F.2d 1261, 1272 (Fed. Cir. 1986), *overruled-in-part on other grounds by Egyptian Goddess, Inc. v. Swisa, Inc.,* 543 F.3d 665 (Fed. Cir. 2008) (en banc) (affirming a district court's finding of direct infringement based on circumstantial evidence of extensive puzzle sales, dissemination of an instruction sheet teaching the infringing method, and the availability of a solution booklet on how to solve the puzzle).

The evidence also supports the ID's finding that Panduit and Siemon instructed their customers how to assemble the accused chassis and modules into infringing configurations. *See* ID at 98 (citing CX-1623 (Panduit FLEX1U, FLEX4U Installation Instructions); CX-1705 (Panduit FLEX1U, FLEX2U, & FLEX4U Installation Instructions)); *id.* at 103 (citing Min Tr. 839-40 (testifying that respondents advertise that their accused products can be combined); CX-1791C (2/17 Siemon LightStack 4U Install Instructions)); Polidan Tr. 193-194 (Respondent AFL's witness testified that he has "seen Panduit's cassettes fully loaded" in the chassis); JX-0018C (Maynard Dep. Tr.) 213 (Siemon shows customers how to install modules in chassis).

Panduit's and Siemon's marketing and promotional materials also encouraged users to use the accused combinations to infringe. ID at 98 (citing CX-0199 (Panduit HD Flex Enclosures Spec.); JX-0029C (Wiltjer Dep. Tr.) 121:7-14; CX-0382 (Panduit HD FLEX Ordering Guide) at 3-6; CX-0146C (6/19/19 Panduit Email);[29] CX-1708 (Panduit HD Flex Fiber Enclosure Spec.); CX-0147 (Panduit HD Flex Cassettes Spec.)); 104 (citing CX-0180C (11/19 Siemon LightStack Spec.) at 1-2 (promoting accused combination and showing users how to install modules in chassis to reach 144 connections per 1U); CX-0181C (11/19 Siemon LightStack 8 Spec.) at 1-2 (same for base-8 combination); CX-0179C (Siemon Plug and Play Presentation) at 1, 3-5, and 10 (promoting accused combination); CX-0173C (Siemon 4U Presentation) (same)).

[29] Panduit did not challenge the ID's reliance on CX-0146 in its petition for review. However, in its submissions before the Commission, Panduit argues that the exhibit does not show a sale of the accused combination in the United States because the customer described in CX-0146 is located in Belgium. Joint Sub. at 6-8. This argument was not raised before the ALJ and, thus, the Commission finds it is waived.

PUBLIC VERSION

Panduit and Siemon submit that their accused products have substantial noninfringing uses. Joint Pet. at 4-5, 21. The ID found that Panduit's and Siemon's accused chassis and modules have substantial noninfringing uses and, thus, Corning did not establish contributory infringement by Panduit and Siemon. *See* ID at 109 (finding Panduit's accused modules can be used with unaccused alternative systems such as SFQ and Opticom systems and Siemon's accused modules can be used in a floor mounted enclosure that cannot be mounted to a rack and therefore does not infringe any of the asserted apparatus claims). Corning did not petition for review of this finding and, as discussed below, the Commission adopts it. However, just as with Leviton's products, the Commission finds the substantial noninfringing uses do not preclude a finding of induced infringement by Panduit and Siemon because the evidence discussed above shows statements and actions directed to promoting infringement by their customers. *See Toshiba.,* 681 F.3d at 1364; *Ricoh Co.*, 550 F.3d at 1341.

Moreover, none of Panduit's and Siemon's non-accused products are designed for the customer application that was the primary driver in developing and marketing the accused products. Panduit's and Siemon's documents demonstrate that, like Corning, they sought to satisfy the demands of data center customers by designing their products to support the most common application in data centers using modules with LC adapters on the front and either MPO or MTP adapters on the rear. *See* ID at 96, 98-99 (citing CX-0621 (Panduit Chassis Spec.) at 3 (stating that enclosures provide a "fiber capacity" of "144" in "1 RU"); CX-1623 (Panduit FLEX1U, FLEX4U Installation Instructions) at 3 (instructing customers to "[p]opulate an entire row" before moving to the next and "[r]epeat [the] process until all desired slots are filled"; "FLEX1U can hold up to 12 cassettes"); *id*. at 4 (illustrating cable routing for a fully populated 1U); CX-1705 (Panduit FLEX1U, FLEX2U, & FLEX4U Installation Instructions) at 8-9 (similar)); CX-0145C (Panduit HD Flex Project Charter); CX-2060C (Prucnal RWS) Q/A 269-276; CX-0138C (Panduit HDFE Business Plan) at 4; CX-0164C (Siemon NPD PRS) at 3; CX-0165C (Siemon Fiber-0030 Gate 1) at 7; CX-0222C (Siemon Octopus Enclosures Stage 2 Presentation) (describing a design of the accused combination);[30] CDX-0016C.15 (citing CX-0102C (Panduit Project Charter, stating "This project is required to evaluate if Corning's new high density 4RU enclosure/system is a threat to Panduit's fiber business" and stating one deliverable is "to achieve a density of 576 fibers" or 144 fibers per 1RU); CDX-0005C.75-131 (Panduit's development timeline and assessment of EDGE products); CDX-0005C.177-194 (Siemon's development timeline and assessment of EDGE products); CX-0116C (Panduit Market Spec. Requirements) at 2 (In 2011, Panduit identified its products' "[l]ack of super high density (>48 ports/RU)" as one factor that "led customers to search for alternate suppliers . . . (read: Corning)."); Kuffel Tr. 621-22 (admitting that Panduit used 3-D printing technology to make EDGE cassette shells during its process of developing its accused chassis); Blumenthal Tr. 718:20-23 (discussing same).

In sum, the Commission affirms, with the supplemental analysis discussed above, the ID's findings that Panduit and Siemon induced their customers to infringe claims 1 and 3 of the '320 patent, claims 11-12, 14-16, 19, 21, and 27-28 of the '456 patent, and claims 9 and 23 of the '153 patent and that Panduit also induced its customers to infringe claims 16 and 26 of the '153 patent.

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[30] Siemon did not challenge the ID's reliance on CX-0222 in its petition for review. However, in its submissions before the Commission, Siemon argues that the exhibit does not show sales of the accused products and provides no evidence that any customer combined the accused products in an infringing way. Joint Sub. at 12. This argument was not raised before the ALJ and, thus, the Commission finds it is waived.

d. FS' Induced Infringement

The Commission affirms the ID's finding that FS induced their customers to infringe claims 1 and 3 of the '320 patent, claims 11-12, 14-16, 19, and 21 of the '456 patent, and claims 9, 16, 23, and 26 of the '153 patent.

As an initial matter, Respondent FS did not challenge the ID's findings that FS' "customers directly infringe the asserted patents" and "FS sells the accused products to customers in the United States" in its petition. ID at 105 (citing Zhang Tr. 580, 588; CX-0428C (FS Sales and Inventory Data) (listing U.S. sales of accused products); JX-0031C (Zhang Dep. Tr.) 115-116), 97 (citing Zhang Tr. 586-587, 589-590, 592-593, 594). FS also did not challenge the ID's finding that it knew of each asserted patent at least as of February 2020, when the complaint was filed. *Id.* at 105.

Before the Commission, FS only challenges the ID's alleged reliance on "unauthenticated evidence in finding that FS had induced infringement." Joint Pet. at 50. FS submits that the ID points to no credible evidence that FS committed any inducing acts after February 2020. *Id.* at 50-51. FS asserts that the ID cited to evidence of FS' "online resources captured in July 2020," ID at 106, but that same evidence was found not authenticated in the context of contributory infringement. Joint Pet. at 50. FS misapprehends the ID in this regard. The ID did not reject all of FS' online resources captured in July 2020, but only one piece of evidence involving a YouTube video screen shot. ID at 110-11; *see* OUII Resp. at 27; Compl. Resp. at 40. The remaining evidence downloaded from FS' website in July 2020 shows that FS has continued to encourage the use of its accused products in an infringing manner even after it learned of the existence of the asserted patents in February 2020. *See* ID at 106 (citing CX-1515 (FS Ultra High Density Solution) (advertising the infringing combination with the Accused Products); CX-

1520 (FS Microsoft Webpage) at 2 (promoting use of accused combination); CX-2059 (FS FHX Ultra HD User Guide)).

The record evidence supports the ID's finding that FS induced its customers to use the accused chassis and modules in an infringing way. Specifically, the ID found that FS instructed its customers how to assemble the accused chassis and modules into infringing configurations. *Id.* at 105 (citing CX-0392C (FS FHX Ultra Fiber Enclosure Spec.)); *see also* CX-0589 (FHX Module Install Instructions) at 2; Prucnal Tr. 370 (testifying that customers learn how to assemble the chassis and modules in infringing combinations from respondents' product literature and instructions).

The ID also found that FS' marketing and promotional materials encouraged customers to use FS' accused products in infringing combinations and touted their ability to provide 144 LC connections. ID at 105-106; *see* CX-1515 (FS Ultra High Density Solution) (advertising the infringing combination of Accused Chassis and Modules on the FS.com webpage); CX-1520 (FS Microsoft Webpage) at 2 (same); CX-0391 (FS FHX Enclosure System article) (same), CX-0397 (FS Tweet) (including an image of an accused chassis filled with multiple accused modules); CX-2059 (FS FHX Ultra HD User Guide) (promoting FS' accused combinations: "This fiber enclosure can hold up to 144 fibers in 1U space. This 1U rack mount enclosure houses 3 independent sliding trays, each of which is able to hold 4 or 6 modules/cassettes that pick up the fibers and their reserves. The front panel of it contains different connectors for transmitting signals via copper. Here you can see two types of cassettes, FHX 8F MTP to LC cassette and FHX 12F MTP to LC cassette with a capacity of 8 fibers and 12 fibers respectively."); CX-0392C (FS FHX Ultra Fiber Enclosure Spec.) ("The 1U enclosure houses 3 independently sliding drawers, each drawer is able to hold MTP-12 cassettes or fiber adapter panels by default."); CX-0419C (FS FHX Ultra Enclosure for MTP-8 Cassette Prod. Spec.) (same); CX-0420C (FS FHX-1UFCP Ultra Fiber Enclosure Prod. Spec.) (same); CX-0421C (FS FHX MTP-12 Cassettes Spec.) ("FHX Ultra Fiber Cassettes are used in conjunction with FHX Ultra Fiber Enclosures . . . ."); CX-0422C (FS FHX MPO-LC Cassettes) (same); CX-0423C (FS FHX MTP-12 Cassettes Prod. Spec.) (same); CX-0424C (FS FHX MTP-8 Cassettes Spec.) (same); CX-0425C (FS FHX MPO-8 Cassettes) (same); CX-0587 (FS.com FHX Chassis Datasheet).

In view of the record evidence discussed above, the Commission affirms the ID's finding that FS induced its customers to infringe claims 1 and 3 of the '320 patent, claims 11-12, 14-16, 19, and 21 of the '456 patent, and claims 9, 16, 23, and 26 of the '153 patent.

3. Contributory Infringement

The ID found the evidence does not establish contributory infringement by Leviton, Panduit, and Siemon because Corning failed to meet its burden to prove lack of substantial non-infringing uses. ID at 60, n.16, 109-10; *see Toshiba*, 681 F.3d at 1363. Corning did not petition the Commission to review these findings on contributory infringement and the Commission finds no clear error in those findings. With regard to Leviton, the ID found that "Leviton's accused UHDX Enclosures can be used with at least 64 varieties of other cassettes, 21 varieties of adapter plates, and 12 varieties of splice modules, none of which are accused of infringement." ID at 109 (citing RX-0005C (Kim WS) Q/A 23-27; RX-0008C (Lebby RWS) Q/A 203-10). The ID noted that Complainant's expert conceded that these uses constitute substantial non-infringing uses. *Id*. (citing Prucnal Tr. 338-339). With respect to Panduit's accused modules, the ID found they "can be used with Panduit products other than the Panduit accused chassis" and Panduit has "developed adapters to allow its accused modules to be used with unaccused alternative systems such as the SFQ and Opticom systems." *Id.* (citations omitted). As to Siemon's accused modules, the ID found "the trays in each of the Siemon accused chassis can be filled with one or more adapter plates instead of the accused modules." *Id.* (citations omitted). Moreover, the ID stated that "Siemon's accused modules can be used in a floor mounted enclosure that cannot be mounted to a rack and therefore does not infringe." *Id.* The Commission thus affirms the ID's finding of no contributory infringement with regard to Leviton, Panduit, and Siemon.

FS did not present any evidence of substantial noninfringing uses, relying instead on its argument that "no [] predicate sales occurred with the knowledge requisite for indirect infringement." *Id.* at 110 (quoting Resps. Br. at 76-77). To rebut this argument, Corning presented screenshots downloaded from the FS.com website on July 7, 2020 and a Youtube video screen shot bearing a date of July 2, 2020. *Id.* The ID found that Corning did not meet its burden in establishing contributory infringement by FS because of Corning's failure to properly authenticate certain evidence. *Id.* at 110-11. Corning did not petition the Commission to review this finding. The Commission determines to take no position on the ID's finding of no contributory infringement by FS.

C. Infringement of the Asserted Module Claims (the '206 patent)

1. Limitation "front opening"

The ID found that (1) FS' and Wirewerks' accused modules infringe claims 22 and 23 of the '206 patent; (2) Siemon's accused modules infringe claim 22 of the '206 patent; and (3) Panduit's accused modules do not infringe claims 22 or 23 of the '206 patent.[31] *Id.* at 323. The Commission determined to review only ID's construction of "a front opening" in the asserted claims of the '206 patent, and the associated infringement findings.

[31] Corning did not petition for review, and the Commission did not review, the ID's finding that Panduit's accused modules do not have a "rail" as required by claims 22 and 23 of the '206 patent. *See* ID at 346-49.

PUBLIC VERSION

The claim term "front opening" appears in unasserted claim 14 of the '206 patent, from which asserted claims 22 and 23 depend. Claims 14, 22 and 23 recite:

> **14**. A fiber optic module, comprising:
>
> a main body defining an internal chamber disposed between a front side and a rear side;
>
> a plurality of optical fibers disposed in the internal chamber;
>
> a front opening disposed along a longitudinal axis in the front side;
>
> a first plurality of fiber optic components optically connected to the plurality of optical fibers, the first plurality of fiber optic components disposed through the front opening providing a fiber optic connection density of at least one fiber optic connection per 7.0 millimeters (mm) of width of the front opening; and
>
> at least one second fiber optic component optically connected to at least one of the plurality of optical fibers to provide optical connection between the at least one second fiber optic component and at least one of the first plurality of fiber optic components.
>
> **22**. The fiber optic module of claim **14**, further comprising at least one rail disposed on the main body.
>
> **23**. The fiber optic module of claim **22**, further comprising at least one latch attached to the at least one rail and configured to engage the at least one rail.

JX-1 ('206 patent) at 20:48-65, 21:27-31.

Below is a chart showing the parties' proposed claim constructions before the Commission.

PUBLIC VERSION

Complainant	Respondents	OUII
"an opening located in the front side of a fiber optic module, *e.g.*, the opening depicted in Figure 13 of the '206 Patent as having dimensions H1 and W1"	"a single opening located in the front side of a fiber optic module"	"a single opening located in the front side of a fiber optic module, *e.g.*, the opening depicted in Figure 13 of the '206 patent as having dimensions H1 and W1, which limits claim 14 to embodiments with one, and only one, contiguous opening, uninterrupted by spacers or other structures.

While the ID states that it adopted OUII's proposed construction, its interpretation of the construction to encompass modules with multiple front openings separated by spacers or other structures is inconsistent with OUII's interpretation and effectively adopts Corning's interpretation.

As explained below, the Commission adopts Corning's proposed construction of "front opening." It is undisputed that the claimed "front opening" is an opening "located in the front side of a fiber optic module." In the embodiment depicted in Figures 11 & 13 of the '206 patent (reproduced below), this front opening has dimensions H1 and W1. The specification explains that "in this embodiment, the width W1 of the front opening **126** is design[ed] to be at least eighty-five percent (85%) of the width W2 of the front side **96** of the main body **90** of the fiber optic module **22**." JX-1 at 10:10-13; *see also* CDX-0005C.22.

PUBLIC VERSION

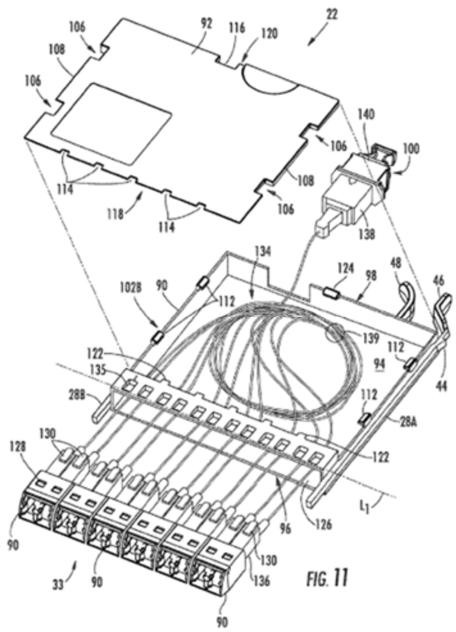

FIG. 11

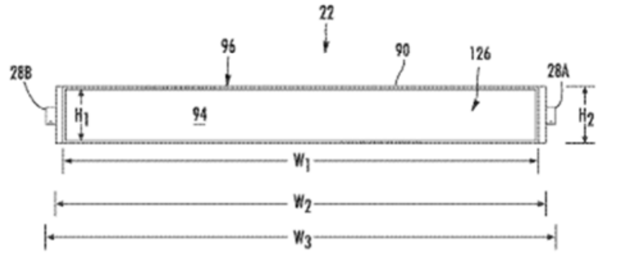

FIG. 13

Whereas Figures 11 & 13 of the ’206 patent depict an embodiment of a module **22** with one front opening **126**, Figures 17 & 18 (reproduced below) depict an embodiment of a module **160** with two “[f]ront openings **178**A, **178**B disposed on each side of the channel **162**.” JX-1 at 14:38-39.

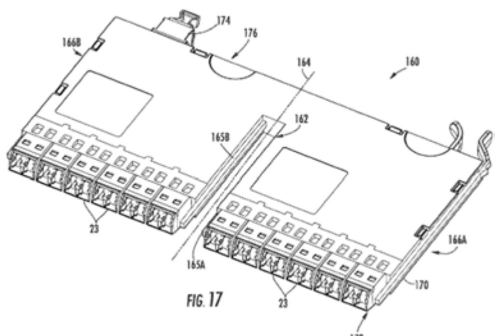

FIG. 17

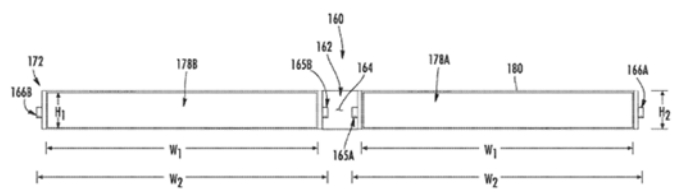

FIG. 18

In yet another embodiment, Figures 23 & 34 (reproduced below) depict an embodiment of a module **220** with one front opening **238** that is “about twice the width” of the front opening **126** illustrated in Figure 13. *Id.* at 17:26-27.

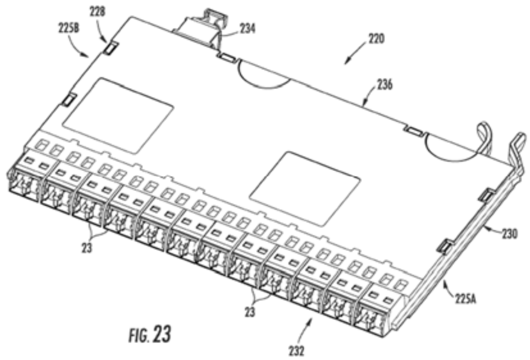
FIG. 23

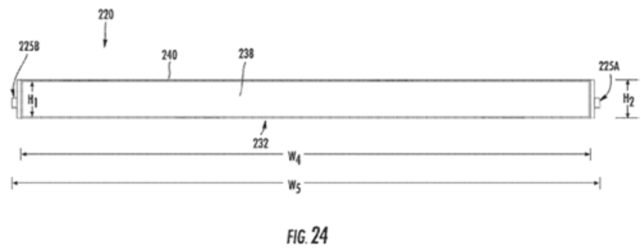
FIG. 24

Thus, the specification teaches that a module can be designed with one or more front openings to support a high connection density capacity.

The specification supports the ID's finding that the claimed "front opening" may contain dividers or spacers and does not have to be "contiguous," as OUII and the Joint Respondents argue. ID at 334, 340-42. The modules in Figures 10A, 14, and 15 of the '206 patent, shown below, all have the same form factor as the module in Figure 13, meaning they have the same dimensions as front opening **126**. *Id.* at 332, 334; JX-1 at 8:20-21, 9:64-10:2, 11:54-59, 12:54-58.

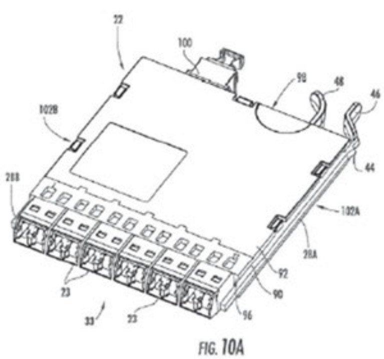
FIG. 10A

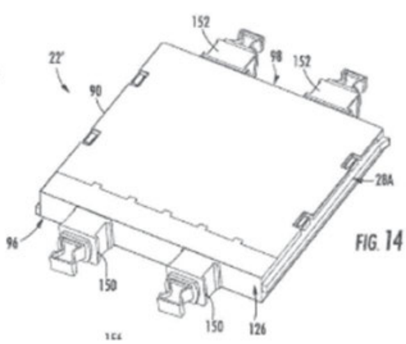
FIG. 14

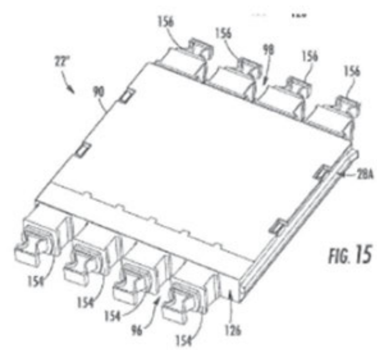
FIG. 15

The ID found the modules in Figures 14 and 15 "contain multiple spaces and [] include the structural material separating the adapters as part of the front opening **126**." ID at 331; *see* CDX-0005C.23. "The main difference between the embodiments," the ID explained, "is that in [Figures 14 and 15], the spacing between the two or four MPO adapters can be easily defined whereas the spacing between the six LC adapters shown in [FIG. 10A] cannot easily be seen. . . . This does not mean that there are no spaces (or dividers) between the six LC adapters." ID at 334. The ID's finding is supported by the opinion of Corning's expert, Dr. Prucnal, who opined that "[f]rom the drawing in Figure 15, a person of ordinary skill would understand . . . that the spaces between the adapters are filled with material that is necessary to support them and to maintain the structural integrity of the module." CX-2060C (Prucnal RWS) Q/A 113. Thus, the Commission finds the ID's conclusion that the claimed "front opening" may include dividers or spacers between the fiber optic components is supported by the record evidence. The Joint Respondents rely on only attorney argument to criticize the ID's findings regarding Figure 15. Joint Pet. at 25. OUII's petition for review does not address the ID's findings regarding Figures 14 and 15. Accordingly, the Commission finds Corning's proposal is supported by the record evidence.

OUII and the Joint Respondents contend the difference between claim 14, which recites "a front opening," and claim 63, which recites "front openings," necessitates a departure from the general rule that the words "a" or "an" in a patent claim carry the meaning of one or more. OUII Pet. at 13; Joint Pet. at 25. The ID adopted their position and, therefore, construed "a front opening" to require a "single opening." However, the Commission finds that claim 63 does not support a narrower reading of claim 14 that excludes modules with multiple openings created by dividers or spacers. As Corning argued in its post-hearing brief, claim 63 is directed to modules with multiple openings, but that does not show that claim 14 must be restricted to modules with only a single opening. Compl. PHB at 51-52 n.11. "It is equally plausible that the drafters of the patent used 'an . . . opening' when they meant to claim either single or plural openings ([as shown in the embodiments of Figures 18 & 24 and] as consistent with *01 Communique* and

Baldwin Graphic) and 'openings' when they meant to narrow a claim to plural openings only." *Id.* In addition, as Corning notes, "claim 63 does not depend from claim 14, so any inference to be drawn from contrasting them is weak." *Id.*

Our adoption of Corning's proposal does not affect the ID's conclusions with regard to infringement, validity, and technical prong of the domestic industry since the ID effectively applied Corning's construction. Under Corning's construction, the front opening of each accused module is the total area in the front of the module that provides for the insertion of adapters. ID at 339-40 (citing CX-0001C (Prucnal WS) Q/A 522-23; CDX-0001C (Prucnal Direct) at 609). Further, that space supports a plurality of fiber optic components. *Id.* at 340. Panduit's Base-12 Module, for example, has six spaces for six duplex LC adapters, and each duplex LC adapter is comprised of two simplex LC adapters. *Id.* (citing CX-0001C (Prucnal WS) Q/A 532; CDX-0001C (Prucnal Direct) at 613-14). The same is true of Panduit's Base-8 modules, which have three spaces for four duplex LC adapters. *Id.* (citing CX-0001C (Prucnal WS) Q/A 307, 533; CDX-0001C (Prucnal Direct) at 615). The other Accused Base-12 and Base-8 Modules have similar arrangements. *Id.* (citing CX-0001C (Prucnal WS) Q/A 310-11, 314-15, 533-38; CDX-0001C (Prucnal Direct) at 618, 621).

In view of the evidence above, the Commission finds the accused modules each have an infringing "front opening" as required by claim 14 of the '206 patent. Because the accused modules literally infringe the "front opening" limitation, the Commission need not reach the ID's alternate finding of infringement under the doctrine of equivalents, and does not adopt that finding. ID at 342-45. The Commission thus affirms, with the modified reasoning set forth above, the ID's finding that FS' and Wirewerks' accused modules[32] infringe claims 22 and 23 of the '206 patent, and Siemon's accused modules infringe claim 22 of the '206 patent.

D. Economic Prong of the Domestic Industry Requirement

When a section 337 investigation is based on allegations of patent infringement, the complainant must show that "an industry in the United States, relating to the articles protected by the patent . . . exists or is in the process of being established." 19 U.S.C. § 1337(a)(2). "[A]n industry is considered to exist if there is in the United States, with respect to the articles protected by the patent . . . concerned –

(A) significant investment in plant and equipment;

(B) significant employment of labor or capital; or

(C) substantial investment in its exploitation, including engineering, research and development, or licensing." 19 U.S.C. § 1337(a)(3).

On review, the Commission affirms, with the supplemental analysis set forth below, the ID's finding that Corning has shown the existence of a domestic industry under section 337(a)(3)(B) and (C) for each of the asserted patents.[33, 34]

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[32] Wirewerks asked for an additional new design to be adjudicated in this investigation, the Wirewerks First Alternative Design. ID at 357 (citing Order No. 23 at 5 (Oct. 14, 2020)). For purposes of its infringement analysis, the ID found there is no difference between the designs of Wirewerks' accused modules and the First Alternative Design. *Id.* at 356-58. Accordingly, the Commission adopts the ID's finding that the First Alternative Design infringes claims 22 and 23 of the '206 patent for the same reasons as Wirewerks' accused modules. *Id.* at 360.

[33] Chair Kearns finds the existence of a domestic industry under section 337(a)(3)(C) and takes no position with respect to subparagraph (B).

[34] Corning's asserted domestic industry investments comprise EDGE-related expenditures directed to labor and capital employed in research and development. More specifically, the investments are described as expenditures in direct labor and capital, field engineering services provided by full-time Corning employees, and field engineer services and technical support provided by contractors, or Pioneer. *See* ID at 396-401.

1. Section 337(a)(3)(B): Significant Employment of Labor or Capital[35]

The evidence shows that Corning's EDGE-related investments directed to labor and capital employed in research and development ("R&D") varied from year to year starting in 2007, at one point [redacted] with next-generation research in 2019 and continuing into 2020. ID at 389-90 (citations omitted). Despite [redacted], the ID's determination to include the entire date range (2008 to February 21, 2020) for Corning's investments in its EDGE solutions in the domestic industry analysis is consistent with Commission precedent as cited in the ID and elaborated below. *Id.* at 390-91 (citing, *e.g.*, *Certain Marine Sonar Imaging Devices, Including Downscan and Sidescan Devices, Products Containing the Same, and Components Thereof*, Inv. No. 337-TA-921, Comm'n Op. at 54-57 (Jan. 6. 2016) (crediting past investments in research and development for discontinued products because of ongoing investments in warranty, technical support, and software updates); *Certain Electronic Digital Media Devices and*

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[35] Chair Kearns joins the discussion and conclusions in this section with respect to (a) including Corning's 2019-2020 R&D investments, (b) the amount of EDGE Project Labor and Direct Expenses, and (c) use of a sales-based allocation to eliminate non-DI related investments, as these are relevant to his analysis and finding under section 337(a)(3)(C). He does not join the remainder of this section. In particular, he does not join the discussion of expenses for Field Engineering Services and Pioneer Technical Support, at least some of which may involve activities akin to those of a mere importer, and thus may not in his view qualify for inclusion in the domestic industry.

Chair Kearns also notes that where a complainant is relying on a comparison of its domestic and foreign expenditures to show significance under section 337(a)(3)(A) or (B), it remains an open question for him whether, in general, a proper assessment of the significance of the domestic expenditures should include all expenditures (including those for manufacturing) related to the domestic industry product(s), and not merely a subset of expenditures that the complainant wishes to rely upon. He expects complainants that are relying on a comparison of domestic to foreign expenditures to place evidence on the record that would enable the Commission to compare all the claimed domestic expenditures to all worldwide expenditures, including manufacturing expenditures. *See Certain Movable Barrier Operator Sys. & Components Thereof*, Inv. No. 337-TA-1118, Separate Views of Chair Kearns Regarding Economic Prong Issues.

Components Thereof, Inv. No. 337-TA-796, Comm'n Op. at 99-100 (Sept. 6, 2013) (crediting past investments where complainant was "further develop[ing] its existing products")). Neither Leviton nor the Joint Respondents address this Commission precedent in their petitions.

When Corning's domestic labor and capital related expenses are added together from 2008 to February 21, 2020, such as direct expense, field engineering services, and Pioneer technical support expenditures, the ID found the result is a total investment in EDGE of [redacted], [redacted] of which was incurred in the period from January 1, 2019 to February 21, 2020. *Id.* at 401.

Summary of Alleged Corning Domestic Industry Investments

Investment Type	2008-Feb. 21, 2020	2019-Feb. 21, 2020
EDGE Project Labor	[redacted]	
EDGE Project Direct Expenses		
EDGE Field Engineering Services		
EDGE Pioneer Technical Support		
Total Investment in Labor and Capital		

Having determined that Corning's past investments in R&D of its EDGE and EDGE8 products may be considered to support its domestic industry claim, we turn to Respondents' argument that the ID improperly included non-DI related investments. The Commission finds that Corning's expert, Mr. Schoettelkotte, reasonably applied a sales-based allocation to eliminate non-DI related investments (*i.e.*, "investments related to EDGE cable assemblies and the small number of EDGE chassis and modules that are not alleged to practice the asserted patents"). *See id.* at 401-05; CX-0003C Q/A 158, 161.

<u>Sales-Based Allocation of Corning DI Investments Including Assemblies</u>

Product Type	Quantity	Quantity-Based Allocation		Revenue	Revenue-Based Allocation	
		% of Total	Investment		% of Total	Investment
All Chassis, Modules, & Cable Assemblies	[redacted]					
DI Chassis & Modules Only						
DI Modules Only ('206 Patent)						

Of the [redacted] amount, approximately [redacted] is attributable to chassis and modules that practice the '320, '153, and '456 patents, and approximately [redacted] is attributable to modules that practice the '206 patent. ID at 403.

Leviton argues that no portion of the investments in the four R&D projects from 2019-2020 should be considered in the DI analysis, using any allocation methodology based on sales or otherwise because those investments are "devoted *exclusively* to non-DI products." Leviton Pet. at 33-34, 40-41. The Commission finds that Leviton is incorrect. Corning's fact witnesses, Mr. Hicks and Mr. Staber, and its economic expert, Mr. Schoettelkotte, testified that since 2015, Corning has continued work related to the DI products. CX-0004C (Hicks WS) Q/A 49 (over the next five years, Corning plans to "continue to sell the current products and invest further in R&D so we can roll out new product developments for both EDGE and EDGE8."), 50 (explaining that Corning's ongoing R&D projects are "trying to increase the density currently available in the EDGE and EDGE8 systems," "continuing to provide accessibility and fiber guides," and "innovation . . . on a new type of EDGE module that will fit into a standard EDGE chassis."); CX-0006C (Staber WS) Q/A 56 ("[A]ll of the project codes were a significant part of the overall research and development work for the overall EDGE solution that is based on that chassis and module design."); CX-0003C (Schoettelkotte WS) Q/A 64-65; Schoettelkotte Tr. 174:14-175:14. The Commission, thus, finds at least a portion of Corning's R&D expenditures in 2019-2020 relate to its DI products and the ALJ did not err in rejecting Leviton's characterization of Corning's R&D projects based on the record evidence.

Mr. Staber, Corning's prior Technology Program Manager, who was responsible for the development of the EDGE and EDGE8 products, explained that Corning's business record-keeping is not able to distinguish between projects related to the DI products versus projects related to non-DI products because its R&D programs were "based on the overall solution set" and the project codes "were based on the different functionalities of the solution set that we needed and were not intended to describe independent projects." CX-0006C (Staber WS) Q/A 33. Another Corning witness explained that its R&D projects, including the 2019 and 2020 R&D projects, involved "getting feedback from customers and us[ing] that feedback to make continuous improvements, such as increases in fiber density and the quality of cable routing." CX-0005C (Clark WS) at Q/A 25. When asked why he chose to use the sales-based allocation, Corning's economic expert, Mr. Schoettelkotte, answered:

> And then, finally, I looked specifically at these project codes and the manner in which they were described to me by Corning witnesses, including Mr. Staber, and what I learned is -- is that the investments themselves are very parallel to the sales, meaning these are not disparate investments. I understand that each one of these project codes is not an independent project but that, for lack of a better phrase, the left hand understood what the right hand was doing at every step of the -- at every step of the way. And the reason that that was important is because trunks function within Corning specifically with the chassis and the way that they're clipped, such that they can provide the density and ease of use that Corning requires.
>
> So it was that level of interaction between the project codes, again, not disparate activities.

Schoettelkotte Tr. 174:14-175:4. Respondents' economic expert does not dispute this. *See* Mulhern Tr. 928:17-932:2. The Commission finds that Respondents have not persuasively rebutted the record evidence discussed above showing that Corning is not able to distinguish between projects related to the EDGE chassis and modules and projects related to non-DI products and that it is therefore reasonable for Corning to have applied an allocation method to estimate DI expenditures.

We agree with the ID that the sales-based allocation method Corning applied was reasonable. In particular, Mr. Schoettelkotte testified that it is possible to eliminate non-DI related investments by using a sales-based allocation method. *See* CX-0003C (Schoettelkotte WS) Q/A 150. He explained that a sales-based allocation was a reasonable approach given that it was not possible to do an allocation based on project codes:

> **Q153. Why did you perform sales-based allocations rather than an allocation based on the project codes you relied on?**
>
> A153. Although Corning tracks its R&D investments and activities according to project codes in the normal course of business, like most companies it does not track them on a product-by-product or patent-by-patent basis. Importantly, I understand that Corning's R&D efforts with respect to EDGE and EDGE8 have involved an overall holistic approach that have taken advantage of Corning's vertical integration, whereby all of the component engineered, and designed to work together to provide an optimal solution that Corning offers to the market as a single integrated platform. In my opinion, a sales-based allocation takes into account those shared research, development, and engineering efforts associated with the various EDGE Project Codes, each of which is geared towards improving and furthering the development of the complete EDGE and EDGE8 solutions, rather than being limited to any particular component. Based on the facts of this case and the realities of the marketplace, I believe a sales-based allocate on is a reasonable approach here given the way Corning has developed and marketed EDGE and EDGE8 as single integrated solutions as opposed to disparate products and components that have no relationship to one another.

Id. Q/A 153. Mr. Schoettelkotte's allocation methodology appears to be reasonable and fact-based. While Leviton objects to the use of a sales-based allocation method, it suggested no alternative method and in the absence of a better alternative, it was reasonable for all of Corning's EDGE R&D projects to be included in the total investment figure and for the ID to adopt the sales allocation approach suggested by Corning's economic expert to ensure that a reasonable share of that total investment was allocated to the DI products that practice the asserted claims. Another methodology also might be acceptable, but a complainant is not obligated to use a particular allocation methodology. *See Certain Solid State Storage Drives, Stacked Electronics Components, and Products Containing Same*, Inv. No. 337-TA-1097 ("*Solid State Storage Drives*"), Comm'n Op. at 21-22 (June 29, 2018) ("[A]ll that is required is the use of reasonable allocations for the purposes of establishing the economic prong of the domestic industry requirement.").

Respondents rely on *Certain Television Sets, Television Receivers, Television Tuners, & Components Thereof*, Inv. No. 337-TA-910 ("*Television Sets*"), Comm'n Op. at 68 (Oct. 30, 2015), to argue that Corning cannot show a domestic industry based on its R&D expenditures because it abandoned any qualifying R&D at least three years before filing the complaint. Leviton Pet. at 38. But *Television Sets* does not support Leviton's position. The Commission held in *Television Sets* that "[p]ast expenditures may be considered to support a DI claim as long as those investments pertain to the complainant's industry with respect to the articles protected by the asserted IP rights and the complainant is continuing to make qualifying investments at the time the complaint is filed." *Television Sets*, Comm'n Op. at 68. Unlike in *Television Sets*, the investments in this case are ongoing, as explained above with regard to Corning's 2019-2020

R&D investment, and also with respect to ongoing field services and technical support. *See* ID at 399-401.

Even if Corning's 2019 and 2020 R&D investments are removed from consideration, as Leviton argues they should be, Corning's ongoing field service and technical support investments of its DI products (sales of which were in the [redacted] dollars), coupled with its R&D expenditures for the DI products from 2008-2017, adds up to [redacted] of dollars.[36] *See* CX-1809C. There is no dispute that Corning has invested in the installation, maintenance, and technical support for its DI products, and those investments are ongoing because it continues to sell the EDGE products in significant volumes.[37] *See* CX-0005C (Clark WS) Q/A 49-55, 57-65; CX-0003C (Schoettelkotte WS) Q/A 96 ("[F]rom January 1, 2017, through February 21, 2020, Corning engineers spent a total of [redacted] days (or [redacted] hours, assuming an 8-hour workday) performing field engineering services for its EDGE customers in the United States), 98, 102 ("[F]rom January 1, 2016, through February 21, 2020, the Pioneer contractors reported spending a total of [redacted] hours performing technical support services for Corning's EDGE customers in the United States), 104; CX-1814C (Corning Field Engineering Investments); CX-1815C (Corning Pioneer Investments); CX-0004C (Hicks WS) Q/A 53; CX-0749C (2016 Pioneer time entries) at 12 ("setting up visit to test Edg[e] modules"), 24 ("switch out trays"), 98

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[36] Removing only Corning's 2019 and 2020 R&D investments from Corning's 2008-2020 qualifying investments would decrease the total DI investment figure from [redacted] to [redacted]. *See* CX-1809C (summary of Corning DI investments). Applying the same sales allocation percentage, Corning's domestic industry for the '320, '456, and '153 patents decreases from [redacted] to [redacted] and its domestic industry for the '206 patent decreases from [redacted] to [redacted].

[37] Corning's investments in service and technical support totaled [redacted] from 2019 to Feb. 21, 2020, ID at 401, which amounts to approximately [redacted] after applying the same sales allocation percentage.

("connector issue with modules"; "module issue"); CX-0751C (2018 Pioneer time entries) at 185 ("Rewire EDGE modules"); CX-0999C (2020 Pioneer time entries) at 7 ("Fiber tray replacement"), 13 ("Fiber tray replacement"), 19 ("fiber tray replacement"), 25 ("Module testing"). Indeed, from 2015-2019, Corning's sales of the DI products alone totaled [redacted], CX-1821C (Corning EDGE Chassis & Modules Sales Revenue Ex. 5.4), CX-1000C (Corning Chassis Sales Data), CX-0973C (Corning Module and Assembly Sales Data), and Corning's witnesses testified that over the next five years Corning intends to "continue to sell the current products and invest in further R&D so we can roll out new product developments for both EDGE and EDGE8." CX-0004C (Hicks WS) Q/A 49.

Most recently, in *Certain Automated Teller Machines, ATM Modules, Components Thereof and Products Containing the Same*, the ALJ considered ongoing field service expenses in conjunction with past investments in research and development that ended more than five years before the complaint, finding that even though the ongoing investments "m[ight] not be significant enough to substantiate a domestic industry on their own," they warranted consideration of past R&D expenses. Inv. No. 337-TA-972, Initial Det. at 198 (Nov. 30, 2016), *not reviewed*, Comm'n Op. (June 12, 2017), *aff'd sub nom*, *Hyosung TNS v. Int'l Trade Comm'n*, 926 F.3d 1353, 1362 (Fed. Cir. 2019).

Leviton argues the ID also erred in finding Corning's employment of labor and capital significant. The ID found that Corning's [redacted] investment for the '320, '456, and '153 patents and its [redacted] investment for the '206 patent are quantitatively significant in and of themselves. Corning contextualizes the significance of its domestic R&D by calculating the percentage of global labor hours that were worked in the United States. The ID found that Corning's domestic R&D labor hours represented approximately [redacted] of Corning's total

R&D labor hours in EDGE-related projects globally when calculated as a percentage of global labor hours.[38] ID at 407 (citing CX-0003C (Schoettelkotte WS) Q/A 136 (calculated as percentage of global labor hours that were worked in the United States)); *see also* CX-1816C (Corning global labor hours); CX-1817C (Corning U.S. vs. global labor hours). Although contextually significant when considering labor hours alone, the ID found that the share of Corning's domestic R&D labor relative to its global R&D labor for EDGE-related products is likely even larger if valued by costs in wages, given the relatively high cost of U.S. employee labor relative to other countries where EDGE-related R&D is being conducted. ID at 407 (citing CX-0003C (Schoettelkotte WS) Q/A 138; Schoettelkotte Tr. 169:8-21); *see* CX-1811C (comparison of Corning's U.S. labor rate with its Mexico labor rate). The Commission adopts these findings.

Leviton claims that Corning artificially compared U.S. to foreign investments by identifying only research projects that had U.S. hours. Leviton Pet. at 43. To the contrary, Corning's expert, Mr. Staber, testified that he identified all of the project codes that were related to the development of the EDGE products, not just those with U.S. hours. CX-0006C (Staber WS) at Q/A 34-35.

Leviton also claims that the ID erred in finding that Corning's foreign manufacturing costs are irrelevant to ascertaining whether the qualifying investments are significant. But the Commission has made clear that there is no requirement that a complainant compare different kinds of domestic and foreign investments. *See Certain Movable Barrier Operator Sys. &*

[38] Corning employees reported spending a total of [redacted] hours working on projects that correspond to the EDGE Project Codes globally, of which [redacted] hours were spent in the United States on research, development, and engineering activities associated with the EDGE and EDGE8 products. CX-0003C Q/A 75, 136; *see* CX-1810C; 1816C; 1817C.

Components Thereof, Inv. No. 337-TA-1118 ("*Movable Barrier*"), Comm'n Op. at 24 (Jan. 12, 2021) ("Nortek has provided no authority that compels a finding that domestic investments cannot satisfy the domestic industry requirement in the absence of presenting a comparison of foreign manufacturing costs to a complainant's U.S. investments."). For instance, the Commission has found a complainant's U.S. investments in R&D and testing activities to be significant because it accounted for a substantial proportion of total worldwide investments in these activities without consideration of foreign manufacturing costs. *See Certain Semiconductor Devices and Consumer Audiovisual Products Containing the Same*, Inv. No. 337-TA-1047, Initial Det. at 438 (May 11, 2018), *unreviewed by* Comm'n Notice (July 17, 2018). Therefore, a complainant may compare its domestic investments with its foreign investments to inform the contextual analysis for determining whether the claimed domestic investments are significant or substantial. *Movable Barrier*, Comm'n Op. at 23.

The evidence also shows that Corning's domestic industry investments are qualitatively significant. As noted in the ID, the result of those investments was a highly successful product line that captured over 50 percent of the market and generated [redacted] in revenue from 2015 to 2019. CX-0004C (Hicks WS) Q/A 23, 55; CX-0003C (Schoettelkotte WS) Q/A 130, 132 (noting Corning's position as "the recognized market leader and largest supplier of high-density fiber optic equipment"). This represents a significant return on Corning's [redacted] investment in the development of EDGE and EDGE8 chassis and modules that practice the asserted patents. *See* CX-0003 Q/A 132. Indeed, the EDGE and EDGE8 solutions have been installed in data centers of "some of the largest U.S.-based technology and financial industry institutions, including [redacted]

[redacted]."[39] *Id*. Q/A 133; CX-0004C (Hicks WS) Q/A 57.

Based on the foregoing, the Commission concludes that Corning has satisfied the economic prong of the domestic industry requirement under section 337(a)(3)(B) for each of the asserted patents.

2. Section 337(a)(3)(C): Substantial Investment in its Exploitation, Including Engineering, Research and Development, or Licensing[40]

The ID found that the same labor and capital related expenses that support a domestic industry under section 337(a)(3)(B) "separately constitute" a domestic industry under subparagraph (C) of section 337(a)(3). ID at 404. Regarding subparagraph (C)'s additional requirement of a substantial investment in the "exploitation" of the asserted patents, the ID found:

> Each asserted patent claims technology relating to aspects of the chassis and modules that make up the base infrastructure of Corning's EDGE and EDGE8 solutions. *See* CX-0003C (Schoettelkotte WS) Q/A 122 ("More specifically, I understand that the Asserted Patents cover the EDGE and EDGE8 system of sliding trays, removable modules, and other innovative features that enable fiber optic connections to be densely packed inside an equipment rack while improving access to adapters and cables.").

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[39] The ID also found Corning's domestic investments are significant when compared to Respondents' own spending in connection with the development of the accused products. ID at 408. The ID relied on Respondents' projected costs for developing their accused products, which are speculative and may not even reflect Respondents' actual development costs. *See* CX-0003C (Schoettelkotte WS) Q/A 145 ("Corning's domestic industry investments, which total more than [redacted], are also significant and/or substantial when considered in the context of the marketplace and what certain Respondents ***appeared to contemplate spending*** in connection with the development of their directly competing high-density fiber optic equipment solutions …") (emphasis added). The Commission does not adopt the ID's finding that Corning's domestic investments are significant when compared to Respondents' own spending in connection with the development of the accused products in light of the speculative nature of the underlying evidence and the fact that this ground for finding significance is not necessary to the decision. ID at 408.

[40] Chair Kearns joins this section except as indicated below.

> Investments related to the research, development, engineering, and implementation of those features of the EDGE chassis and modules are thus related to the asserted patents.

Id. at 405. Thus, the ID concluded the evidence demonstrates a sufficient "nexus" between the asserted patents and Corning's claimed domestic industry investments to consider them an exploitation of the patent. *Id.*

The evidence supports finding that Corning's R&D for its EDGE products substantially occurs in the United States, and that Corning's engineering and R&D efforts went towards developing and improving the functionality of the DI products. ID at 406; CX-0003C (Schoettelkotte WS) at Q/A 68, 133-37. There is also no dispute that the asserted patents relate to the fundamental technology embedded in the DI products. *See* CX-0003C (Schoettelkotte WS) Q/A 122; *see generally Certain Gas Spring Nailer Products and Components Thereof*, Inv. No. 337-TA-1082 ("*Gas Spring Nailer*"), Comm'n Op. at 80 (Apr. 28, 2020) ("The requisite nexus between Kyocera's exploitation activities and the '718 patent is met here because the activities here go toward developing DI products that embody and practice the asserted claims."). While Corning developed and released its first EDGE product more than ten years ago, Corning continues to exploit the technologies claimed in the asserted patents through its ongoing investments in research and engineering of its EDGE products. *See* CX-0003C (Schoettelkotte WS) at Q/A 84, 132. Accordingly, the Commission agrees with the ID that Corning's U.S. R&D and engineering expenditures directed to the DI products exploit the inventions of the asserted patents, and for the period 2008 to February 21, 2020, total approximately [redacted] for the apparatus combination claims and approximately [redacted] for the module claims.[41] ID at 404-405.

Leviton and the Joint Respondents do not challenge the finding that Corning's engineering and R&D investments prior to 2018 exploited the asserted patents. Rather, they assert that Corning's 2019 and 2020 research projects and Corning's field engineering and Pioneer technical support investments do not practice any of the claims of the asserted patents. *See* Joint Sub. at 25-27; Leviton Sub. at 53-54, 56. However, as discussed above, Corning's expert applied a sales-based allocation of Corning's domestic engineering and R&D expenditures for the DI products to eliminate non-DI related investments. ID at 403; CX-0003C (Schoettelkotte WS) at Q/A 158, 160-61. The Commission routinely accepts a sales-based allocation method for expenditures that are allocated to prong (C) of section 337(a)(3). *See, e.g.*, *Certain Industrial Automation Systems and Components Thereof Including Control Systems, Controllers, Visualization Hardware, Motion and Motor Control Systems, Networking Equipment, Safety Devices, and Power Supplies*, Inv. No. 337-TA-1074, Final ID at 50 (Nov. 15, 2018), *unreviewed by* Comm'n Notice (Dec. 20, 2018) (allocating complainant's R&D investments using sales allocation and finding those investments meet the nexus requirement for sub-prong (C) because they are "closely related to and enable exploitation of" the copyrighted software). Thus, the Commission finds the ID reasonably adopted Mr. Schoettelkotte's

[41] Chair Kearns does not include investments for Field Engineering Services and Pioneer Technical Support, some of which may involve activities akin to those of a mere importer, and thus may not in his view qualify for inclusion in the domestic industry. He need not resolve the issue of how much of those investments to credit because he finds the economic prong satisfied based on Corning's other credited investments, which when allocated amount to approximately [redacted] for the apparatus combination claims and approximately [redacted] for the module claims.

allocation, which resulted in approximately [redacted] of investments for the ’320, ’456, and ’153 patents and approximately [redacted] of investments for the ’206 patent.[42]

The Commission also adopts the ID’s finding that Corning’s investments in the exploitation of the asserted patents are quantitatively and qualitatively substantial. ID at 406-08.[43, 44]

Based on the foregoing, the Commission affirms the ID’s finding that Corning has satisfied the economic prong of the domestic industry requirement under section 337(a)(3)(C) for each of the asserted patents.

V. REMEDY, PUBLIC INTEREST, AND BONDING

The Commission has determined above that Corning has shown a violation of section 337 based on infringement of the asserted claims of the ’320, ’456, ’153, and ’206 patents. Under the

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[42] As discussed above in fn. 41, Chair Kearns bases his analysis on allocated amounts of approximately [redacted] for the ’320, ’456, and ’153 patents and approximately [redacted] for the ’206 patent. These values are not materially lower than those relied upon by the ID and his colleagues.

[43] As discussed in fn. 39, the Commission does not adopt the ID’s finding regarding Corning’s domestic investments compared to Respondents’ own spending in connection with the development of the accused products. ID at 408.

[44] Chair Kearns adopts the ID’s finding that Corning’s research and development investments are substantial with the following modifications. He does not adopt the discussion on p. 407 of the ID regarding the relevance of comparing activities in different areas. However, because his analysis is under (C) only (whereas the ID’s discussion is for both (B) and (C)) he finds it appropriate to compare Corning’s domestic investments in research and development with foreign investments in the same activities. In this regard, while he does not consider the Field Engineering Services and Pioneer Technical Support in his analysis regarding substantiality, the monetary figures he considered are not materially different from those used in the ID and by his colleagues. Moreover, he adopts the analysis in the ID at 406-407 relating to labor costs for research and development, which do not include Field Engineering Services and Pioneer Technical Support. Finally, he does not adopt the ID’s finding regarding Corning’s domestic investments compared to Respondents’ own spending in connection with the development of the accused products. ID at 408.

statute, if the Commission determines that a violation has occurred, "it shall direct that the articles concerned . . . be excluded from entry into the United States, unless, after considering the effect of such exclusion upon the public health and welfare, competitive conditions in the United States economy, the production of like or directly competitive articles in the United States, and United States consumers, it finds that such articles should not be excluded from entry." 19 U.S.C. § 1337(d)(1). The Commission may also issue CDOs to prevent further violations, including sale or distribution of infringing articles within the United States, after consideration of these public interest factors. *See* 19 U.S.C. § 1337(f)(1), (g)(1).

As explained below, the Commission has determined that the appropriate remedy is: (1) a GEO prohibiting the entry of infringing high-density fiber optic equipment and components thereof; and (2) CDOs directed to respondents Leviton, Panduit, and FS. The Commission has also determined that the public interest factors do not preclude issuance of these remedial orders and that a bond as set forth in the orders is required during the period of Presidential review. 19 U.S.C. § 1337(j)(3).

A. Remedy

The Commission has "broad discretion in selecting the form, scope, and extent of the remedy." *Viscofan, S.A. v. US. Int'l Trade Comm'n*, 787 F.2d 544, 548 (Fed. Cir. 1986). The RD recommends issuance of a GEO under subparagraph (B) of section 337(d)(2), but not under subparagraph (A), and issuance of CDOs against the Defaulting Respondents and Respondents Leviton, Panduit, and FS. RD at 420-43.

1. General Exclusion Order

Section 337(d)(2) provides that "[t]he authority of the Commission to order an exclusion from entry of articles shall be limited to persons determined by the Commission to be violating this section unless the Commission determines that— (A) a general exclusion from entry of articles is necessary to prevent circumvention of an exclusion order limited to products of named persons; or (B) there is a pattern of violation of this section and it is difficult to identify the source of infringing products." 19 U.S.C. § 1337(d)(2); *see also* 19 C.F.R. § 210.50(c). The Active Respondents seek certain exceptions to any exclusion order, as explained *infra* at part (c), but do not dispute that issuance of a GEO is appropriate in this investigation.

a. Section 337(d)(2)(B): A Pattern of Violation and Difficulty in Identifying the Source of Infringing Products

Based on the evidence in the record, the Commission agrees with the ALJ that Corning has established the need for a GEO under section 337(d)(2)(B). The RD found that a pattern of violation of the asserted patents exists. Of the thirteen original Respondents in this investigation, the RD found that the five Active Respondents infringe and that it is more likely than not that the five Defaulting Respondents also infringe. RD at 426-27. Corning's Mr. Hicks identified 31 nonrespondent entities that sell or offer to sell products that he alleges are "strikingly similar to EDGE" and likely to infringe the asserted patents. *Id.* at 427 (quoting CX-0004C (Hicks WS) Q/A 70). This evidence thus establishes a pattern of violation.

Mr. Hicks also testified regarding the difficulty in identifying the sources of potentially infringing products. *Id.* at 428. For example, he testified that some entities, such as defaulting respondents TARLUZ and Wulei Bonelinks, sell potentially infringing products without branding or identification. *Id*. (citing CX-0004C at Q/A 77; CX-0640; CX-0651). He explained that original equipment manufacturers "may easily produce EDGE copies and then sell them to anyone under any brand." *Id.* (citing CX-0004C at Q/A 79). Additionally, Corning demonstrated that a number of nonrespondents' products closely resemble Respondent's infringing products. *Id.* at 429-30. Finally, the RD noted that while Corning and the Respondents account for the majority of the fiber optic equipment market, both globally and in the United States, "the portion of the market not occupied by the named respondents, appears to be full of rapidly appearing and disappearing manufacturers and distributors that make and sell products with strong similarities to both Corning's EDGE products and the infringing products of the named respondents." *Id.* at 430-31. In view of the evidence discussed above, the Commission finds that Corning has established the need for a GEO under section 337(d)(2)(B).

b. Section 337(d)(2)(A): Prevent Circumvention of an Exclusion Order Limited to Products of Named Persons

The RD did not recommend issuance of a GEO under section 337(d)(2)(A) because it found the "evidence does not demonstrate that conditions in the market for fiber optic equipment provide incentives for the named respondents to attempt to circumvent a limited exclusion order." RD at 424. In particular, the RD found, for example, the evidence suggests that barriers to entry are high and "[c]ustomer expectations [] provide a significant disincentive for the named respondents to attempt to circumvent a limited exclusion order by importing products under other, less-established brand names or distribution channels." *Id.* at 425.

Corning submits that the evidence in this case supports a finding that a GEO is necessary to prevent circumvention. *See* Compl. Sub. at 59-63. Having reviewed the record evidence, the Commission finds that Corning has established a GEO is also appropriate under section 337(d)(2)(A). The RD's analysis of circumvention focused extensively on the largest customers and did not account for smaller data center customers, which make up nearly half of the market. *Id.* at 63-64 (citing RD at 424-25). The evidence shows that the barrier to entry can be quite low because many established foreign manufacturers offer OEM and private-label services, resulting in easy market penetration and low production costs due to foreign manufacturers producing infringing articles under different labels that are lower in price. *See id.* at 60-61 (citing CX-0004C (Hicks WS) Q/A 65, 77, 79), 64. The evidence also shows that even if some of the

Active Respondents have long-standing positions in the fiber optics market, many, if not all, of the Defaulting Respondents and nonrespondents identified by Mr. Hicks are not established or reputable, making them more likely to attempt to evade an LEO. *Id.* at 64. For these reasons, the Commission finds that Corning has satisfied the criteria for issuing a GEO under section 337(d)(2)(A).

c. Scope of the Order

The Active Respondents seek certain exceptions to any exclusion order. First, they request that any exclusion order not extend to domestically-manufactured, non-imported products, such as Leviton's U.S.-made modules and Panduit's and Siemon's U.S.-made chassis. *See* Leviton Sub. at 65-66; Joint Sub. at 36-37. However, it is unnecessary to tailor the orders to carve out domestically-manufactured products because the Commission's GEO and CDOs apply only to imported products. Respondents do not dispute this in their replies. *See* Leviton Reply at 43; Joint Reply at 28-29.

Second, the Active Respondents argue that "the ALJ declined to recommend the statutorily mandated exemption under 19 U.S.C. § 1337(l) that any remedial order shall not apply to any articles imported by and for use of the United States." Joint Sub. at 37 (citing ID at 421); *see* Leviton Sub. at 66. Again, such tailoring is unnecessary because the Commission's standard GEO language already encompasses this exemption by providing that articles found to be in violation "are excluded from entry for consumption into the United States . . . except . . . as provided by law" and that the order "shall not apply to covered articles that are imported by and for the use of the United States, or imported for, and to be used for, the United States with the authorization or consent of the Government." Respondents do not dispute this in their replies. *See* Leviton Reply at 43; Joint Reply at 28-29.

Third, the Joint Respondents argue that "any remedy . . . should not extend to products with substantial non-infringing uses[.]" Joint Sub. at 36; *see* Leviton Sub. at 69-70. As discussed in more detail below, the definition of "covered articles" in the orders do not include "cable assemblies for use with the covered chassis and modules or noninfringing products such as adapter plates, splice panels, or patch panels." In addition, the covered "modules have simplex/duplex components (*e.g.*, LC adapters) on the front and multi-fiber components (*e.g.*, MPO/MTP adapters) on the rear, and are configured to support at least 98 connections per standard rack unit (or "U space"))." Thus, the Commission believes the orders appropriately identify the high-density fiber optic equipment and components thereof that are subject to the orders. To the extent the Respondents urge the Commission to exclude their accused products because they have substantial non-infringing uses, such a request is contrary to Commission practice. Leviton, Panduit, Siemon, and FS have been found to have induced infringement even though their imported accused products were also found to have substantial noninfringing uses. ID at 108-110. Moreover, Siemon's and FS' imported modules have also been found to directly infringe the asserted claims of the '206 patent, which is specifically directed to the accused modules and does not claim a combination of chassis and modules. Any Respondent seeking to import any of the accused products for a non-infringing use can seek a determination as to the importation of those products for those purposes.[45] *See* 19 U.S.C. § 1337(k) (modification proceeding); 19 C.F.R. § 210.76 (same); *id*. § 210.79 (advisory opinions).

[45] The Commission also notes that the RD recommended, and no party disputes, the inclusion of a standard certification provision in the exclusion order. The standard certification provision authorizes U.S. Customs and Border Protection ("CBP") to require an importer to certify that "the products being imported are not excluded from entry under" the terms of the exclusion order. The standard certification provision in exclusion orders "does not allow an importer simply to certify that it is not violating the exclusion order." *Certain Network Devices, Related Software and Components Thereof (II)*, Inv. No. 337-TA-945, Comm'n Op. at 123 n.73

Fourth, the Joint Respondents argue that the scope of the ID's exception for service and repair requires clarification because it does not "confirm Respondents' request . . . that the service and repair exception allow Respondents to continue to supply current third-party customers with specific parts for servicing existing products." Joint Sub. at 37; *see* RD at 419-20. For example, Panduit and Siemon submit that under the service and repair exception, they should be allowed to continue to supply the imported modules that are used to induce infringement to any customer who possesses an accused chassis when the exclusion order takes effect. Joint Sub. at 37-38; *see* Joint Reply at 29. Corning submits that the Commission has denied a service and repair exception in similar circumstances where "Respondents do not identify any specific end users or other customers whose operations will allegedly be disrupted." Compl. Reply at 44. OUII believes the service and repair exception in the GEO should track the Commission's standard language and recommends that the Commission deny the "clarification" that the Joint Respondents request because the modules that Panduit and Siemon would like to continue to import have been used to induce infringement in violation of section 337. OUII Reply at 40.

The Commission has determined to deny the Joint Respondents' request for a service and repair exception. As Corning argues, the Commission finds that "[c]ontinuing to import infringing modules to be used with infringing chassis would not be 'service and repair' – it would be circumvention of the exclusion order." Compl. Sub. at 70. The Commission also finds that Respondents have not come forward with any evidentiary support and do not cite to any evidence in support of a service and repair exception. Under similar circumstances, the

(June 1, 2017). Rather, CBP "only accept a certification that the goods have been previously determined by CBP or the Commission not to violate the exclusion order." *Id.*

Commission has refused to include such an exception. *See, e.g.*, *Gas Spring Nailer*, Comm'n Op. at 85-86 ("[T]he Commission has granted [service and repair] exemptions when unopposed, in view of the public interest, or upon some showing of a need for service and repair."); *Non-Volatile Memory Devices*, Recommended Det. at 4 (May 10, 2018) (finding respondent's "conclusory arguments do not support any service and repair exception"), *affirmed by* Comm'n Op. at 51 (Oct. 26, 2018). Because the Joint Respondents have made no showing as to why such an exemption is necessary and due to the potential for circumvention of the orders, the Commission denies the request for a service and repair exception.

Finally, Corning notes that OUII's proposed remedial orders omit the '206 patent. Since the Commission finds a violation as to claims 22 and 23 of the '206 patent by Respondents FS, Siemon, and Wirewerks, the Commission's GEO includes the '206 patent.

i. Definition of "Covered Articles"

After consulting with CBP, OUII submits that the products and components at issue are as follows:

> (a) chassis (or "enclosures") with sliding trays that fit within the standardized racks used in data centers; (b) removable modules (or "cassettes") that are inserted into the sliding trays of the chassis, wherein the chassis and modules are used to terminate large numbers of fiber-optic cables using standardized connectors (at least 98 connections per standard rack unit (or "U space")); (c) combinations of such chassis and modules; and (d) subassemblies (such as tray subassemblies) that are components of such chassis and modules.

OUII Sub. at 65-66. Parts (a) and (b) of OUII's definition for "covered articles" are nearly identical to the plain language description of the accused products or category of accused products.[46] *See* 85 FR 16653 (Mar. 24, 2020). Parts (c) and (d), which are not part of the plain language description, have been added to address CBP's "suggest[ion] that any remedial order issued in this investigation should specify which high-density fiber optic equipment and components thereof are subject to the order." OUII Sub. at 65-66. OUII also submits that the "order should further specify that it does not cover cable assemblies for use with the covered chassis and modules or noninfringing [products] such as adapter plates, splice panels, or patch panels." *Id.* at 66.

Corning, Leviton, and the Joint Respondents suggest several modifications to OUII's definition for "covered articles" in the proposed remedial orders. *See* Compl. Reply at 45-46; Leviton Reply at 47-48; Joint Reply at 29-30. With the exception of one modification, the Commission adopts the modifications suggested by Corning because they clarify the features of the accused modules that are covered by the order. As for the one exception, the Commission replaces the language "(in a chassis fully loaded with such modules) support at least 98 connections" with the language "are configured to support at least 98 connections" because it mirrors the language used in the asserted apparatus claims. The Commission finds the Joint Respondents' modification is unnecessary in view of Corning's modifications. Leviton's modifications reflect Leviton's position that the order should not cover its domestically-produced modules. However, as discussed above, the GEO covers only imported articles and is not directed to a specific respondent.

[46] OUII's proposed definition adds "enclosures" and "cassettes" as alternative names for chassis and modules, respectively.

2. Cease and Desist Orders

Section 337(f)(1) provides that in addition to, or in lieu of, the issuance of an exclusion order, the Commission may issue a CDO as a remedy for violation of section 337. *See* 19 U.S.C. § 1337(f)(1). CDOs are generally issued when, with respect to the imported infringing products, respondents maintain commercially significant inventories in the United States or have significant domestic operations that could undercut the remedy provided by an exclusion order. *See, e.g.*, *Certain Table Saws Incorporating Active Injury Mitigation Technology & Components Thereof* ("*Table Saws*"), Inv. No. 337-TA-965, Comm'n Op. at 4-6 (Feb. 1, 2017); *Certain Protective Cases & Components Thereof*, Inv. No. 337-TA-780, USITC Pub. No. 4405, Comm'n Op. at 28 (Nov. 19, 2012) (citing *Certain Laser Bar Code Scanners & Scan Engines, Components Thereof & Prods. Containing Same*, Inv. No. 337-TA-551, Comm'n Op. at 22 (June 24, 2007)). Complainants bear the burden on this issue. "A complainant seeking a cease and desist order must demonstrate, based on the record, that this remedy is necessary to address the violation found in the investigation so as to not undercut the relief provided by the exclusion order." *Table Saws*, Comm'n Op. at 5 (citing *Certain Integrated Repeaters, Switches, Transceivers, & Prods. Containing Same*, Inv. No. 337-TA-435, USITC Pub. No. 3547 (Oct. 2002), Comm'n Op. at 27 (Aug. 16, 2002); *see also* H.R. REP. No. 100-40, at 160 (1987)).

a. Active Respondents

The Commission finds the evidence is sufficient to support the issuance of CDOs against Leviton, Panduit, and FS.[47] Apart from FS, the Respondents admit that they each hold inventory of their accused, have imported products, and have U.S. operations, but they submit that their

[47] As to the Active Respondents, Corning requests CDOs against Leviton, Panduit, and FS. It does not request a CDO against Siemon or Wirewerks.

inventory is not commercially significant to warrant issuance of a CDO. *See* Joint Sub. at 38; Joint Reply at 30; Leviton Reply at 44. Leviton argues that its inventory of imported enclosures "is not commercially significant at less than [redacted] of Complainant's yearly sales of its chassis."[48] Leviton Reply at 44 (citing CX-1820C). The Joint Respondents argue that the methodology used by Corning's expert, Mr. Schoettelkotte, to calculate the amount of their inventory is flawed and overstated. *See* Joint Sub. at 38; Joint Reply at 30.

Corning submits that its expert analyzed the available evidence of Respondents' inventory and commercial significance of their sales, as well as evidence of Respondents' domestic business operations. Regarding commercially significant inventory, Mr. Schoettelkotte analyzed the available data to determine the average sales of Accused Products per month for each Respondent, separated by accused chassis and accused modules. CX-0003C (Schoettelkotte WS) Q/A 195-97 (FS.com); 204 (Leviton); 212-13 (Panduit). He used this information to calculate the number of months of inventory held by FS.com, Leviton, and Panduit, which he found commercially significant. *Id.*

Mr. Schoettelkotte also examined additional evidence showing that these Respondents' business operations in the U.S. relating to the accused products are commercially significant. *Id.* Q/A 192, 198 (FS.com); 200-01, 205 (Leviton); 207-08, 214 (Panduit).

With respect to Leviton, the evidence shows it has significant domestic commercial business operations and maintains commercially significant domestic inventory of its accused chassis. Leviton keeps domestic inventory of the accused chassis at facilities in Bothell, Washington, and Bloomingdale, Illinois, and at distribution centers in Nevada and Tennessee.

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[48] Leviton's submissions repeatedly discuss the lack of inventory of its accused modules. This is irrelevant, however, because, as discussed above, any remedial order would not reach Leviton's domestically-produced modules.

Id. Q/A 201. Leviton maintained approximately [redacted] of inventory of its accused chassis at those domestic facilities. OUII Sub. at 68 (citing JX-0013C (Byquist Dep. Tr.) at 55:15-56:18, 90:5-91:10); CX-0003C (Schoettelkotte WS) Q/A 204 (As of March 23, 2020, Leviton maintained a U.S. inventory of [redacted] chassis valued at approximately [redacted]; and, as of May 31, 2020, Leviton had a U.S. inventory of [redacted] chassis valued at approximately [redacted], which represents approximately [redacted] of sales of chassis). Thus, the Commission finds that a CDO is warranted against Leviton.

Regarding Panduit, the evidence shows that it had a U.S. inventory of 8,353 modules valued at approximately $1,733,665 as of June 2, 2020, which represents approximately two months of sales of modules. CX-0003C (Schoettelkotte WS) Q/A 212-13; CX-1839C. Panduit also maintains a warehouse in DeKalb, Illinois. CX-0003C (Schoettelkotte WS) Q/A 209 (citing JX-0028C (Wagner Dep. Tr.) at 104:19-105:9). Based on Mr. Schoettelkotte's analysis of Panduit's inventory and its domestic operations, the Commission finds that a CDO is warranted against Panduit.

As for FS, the evidence shows that it has significant domestic commercial business operations and maintained a commercially significant inventory of accused products just before filing of the complaint. The RD found FS' "sales and inventory data relating to the accused products indicate that its domestic inventory is sufficient to satisfy approximately 15-19 months of sales of chassis and modules." RD at 435 (citing CX-0003C (Schoettelkotte WS) Q/A 197; CX-1838C). Although FS claims that it had no inventory as of May 2020, the RD noted that "this is inconsistent with FS data showing that it had an inventory of nearly 800 chassis worth over $100,000 just days before the complaint was filed" and Mr. Schoettelkotte therefore considered the data from just before the complaint in his analysis of months of chassis sales for

FS. *Id.* at 435-36 (citing CX-0003C at Q/A 195). Mr. Schoettelkotte also testified that FS maintains a 44,000 square foot warehouse in Delaware built to ensure fast same-day shipping for most in-stock orders of more than 2,000 different products. CX-0003C (Schoettelkotte WS) Q/A 192; CX-1478 (FS.com About Us) at 2. For these reasons, the Commission finds that a CDO is warranted against FS.[49]

As with the GEO, the Active Respondents request that any CDO not apply to domestically-manufactured, non-imported products nor extend to products with substantial non-infringing uses. *See* Joint Reply at 30; Leviton Sub. at 67-68. As discussed above, the Commission has determined to deny these requests because the Commission's remedial orders apply to imported articles only and the accused, imported products have been found to have induced infringement.

b. Defaulting Respondents

In the case of named respondents in the United States who have been found in default or who have not participated in the investigation, the Commission has inferred commercially significant domestic inventories or significant domestic operations with respect to the infringing articles. *See*, *e.g.*, *Certain Earpiece Devices and Components Thereof* ("*Earpiece Devices*"),

[49] Commissioner Schmidtlein supports issuance of the CDOs against Leviton, Panduit, and FS and agrees that the governing authority for CDO relief as to those respondents is section 337(f)(1). Section 337(f)(1) is the operative provision for requested CDO relief against participating respondents that do not satisfy the requirements of subsection 337(g)(1)(A)-(E). There is no dispute that Leviton, Panduit and FS do not satisfy the requirement of subsection 337(g)(1)(A)-(E). When the presence of infringing domestic inventory or domestic operations is asserted as the basis for a CDO under section 337(f)(1), Commissioner Schmidtlein does not adopt the view that the inventory or domestic operations needs to be "commercially significant" in order to issue the CDO. *See, e.g.*, *Certain Magnetic Tape Cartridges and Components Thereof*, Inv. No. 337-TA-1058, Comm'n Op. at 65, n.24 (Apr. 9, 2019); *Table Saws*, Comm'n Op. at 6-7, n.2 (Feb. 1, 2017). In Commissioner Schmidtlein's view, the presence of some infringing domestic inventory or domestic operations maintained by Leviton, Panduit, and FS, regardless of commercial significance, provides a basis to issue CDOs against those respondents.

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Inv. No. 337-TA-1121, Comm'n Op. at 41-42 (Nov. 8, 2019); *Certain Hand Dryers and Housing for Hand Dryers*, Inv. No. 337-TA-1015, Comm'n Op. at 24 (Oct. 30, 2017); *Certain Mobile Device Holders and Components Thereof* ("*Mobile Device Holders*"), Inv. No. 337-TA-1028, Comm'n Op. at 27 (Mar. 22, 2018); *Certain Agricultural Tractors, Lawn Tractors, Riding Lawnmowers, and Components Thereof*, Inv. No. 337-TA-486, Comm'n Op. at 18 (Aug. 19, 2003); *Certain Rare-Earth Magnets and Magnetic Materials and Articles Containing Same* ("*Rare-Earth Magnets*"), Inv. No. 337-TA-413, USITC Pub. No. 3307, Comm'n Op. at 17-18 (May 2000).

The RD recommends that CDOs issue to each of the Defaulting Respondents Huber+Suhner Inc. Huber+Suhner AG, TARLUZ, Anfkom, and Wulei Bonelinks, under "[s]ection 337(g)(1) [which] authorizes the Commission to issue cease and desist orders against defaulted respondents." RD at 437 (citing 19 U.S.C. § 1337(g)(l)). Because Corning requests a GEO and the Active Respondents participated in the investigation, the Commission evaluates the violation and exclusion of articles from entry for Defaulting Respondents under section 337(d)(2) rather than section (g)(2). *See Certain Water Filters and Components Thereof*, Inv. No. 337-TA-1126, Comm'n Op. at 13-14 n.2 (Nov. 15, 2019). Moreover, Corning's requested CDOs are "[i]n addition to . . . taking action under subsection (d)," and such request is evaluated under section 337(f)(1) rather than 337(g)(1). *Id.* In this case, the ALJ did not find the Defaulting Respondents in violation (nor did Corning request a violation to be found with respect to the Defaulting Respondents). Accordingly, because the Defaulting Respondents have not been found to "violat[e] this section," Corning's request for CDOs to be issued against the Defaulting Respondents must be denied. 19 U.S.C. § 1337(f)(1).[50]

[50] Commissioner Karpel and Commissioner Schmidtlein would issue CDOs directed to the Defaulting Respondents. They consider section 337(g)(1) to be the appropriate authority for the issuance of CDOs as to these Defaulting Respondents because the criteria for issuance of CDOs under subsection 337(g)(1)(A)-(E) are met as to these respondents. 19 U.S.C. § 1337(g)(1)(A)-(E). *See also* RD at 437. Each Defaulting Respondent was named in the complaint and each was served or refused service of the complaint and notice of investigation. *See* Order Nos. 7 & 8 (June 9, 2020), *unreviewed by* Comm'n Notice (June 22, 2020); Order No. 13 (Aug. 21, 2020), *unreviewed by* Comm'n Notice (Sept. 15, 2020). Each Defaulting Respondent failed to show good cause why they should not be held in default for failing to respond to the complaint and notice of investigation. *See id*. These findings satisfy subsections 337(g)(1)(A)-(D). Corning requested CDOs limited to each Defaulting Respondent in its initial submission on remedy, bonding, and the public interest thus satisfying subsection 337(g)(1)(E). Given that subsections 337(g)(1)(A)-(E) are satisfied, the statute directs the Commission to issue the requested CDOs, subject to consideration of the public interest. The public interest factors as detailed in Section V.B *infra* do not support a finding that CDOs directed to the Defaulting Respondents in this investigation would be contrary to the public interest. Accordingly, Commissioner Karpel and Commissioner Schmidtlein would issue CDOs against the Defaulting Respondents under section 337(g)(1).

Commissioner Karpel and Commissioner Schmidtlein find that Corning's request for CDOs against the Defaulting Respondents in its initial remedy submission accords with the Commission's notice, 86 Fed. Reg. 28890, 28892 (May 28, 2021), and its CDO request is consistent with the remedies requested in its Complaint. *See* DN 3436, Complaint ¶ 438(e) (EDIS Doc. ID 703129). Moreover, neither section 337(g)(1) nor Commission Rule 210.50 require Corning's CDO request directed to Defaulting Respondents to be denied "because the Defaulting Respondents have not been found to 'violat[e] this section [§ 337(d)].'" Further, section 337(g)(1) does not require the ALJ to make explicit findings with respect to whether Defaulting Respondents violated section 337, nor does it require the complainant to request the ALJ to make such findings. Thus, the facts that "the ALJ did not find the Defaulting Respondents in violation (nor did Corning request a violation to be found with respect to the Defaulting Respondents)" are not relevant to whether CDOs directed to the Defaulting Respondents should issue. To the contrary, where, as here, the requirements of section 337(g)(1) are satisfied as discussed above, the Commission "shall presume" the factual allegations to support a violation by each Defaulting Respondent "to be true" and must issue the complainant's requested remedy, here a CDO, limited to that Defaulting Respondent, upon consideration of the public interest. 19 U.S.C. § 1337(g)(1).

B. Public Interest

Section 337 requires the Commission, upon finding a violation of section 337, to issue an LEO "unless, after considering the effect of such exclusion upon the public health and welfare, competitive conditions in the United States economy, the production of like or directly competitive articles in the United States, and United States consumers, it finds that such articles should not be excluded from entry." 19 U.S.C. § 1337(d)(l). Similarly, the Commission must consider these public interest factors before issuing a GEO or CDO. 19 U.S.C. § 1337(d)(2), (f)(1), (g)(1).[51]

1. Public Health and Welfare

No party argues that the public health and welfare would be adversely impacted by the exclusion of Respondents' infringing products and other infringing high-density fiber optic equipment and components thereof of other suppliers. Corning submits that "excluding all infringing products will not adversely affect the public health and welfare" as high-density fiber optic equipment does not involve products necessary for some important health or welfare need. Compl. Stmt at 3; *see also* OUII Sub. at 74 ("There is no evidence that high-density fiber optic equipment has any public health or welfare implications."). Respondents do not argue to the contrary. Accordingly, based on the record, the Commission finds the remedial orders will not adversely affect the public health and welfare.

[51] Defaulting Respondent Huber+Suhner AG submitted a public interest statement. Huber+Suhner seeks similar carveouts to the remedial orders as the Active Respondents, including an exception for equipment "which is imported for non-infringing use." H+S Stmt at 3. The Commission notes that Huber+Suhner's defaulted and waived its opportunity to contest the infringement alleged in the complaint, including the allegation that Huber+Suhner's products have no substantial noninfringing uses. Compl. Reply at 49-50 (citing Compl. ¶ 150). Accordingly, the Commission denies Huber+Suhner's request for carveouts.

2. Competitive Conditions in the United States Economy

With respect to competitive conditions in the United States, Corning submits that it and its two licensees, AFL and CommScope, could serve the entire market and "ensur[e] direct (and legal) competition for products practicing the patented EDGE design." Compl. Stmt at 3-4. Corning contends that it and its licensees already hold a large majority of the U.S. market and can easily supply the rest with lawful products. *Id.* at 5 (citing RX-0731C (Data Center Market: Revenues by Segment Worldwide and Americas); RX-0733C (Fiber Optics Market Shares by Region as of Approximately June 2020) (same); RDX-0007C.020 (Mulhern Rebuttal) (same)). Corning notes that the "market for high-density fiber optic equipment is highly competitive, and will remain so even after infringing products are excluded." Compl. Sub. at 74. Corning also argues that since two of Corning's major competitors, CommScope and AFL, are now licensed, this legal competition for products practicing the patented EDGE design ensures that the exclusion order will not adversely impact competitive conditions. *Id.* (citing *Certain EPROM, EEPROM, Flash Memory, & Flash Microcontroller Semiconductor Devices & Prods. Containing Same*, Inv. No. 337-TA-395 (Reconsideration) ("*EPROM*"), Comm'n Op. at 86-87 (Dec. 11, 2000) (finding that no public interest considerations precluded a limited exclusion order because numerous non-infringing products guaranteed continued competition and adequate supply)). Corning also points out that, as the ALJ found, the "recent influx of cheap knock-offs is supplied by a large number of 'rapidly appearing and disappearing manufacturers and distributors' that are difficult to identify" thereby threatening legitimate competition. *Id.* (quoting ID at 431). Thus, Corning argues that "excluding these competitors and other infringing products will benefit competition in the United States by reinforcing the value of intellectual property rights." *Id.* at 74-75.

OUII submits that the evidence of record shows that "with regard to competitive conditions, Corning and its licensees CommScope and AFL supply a sufficiently large portion of the U.S. fiber optics market that the effect of the proposed remedy on competitive conditions in that market would be relatively small." OUII Sub. at 74 (citing RX-0733C at 1-2 (market shares by region) (Corning, CommScope, and AFL have a combined 88% market share for sales of fiber optic equipment to "Hyper4" data center customers in the U.S./Canada market, and a "Global" combined market share of 71% in the U.S./Canada market)).

Respondents do not dispute the evidence submitted by Corning and OUII indicating that the remedial orders would have a relatively small impact on competitive conditions in the United States or that Corning and its licensees have the capacity to supply the market demand for high-density optical equipment and components thereof. Joint Sub. at 40-41; Joint Reply at 31; Leviton Sub. at 68-70; Leviton Stmt at 4-5. Instead, they argue that because "Complainant and Respondents comprise a substantial majority of the North American market in each of the largest market segments," the remedial orders "would significantly reduce consumer choice and severely affect competitive conditions, to the benefit of entirely foreign-made products." Joint Sub. at 41 (citing RX-0007C (Mulhern WS) Q/A 198-200); Leviton Sub. at 70. Apart from pointing out market share statistics for the North American market, Respondents and their expert, Ms. Mulhern, offer no explanation as to how these statistics support their assertion that exclusion of imported infringing articles would have any particular effect on competitive conditions in the United States. Joint Sub. at 41; Leviton Sub. at 70.

Based on the record evidence and submissions of the parties, the Commission finds that the remedial orders will not adversely affect competitive conditions in the United States economy.

3. The Production of Like or Directly Competitive Articles in the United States

As to domestic production of like or directly competitive products, OUII submits that "Leviton's recent actions in transferring manufacturing activities for its accused chassis from Mexico to the United States in response to this investigation suggests that, if anything, the effect of the proposed remedy would be to increase production of like articles in the United States." OUII Sub. at 74 (citing RX-0005.1C (Errata to Kim WS)). Corning argues that "mere domestic activity [of the Respondents] does not warrant a public interest exception." Corning Sub. at 76.

Respondents do not challenge OUII's argument. Rather, Respondents make note of the extent of their own domestic production of fiber optic equipment and components. For example, Respondents state that Panduit's chassis are developed and manufactured in Illinois; Siemon's LightStack enclosures are developed and manufactured by Siemon in Connecticut; and Leviton manufactures all of its HDX Enterprise Cassettes in Bloomingdale, Illinois and final assembly, and now all manufacture, of the Leviton enclosures occurs in Bothell, Washington. Joint Sub. at 40 (citing ID at 52, 417); Leviton Sub. at 68; Leviton Stmt. at 3. Apart from stating their policy views on the purpose of section 337, however, Respondents offer no argument or evidence that their domestic production of fiber optic equipment identified above would be adversely affected by the remedial orders here.

The Commission finds that the evidence of record and arguments of the parties indicate no adverse impact of the remedial orders on the production of like or directly competitive articles in the United States.

4. United States Consumers

With respect to U.S. consumers, OUII submits that there is no evidence that U.S. consumers of fiber optic equipment, who are "sophisticated and demanding," would be adversely

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affected by the proposed remedy. OUII Sub. at 74 (citing RX-0007C (Mulhern RWS) Q/A 179; *accord* Schoettelkotte Tr. at 177:2-7). Corning argues that it is "the market leader, supplying more than 50% of the general data-center demand, and a larger share of the demand for high density solutions at issue here." Corning Sub. at 73 (citing CX-0004C (Hicks WS) Q/A 23). Corning also asserted that its "witnesses have testified that Corning could and would sell its products to customers who now purchase from Respondents." *Id.* (citing ID at 434). In addition, Corning states that together Corning and its two licensees can supply non-infringing high-density fiber optic equipment to meet U.S. demand. *Id.* at 74. Corning notes that the products covered by the asserted patents fit into standard data center racks. Once the remedial orders take effect, former customers of excluded competitors can easily buy chassis and modules from Corning (or the other two licensed companies) for data center growth. *Id.* at 75. Competing, non-infringing products will also ensure that data centers can be adequately served with high-density fiber optic equipment, and that consumers will continue to enjoy the same services that rely on data centers that they receive today. *Id.* (citing *EPROM*, Comm'n Op. at 86-87).

Respondents do not dispute OUII's evidence that purchasers of these products would not be adversely impacted by the remedial orders nor do they challenge Corning's assertion that it and its licensees are willing and able to supply the market demand in place of the infringing imports. The only evidence Respondents offer is the same North American market statistics discussed above. Joint Sub. 41; Joint Reply at 31; Leviton Sub. at 70; Leviton Stmt at 4-5. Apart from submitting such statistics, Respondents offer no explanation as to how these statistics support the assertion that U.S. consumers would be adversely impacted by the remedial orders here.

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Leviton also argues that "[a]ny injunction against [its] enclosures would deprive the public of thousands of critical non-infringing uses" and "[s]uch an injunction would result in an exaggerated detrimental impact on legitimate domestic manufacture and use, disproportionate to the accused infringement and importation." Leviton Stmt at 4; *see also* Joint Sub. at 40-41. Other than attorney argument, however, Leviton provides no evidence substantiating its claim of thousands of "critical noninfringing uses" and identifies no specific customers that would be harmed by the proposed remedial orders.

Moreover, Leviton has been found to have induced infringement even though its imported enclosures were also found to have substantial noninfringing uses. The proposed remedial orders, here, are consistent with the Commission's issuance of exclusion orders in cases involving induced infringement based on the importation of an infringing component having substantial noninfringing uses. *See Suprema*, 796 F.3d at 1342-43 (affirming the Commission's orders excluding imported scanners that induced the direct infringement only after being combined with domestically made software); *Comcast*, 951 F.3d at 1305, 1307-08 (affirming the Commission's orders excluding imported set-top boxes that induced direct infringement only when used with domestic servers). In addition, as discussed above, the orders appropriately identify the high-density fiber optic equipment and components thereof that are subject to the orders and do not include noninfringing products such as adapter plates, splice panels, or patch panels.[52]

[52] As discussed above, any Respondent seeking to import any of the accused products for a non-infringing use can seek a determination as to the importation of those products for those purposes. *See* 19 U.S.C. § 1337(k) (modification proceeding); 19 C.F.R. § 210.76 (same); *id.* § 210.79 (advisory opinions).

On this record, the Commission concludes that its remedial orders will not impact U.S. consumers of fiber optic equipment.

5. Respondents' Policy Arguments

Leviton argues that "[f]avoring and protecting Complainant's exclusively *foreign* products to the detriment of Leviton and other Respondents' *domestic* products negatively impacts competitive conditions in the U.S. economy, the production of like or directly competitive articles in the United States, and U.S. consumers." Leviton Stmt at 3. Leviton argues that doing so also "flies in the face of the Commission's purpose." *Id.* (citing H. Rep. No. 100-40, pt. 1 at 157). The Joint Respondents make similar arguments. *See* Joint Sub. at 40-41. According to Leviton, "[b]ringing back U.S. manufacturing is essential to benefit the U.S. economy, U.S. consumers and U.S. jobs." Leviton Stmt at 3-4 (citing Remarks by President Biden at Signing of Executive Order on Strengthening American Manufacturing available at https://www.whitehouse.gov/briefing-room/speeches-remarks/2021/01/25/remarks-by-president-biden-at-signing-of-executive-order-on-strengthening-american-manufacturing/ (Jan. 25, 2021)).

The Commission has considered Respondents' policy argument that "bringing back U.S. manufacturing is essential to benefit the U.S. economy, U.S. consumers and U.S. jobs," but Respondents' submissions provide no explanation as to how this argument pertains to the question of whether the remedial orders here would adversely impact the statutory public interest considerations. The Commission's orders are not directed to domestically-produced goods; they are directed to infringing imports, which are not produced in the United States. Moreover, the thrust of Respondents' argument appears to be that because Corning has manufacturing operations outside the United States, Corning is not entitled to relief under Section 337. That assertion, however, is inconsistent with the statutory domestic industry requirement, which does not require a manufacturing industry in the United States. *See Solid State Storage Drives*, Comm'n Op. at 6-10; S. Rep. No. 100-71, at 127-129 (1987); H. Rep. No. 99-581, at 112 (1986). Here, as discussed above, Corning has established a domestic industry based on its investments in engineering, R&D, warranty, field engineering service, and technical support.[53]

Accordingly, based on the submissions that the Commission received and the evidence in the record, the Commission finds that the public interest does not preclude the issuance of a GEO and CDOs against Leviton, Panduit, and FS.

C. Bonding

If the Commission enters a GEO or a CDO, a respondent may continue to import and sell its products during the 60-day period of Presidential review under a bond in an amount determined by the Commission to be "sufficient to protect the complainant from any injury." 19 U.S.C. § 1337(j)(3); *see also* 19 C.F.R. § 210.50(a)(3). When reliable price information is available in the record, the Commission has often set the bond in an amount that would eliminate the price differential between the domestic product and the imported, infringing product. *See Certain Microsphere Adhesives, Processes for Making Same, & Prods. Containing Same, Including Self-stick Repositionable Notes*, Inv. No. 337-TA-366, USITC Pub. No. 2949, Comm'n Op. at 24 (Jan. 16, 1996). The complainant bears the burden of establishing the need for a bond. *Certain Rubber Antidegradants, Components Thereof & Prods. Containing Same*, Inv. No. 337-TA-533, USITC Pub. No. 3975, Comm'n Op. at 40 (July 21, 2006).

In this case, the Active Respondents provided information on their pricing of the accused products. Using this information, Corning's expert calculated bond rates based on the price differential between each Respondents' accused chassis and modules and the domestic industry

[53] As discussed earlier, Chair Kearns does not rely on field engineering services or Pioneer Technical Support in finding that Corning has established a domestic industry.

chassis and modules. *See* CX-1840C (Summary of Price Differential Amended Ex. 8.1). Corning submits the Commission should set two separate bond rates for each Respondent, one for chassis and one for modules, as shown below.

Complainant's Suggested Bond Rates

Respondent	Chassis Rate	Module Rate
FS	262.5%	239.9%
Leviton	72.5%	N/A
Panduit	43.9%	20.7%
Siemon	N/A	82.4%
Wirewerks	N/A	4.4%
All Other Imports	100%	100%

ID at 446.

The Commission has set different bond amounts for different infringing products where warranted by the record evidence. *See, e.g.*, *Certain Protective Cases and Components Thereof*, Inv. No. 337-TA-780, USITC Pub. No. 4405, Comm'n Op. at 31-33 (Nov. 19, 2012) (setting bonds for various products at zero percent to 331.80 percent of entered value based on price differential between complainant's and respondent's products); *Certain Baseband Processor Chips and Chipsets, Transmitter and Receiver (Radio) Chips, Power Control Chips, and Products Containing Same, Including Cellular Telephone Handsets*, Inv. No. 337-TA-543, Comm'n Op. at 159-60 (June 19, 2007) (setting bond at 100 percent of entered value of chips and 5 percent of entered value of handheld devices incorporating chips). OUII agrees with Complainant's proposed bond rates. OUII Reply at 36 n.16. Respondents did not provide any comments on the bonding issue. The Commission finds Corning's proposed rates are appropriate for the Active Respondents.

Regarding the Defaulting Respondents, where "there is no reliable pricing information because the respondents have defaulted and failed to participate in discovery," the Commission typically sets the bond at 100% of the value of the infringing products. *See, e.g., Certain Ink*

Cartridges and Components Thereof, Inv. No. 337-TA-946, Comm'n Op. at 18 (June 29, 2016); *Certain Pocket Lighters*, Inv. No. 337-TA-1142, Comm'n Op. at 23-24 (July 13, 2020). Therefore, the Commission finds a bond of 100% is appropriate against the Defaulting Respondents and all other imports.

VI. CONCLUSION

For the reasons set forth herein, the Commission determines that Complainant has established a violation of section 337 with respect to claims 1 and 3 of the '320 patent; claims 11, 12, 14-16, 19, 21, 27, and 28 of the '456 patent; claims 9, 16, 23, and 26 of the '153 patent; and claims 22 and 23 of the '206 patent. The Commission determines that the appropriate remedy is a GEO prohibiting the entry of infringing high-density fiber optic equipment and components thereof, and CDOs directed to Respondents Leviton, Panduit, and FS. The Commission also determines that the public interest does not preclude that remedy, and that a bond as set forth in the orders is required during the period of Presidential review.

By order of the Commission.

Lisa R. Barton
Secretary to the Commission

Issued: August 23, 2021

Additional Views of Chair Kearns Regarding "Articles that Infringe"

This investigation again raises the issue of what are "articles that infringe" under 19 U.S.C. § 1337(a)(1)(B) and (a)(1)(B)(i). This issue can arise when the imported articles at issue are components of a device or object that infringes an apparatus claim, or articles that, after importation, are used, either alone or in combination with other articles, to infringe a claimed method. The question in this investigation is whether the articles imported by Leviton are "articles that infringe" for purposes of finding a violation of section 337 by that Respondent's direct infringement. The parties were asked to brief questions related to this issue, and their input has been very helpful to my consideration of this issue.

Like my colleagues, I have determined to take no position on that question here, as the Commission finds induced infringement by Leviton, and resolution of the "articles that infringe" issue under the framework I set forth below would likely delay completion of this investigation without changing the result or the remedy provided to the complainant. However, because this issue has arisen more frequently in our investigations, I below set forth a framework that I expect to apply in future investigations and that I believe is most consistent with the statute and its purpose, case law, and Commission precedent, and which takes into account the parties' briefing on the issue. This framework will hopefully provide useful guidance to parties in future investigations in which the issue arises.

To resolve the question of whether such articles constitute "articles that infringe," I look first to *Suprema, Inc. v. International Trade Commission*, 796 F.3d 1338 (Fed. Cir. 2015) (*en banc*). In *Suprema*, the Federal Circuit, sitting *en banc*, was asked "to decide whether goods qualify as 'articles that infringe' when the Commission has found that such goods were used, after importation, to directly infringe [a patented method] by the importer at the inducement of the goods' seller." *Suprema*, 796 F.3d at 1345. The Federal Circuit held in the affirmative that such goods are "articles that infringe." *Id.* at 1352-53. To arrive at its conclusion, the Federal Circuit determined that the phrase "articles that infringe" in section 337 has "textual uncertainty" because 35 U.S.C. § 271, which defines the term "infringe," refers to *actions* that infringe, while section 337 refers to *articles* that infringe. *Suprema*, 796 F.3d at 1346-47; *see also Chevron, U.S.A. Inc. v. Nat'l Res. Def. Council, Inc.*, 467 U.S. 837, 842-43 (1984). The Federal Circuit found that Congress had not provided an unambiguous resolution to that uncertainty. *Suprema*, 796 F.3d at 1347-9.

The Federal Circuit concluded in *Suprema* that the Commission's interpretation of the phrase "articles that infringe" in section 337 to cover articles that were used by the goods seller to induce the importer to directly infringe the claimed method was reasonable and consistent with the statutory text, the text of section 337 as a whole, the legislative history, and the statutory policy, and as such, should not be overturned. *Suprema*, 796 F.3d at 1349-52. The Court reasoned that "[i]nduced infringement is one kind of infringement, and when it is accomplished by supplying an article, the article supplied can be an 'article that infringes' if the other requirements of inducement are met." *Suprema*, 796 F.3d at 1349. The Court also stated that the Commission properly recognized "that the acts necessary for induced infringement, including acts of direct infringement, may not occur simultaneously at the time of importation," and indeed, "[i]n many cases, such acts cannot occur at the time of importation." *Suprema*, 796 F.3d at 1349. The Court in *Comcast Corp. v. International Trade Commission*, 951 F.3d 1301 (Fed. Cir. 2020), again held that section 337 covers violation determinations based on respondent's induced infringement in connection with the importation of articles even if the imported articles do not satisfy all the claim limitations at the time of importation.

The Commission is "a creature of statute, and must find authority for its actions in its enabling statute." *Kyocera v. Int'l Trade Comm'n*, 545 F.3d 1340, 1355 (Fed. Cir. 2008). The Commission's enabling statute, section 337(a)(1)(B)(i), defines unlawful acts with regard to "articles that infringe" as follows:

> **(a) Unlawful Activities; covered industries; definitions**
> (1) [T]he following are unlawful. . .:
>
> (B) The importation into the United States, the sale for importation, or the sale within the United States after importation by the owner, importer, or consignee, of *articles that* —
>
> (i) *infringe* a valid and enforceable United States patent. . .

19 U.S.C. § 1337(a)(1)(B)(i) (emphasis added). Infringement, on the other hand, is defined by section 271. That section sets forth different types of acts that constitute infringement by the actor. Section 271(a) defines direct infringement as making, using, offering to sell, or selling any patented invention, within the United States, or importing into the United States any patented invention. 35 U.S.C. § 271(a). Section 271(c) defines contributory infringement as follows:

> Whoever offers to sell or sells within the United States or imports into the United States a component of a patented machine, manufacture, combination or composition, or a material or apparatus for use in practicing a patented process, constituting a material part of the invention, knowing the same to be especially made or especially adapted for use in an infringement of such patent, and not a staple article or commodity of commerce suitable for substantial noninfringing use, shall be liable as a contributory infringer.[54]

The Commission is increasingly faced with situations in which an imported article is a component of an apparatus, or is used to perform only part or all of a claimed method after importation. Often, imported articles are components of an infringing system – whether in an attempt to circumvent section 337 liability or by virtue of an increasingly global supply chain.

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[54] Section 271(b) states that whoever actively induces infringement is liable as an infringer.

Upon importation, these component articles are physically modified or combined by the owner, importer, or consignee, and then used, sold, or offered for sale in a manner that directly infringes a U.S. patent.

I initially note that the Federal Circuit has recognized that liability under section 337 cannot be circumvented "by importing articles in a state requiring post-importation combination or modification before direct infringement could be shown." *Suprema*, 796 F.3d at 1352. The fact that section 337 covers articles requiring combination or modification after importation means that, consistent with Congressional intent, section 337 does not permit an importer to escape liability by importing a component of an infringing invention. The question becomes which components, if imported, violate section 337 and which are articles of commerce that do not infringe?

I also note that there is textual uncertainty in the statute with respect to this issue. In the past, the Commission used a "nexus" test to determine if the imported article was sufficiently related to the infringement to qualify as an "article that – infringes." As OUII points out in its brief on the issues under review, a nexus approach was used by the Commission as long ago as 1984, in *Certain Cardiac Pacemakers and Components Thereof*, Inv. No. 337-TA-162, 1984 WL 273827, Order No. 37 (Mar. 21, 1984) (granting summary det. of no violation).[55] In the investigation underlying the appeal that led to the *Suprema* decision, *Certain Biometric Scanning Devices, Components Thereof, Associated Software, and Products Containing the* Same, Inv. No. 337-TA-720 (2011) ("*Biometric Scanning Devices*"), the Commission stated the test as

[55] *See* Brief of the Office of Unfair Import Investigations on the Issues Under Review and on Remedy, the Public Interest, and Bonding (June 7, 2021) at 3-5.

"whether there is a sufficient nexus between the infringer's unfair acts and importation to find a violation of section 337." *Biometric Scanning Devices,* Comm. Op. at 5.

A nexus test has never been rejected by our reviewing court, and I do not believe that we are foreclosed from applying such a test. However, I also recognize that a more explicit framework with more predictability is preferable. In addressing this issue, I find guidance in the provisions of section 271, which express Congressional intent regarding what is deemed to constitute various forms of infringement. In particular, section 271(c), addressing contributory infringement, is the only relevant part of the section that speaks to the standard for infringement by components of an invention.[56] I therefore find it appropriate to use the concepts in this subsection to guide my interpretation of "articles that infringe" in section 337.

I also interpret the statute in a manner that avoids the absurd result under which an article would be an "article that – infringes" based on an importer's indirect infringement (through supply of an imported article to an infringing third party that directly infringes an asserted claim), but the same article would not be an "article that – infringes" based on the importer's direct infringement, a situation arguably involving greater culpability. The wording of the statute, and Congress' intent in enacting it, does not require such a result. Moreover, an interpretation that avoids this result reduces the risk of circumvention of the Commission's exclusion orders.

Thus, in considering whether there is a violation of section 337 when an imported article is a component of an apparatus or is used to perform part of a method claim, and a respondent combines and/or modifies that component to be used, sold, or offered for sale in a manner that

[56] Section 271(f) relates to indirect infringement through the export of components of a patented invention, and contains similar language as section 271(c). Section 271(g) relates to products made by a patented process outside the United States.

directly infringes an asserted patent claim in the United States (whatever form the claim takes, *e.g.*, apparatus or method), I intend to consider the following factors: (a) whether the article is a material part of the invention, (b) whether it is especially designed and/or configured for use in an infringing manner, (c) whether it is a staple article and the extent to which it has non-infringing uses, and (d) the extent to which it is modified or combined with other articles after importation.[57]

I believe that this approach is consistent with the Federal Circuit's *en banc* decision in *Suprema* and its decision in *Comcast*, as well as with Congress's consistent intent, evidenced by the legislative history, for the Commission to have broad authority to remedy unfair trade practices. *See Suprema*, 796 F.3d at 1350 (stating that the legislative history and statutory policy have "consistently evidence[d] Congressional intent to vest the Commission with broad enforcement authority to remedy unfair trade acts").This approach is also consistent with the Commission's broad remedial authority once a violation has been shown, because a violation of section 337 as to an imported article may include a remedy that applies to the components thereof, *Cisco Sys., Inc. v. International Trade Commission*, 873 F.3d 1354, 1363 (Fed. Cir. 2017), in order to avoid circumvention of Commission orders, in which an adjudged infringer modifies its supply chain (sometimes trivially) to evade the trade laws, *see, e.g.*, *Certain Marine Sonar Imaging Devices, Including Downscan and Sidescan Devices, Products Containing the Same, and Components Thereof*, Inv. No. 337-TA-921 (Modification), Comm'n Op., 2016 WL 11603660, at *6 (Aug. 29, 2019) (discussing an importer's unsuccessful attempt to evade an exclusion order by importing two components separately, and then "kitting" them together in the

[57] I previously indicated the likelihood that I would take an approach along these lines in *Blood Cholesterol Testing Strips*, Comm'n Op. at 33 n.26.

United States for combined sale to consumers). The Federal Circuit has recognized that Commission authority extends to "articles in a state requiring post-importation combination or modification before direct infringement could be shown." *Suprema*, 796 F.3d at 1352.

CERTAIN HIGH-DENSITY FIBER OPTIC EQUIPMENT AND COMPONENTS THEREOF **Inv. No. 337-TA-1194**

PUBLIC CERTIFICATE OF SERVICE

I, Lisa R. Barton, hereby certify that the attached **ORDER, COMMISSION** has been served via EDIS upon the Commission Investigative Attorney, **Lisa J. Murray, Esq.**, and the following parties as indicated, on **August 23, 2021.**

Lisa R. Barton, Secretary
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**UNITED STATES INTERNATIONAL TRADE COMMISSION
WASHINGTON, D.C. 20436**

In the Matter of **CERTAIN HIGH-DENSITY FIBER OPTIC EQUIPMENT AND COMPONENTS THEREOF**	**Inv. No. 337-TA-1194**

FINAL INITIAL DETERMINATION

Administrative Law Judge David P. Shaw

Pursuant to the notice of investigation, 85 Fed. Reg. 16653 (Mar. 24, 2020), this is the Initial Determination in *Certain High-Density Fiber Optic Equipment and Components Thereof*, United States International Trade Commission Investigation No. 337-TA-1194.

It is held that a violation of section 337 (19 U.S.C. § 1337) has occurred with respect to U.S. Patent No. 9,020,320; U.S. Patent No. 10,444,456; U.S. Patent No. 10,120,153; and United States Patent No. 8,712,206.

[redacted]

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[redacted]

The following abbreviations may be used in this Initial Determination:

ALJ	-	Administrative Law Judge
CDX	-	Complainant's Demonstrative Exhibit
CPX	-	Complainant's Physical Exhibit
CX	-	Complainant's Exhibit
Dep.	-	Deposition
EDIS	-	Electronic Document Imaging System
JPX	-	Joint Physical Exhibit
JX	-	Joint Exhibit
P.H.	-	Prehearing
RDX	-	Respondents' Demonstrative Exhibit
RPX	-	Respondents' Physical Exhibit
RWS	-	Rebuttal Witness Statement
RX	-	Respondents' Exhibit
Tr.	-	Transcript
WS	-	Witness Statement

[redacted]

I. Background

A. Institution of the Investigation; Procedural History

By publication of a notice in the *Federal Register* on March 24, 2020, pursuant to subsection (b) of section 337 of the Tariff Act of 1930, as amended, the Commission instituted this investigation to determine:

> [W]hether there is a violation of subsection (a)(1)(B) of section 337 in the importation into the United States, the sale for importation, or the sale within the United States after importation of certain products identified in paragraph (2) by reason of infringement of one or more of claims 1-3 of the '320 patent [U.S. Patent No. 9,020,320]; claims 1, 2, 10, 11, 14, 22, and 23 of the '206 patent [U.S. Patent No. 8,712,206]; claims 1, 2, 5-16, 19, and 23-27 of the '153 patent [U.S. Patent No. 10,120,153]; claims 22-29 of the '996 patent [U.S. Patent No. 10,094,996]; and claims 11, 12, 14-21, and 27-30 of the '456 patent [U.S. Patent No. 10,444,456]; and whether an industry in the United States exists as required by subsection (a)(2) of section 337.

85 Fed. Reg. 16653 (Mar. 24, 2020).

Pursuant to section 210.10(b)(1) of the Commission's Rules of Practice and Procedure, 19 C.F.R. § 210.10(b)(1):

> [T]he plain language description of the accused products or category of accused products, which defines the scope of the investigation, is "high-density fiber optic equipment and components thereof, which consist of (1) a chassis with sliding trays that fits within the standardized racks used in data centers, and (2) removable modules that are inserted into the sliding trays of the chassis, wherein the chassis and modules are used to terminate large numbers of fiber-optic cables using standardized connectors (at least 98 connections per standard rack unit (or 'U space'))."

Id.

[redacted]

The complainant is Corning Optical Communications LLC of Charlotte, North Carolina. The respondents are:

1. AFL Telecommunications Holdings LLC d/b/a AFL of Duncan, South Carolina;
2. FS.com Inc. of New Castle, Delaware;
3. Huber+Suhner AG of Herisau, Switzerland;
4. Huber + Suhner, Inc. of Charlotte, North Carolina;
5. Legrand North America, LLC of West Hartford, Connecticut;
6. Leviton Manufacturing Co., Inc. of Melville, New York;
7. Panduit Corporation of Tinley, Illinois;
8. Shanghai TARLUZ Telecom Tech. Co., Ltd. d/b/a TARLUZ of Shanghai, China;
9. Shenzhen Anfkom Telecom Co., Ltd. d/b/a Anfkom Telecom of Shenzhen, China;
10. The LAN Wirewerks Research Laboratories Inc. d/b/a Wirewerks of Québec, Canada;
11. The Siemon Company of Watertown, Connecticut;
12. Total Cable Solutions, Inc. of Springboro, Ohio; and
13. Wulei Technology Co., Ltd. d/b/a Bonelinks of Shenzhen, China.

The Office of Unfair Import Investigations is a party to this investigation. *Id.*

The target date for completion of this investigation was originally set at 15 months, *i.e.*, June 24, 2021, with an evidentiary hearing scheduled to commence on October 21, 2020. Order No. 3 (Apr. 14 2020).

The Commission affirmed the following initial determinations:

- Order No. 5 (Initial Determination Granting Complainant's Motion to Terminate the Investigation As to Legrand North America, LLC Based on Withdrawal of Allegations in the Complaint) (Apr. 16, 2020), *aff'd*, Commission Determination Not to Review an Initial Determination Terminating the Investigation with Respect to a Respondent (May 7, 2020).

- Order No. 7 (Initial Determination Finding Respondent Huber+Suhner AG in Default) (June 9, 2020), Order No. 8 (Initial Determination Finding

[redacted]

Respondent Huber+Suhner Inc. in Default) (June 9, 2020), *aff'd*, Commission Determination Not to Review Initial Determinations Finding Two Respondents in Default (June 22, 2020).

- Order No. 9 (Initial Determination Granting Motion to Amend the Complaint and Notice of Investigation to Substitute AFL Telecommunications for Respondent AFL Telecommunications Holdings) (June 19, 2020), *aff'd*, Commission Determination Not to Review an Initial Determination Granting a Motion to Amend the Complaint and Notice of Investigation (July 20, 2020).

- Order No. 11 (Initial Determination Granting Complainant's Motion to Terminate the Investigation As to Certain Claims) (July 29, 2020), *aff'd*, Commission Determination Not to Review an Initial Determination Terminating the Investigation with Respect to Certain Asserted Claims (Aug. 13, 2020).

- Order No. 13 (Initial Determination Finding Respondents Anfkom, Tarluz, and Wulei Bonelinks in Default) (Aug. 21, 2020), *aff'd*, Commission Determination Not to Review an Initial Determination Finding Three Respondents in Default (Sept. 15, 2020).

- Order No. 16 (Initial Determination Granting Complainant's Motion to Terminate the Investigation As to Total Cable Solutions Based on Consent Order) (Sept. 10, 2020), *aff'd*, Commission Determination to Review and, on Review, to Affirm with Modification an Initial Determination Terminating the Investigation as to Respondent Total Cable Solutions, Inc. Based on Consent Order Stipulation, Issuance of a Consent (Sept. 29, 2020).

- Order No. 18 (Initial Determination Granting Complainant's Motion to Terminate the Investigation As to Claim 1 of U.S. Patent No. 8,712,206) (Sept. 14, 2020), *aff'd*, Commission Determination Not to Review an Initial Determination Terminating the Investigation with Respect to an Asserted Claim (Oct. 14, 2020).

- Order No. 19 (Initial Determination Granting Complainant's Motion to Terminate the Investigation As to Certain Claims) (Oct. 2, 2020), *aff'd*, Commission Determination Not to Review an Initial Determination Terminating the Investigation with Respect to Certain Asserted Patent Claims (Oct. 27, 2020).

- Order No. 27 (Initial Determination Granting Motion to Terminate the Investigation As to AFL Telecommunications LLC Based on Settlement Agreement) (Oct. 20, 2020), *aff'd*, Commission Determination Not to Review an Initial Determination Terminating the Investigation as to Respondent AFL Telecommunications LLC Based on a Settlement (Nov. 2, 2020).

[redacted]

As a result of termination of certain asserted claims, the following 17 claims remain at issue in this investigation:

Asserted Claims for Infringement		
Patent	**Independent Claims**	**Dependent Claims**
'320	1	3
'456	11, 27	12, 14-16, 19, 21, 28
'153	23	9, 16, 26
'206	none	22, 23

A prehearing conference was held on October 21, 2020, with the evidentiary hearing in this investigation commencing immediately thereafter. The hearing concluded on October 26, 2020. *See* Order No. 6 (May 4, 2020); P.H. Tr. 1-16; Tr. 1-1086. The parties were requested to file post-hearing briefs not to exceed 300 pages in length, and to file reply briefs not to exceed 80 pages in length. *See* Order No. 28 (Oct. 20, 2020) at 3. On November 10, 2020, the parties filed a joint outline of the issues to be decided in the Final Initial Determination. *See* Joint Outline of the Issues to Be Decided ("Joint Outline") (EDIS Doc. ID No. 724602). On November 3, 2020, the parties filed a joint outline for the reply briefs. *See* Joint Outline of the Issues to Be Decided – Reply Brief ("Joint Outline – Reply Brief") (EDIS Doc. ID No. 726188).

On February 17, 2021, the administrative law judge issued an order setting the target date at approximately 16 months, *i.e.*, July 23, 2021, which makes the deadline for this initial determination March 23, 2021. Order No. 29 (Feb. 17, 2021).

[redacted]

B. The Parties

1. Complainant

Complainant Corning Optical Communications LLC ("Corning") is located in Charlotte, North Carolina. Complaint, ¶ 11. According to the complaint, from its industrial research lab in Corning, New York, Corning and its affiliates have developed expertise in glass science, ceramics science, and optical physics. *Id.*, ¶ 12. Corning developed the first optical fiber that could maintain laser light signals over long distances in 1970. *Id.*, ¶ 13.

2. Remaining Respondents

Respondent FS.com Inc. ("FS") is a Delaware corporation with a principal place of business in New Castle, Delaware. Complaint, ¶ 17. Corning asserts that according to U.S. Customs records, Fiberstore Co., Ltd., a Chinese corporation located in Shenzhen, China, has shipped "FIBER ENCLOSURES" and "PATCH PANELS" from China to the United States with FS.com listed as the consignee. *Id*. FS denies that it is an affiliate of Fiberstore Co., Ltd. FS Response to Complaint, ¶ 17.

Respondent Leviton Manufacturing Co., Inc. ("Leviton") is a Delaware corporation with a principal place of business in Melville, New York. Complaint, ¶ 21; Leviton Response to Complaint, ¶ 21. Corning alleges that Leviton sells for importation, imports, or sells after importation high-density fiber optic equipment that infringes the asserted patents. Complaint, ¶ 21.

Respondent Panduit Corp. ("Panduit") is a Delaware corporation with a principal place of business in Tinley, Illinois. Complaint, ¶ 22.; Panduit Response to Complaint, ¶ 22. Corning alleges that Panduit sells for importation, imports, or sells after

[redacted]

importation high-density fiber optic equipment that infringes the asserted patents. Complaint, ¶ 22.

Respondent The Siemon Company ("Siemon") is a Connecticut corporation located in Watertown, Connecticut. Complaint, ¶ 26; Siemon Response to Complaint, ¶ 26. Corning alleges that Siemon sells for importation, imports, or sells after importation high-density fiber optic equipment that infringes the asserted patents. Complaint, ¶ 26.

Respondent The LAN Wirewerks Research Laboratories Inc. d/b/a Wirewerks ("Wirewerks") is a Canadian corporation with its principal place of business in Baie-d'Urfé, Québec, Canada. Complaint, ¶ 25; Wirewerks Response to Complaint, ¶ 25. Corning alleges that Wirewerks sells for importation, imports, or sells after importation high-density fiber optic equipment that infringes the asserted patents. Complaint, ¶ 25.

* * *

As noted, the Office of Unfair Import Investigations is also a party to this investigation. 85 Fed. Reg. 16653 (Mar. 24, 2020).

C. Asserted Patents and Technological Background

The four asserted patents are related. The '320 and '456 patents share a specification. The '153 patent is in the same family as the '320 and '456 patents. The '206 patent is from a different family, but shares 25 figures with the '320 and '456 patents. *See* Compl. Br. at 8.

As noted, Corning asserts the following 17 claims for infringement:

[redacted]

Asserted Claims for Infringement		
Patent	**Independent Claims**	**Dependent Claims**
'320	1	3
'456	11, 27	12, 14-16, 19, 21, 28
'153	23	9, 16, 26
'206	none	22, 23

See Compl. Br. at 8.

Table 2 below identifies the claims asserted against each respondent and for domestic industry.

Table 2. Asserted Claims for Infringement and Domestic Industry Technical Prong				
	'320	**'456**	**'153**	**'206**
Participating Respondents				
Panduit	1, 3	11, 12, 14-16, 19, 21, 27, 28	9, 16, 23, 26	22, 23
Leviton	1, 3	11, 14-16, 19, 27		
Siemon	1, 3	11, 12, 14-16, 19, 21, 27, 28	9, 23	22
FS.com	1, 3	11, 12, 14-16, 19, 21	9, 16, 23, 26	22, 23
Wirewerks				22, 23
Defaulting Respondents				
Anfkom	1, 3	11, 12, 14-16, 19, 21	9, 16, 23, 26	22, 23
Huber+Suhner	1, 3	11, 14-16, 19, 21, 27	9, 16, 23, 26	
TARLUZ	1, 3	11, 12, 14-16, 19, 21		22, 23
Wulei Bonelinks	1, 3	11, 12, 14-16, 19, 21		22, 23
Domestic Industry Technical Prong				

[redacted]

Table 2. Asserted Claims for Infringement and Domestic Industry Technical Prong				
	‘320	**‘456**	**‘153**	**‘206**
Corning	1, 3	11, 12, 14-16, 19, 21, 27, 28	9, 16, 23, 26	22, 23

See Compl. Br. at 9.

<u>The ‘320 Patent</u>

U.S. Patent No. 9,020,320, entitled “High Density and Bandwidth Fiber Optic Apparatuses and Related Equipment and Methods,” was filed on January 22, 2013 and issued on April 28, 2015. JX-0004 (‘320 Patent). The ‘320 patent is assigned to Corning. JX-0006 (‘320 Patent Assignment Record). The ‘320 patent is related to, and shares a specification with, the ‘153 and ‘456 patents. The ‘320 patent states, “The technology of the disclosure relates to fiber optic connection density and bandwidth provided in fiber optic apparatuses and equipment.” JX-0004 at 1:32-34. The ‘320 patent has a total of 28 claims, of which Corning asserts independent claim 1 and dependent claim 3. *See* Compl. Br. at 8.

<u>The ‘153 Patent</u>

U.S. Patent No. 10,120,153, entitled “Independently Translatable Modules and Fiber Optic Equipment Trays in Fiber Optic Equipment,” was filed on January 23, 2017 and issued on November 6, 2018. JX-0007 (‘153 Patent). The ‘153 patent is assigned to Corning. JX-0009 (‘153 Patent Assignment Record). The ‘153 patent is related to, and shares a specification with the ‘320 and ‘456 patents. The ‘153 patent states, “The technology of the disclosure relates to fiber optic modules for fiber optic equipment. The fiber optic modules can be included in fiber optic equipment rack and/or trays.” JX-0007

[redacted]

at 2:4-6. The '153 patent has a total of 29 claims of which Corning asserts independent claim 23 and dependent claims 9, 16, and 26. *See* Compl. Br. at 8.

<u>The '456 Patent</u>

U.S. Patent No. 10,444,456, entitled "High Density and Bandwidth Fiber Optic Apparatuses and Related Equipment and Methods," was filed on April 5, 2019 and issued on October 15, 2019. JX-0010 ('456 Patent). The '456 patent is assigned to Corning. JX-0012 ('456 Patent Assignment Record). The '456 patent is related to and shares a specification with the '320 and '153 patents. The '456 patent states, "The technology of the disclosure relates to fiber optic connection density and bandwidth provided in fiber optic apparatuses and equipment." JX-0010 at 1:33-35. The '456 patent has a total of 30 claims, of which Corning asserts independent claims 11 and 27 and dependent claims 12, 14-16, 19, 21, and 28. *See* Compl. Br. at 8.

<u>The '206 Patent</u>

U.S. Patent No. 8,712,206, entitled "High-Density Fiber Optic Modules and Module Housings and Related Equipment," was filed on April 30, 2010 and issued on April 29, 2014. JX-0001 ('206 Patent). The '206 patent is assigned to Corning. JX-0003 ('206 Patent Assignment Record). The '206 patent states, "The technology of the disclosure relates to fiber optic modules and fiber optic modules housings provided in fiber optic equipment to support fiber optic connections." JX-0001 at 1:17-19. The '206 patent has a total of 73 claims, of which Corning asserts dependent claims 22 and 23. *See* Compl. Br. at 8.

[redacted]

D. The Accused Products

The accused products consist of chassis, modules, and combinations thereof. There are three categories of accused products, Base-8, Base-12, and Base-24, which are defined by the number of fiber connections available per module. First, a Base-8 module supports eight fiber connections, and a Base-8 chassis supports eighteen Base-8 modules per 1U space. CX-0001C (Prucnal WS) Q/A 63. Second, a Base-12 module supports twelve fiber connections, and a Base-12 chassis supports twelve Base-12 modules per 1U space. *Id*. Finally, a Base-24 module supports twenty-four fiber connections, and a Base-24 chassis supports six Base-24 modules per 1U space. *Id*. In each case, there are a total of 144 connections available in a 1U space; the difference in the three categories is in the number of modules needed to fill that space.

Within each category, there are three chassis sizes: 1U, 2U, and 4U, which refer to the chassis height. *Id*. Apart from the total height, these types are materially the same for each respondent. *Id*. That is, the fiber optic connection density for a 1U chassis from a given respondent is the same as the density for a 2U or 4U chassis from that respondent. *Id*. Q/A 64. Complainant argues that therefore "for each Respondent, and within each fiber connectivity configuration (Base-12, Base-8, and Base-24), a 1U chassis is representative of a 2U chassis and a 4U chassis for purposes of the asserted patents." *Id*.; *see also* CX-2042 (Compl. & Siemon Stip. Re Representative Accused Prods.) (stipulating that within each of the three categories, Siemon's 1U chassis is representative of its 2U and 4U chassis for purposes of the asserted patents).

Complainant's infringement expert, Dr. Prucnal, testified that he identified representative products and product combinations for each respondent. For example,

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Siemon produces chassis and modules in Base-8 and Base-12 configurations, and is accused of infringing all four asserted patents. Accordingly, Dr. Prucnal identified the following representative products for Siemon:

Asserted Patents	Representative Siemon Product	Model Nos.
‘320 Patent ‘153 Patent ‘456 Patent (claims 11-12, 14-16, 19, 21)	Representative Siemon Base-12 combination (Siemon Base-12 chassis with Siemon Base-12 modules)	Chassis: LS-1U-01 Module: LS-12-LSSM-01
	Representative Siemon Base-8 combination (Siemon Base-8 chassis with Siemon Base-8 modules)	Chassis: LS8-1U-01 Module: LSF8-LS5V-04B2
‘456 Patent (claims 27-28)	Representative Siemon 4U Base-12 chassis with Representative Siemon Base-12 module	Chassis: LS-4U-01 Module: LS-12-LSSM-01
	Representative Siemon 4U Base-8 chassis with Representative Siemon Base-8 module	Chassis: LS8-4U-01 Module: LSF8-LS5V-04B2
‘206 Patent	Representative Siemon Base-12 module	Module: LS-12-LSSM-01
	Representative Siemon Base-8 module	Module: LSF8-LS5V-04B2

See Staff Br. at 19 (citing CDX-0001C (Prucnal demonstratives) at 9, 679-82).

Complainant has offered a complete list of representative accused products for each respondent, along with the group of accused products represented by each such product, through the testimony of Dr. Prucnal. CX-0001C (Prucnal WS) Q/A 62; *see* CDX-0013 (Prucnal list of accused products).

[redacted]

Not all respondents market all types of accused products. The following describes the accused products allegedly imported and/or sold in the United States by each respondent:

Summary of Accused Products

Respondent	Brand	Chassis			Module		
		Base-8	Base-12	Base-24	Base-8	Base-12	Base-24
FS	FHX	1U	1U		X	X	
Leviton	OPT-X		1U/2U/4U			X	X
Panduit	HD FLEX	1U/2U/4U	1U/2U/4U	1U/2U/4U	X	X	X
Siemon	LightStack	1U/2U/4U	1U/2U/4U		X	X	
Wirewerks	NextSTEP					X	

See Staff Br. at 20.

1. FS

The FS accused products are marketed under the names "FHX Series" and "FHX-FCP/ FHX-C Series" and include both chassis and modules. The accused FS chassis fall into two categories (Base-8 and Base-12) and are available in just one size (1U). The accused FS modules are available in Base-8 and Base-12 configurations. *See* CX-0001C (Prucnal WS) Q/A 117; CPX-0053 (FS Base-8 1U chassis); CPX-0054 (FS Base-12 1U chassis); CPX-0055 (FS Base-8 module); CPX-0056 (FS Base-12 module).

2. Leviton

The Leviton accused products are marketed under the names "OPT-X UHDX Enclosures" and "HDX Enterprise Cassettes." The accused Leviton enclosures are all

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Base-12 chassis, available in three sizes (1U, 2U, and 4U). The accused Leviton modules are available in two configurations (Base-12 and Base-24). Both the Base-12 and the Base-24 modules are used with the Leviton Base-12 chassis. *See* CX-0001C (Prucnal WS) Q/A 98; CPX-0057 (Leviton Base-12 1U chassis); CPX-0060 (Leviton Base-12 module); CPX-0061 (Leviton Base-24 module).

3. Panduit

The Panduit accused products are marketed as "HD FLEX Fiber" enclosures and cassettes. The accused Panduit chassis fall into three categories (Base-8, Base-12, and Base-24), and are available in three sizes (1U, 2U, and 4U). The accused Panduit modules are available in three configurations (Base-8, Base-12, and Base-24). *See* CX-0001C (Prucnal WS) Q/A 85; CPX-0062 (Panduit Base-8 1U chassis); CPX-0063 (Panduit Base-12 1U chassis); CPX-0065 (Panduit Base-24 1U chassis); CPX-0073 (Panduit Base-8 module); CPX-0074 (Panduit Base-12 module); CPX-0075 (Panduit Base-24 module).

4. Siemon

The Siemon accused products are marketed under the name "LightStack Ultra High-Density Fiber Plug and Play system." The accused Siemon chassis fall into two categories (Base-8 and Base-12) and are available in three sizes (1U, 2U, and 4U). The accused Siemon modules are available in Base-8 and Base-12 configurations. *See* CX-0001C (Prucnal WS) Q/A 106; CPX-0076 (Siemon Base-8 1U chassis); CPX-0077 (Siemon Base-12 1U chassis); CPX-0078 (pre-Aug. 2019 version of Siemon Base-12 1U chassis); CPX-0079 (Siemon Base-8 module); CPX-0080 (Siemon Base-12 module).

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5. Wirewerks

The Wirewerks accused products consist of modules only, marketed under the name "NextSTEP." The NextSTEP modules all have LC adapters supporting twelve fiber connections on the front and a twelve-fiber MPO adapter on the rear. *See* CX-0001C (Prucnal WS) Q/A 117; CPX-0081 (Wirewerks Base-12 module).

In addition to the Wirewerks accused products, Order No. 23 provided that the parties may seek adjudication of an additional Wirewerks product identified as the "Wirewerks First Alternative Design." Order No. 23 at 5 (Oct. 14, 2020); RPX-0078C (First Alternative Design module). The First Alternative Design includes a new adapter, which is used in the same housing as the accused NextSTEP module. RX-0006C (Min RWS) Q/A 227-28. The adapter includes additional material on the front side that, according to Wirewerks, increases the "connection density" of the total product when using the method for measuring density that was used in the complaint. *Id.*; RX-1673C (Tabet WS) Q/A 41-53.

E. The Domestic Industry Products

Corning's high-density fiber optic equipment is referred to as the "EDGE" product line. CX-0002C (Ralph WS) Q/A 23. Corning's technical prong expert, Dr. Ralph, testified as follows:

> The Corning EDGE Products are a plug-and-play system for providing high-density connections in data centers. A plug-and-play system typically refers to a modular system – a system in which you can readily insert and remove different types of components. The EDGE system is a new way of packing fiber optic connections into a standardized rack unit (or U space) and improving access for technicians, while protecting the fibers from damage or excessive bends.

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Id. The EDGE product line includes at least the following products: "EDGE Chassis, EDGE Modules, EDGE MTP Trunks, EDGE Panels, EDGE Duplex Jumpers, EDGE MTP Jumpers, EDGE Duplex Jumper Accessories, EDGE Harnesses, and a variety of EDGE accessories." *Id*. Q/A 35. The relevant products, the EDGE chassis and modules, are available in Base-12 and Base-8 configurations. *Id*. EDGE Base-12 and Base-8 chassis are available in 1U, 2U, and 4U heights, and there is also a 5U version of the Base-12 chassis. *Id*. Q/A 36. As with the accused products, Corning argues that the 1U versions of the chassis are representative of the other available heights. *Id*.

Corning asserts that the following representative products, and the groups of Corning products that they represent, satisfy the technical prong of the domestic industry requirement by practicing at least one valid claim of an asserted patent:

Asserted Patents	**Representative Product**	**Model Nos.**
'320 Patent '153 Patent '456 Patent (claims 11-12, 14-16, 19, 21)	Representative EDGE Base-12 combination (EDGE Base-12 chassis with EDGE Base-12 modules)	Chassis: EDGE-01U-SP Module: ECM-UM12-05-93T
	Representative EDGE Base-8 combination (EDGE Base-8 chassis with EDGE Base-8 modules)	Chassis: EDGE8-01U-SP Module: ECM8-UM08-05-E6Q-ULL
'456 Patent (claims 27-28)	Representative EDGE 4U Base-12 chassis with Representative EDGE Base-12 module	Chassis: LS-4U-01 Module: ECM-UM12-05-93T
	Representative EDGE 4U Base-8 chassis with Representative EDGE Base-8 module	Chassis: LS8-4U-01 Module: ECM8-UM08-05-E6Q-ULL

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Asserted Patents	Representative Product	Model Nos.
'206 Patent	Representative EDGE Base-12 module	Module: ECM-UM12-05-93T
	Representative EDGE Base-8 module	Module: ECM8-UM08-05-E6Q-ULL

See Staff Br. at 23 (citing CX-0002C (Ralph WS) Q/A 43-48; *see* CDX-0002C (Ralph demonstratives) at 142-49).

II. Jurisdiction and Importation

A. Jurisdiction

Section 337(a)(1)(B) declares unlawful, *inter alia*, "[t]he importation into the United States, the sale for importation, or the sale within the United States after importation by the owner, importer, or consignee, of articles that . . . infringe a valid and enforceable United States patent." 19 U.S.C. § 1337(a)(1)(B). Complainant has filed a complaint alleging a violation of this subsection, and the Commission therefore has subject matter jurisdiction. *See Amgen, Inc. v. United States Int'l Trade Comm'n*, 902 F.2d 1532, 1535-37 (Fed. Cir. 1990).

No respondent contested the Commission's personal jurisdiction. *See* Resps. Br. at 23. Indeed, all respondents have appeared and participated in the investigation. The Commission therefore has personal jurisdiction over those respondents. *See e.g., Certain Liquid Crystal Display Modules, Products Containing Same, and Methods for Using the Same*, Inv. No. 337-TA-634, Final Initial and Recommended Determinations at 3 (June 12, 2009) (unreviewed).

The Commission has *in rem* jurisdiction over the accused products. *See e.g.,*

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Sealed Air Corp. v. United States Int'l Trade Comm'n, 645 F.2d 976, 985-86 (C.C.P.A. 1981).

Respodents argue that the Commission has jurisdiction over Wirewerks' First Alternative Design for adjudication of infringement. It is argued:

> The Commission has jurisdiction over Wirewerks' First Alternative Design for adjudication of non-infringement. The Commission looks at the following four factors to determine whether redesigned products should be adjudicated: whether the product is (1) within the scope of the investigation, (2) imported, (3) sufficiently fixed in design, and (4) subject to extensive discovery." *Certain Human Milk Oligosaccharides and Methods of Producing The Same*, Inv. No. 337-TA-1120, Comm'n Op. at *11 (Dec. 18, 2018) ("*Certain Human Milk*").
>
> Wirewerks' First Alternative Design satisfies these factors. First, the First Alternative Design is a Fiber-Optic module, similar to the accused NextSTEP module. There can be no dispute that it is within the scope of the investigation. Second, this product was imported and produced to Corning during fact discovery. RX-1673C Q/A 41-45, 53; Tabet Tr. 445:11-17. Third, the First Alternative Design is fixed in design – its key measurements can be ascertained from the produced prototype and it is ready to be sold to customers. *Id.*; Tabet Tr. 446:9-18, 449:7-10, 450:21-451:10. Fourth, Corning had substantial discovery over the product, including analysis of a prototype and specification, two fact depositions, timely contentions, and expert testimony. *Id.*

Resps. Br. at 9-10.

Complainant argues, "Wirewerks has also imported two non-functioning samples of its First Alternative Design into the United States." Compls. Br. at 30 (citing Tabet Tr. 445:11-19).

The Staff argues:

> In addition to the Wirewerks accused products, Order No. 14 provided that the parties may seek adjudication of an additional Wirewerks product identified as the "Wirewerks First Alternative Design." Order No. 23 at 5 (Oct. 14, 2020); RPX-0078C (First Alternative Design module). The First Alternative Design includes a new adapter, which is used in the same housing as the accused NextSTEP

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module. RX-0006C (Min RWS) Q/A 227-28. The adapter includes additional material on the front side that, according to Wirewerks, increases the "connection density" of the total product when using the method for measuring density that was used in the opined. *Id.*; RX-1673C (Tabet WS) Q/A 41-53.

Staff Br. at 22.

In Order No. 23, the administrative law judge provided his ruling on this issue. It states:

> Accordingly, the administrative law judge has determined that Wirewerks' First Alternative Design may be adjudicated in this investigation, including during the evidentiary hearing. The parties may supplement their prehearing briefs and witness statements with respect to the First Alternative Design, to the extent necessary, although it appears that little if any supplementation will be required. The administrative law judge acknowledges the Staff's situation with respect to its ultimate position on the question of infringement.

Order No. 23 at 5 (Oct. 14, 2021).

Thus, as noted in Order No. 23, the administrative law judge determined that Wirewerks' First Alternative Design may be adjudicated in this investigation, including during the evidentiary hearing.

B. Importation

Issues relating to importation of accused products are discussed in the Infringement section for the '320 patent, *infra*.

III. General Principles of Applicable Law

A. Claim Construction

Claim construction begins with the plain language of the claim.[1] Claims should

[1] Only those claim terms that are in controversy need to be construed, and only to the extent necessary to resolve the controversy. *Vanderlande Indus. Nederland BV v. Int'l*

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be given their ordinary and customary meaning as understood by a person of ordinary skill in the art, viewing the claim terms in the context of the entire patent.[2] *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312-13 (Fed. Cir. 2005), *cert. denied*, 546 U.S. 1170 (2006).

In some instances, claim terms do not have particular meaning in a field of art, and claim construction involves little more than the application of the widely accepted meaning of commonly understood words. *Phillips*, 415 F.3d at 1314. "In such circumstances, general purpose dictionaries may be helpful." *Id.*

In many cases, claim terms have a specialized meaning, and it is necessary to determine what a person of skill in the art would have understood the disputed claim language to mean. "Because the meaning of a claim term as understood by persons of skill in the art is often not immediately apparent, and because patentees frequently use terms idiosyncratically, the court looks to 'those sources available to the public that show what a person of skill in the art would have understood disputed claim language to mean.'" *Phillips*, 415 F.3d at 1314 (quoting *Innova/Pure Water, Inc. v. Safari Water Filtration Sys., Inc.*, 381 F.3d 1111, 1116 (Fed. Cir. 2004)). The public sources identified in *Phillips* include "the words of the claims themselves, the remainder of the specification, the prosecution history, and extrinsic evidence concerning relevant

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Trade Comm., 366 F.3d 1311, 1323 (Fed. Cir. 2004); *Vivid Tech., Inc. v. American Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999).

[2] Factors that may be considered when determining the level of ordinary skill in the art include: "(1) the educational level of the inventor; (2) type of problems encountered in the art; (3) prior art solutions to those problems; (4) rapidity with which innovations are made; (5) sophistication of the technology; and (6) educational level of active workers in the field." *Environmental Designs, Ltd. v. Union Oil Co.*, 713 F.2d 693, 696 (Fed. Cir. 1983), *cert. denied*, 464 U.S. 1043 (1984).

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scientific principles, the meaning of technical terms, and the state of the art." *Id.* (quoting *Innova*, 381 F.3d at 1116).

In cases in which the meaning of a claim term is uncertain, the specification usually is the best guide to the meaning of the term. *Phillips*, 415 F.3d at 1315. As a general rule, the particular examples or embodiments discussed in the specification are not to be read into the claims as limitations. *Markman v. Westview Instruments, Inc.*, 52 F.3d 967, 979 (Fed. Cir. 1995) (*en banc*), *aff'd*, 517 U.S. 370 (1996). The specification is, however, always highly relevant to the claim construction analysis, and is usually dispositive. *Phillips*, 415 F.3d at 1315 (quoting *Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1582 (Fed. Cir. 1996)). Moreover, "[t]he construction that stays true to the claim language and most naturally aligns with the patent's description of the invention will be, in the end, the correct construction." *Id.* at 1316.

Claims are not necessarily, and are not usually, limited in scope to the preferred embodiment. *RF Delaware, Inc. v. Pacific Keystone Techs., Inc.*, 326 F.3d 1255, 1263 (Fed. Cir. 2003); *Decisioning.com, Inc. v. Federated Dep't Stores, Inc.*, 527 F.3d 1300, 1314 (Fed. Cir. 2008) ("[The] description of a preferred embodiment, in the absence of a clear intention to limit claim scope, is an insufficient basis on which to narrow the claims."). Nevertheless, claim constructions that exclude the preferred embodiment are "rarely, if ever, correct and require highly persuasive evidentiary support." *Vitronics*, 90 F.3d at 1583. Such a conclusion can be mandated in rare instances by clear intrinsic evidence, such as unambiguous claim language or a clear disclaimer by the patentees during patent prosecution. *Elekta Instrument S.A. v. O.U.R. Sci. Int'l, Inc.*, 214 F.3d 1302, 1308 (Fed. Cir. 2000); *Rheox, Inc. v. Entact, Inc.*, 276 F.3d 1319 (Fed. Cir. 2002).

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If the intrinsic evidence does not establish the meaning of a claim, then extrinsic evidence may be considered. Extrinsic evidence consists of all evidence external to the patent and the prosecution history, and includes inventor testimony, expert testimony, and learned treatises. *Phillips*, 415 F.3d at 1317. Inventor testimony can be useful to shed light on the relevant art. In evaluating expert testimony, a court should discount any expert testimony that is clearly at odds with the claim construction mandated by the claims themselves, the written description, and the prosecution history, in other words, with the written record of the patent. *Id*. at 1318. Extrinsic evidence may be considered if a court deems it helpful in determining the true meaning of language used in the patent claims. *Id.*

B. Infringement

1. Direct Infringement

Under 35 U.S.C. §271(a), direct infringement consists of making, using, offering to sell, or selling a patented invention without consent of the patent owner. The complainant in a section 337 investigation bears the burden of proving infringement of the asserted patent claims by a "preponderance of the evidence." *Certain Flooring Products*, Inv. No. 337-TA-443, Comm'n Notice of Final Determination of No Violation of Section 337, 2002 WL 448690, at *59, (Mar. 22, 2002); *Enercon GmbH v. Int'l Trade Comm'n*, 151 F.3d 1376 (Fed. Cir. 1998).

Literal infringement of a claim occurs when every limitation recited in the claim appears in the accused device, *i.e.*, when the properly construed claim reads on the

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accused device exactly.[3] *Amhil Enters., Ltd. v. Wawa, Inc.*, 81 F.3d 1554, 1562 (Fed. Cir. 1996); *Southwall Tech. v. Cardinal IG Co.*, 54 F.3d 1570, 1575 (Fed Cir. 1995).

If the accused product does not literally infringe the patent claim, infringement might be found under the doctrine of equivalents. "Under this doctrine, a product or process that does not literally infringe upon the express terms of a patent claim may nonetheless be found to infringe if there is 'equivalence' between the elements of the accused product or process and the claimed elements of the patented invention." *Warner-Jenkinson Co., Inc. v. Hilton Davis Chemical Co.*, 520 U.S. 17, 21 (1997) (citing *Graver Tank & Mfg. Co. v. Linde Air Products Co.*, 339 U.S. 605, 609 (1950)). "The determination of equivalence should be applied as an objective inquiry on an element-by-element basis."[4] *Id*. at 40.

"An element in the accused product is equivalent to a claim limitation if the differences between the two are insubstantial. The analysis focuses on whether the element in the accused device 'performs substantially the same function in substantially the same way to obtain the same result' as the claim limitation." *AquaTex Indus. v. Techniche Solutions*, 419 F.3d 1374, 1382 (Fed. Cir. 2005) (quoting *Graver Tank*, 339 U.S. at 608); *accord Absolute Software*, 659 F.3d at 1139-40.[5]

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[3] Each patent claim element or limitation is considered material and essential. *London v. Carson Pirie Scott & Co.*, 946 F.2d 1534, 1538 (Fed. Cir. 1991). If an accused device lacks a limitation of an independent claim, the device cannot infringe a dependent claim. *See Wahpeton Canvas Co. v. Frontier, Inc.*, 870 F.2d 1546, 1552 n.9 (Fed. Cir. 1989).

[4] "Infringement, whether literal or under the doctrine of equivalents, is a question of fact." *Absolute Software, Inc. v. Stealth Signal, Inc.*, 659 F.3d 1121, 1130 (Fed. Cir. 2011).

[5] "The known interchangeability of substitutes for an element of a patent is one of the express objective factors noted by *Graver Tank* as bearing upon whether the accused

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Prosecution history estoppel can prevent a patentee from relying on the doctrine of equivalents when the patentee relinquished subject matter during the prosecution of the patent, either by amendment or argument. *AquaTex*, 419 F.3d at 1382. In particular, "[t]he doctrine of prosecution history estoppel limits the doctrine of equivalents when an applicant makes a narrowing amendment for purposes of patentability, or clearly and unmistakably surrenders subject matter by arguments made to an examiner." *Id.* (quoting *Salazar v. Procter & Gamble Co.*, 414 F.3d 1342, 1344 (Fed. Cir. 2005)).

2. Direct Infringement

a. Induced Infringement

Section 271(b) of the Patent Act provides: "Whoever actively induces infringement of a patent shall be liable as an infringer." 35 U.S.C. § 271(b).

Under 35 U.S.C. § 271(b), whoever actively induces infringement of a patent shall be liable as an infringer. In contrast to direct infringement, liability for inducing infringement attaches only if the defendant knew of the patent and that the induced acts constituted patent infringement. *Commil USA, LLC v. Cisco Sys., Inc.*, 135 S. Ct. 1920, 1926 (2015); *see also Microsoft Corp. v. Datatern, Inc.*, 755 F.3d 899, 904 (Fed. Cir. 2014) (to prove induced infringement, patentee must show that accused inducer took an affirmative act to encourage infringement with knowledge that the induced acts constitute patent infringement). Induced infringement requires a finding that the infringer

device is substantially the same as the patented invention. Independent experimentation by the alleged infringer would not always reflect upon the objective question whether a person skilled in the art would have known of the interchangeability between two elements, but in many cases it would likely be probative of such knowledge." *Warner-Jenkinson*, 520 U.S. at 36.

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possessed a specific intent to encourage another's infringement. *i4i Ltd. Partnership v. Microsoft Corp.*, 598 F.3d 831, 851 (Fed. Cir. 2010), *aff'd*, 564 U.S. 91 (2011).

b. Contributory Infringement

Section 271(c) of the Patent Act provides: "Whoever offers to sell or sells within the United States or imports into the United States a component of a patented machine, manufacture, combination or composition, or a material or apparatus for use in practicing a patented process, constituting a material part of the invention, knowing the same to be especially made or especially adapted for use in an infringement of such patent, and not a staple article or commodity of commerce suitable for substantial noninfringing use, shall be liable as a contributory infringer." 35 U.S.C. § 271(c).

Section 271(c) "covers both contributory infringement of system claims and method claims."[6] *Arris*, 639 F.3d at 1376 (footnotes omitted). To hold a component supplier liable for contributory infringement, a patent holder must show, inter alia, that (a) the supplier's product was used to commit acts of direct infringement; (b) the product's use constituted a material part of the invention; (c) the supplier knew its product was especially made or especially adapted for use in an infringement" of the patent; and (d) the product is not a staple article or commodity of commerce suitable for substantial noninfringing use. *Id.*

[6] "Claims which recite a 'system,' 'apparatus,' 'combination,' or the like are all analytically similar in the sense that their claim limitations include elements rather than method steps. All such claims can be contributorily infringed by a component supplier." *Arris*, 639 F.3d at 1376 n.8.

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C. Validity

One cannot be held liable for practicing an invalid patent claim. *See Pandrol USA, LP v. AirBoss Railway Prods., Inc.*, 320 F.3d 1354, 1365 (Fed. Cir. 2003). Nevertheless, each claim of a patent is presumed to be valid, even if it depends from a claim found to be invalid. 35 U.S.C. § 282; *DMI Inc. v. Deere & Co.*, 802 F.2d 421 (Fed. Cir. 1986).

A respondent that has raised patent invalidity as an affirmative defense must overcome the presumption by "clear and convincing" evidence of invalidity. *Checkpoint Systems, Inc. v. United States Int'l Trade Comm'n*, 54 F.3d 756, 761 (Fed. Cir. 1995).

1. Anticipation

Anticipation under 35 U.S.C. § 102 is a question of fact. *z4 Techs., Inc. v. Microsoft Corp.*, 507 F.3d 1340, 1347 (Fed. Cir. 2007). Section 102 provides that, depending on the circumstances, a claimed invention may be anticipated by variety of prior art, including publications, earlier-sold products, and patents. *See* 35 U.S.C. § 102 (*e.g.*, section 102(b) provides that one is not entitled to a patent if the claimed invention "was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of the application for patent in the United States").

The general law of anticipation may be summarized, as follows:

> A reference is anticipatory under § 102(b) when it satisfies particular requirements. First, the reference must disclose each and every element of the claimed invention, whether it does so explicitly or inherently. *Eli Lilly & Co. v. Zenith Goldline Pharms., Inc.*, 471 F.3d 1369, 1375 (Fed.Cir.2006). While those elements must be "arranged or combined in the same way as in the claim," *Net MoneyIN, Inc. v. VeriSign, Inc.*, 545 F.3d 1359, 1370

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> (Fed.Cir.2008), the reference need not satisfy an *ipsissimis verbis* test, *In re Bond*, 910 F.2d 831, 832-33 (Fed.Cir.1990). Second, the reference must "enable one of ordinary skill in the art to make the invention without undue experimentation." *Impax Labs., Inc. v. Aventis Pharms. Inc.*, 545 F.3d 1312, 1314 (Fed.Cir.2008); *see In re LeGrice*, 49 C.C.P.A. 1124, 301 F.2d 929, 940-44 (1962). As long as the reference discloses all of the claim limitations and enables the "subject matter that falls within the scope of the claims at issue," the reference anticipates -- no "actual creation or reduction to practice" is required. *Schering Corp. v. Geneva Pharms., Inc.*, 339 F.3d 1373, 1380-81 (Fed.Cir.2003); *see In re Donohue*, 766 F.2d 531, 533 (Fed.Cir.1985). This is so despite the fact that the description provided in the anticipating reference might not otherwise entitle its author to a patent. *See Vas-Cath Inc. v. Mahurkar*, 935 F.2d 1555, 1562 (Fed.Cir.1991) (discussing the "distinction between a written description adequate to support a claim under § 112 and a written description sufficient to anticipate its subject matter under § 102(b)").

In re Gleave, 560 F.3d 1331, 1334 (Fed. Cir. 2009).

2. Obviousness

Under section 103 of the Patent Act, a patent claim is invalid "if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains."[7] 35 U.S.C. § 103. While the ultimate determination of whether an invention would have been obvious is a legal conclusion, it is based on "underlying factual inquiries including: (1) the scope and content of the prior art; (2) the level of ordinary skill in the art; (3) the differences between the claimed invention and the prior art; and (4) objective evidence of

[7] The standard for determining whether a patent or publication is prior art under section 103 is the same as under 35 U.S.C. § 102, which is a legal question. *Panduit Corp. v. Dennison Mfg. Co.*, 810 F.2d 1561, 1568 (Fed. Cir. 1987).

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nonobviousness." *Eli Lilly and Co. v. Teva Pharmaceuticals USA, Inc.*, 619 F.3d 1329 (Fed. Cir. 2010).

The objective evidence, also known as "secondary considerations," includes commercial success, long felt need, and failure of others. *Graham v. John Deere Co.*, 383 U.S. 1, 13-17 (1966); *Dystar Textilfarben GmbH v. C.H. Patrick Co.*, 464 F.3d 1356, 1361 (Fed. Cir. 2006). "[E]vidence arising out of the so-called 'secondary considerations' must always when present be considered en route to a determination of obviousness." *Stratoflex, Inc. v. Aeroquip Corp.*, 713 F.2d 1530, 1538 (Fed. Cir. 1983). Secondary considerations, such as commercial success, will not always dislodge a determination of obviousness based on analysis of the prior art. *See KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 426 (2007) (commercial success did not alter conclusion of obviousness).

"One of the ways in which a patent's subject matter can be proved obvious is by noting that there existed at the time of invention a known problem for which there was an obvious solution encompassed by the patent's claims." *KSR*, 550 U.S. at 419-20. "[A]ny need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed." *Id.*

Specific teachings, suggestions, or motivations to combine prior art may provide helpful insights into the state of the art at the time of the alleged invention. *Id.* at 420. Nevertheless, "an obviousness analysis cannot be confined by a formalistic conception of the words teaching, suggestion, and motivation, or by overemphasis on the importance of published articles and the explicit content of issued patents. The diversity of inventive pursuits and of modern technology counsels against limiting the analysis in this way." *Id.*

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"Under the correct analysis, any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed." *Id.* A "person of ordinary skill is also a person of ordinary creativity." *Id.* at 421.

Nevertheless, "the burden falls on the patent challenger to show by clear and convincing evidence that a person of ordinary skill in the art would have had reason to attempt to make the composition or device, or carry out the claimed process, and would have had a reasonable expectation of success in doing so." *PharmaStem Therapeutics, Inc. v. ViaCell, Inc.*, 491 F.3d 1342, 1360 (Fed. Cir. 2007); *see KSR*, 550 U.S. at 416 (a combination of elements must do more than yield a predictable result; combining elements that work together in an unexpected and fruitful manner would not have been obvious).[8]

3. Enablement

The Patent Act requires that "[t]he full scope of the claimed invention . . . be enabled." *Sitrick v. Dreamworks, LLC*, 516 F.3d 993, 999 (Fed. Cir. 2008); *see also Northpoint Tech. Ltd. v. MDS America Inc.*, 413 F.3d 1301, 1308-10 (Fed. Cir. 2005) (affirming a finding of invalidity for lack of enablement due to the patent's failure to disclose an embodiment with an antenna that met the "directional reception range" limitation of each claim). Namely, "[a] patentee who chooses broad claim language must make sure the broad claims are fully enabled. 'The scope of the claims must be less than or equal to the scope of enablement' to 'ensure[] that the public knowledge is enriched by

[8] Further, "when the prior art teaches away from combining certain known elements, discovery of a successful means of combining them is more likely to be nonobvious." *KSR*, 550 U.S. at 416 (citing *United States v. Adams*, 383 U.S. 39, 52 (1966)).

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the patent specification to a degree at least commensurate with the scope of the claims.'" *Sitrick*, 516 F.3d at 999 (quoting *National Recovery Techs., Inc. v. Magnetic Separation Sys., Inc.*, 166 F.3d 1190, 1195-96 (Fed. Cir. 1999)). The enablement requirement is satisfied when one skilled in the art, after reading the specification, could practice the claimed invention without undue experimentation. *AK Steel Corp. v. Sollac & Ugine*, 344 F.3d 1234, 1244 (Fed. Cir. 2003), citing *In re Wands*, 858 F.2d 731, 737 (Fed. Cir. 1988).

> The question of undue experimentation is a matter of degree, and what is required is that the amount of experimentation not be "unduly extensive." *Chiron Corp. v. Genentech, Inc.*, 363 F.3d 1247, 1253 (Fed. Cir. 2004) (quoting *PPG Indus., Inc. v. Guardian Indus., Corp.*, 75 F.3d 1558, 1564 (Fed. Cir. 1996)). For example, the fact that a clinician's involvement may be necessary to determine effective amounts of the single compound effervescent agent and its corresponding soluble acid source does not itself constitute undue experimentation. *See Ortho–McNeil Pharm., Inc. v. Mylan Labs., Inc.*, 520 F.3d 1358, 1365–66 (Fed. Cir. 2008) ("[E]ven if clinical trials informed the anticonvulsively effective amount, this record does not show that extensive or 'undue' tests would be required to practice the invention."). In addition, extensive experimentation does not necessarily render the experiments unduly extensive where the experiments involve repetition of known or commonly used techniques. *See Johns Hopkins Univ. v. CellPro, Inc.*, 152 F.3d 1342, 1360 (Fed. Cir. 1998) (finding that the difficulty in producing certain antibodies could not be attributed to the shortcomings in the disclosure of the patent at issue, but rather, the difficulty was attributed to the technique commonly used during experimentation that generally required repetition). Thus, the focus "is not merely quantitative, since a considerable amount of experimentation is permissible, if it is merely routine, or if the specification in question provides a reasonable amount of guidance . . . ." *PPG Indus., Inc.*, 75 F.3d at 1564 (citation and quotation omitted).

Cephalon, Inc. v. Watson Pharms., Inc., 70 F.3d 1330, 1338-39 (Fed. Cir. 2013).

Enablement is determined from the viewpoint of persons of ordinary skill in the field of the invention at the time the patent application was filed. *Ajinomoto Co., Inc. v.*

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Archer-Daniels-Midland Co., 228 F.3d 1338, 1345 (Fed. Cir. 2000). Thus, a claim in an issued patent can be rendered invalid due to lack of enablement if its scope is not fully enabled. *Id*.

4. Indefiniteness

The definiteness requirement of 35 U.S.C. § 112 ensures that the patent claims particularly point out and distinctly claim the subject matter that the patentee regards to be the invention. *See* 35 U.S.C. § 112, ¶ 2; *Metabolite Labs., Inc. v. Lab. Corp. of Am. Holdings*, 370 F.3d 1354, 1366 (Fed. Cir. 2004). If a claim's legal scope is not clear enough so that a person of ordinary skill in the art could determine whether or not a particular product infringes, the claim is indefinite, and is, therefore, invalid. *Geneva Pharm., Inc. v. GlaxoSmithKline PLC*, 349 F.3d 1373, 1384 (Fed. Cir. 2003).[9]

Thus, it has been found that:

> When a proposed construction requires that an artisan make a separate infringement determination for every set of circumstances in which the composition may be used, and when such determinations are likely to result in differing outcomes (sometimes infringing and sometimes not), that construction is likely to be indefinite.

Halliburton Energy Servs. v. M-I LLC, 514 F.3d 1244, 1255 (Fed. Cir. 2008).

The Supreme Court addressed the issue of indefiniteness, and stated that a finding of indefiniteness should not be found if the claims, "viewed in light of the specification and prosecution history, inform those skilled in the art about the scope of the invention

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[9] Indefiniteness is a question of law. *IGT v. Bally Gaming Int'l, Inc.*, 659 F.3d 1109 (Fed. Cir. 2011).

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with reasonable certainty." *Nautilus, Inc. v. Biosig Instruments, Inc.*, 134 S. Ct. 2120, 2124 (2014).

A patent is not indefinite if the claims, "viewed in light of the specification and prosecution history, inform those skilled in the art about the scope of the invention with reasonable certainty." *Nautilus, Inc. v. Biosig Instruments, Inc.*, 134 S. Ct. 2120, 2124 (2014). "If, after a review of the intrinsic and extrinsic evidence, a claim term remains ambiguous, the claim should be construed so as to maintain its validity." *Certain Consumer Electronics and Display Devices With Graphics Processing and Graphics Processing Units Therein*, Inv. No. 337-TA-932, Order No. 20 (Apr. 2, 2015) (quoting *Phillips*, 415 F.3d at 1327).

The burden is on the accused infringer to come forward with clear and convincing evidence to prove invalidity. *See Young v. Lumenis, Inc.*, 492 F.3d 1336, 1344 (Fed. Cir. 2007) ("A determination that a patent claim is invalid for failing to meet the definiteness requirement in 35 U.S.C. § 112, ¶ 2 is a legal question reviewed de novo.").

D. Domestic Industry

A violation of section 337(a)(1)(B), (C), (D), or (E) can be found "only if an industry in the United States, with respect to the articles protected by the patent, copyright, trademark, mask work, or design concerned, exists or is in the process of being established." 19 U.S.C. § 1337(a)(2). Section 337(a) further provides:

> (3) For purposes of paragraph (2), an industry in the United States shall be considered to exist if there is in the United States, with respect to the articles protected by the patent, copyright, trademark, mask work, or design concerned—
>
> (A) significant investment in plant and equipment;

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> (B) significant employment of labor or capital; or
>
> (C) substantial investment in its exploitation, including engineering, research and development, or licensing.

19 U.S.C. § 1337(a)(3).

These statutory requirements consist of an economic prong (which requires certain activities)[10] and a technical prong (which requires that these activities relate to the intellectual property being protected). *Certain Stringed Musical Instruments and Components Thereof*, Inv. No. 337-TA-586, Comm'n Op. at 13 (May 16, 2008) ("*Stringed Musical Instruments*"). The burden is on the complainant to show by a preponderance of the evidence that the domestic industry requirement is satisfied. *Certain Multimedia Display and Navigation Devices and Systems, Components Thereof, and Products Containing Same*, Inv. No. 337-TA-694, Comm'n Op. at 5 (July 22, 2011) ("*Navigation Devices*").

With respect to the economic prong, and whether or not section 337(a)(3)(A) or (B) is satisfied, the Commission has held that "whether a complainant has established that its investment and/or employment activities are significant with respect to the articles

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[10] The Commission practice is usually to assess the facts relating to the economic prong at the time that the complaint was filed. *See Certain Coaxial Cable Connectors and Components Thereof and Products Containing Same*, Inv. No. 337-TA-560, Comm'n Op. at 39 n.17 (Apr. 14, 2010) ("We note that only activities that occurred before the filing of a complaint with the Commission are relevant to whether a domestic industry exists or is in the process of being established under sections 337(a)(2)-(3).") (citing *Bally/Midway Mfg. Co. v. U.S. Int'l Trade Comm'n*, 714 F.2d 1117, 1121 (Fed. Cir. 1983)). In some cases, however, the Commission will consider later developments in the alleged industry, such as "when a significant and unusual development occurred after the complaint has been filed." *See Certain Video Game Systems and Controllers*, Inv. No. 337-TA-743, Comm'n Op., at 5-6 (Jan. 20, 2012) ("[I]n appropriate situations based on the specific facts and circumstances of an investigation, the Commission may consider activities and investments beyond the filing of the complaint.").

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protected by the intellectual property right concerned is not evaluated according to any rigid mathematical formula." *Certain Printing and Imaging Devices and Components Thereof*, Inv. No. 337-TA-690, Comm'n Op. at 27 (Feb. 17, 2011) ("*Printing and Imaging Devices*") (citing *Certain Male Prophylactic Devices*, Inv. No. 337 TA-546, Comm'n Op. at 39 (Aug. 1, 2007)). Rather, the Commission examines "the facts in each investigation, the article of commerce, and the realities of the marketplace." *Id.* "The determination takes into account the nature of the investment and/or employment activities, 'the industry in question, and the complainant's relative size.'" *Id.* (citing *Stringed Musical Instruments* at 26).

With respect to section 337(a)(3)(C), whether an investment in domestic industry is "substantial" is a fact-dependent inquiry for which the complainant bears the burden of proof. *Stringed Musical Instruments* at 14. There is no minimum monetary expenditure that a complainant must demonstrate to qualify as a domestic industry under the "substantial investment" requirement of this section. *Id.* at 25. There is no need to define or quantify an industry in absolute mathematical terms. *Id.* at 26. Rather, "the requirement for showing the existence of a domestic industry will depend on the industry in question, and the complainant's relative size." *Id.* at 25-26.

Investments in plant and equipment, labor, and capital that are also related to research and development or licensing may be considered under subparagraph (C) as well as under subparagraphs (A) and (B). *Certain Optoelectronic Devices for Fiber Optic Communications, Components Thereof, and Products Containing the Same*, Inv. No. 337-TA-860, USITC Pub. No. 4852, Comm'n Op. at 15 (Nov. 2018); *Certain Solid State Storage Drives, Stacked Electronics Components, and Products Containing Same*, Inv.

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No. 337-TA-1097, Comm'n Op. at 14 (June 29, 2018) ("[T]he text of the statute, the legislative history, and Commission precedent do not support narrowing subsections (A) and (B) to exclude non-manufacturing activities, such as investments in engineering and research and development. Rather, the guiding principle is whether the asserted expenditures satisfy the plain language of the statute."); *Certain Marine Sonar Imaging Devices, Including Downscan and Sidescan Devices, Products Containing the Same, and Components Thereof*, Inv. No. 337-TA-921, Comm'n Op. at 58-59, 64, 66 (Jan. 6, 2016) (reversing finding that expenses could not be counted under both subparagraphs (B) and (C); holding that the same R&D expenses "separately constitute[d]" a domestic industry under each subparagraph).

IV. U.S. Patent No. 9,020,320

U.S. Patent No. 9,020,320, entitled "High Density and Bandwidth Fiber Optic Apparatuses and Related Equipment and Methods," was filed on January 22, 2013 and issued on April 28, 2015. JX-0004 ('320 Patent). The '320 patent is assigned to Corning. JX-0006 ('320 Patent Assignment Record). The '320 patent is related to, and shares a specification with, the '153 and '456 patents. The '320 patent states, "The technology of the disclosure relates to fiber optic connection density and bandwidth provided in fiber optic apparatuses and equipment." JX-0004 at 1:32-34. The '320 patent has a total of 28 claims, of which Corning asserts independent claim 1 and dependent claim 3. *See* Compl. Br. at 8.

As discussed below, the evidence shows that (1) the asserted claims of the '320 patent are infringed by the accused products; (2) complainant has satisfied the technical

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prong of the domestic industry requirement; and (3) the asserted claims are not invalid.

A. Claim Construction

1. A Person of Ordinary Skill in the Art

Complainant argues:

> A person of ordinary skill in the art at the time of the priority date of the Asserted Patents would have had at least a bachelor's degree in mechanical engineering, materials science, or a related field; and 2 years of experience in fiber optic equipment. *See* CX-0001C (Prucnal WS) Q/A 58-59; CX-0002C (Ralph WS) Q/A 30-31. Both Dr. Prucnal and Dr. Ralph were persons of ordinary skill at the time of the inventions. CX-0001C (Prucnal WS) Q/A 60; CX-0002C (Ralph WS) Q/A 32.

Compl. Br. at 30.

Respondents argue:

> A person of ordinary skill in the art (POSITA) at the time of the alleged invention of the Asserted Patents would have had a Bachelor's Degree in Mechanical Engineering, Electrical Engineering or similar and at least 5 years of experience designing fiber optic equipment and apparatuses; or a Master's Degree in Mechanical Engineering, Electrical Engineering or similar and at least 3-5 year of experience designing fiber optic equipment and apparatuses. See RX-0001C (Blumenthal WS) Q/A 87. Complainant has asserted a different level of skill in the art, but the arguments in this brief would not change under Complainant's level unless otherwise noted.

Resps. Br. at 26.

The Staff argues, *inter alia*:

> Complainant's expert, Dr. Prucnal, opined that for each of the asserted patents, a person of ordinary skill in the art during that period "would have had at least a bachelor's degree in mechanical engineering, materials science, or a related field; and 2 years of experience in fiber optic equipment." CX-0001C (Prucnal WS) Q/A 58. Respondents' invalidity expert, Dr. Blumenthal, largely agreed, opining that one of ordinary skill would have had "a Bachelor's Degree in Mechanical Engineering, Electrical Engineering or similar and at least 5 years of experience designing fiber optic equipment and apparatuses; or a Master's Degree in Mechanical Engineering, Electrical Engineering or similar and

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> at least 3-5 year of experience designing fiber optic equipment and apparatuses." RX-0001C (Blumenthal WS) Q/A 87. The Staff is of the view that, given the relatively uncomplicated nature of the technology claimed in the asserted patents, the shorter time-in-field requirement proposed by Complainant is more appropriate.

Staff Br. at 45-46.

Corning's proposed level of ordinary skill is more persuasive. Corning's proposed level requires at least a bachelor's degree in mechanical engineering, materials science, or a related field, and two years of experience in fiber optic equipment. In view of the technology claimed in the asserted patents, two years of experience in fiber optic equipment is appropriate. Thus, the administrative law judge finds that a person of ordinary skill in the art with respect to the four asserted patents is a person who has at least a bachelor's degree in mechanical engineering, materials science, or a related field, and at least two years of experience in fiber optic equipment.

2. "fiber optic connection density"

Pursuant to Ground Rule 6.d, the parties filed a joint claim construction chart on June 1, 2020. *See* Joint Claim Construction Chart ("Joint Chart") (EDIS Doc. ID No. 711588). As shown in that chart, the parties have agreed on the construction of the following claim term that appears in asserted claim 1 of the '320 patent. Below is a chart showing the parties' proposed claim construction.

Claim Term	Asserted Claims	Agreed-Upon Construction
"fiber optic connection density"	'320: 1	"number of fiber optic connections that can be made to the front side of the fiber optic equipment"

See Joint Chart at 3-4; Resps. Br. at 53; Staff Br. at 46-47.

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The claim term "fiber optic connection density" appears in asserted claim 1 of the '320 patent. Asserted claim 1 reads as follows:

> **1**. A fiber optic apparatus, comprising:
>
> a chassis; and
>
> a fiber optic connection equipment provided in the chassis; the fiber optic connection equipment configured to support a ***fiber optic connection density*** of at least ninety-eight (98) fiber optic connections per U space, based on using at least one simplex fiber optic component or at least one duplex fiber optic component.

JX-0004 ('320 Patent) at 19:52-59 (emphasis added).[11]

The parties have agreed to construe the claim term "fiber optic connection density" as "number of fiber optic connections that can be made to the front side of the fiber optic equipment." *See* Joint Chart; Resps. Br. at 53; Staff Br. at 46-47.

Accordingly, as argued by the parties, the administrative law judge adopts the joint proposed claim construction and has determined that the claim term "fiber optic connection density" should be construed to mean "number of fiber optic connections that can be made to the front side of the fiber optic equipment."

3. "based on using at least one simplex fiber optic component or at least one duplex fiber optic component"

The claim term "based on using at least one simplex fiber optic component or at least one duplex fiber optic component" appears in asserted claim 1 of the '320 patent. Below is a chart showing the parties' proposed claim constructions.

[11] In this Initial Determination, unless noted otherwise, when quoting, emphasis are from the original source, and footnotes from the original source are omitted.

[redacted]

Complainant and the Staff	Respondents
"based on using at least one fiber optic connector comprising either one or two strands of fiber, or at least one fiber optic adapter that receives such a connector"	"including at least one device that receives connectors to support no more than a two-fiber connection" Otherwise indefinite.

See Staff Br. at 47-50 (citing Joint Chart at 3); Compl. Br. at 42-44; Resps. Br. at 32-37.

For the reasons discussed below, the administrative law judge has determined that the claim term "based on using at least one simplex fiber optic component or at least one duplex fiber optic component" should be construed to mean "based on using at least one fiber optic connector comprising either one or two strands of fiber, or at least one fiber optic adapter that receives such a connector."

Asserted claim 1 reads as follows:

> **1**. A fiber optic apparatus, comprising:
>
> a chassis; and
>
> a fiber optic connection equipment provided in the chassis; the fiber optic connection equipment configured to support a fiber optic connection density of at least ninety-eight (98) fiber optic connections per U space, ***based on using at least one simplex fiber optic component or at least one duplex fiber optic component***.

JX-0004 ('320 Patent) at 19:52-59 (emphasis added).

First, the intrinsic evidence shows that a "fiber optic component" may be either a fiber optic adapter or a fiber optic connector. JX-0004 ('320 Patent) at 5:16-19 ("FIG. 1 shows exemplary fiber optic components **23** disposed in the fiber optic modules **22** that support fiber optic connections. For example, the fiber optic components **23** may be fiber optic adapters or fiber optic connectors."). The term is not limited to fiber optic adapters,

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as respondent's expert opines. *See* RX-0001C (Blumenthal WS) Q/A 141-42 ("The specification does not describe these devices disposed through the front as fiber optic connectors.").

Second, the claim term refers to two types of fiber optic components: "simplex" and "duplex." A simplex connection is a one-fiber connection, while a duplex connection is a two-fiber connection. *See*, *e.g.*, RX-0001C (Blumenthal WS) Q/A 111-12; CX-0001C (Prucnal WS) Q/A 26-30. A simplex fiber optic cable contains only a single optical fiber, while a duplex fiber optic cable contains two optical fibers. CX-0001C Q/A 26. A simplex connector terminates a simplex fiber optic cable with a single ferrule containing one fiber. *Id*. Q/A 29. A duplex connector consists of two ferrules with one fiber each, joined side-by-side to that the two fibers can be connected simultaneously. *Id*. These are in contrast to a "multi-fiber connector," which contains more than two fibers. *See id*. Q/A 26-27. Finally, "[a]n adapter is a two-sided device that receives a connector on the front and the rear[,]" such that "[w]hen two fiber optic cables with connectors are plugged into opposite sides of an adapter, a connection between the cables is formed." *Id*. Q/A 25, 30. A simplex adapter supports simplex connectors, while a duplex adapter supports either simplex or duplex connectors. RX-0001C (Blumenthal WS) Q/A 115; CX-0002C (Ralph WS) Q/A 61.

The parties' dispute regarding this claim term turns on whether a duplex adapter is defined by the number of connectors (and therefore the number of connections) that it can support, or whether it is defined by the type of connectors that it supports (either simplex or duplex). *See* Compl. Br. at 42-44; Resps. Br. at 32-37; Staff Br. at 47-50. Respondents' expert opines that "a person of ordinary skill in the art would understand

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the claims to be using 'simplex' and 'duplex' to refer to the maximum number of fiber optic connections that the claimed 'fiber optic components' can support and not the type of connectors that they can receive." RX-0001C (Blumenthal WS) Q/A 140. Under this construction, an adapter that accepted two duplex connectors would not be a duplex fiber optic component. Complainant and the Staff argue that any adapter that can receive simplex and duplex connectors is a duplex adapter, and is therefore a duplex fiber optic component. *See*, *e.g.*, CX-0001C (Prucnal WS) Q/A 157, 186.

Support for complainant's and the Staff's proposed construction can be found in the specification of the '320 patent, which contrasts embodiments using "duplex fiber optic components" to achieve 120 or 144 fiber optic connections per 1U space with embodiments using "multi-fiber fiber optic components . . . such as MPO components" to achieve 576 or 1152 fiber optic connections in the same 1U space. JX-0004 ('320 Patent) at 5:33-67. When describing the embodiment depicted in Figures 10A and 10B, the specification indicates that duplex fiber optic adapters are adapters that are configured to receive duplex fiber optic connectors. *Id*. at 8:65-9:12 ("In this example, the fiber optic components **23** are duplex LC fiber optic adapters that are configured to receive and support connections with duplex LC fiber optic connectors. However, any fiber optic connection type desired can be provided in the fiber optic module **22**."). Thus, while the patent as a whole is not limited to embodiments with duplex connections, where a duplex fiber optic adapter is specified, it refers to an adapter that accepts duplex connectors. *Id*.

The '320 patent states that "the fiber optic components . . . may be fiber optic adapters or fiber optic connectors." JX-0004 ('320 Patent) at 5:18-19. Context from other claims confirms that the '320 patent uses "component" to include connectors.

[redacted]

Claim 10 recites "at least one simplex . . . [or] duplex fiber optic component" that "is comprised of: at least one simplex fiber optic connector or at least one duplex fiber optic connector, or at least one simplex fiber optic adapter or at least one duplex fiber optic adapter." JX-0004 ('320 Patent) at cl. 10. *See CIAS, Inc. v. All. Gaming Corp.*, 504 F.3d 1356, 1360 (Fed. Cir. 2007) ("'[C]omprising' is well understood to mean 'including but not limited to.'"). Inasmuch as claim 10 depends from claim 1, it is "presumed to be of narrower scope," *AK Steel Corp.*, 344 F.3d at 1242 — so that a "component" within the broader scope of claim 1 should include any "component" within the narrower scope of claim 10.

Further support can be found in extrinsic evidence. For example, industry standard TIA-568-C.0, *Generic Telecommunications Cabling for Customer Premises* (Feb. 2009), defines "adapter; optical fiber duplex" as "[a] mechanical device designed to align and join two duplex optical fiber connectors (plugs) to form an optical duplex connection." CX-0922C (TIA-568-C.0) at 2. It does not define an adapter according to the maximum number of connections, but according to the type of connectors supported. Also, Dr. Prucnal testified that one of ordinary skill in the art would understand that "there is an important difference between, on the one hand, a component that supports simplex (one-fiber) or duplex (two-fiber) connections, and on the other hand, a component that supports multi-fiber connections." CX-0001C (Prucnal WS) Q/A 186. He testified that a "quad" adapter that receives four fibers, for example, nevertheless qualifies as a duplex fiber optic component if those four fibers can only be used for simplex or duplex connections, and not for a single multi-fiber connector. *See id.* ("There is no such thing as a quad LC connector that supports a four-fiber LC

[redacted]

connection."); Prucnal Tr. 372 ("There's no such thing as a quad connector to my knowledge."); 825 ("[T]he only type of connectors that a quad LC adapter could accept are simplex LC connectors and duplex LC connectors[.]"); *see also* Ralph Tr. 243 ("I don't recall hearing of a quad connector.").

Respondents' argument concerning indefiniteness is discussed in the Validity section, *infra*.

4. "U space"

The claim term "U space" appears in asserted claims 1 and 3 of the '320 patent and in asserted claims 11, 19, and 27 of the related '456 patent. Below is a chart showing the parties' proposed claim constructions.

Complainant and the Staff	Respondents
Plain and ordinary meaning, an example of which is "a rack unit, which is a standardized measurement of 1.75 inches (44.45mm) in height within a standardized 19-inch rack or 23-inch rack.	'320 patent: § 112 (indefinite); if not indefinite, then "space comprising a height of 1.75 inches and width of 19 or 23 inches." '456 patent: "space comprising a height of 1.75 inches and width of 19 or 23 inches"; otherwise §112 (indefinite)

Staff Br. at 54-55 (citing Joint Chart at 5); Compl. Br. at 44-46; Resps. Br. at 45-47.

For the reasons discussed below, the administrative law judge has determined that the claim term "U space" should be given its "plain and ordinary meaning, an example of which is a rack unit, which is a standardized measurement of 1.75 inches (44.45mm) in height within a standardized 19-inch rack or 23-inch rack."

[redacted]

Asserted claims 1 and 3 read as follows:

> **1**. A fiber optic apparatus, comprising:
>
> a chassis; and
>
> a fiber optic connection equipment provided in the chassis; the fiber optic connection equipment configured to support a fiber optic connection density of at least ninety-eight (98) fiber optic connections per ***U space***, based on using at least one simplex fiber optic component or at least one duplex fiber optic component.
>
> **3**. The fiber optic apparatus of claim **1**, wherein the fiber optic connection equipment is configured to support a fiber optic connection density of at least one hundred forty-four (144) fiber optic connections per ***U space***.

JX-0004 ('320 Patent) at 19:52-67 (emphasis added).

The claim term "U space" should be construed in the same manner for related '320 and '456 patents. *See Paice LLC v. Ford Motor Co.*, 881 F.3d 894, 904 (Fed. Cir. 2018) ("[U]nless otherwise compelled . . . the same claim term in the same patent or related patents carries the same construed meaning.") (quoting *Omega Eng'g, Inc. v. Raytek Corp.*, 334 F.3d 1314, 1334 (Fed. Cir. 2003)); *accord In re Rambus, Inc.*, 694 F.3d 42, 48 (Fed. Cir. 2012).

The term "U space" is a standard term that is well understood in the field of fiber optic equipment, and it is explicitly defined in the specification shared by the related '320 and '456 patents, as well as in claims 1, 11, 22, and 27 of the '456 patent. The specification states: "The fiber optic equipment rack **14** may support 1-U-sized shelves, with 'U' equal to a standard 1.75 inches in height and nineteen (19) inches in width. In certain applications, the width of 'U' may be twenty-three (23) inches." JX-0004 ('320

[redacted]

Patent) at 5:1-5; *accord* JX-0010 (‘456 Patent) at 5:13-17. Claims 1 and 11 of the ‘456 patent define the term as follows: “wherein a U space comprises a height of 1.75 inches and comprises a width of 19 inches or 23 inches.” JX-0010 (‘456 Patent) at 20:55-56, 22:8-9.

Claims 22 and 27 of the ‘456 patent contain the limitation: “wherein the chassis defines a 4-U space, in which a U space comprises a height of 1.75 inches and comprises a width of 19 inches or 23 inches[.]” *Id*. at 23:29-31, 24:28-30. These definitions are consistent with those found in the industry standards. CX-0684 (EIA/ECA Standard, Cabinets, Racks, Panels, and Associated Equipment, EIA/ECA-310-E (Dec. 2005)); CX-0918C (IEC 60297-3-108, Mechanical Structures for Electronic Equipment – Dimensions of Mechanical Structures of the 482.6mm (19 in) Series (Sept. 2014)).

Respondents argue that the claim term “U space” is indefinite. Respondents argue, *inter alia*:

> Respondents’ proposed construction is supported by the intrinsic record. Complainant’s and Staff’s proposed constructions are improper in light of the specification, the claims, and the understanding of a POSITA. A POSITA, as of the ‘320 Patent’s priority date, would interpret “U Space” to mean “space comprising a height of 1.75 inches and width of 19 or 23 inches,” as Respondents propose. RX-0001C (Blumenthal WS) Q/A 161-176. Additionally, irrespective of whether the term “U space” is construed and irrespective of which construction is adopted, the way in which the term “U space” is used in ‘320 Patent claims 1 and 3 and ‘456 Patent claims 11, 12, 14-16, 19, and 21 renders these claims indefinite as explained in detail in Sections VI.B.2 and VII.B.2.a. below. *See also* RX-0001C (Blumenthal WS) Q/A 161-176.

Resps. Br. at 46; *see id.* at 85-87, 156-57.

This is incorrect for two reasons. First, the asserted patents are concerned with fiber optic connection density. The parties’ agreed construction of “fiber optic

[redacted]

connection density" shows why no depth need be specified to apply the term "U space." Under that construction, adopted by the administrative law judge, density means "the number of fiber optic connections that can be made to the front side of the fiber optic connection equipment." The "front side of the fiber optic connection equipment" is a two-dimensional space. Accordingly, when the claims of the '320 and '456 patents recite limitations such as "a fiber optic connection density of at least ninety-eight (98) fiber optic connections per U space," as in claim 1 of the '320 patent, those claims are referring to connections that can be made to a two-dimensional space. *See* CX-2060C (Prucnal RWS) Q/A 155. Depth, which varies by manufacturer and product line, need not be specified.

Second, one of ordinary skill in the art would be familiar with the usual dimensions of a fiber optic rack (or chassis), and would readily understand what would be the typical depth of a 1U space (also known as one rack unit) in various applications. CX-0001C (Prucnal WS) Q/A 159-60; *see*, *e.g.*, CX-0684 (EIA/ECA-310-E) at CORNING-ITC-0086659; CX-0918C (IEC 60297-3-108). A claim is not indefinite if, when viewed in light of the specification and prosecution history, it informs those skilled in the art at the time of the patent application about the scope of the invention "with reasonable certainty." *Nautilus, Inc. v. Biosig Instruments, Inc.*, 572 U.S. 898, 910 (2014). The *Nautilus* standard is satisfied in this instance.

The parties' documents and witness testimony further confirm that a person of ordinary skill understand the phrase "U space" as the two-dimensional size of a standard rack unit. *See* CX-2060C (Prucnal RWS) Q/A 146-152. Corning's and respondents' documents refer to their products as providing a certain number of fibers or connections

[redacted]

in a "U," "1U," "2U" or "4U" space. CX-0666 (EDGE Brochure) at 8; CX-0199 (Panduit HD Flex Enclosures Spec.) at 2. Respondents' witnesses likewise showed familiarity with the term "U space" or "rack unit space." JX-0016C (Kim Dep. Tr.) 91:14-16, 92:9-11; JX-0017C (Kuffel Dep. Tr.) 32:10-13; JX-0018C (Maynard Dep. Tr.) 69:3-5, 87:10-17; JX-0029C (Wiltjer Dep. Tr.) 163:3-18. Respondent Panduit described U space as a "standard rack unit space[] . . . with a height of 1.75 inches and a preferred standard width of 19 inches" in its unsuccessful *inter partes* challenge to the '320 patent. CX-2063 ('320 IPR Petition) at 21; CX-2064 (DeCusatis Decl. '320 IPR) at 15.

Other than Dr. Blumenthal's conclusory opinion, respondents provide no support for their contention that a person of skill "would understand 'space' to comprise three dimensions: a width, a length and a height." RX-0001C (Blumenthal WS) Q/A 164; *but see* CX-2060C (Prucnal RWS) Q/A 153 (disagreeing). Neither the claims nor the specification specifies a depth for a U space; the industry standards contain none; and respondents' witnesses testified they knew of no standard depth. *See*, *e.g.*, JX-0018C (Maynard Dep. Tr.) 87-88.

B. Infringement Analysis of the '320 Patent

As noted, Corning asserts independent claim 1 and dependent claim 3. For the reasons discussed below, Corning has shown by a preponderance of the evidence that respondent's accused products infringe claims 1 and 3 of the '320 patent.

1. Accused Products

The accused products consist of chassis, modules, and combinations thereof. There are three categories of accused products, Base-8, Base-12, and Base-24, which are defined by the number of fiber connections available per module. First, a Base-8 module

[redacted]

supports eight fiber connections, and a Base-8 chassis supports eighteen Base-8 modules per 1U space. CX-0001C (Prucnal WS) Q/A 63. Second, a Base-12 module supports twelve fiber connections, and a Base-12 chassis supports twelve Base-12 modules per 1U space. *Id*. Finally, a Base-24 module supports twenty-four fiber connections, and a Base-24 chassis supports six Base-24 modules per 1U space. *Id*. In each case, there are a total of 144 connections available in a 1U space; the difference in the three categories is in the number of modules needed to fill that space.

Within each category, there are three chassis sizes: 1U, 2U, and 4U, which refer to the chassis height. *Id*. Apart from the total height, these types are materially the same for each respondent. *Id*. That is, the fiber optic connection density for a 1U chassis from a given respondent is the same as the density for a 2U or 4U chassis from that respondent. *Id*. Q/A 64. Complainant argues that therefore "for each Respondent, and within each fiber connectivity configuration (Base-12, Base-8, and Base-24), a 1U chassis is representative of a 2U chassis and a 4U chassis for purposes of the asserted patents." *Id*.; *see also* CX-2042 (Compl. & Siemon Stip. Re Representative Accused Prods.) (stipulating that within each of the three categories, Siemon's 1U chassis is representative of its 2U and 4U chassis for purposes of the asserted patents).

Complainant has offered a complete list of representative accused products for each respondent, along with the group of accused products represented by each such product, through the testimony of Dr. Prucnal. CX-0001C (Prucnal WS) Q/A 62; *see* CDX-0013 (Prucnal list of accused products).

[redacted]

Not all respondents market all types of accused products. The following describes the accused products allegedly imported and/or sold in the United States by each respondent:

Summary of Accused Products

Respondent	Brand	Chassis			Module		
		Base-8	Base-12	Base-24	Base-8	Base-12	Base-24
FS	FHX	1U	1U		X	X	
Leviton	OPT-X		1U/2U/4U			X	X
Panduit	HD FLEX	1U/2U/4U	1U/2U/4U	1U/2U/4U	X	X	X
Siemon	LightStack	1U/2U/4U	1U/2U/4U		X	X	

See Staff Br. at 20.

a. Panduit

The Panduit accused products are marketed as “HD FLEX Fiber” enclosures and cassettes. The accused Panduit chassis fall into three categories (Base-8, Base-12, and Base-24), and are available in three sizes (1U, 2U, and 4U). The accused Panduit modules are available in three configurations (Base-8, Base-12, and Base-24). *See* CX-0001C (Prucnal WS) Q/A 85; CPX-0062 (Panduit Base-8 1U chassis); CPX-0063 (Panduit Base-12 1U chassis); CPX-0065 (Panduit Base-24 1U chassis); CPX-0073 (Panduit Base-8 module); CPX-0074 (Panduit Base-12 module); CPX-0075 (Panduit Base-24 module).

[redacted]

b. Leviton

The Leviton accused products are marketed under the names "OPT-X UHDX Enclosures" and "HDX Enterprise Cassettes." The accused Leviton enclosures are all Base-12 chassis, available in three sizes (1U, 2U, and 4U). The accused Leviton modules are available in two configurations (Base-12 and Base-24). Both the Base-12 and the Base-24 modules are used with the Leviton Base-12 chassis. *See* CX-0001C (Prucnal WS) Q/A 98; CPX-0057 (Leviton Base-12 1U chassis); CPX-0060 (Leviton Base-12 module); CPX-0061 (Leviton Base-24 module).

c. Siemon

The Siemon accused products are marketed under the name "LightStack Ultra High-Density Fiber Plug and Play system." The accused Siemon chassis fall into two categories (Base-8 and Base-12) and are available in three sizes (1U, 2U, and 4U). The accused Siemon modules are available in Base-8 and Base-12 configurations. *See* CX-0001C (Prucnal WS) Q/A 106; CPX-0076 (Siemon Base-8 1U chassis); CPX-0077 (Siemon Base-12 1U chassis); CPX-0078 (pre-Aug. 2019 version of Siemon Base-12 1U chassis); CPX-0079 (Siemon Base-8 module); CPX-0080 (Siemon Base-12 module).

d. FS

The FS accused products are marketed under the names "FHX Series" and "FHX-FCP/ FHX-C Series" and include both chassis and modules. The accused FS chassis fall into two categories (Base-8 and Base-12) and are available in just one size (1U). The accused FS modules are available in Base-8 and Base-12 configurations. *See* CX-0001C (Prucnal WS) Q/A 117; CPX-0053 (FS Base-8 1U chassis); CPX-0054 (FS Base-12 1U chassis); CPX-0055 (FS Base-8 module); CPX-0056 (FS Base-12 module).

[redacted]

2. Importation (All Asserted Patents)

Section 337 is a trade statute enacted to regulate international commerce. *Suprema, Inc. v. International Trade Comm'n*, 796 F.3d 1338, 1344 (Fed. Cir. 2015). In an investigation predicated on allegations of patent infringement, the statute prohibits "[t]he importation into the United States, the sale for importation, or the sale within the United States after importation . . . of articles that . . . infringe[.]" 19 U.S.C. § 1337(a)(1)(B). "A complainant need only prove importation of a single accused product to satisfy the importation element." *Certain Electronic Nicotine Delivery Systems and Components Thereof*, Inv. No. 337-TA-1139, Order No. 35 at 6-11 (Aug. 5, 2019) (reviewed on other grounds, *see* Comm'n Notice (Sept. 4, 2019)); *Certain Trolley Wheel Assemblies*, Inv. No. 337-TA-161, USITC Pub. No. 1605, Comm'n Op. at 7-8 (Nov. 1984).

<u>Importation - Leviton</u>

Leviton argues that it has not imported any accused product. *See* Resps. Br. at 16-26; Leviton Response to Complaint. Ex. A (EDIS Doc. ID No. 711309).

Leviton argues, *inter alia*:

> **1. Leviton Does Not Import the Leviton Accused Combinations**
>
> Leviton does not import, sell for importation, or sell after importation the allegedly infringing combinations of a Leviton Enclosure with Leviton Accused Modules. The importation requirement requires importation of "articles that infringe." 19 U.S.C. § 1337(a)(1)(B). Complainant's only infringement allegations are directed to the ***combination*** of a Leviton Enclosure with Leviton Accused Modules. CX-0001C (Prucnal WS) Q/A 134, 206. Leviton does not import any such combination. RX-0005C (Kim WS) Q/A 35, 36; Prucnal Tr. 306:18–22, 308:10–14; Schoettelkotte Tr. 128:11–15. Complainant did not respond to Leviton's Motion for Summary Determination as to the accused

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combinations, or as to the Leviton Accused Modules discussed below, or address them in its prehearing brief and thus waives any argument of violation, importation, or remedy based on such combinations or Leviton Accused Modules.

2. Leviton Does Not Import the Leviton Accused Modules

Leviton does not import, sell for importation, or sell after importation any of the Leviton Accused Modules. Complainant identifies 97 Leviton Accused Modules as "accused products." CX-0001C (Prucnal WS) Q/A 100–101. Leviton manufactures the Leviton Accused Modules in its manufacturing plant in Bloomingdale, Illinois. RX-0005C (Kim WS) Q/A 34; RDX-0019C.0005; RDX-0005C; RDX-0008C.198. At the same plant in Bloomingdale, Leviton manufactures nearly 100 varieties of non-accused, non-infringing cassettes, adapter plates, and splice modules that can be used in the Leviton Enclosures. RX-0005C (Kim WS) Q/A 23-27, 36; RX-0008C (Lebby RWS) Q/A 49-65, 203-210. Complainant does not allege that the Leviton Accused Modules are imported or directly or indirectly infringe. Prucnal Tr. 306:5-8.

3. Leviton Does Not Import the Leviton Enclosures

Leviton does not import, sell for importation, or sell after importation the Leviton Enclosures. "Articles that infringe" can include articles that indirectly infringe. *Suprema*, 796 F.3d 1338. Here, at most, only the Leviton Enclosures are alleged to indirectly infringe. But they are not (and were not) imported. Leviton manufactures the Leviton Enclosures in its manufacturing plant in Bothell, Washington. RX-0005C (Kim WS) Q/A 34-36, 48, 49; RX-0008C (Lebby RWS) Q/A 325-333; RX-0286C–0288C (Enclosure Assembly Instructions); RX-1269C (Tray Assembly Instructions); CX-0054C (Bills of Materials); RDX-0005C.

Resps. Br. at 16-17 (footnotes omitted).

Thus, Leviton argues that neither the chassis nor the modules, nor any combination of the two, are ever imported into the United States. *See* Resps. Br. at 18-26. For the reasons discussed below, the importation requirement of section 337 is met with respect to the Leviton accused products.

All of the patent claims asserted against Leviton in this investigation disclose a combination of a "chassis" and one or more removable "modules." The Leviton accused

[redacted]

products are marketed under the name OPT-X UHDX Enclosures (chassis) and HDX Enterprise Cassettes (modules). CX-0001C (Prucnal WS) Q/A 98. Leviton manufactures all of its HDX Enterprise Cassettes in Bloomingdale, Illinois. JX-0013C (Byquist Dep. Tr.) at 113-114. Leviton assembles the OPT-X UHDX Enclosures in Bothell, Washington. *Id*. at 56.

Although the final assembly of Leviton's chassis has always occurred in Bothell, Washington, the evidence indicates that until recently, most manufacturing activities occurred in Mexico.[12] Approximately one-sixth of the number of components that Leviton uses to assemble the OPT-X UHDX enclosures in the United States are either [redacted], and until recently both were manufactured in and imported from Leviton facilities in Mexico. *See* CX-0054C (Leviton 1U enclosure bill of materials); JX-0013C (Byquist Dep. Tr.) at 118; Kim Tr. 487-489. For example, [redacted]. JX-0013C (Byquist Dep.

[12] Shortly before the evidentiary hearing, Leviton's Mr. Kim amended his direct testimony to state that [redacted] formerly imported from Mexico are now manufactured and sourced in the United States. *See* RX-0005.1C (Errata to Kim WS). Voluntary cessation of importation, however, does not deprive the Commission of jurisdiction or prevent the Commission from imposing a remedy. *Certain Road Milling Machines and Components Thereof*, Inv. No. 337-TA-1067, Comm'n Op. at 22-23 (Aug. 7, 2020) ("Under Commission precedent, 'the fact that respondents allege to have discontinued importation does not preclude a finding that section 337 has been violated, nor does it preclude the imposition of a remedy.'") (quoting *Certain Hardware Logic Emulation Systems and Components Thereof*, Inv. No. 337-TA-383, Initial Det., 1997 WL 665006 at *8 (July 31, 1997)); *see also Intel Corp. v. International Trade Comm'n*, 946 F.2d 821, 830 n.14 (Fed. Cir. 1991) ("[M]ere voluntary cessation of allegedly illegal conduct does not moot a case; if it did, the courts would be compelled to leave '[t]he defendant . . . free to return to his old ways.'") (quoting *United States v. Concentrated Phosphate Export Ass'n, Inc.*, 393 U.S. 199, 203 (1968)).

[redacted]

Tr.) at 130-138; CX-0059C (Leviton UHD-W2 1RU sub drawing). These imported components represented over [redacted] percent of the value of Leviton's chassis, in terms of materials costs. Kim Tr. 529-533. When the cost of labor in Mexico is added, the percentage rises to [redacted] percent. *See* CX-0054C (Leviton 1U enclosure bill of materials); JX-0013C (Byquist Dep. Tr.) at 141-144.

The amount of manufacturing activity that took place in Mexico rather than in Bothell, Washington was significant enough that until recently Mexico was identified as the country of origin for the fully assembled chassis, which were shipped to Leviton customers in boxes labeled "Made in Mexico." *See* CX-0055 (packaging labels for Leviton 1U and 4U chassis); JX-0013C (Byquist Dep. Tr.) at 50-51; Kim Tr. 534. Moreover, [redacted] imported from Mexico had no substantial uses other than to be assembled into Leviton's accused chassis. *See* JX-0013C (Byquist Dep. Tr.) at 116-120 (contrasting [redacted] shown on bills of materials with "common" parts also listed on bills of materials); *see also*, *e.g.*, CX-0060C (Leviton 001-5R1UD-S12 assembly instructions) (depicting component parts), CX-0054C (Leviton 1U enclosure bill of materials).

Due to its final assembly operations in Bothell, Washington, Leviton argues that its chassis have always been manufactured in the United States, and that therefore there has been no importation within the meaning of section 337. This is incorrect. Leviton's accused chassis were actually "manufactured" in Mexico, with the exception of certain minor and insignificant assembly steps performed after importation. Kim Tr. 504-505 ("[redacted]"). There was a sufficient nexus between

[redacted]

[redacted] and the "articles that infringe" sold after importation to conclude that the importation requirement has been satisfied.[13]

Early Commission precedent established that there must be a nexus between the importation (in this case, of the [redacted] manufactured in Mexico) and the alleged unfair acts (for example, inducing or contributing to direct infringement by Leviton customers). *See Certain Cardiac Pacemakers and Components Thereof*, Inv. No. 337-TA-162, 1984 WL 273827, Order No. 37 (Mar. 21, 1984) (granting summary det. of no violation). In *Cardiac Pacemakers*, the presiding administrative law judge found that no unfair acts had been committed within the meaning of section 337 because the accused respondent imported only two minor components of the accused products, "interchangeable, staple items that are used in several non-infringing applications[,]" and did not infringe the patent directly, contributorily, or by inducement. *Cardiac Pacemakers*, Order No. 37, 1984 WL 273827 at *1-*2. He concluded that "[n]o nexus can be established between the importation and the alleged infringement; consequently, the Commission cannot find a violation of the statute and lacks jurisdiction to issue a remedy." *Id*. at *2; *see also Dynamic Random Access Memories, Components Thereof and Products Containing Same*, Inv. No. 337-TA-242, USITC Pub. 2034, Comm'n Op. at 90-92 (Nov. 1987) (determining not to exclude "upstream" products (*i.e.*, components of an infringing device) because there had been no allegation or showing of indirect

[13] The term "articles that . . . infringe" in 19 U.S.C. § 1337(a)(1)(B) includes not only articles that directly infringe a patent at or after the time of importation, but also articles used to induce infringement or to contributorily infringe. *Suprema*, 796 F.3d at 1348-52; *see also Comcast Corp. v. International Trade Comm'n*, 951 F.3d 1301, 1308 (Fed. Cir. 2020); *Certain Blood Cholesterol Testing Strips and Associated Systems Containing the Same*, Inv. No. 337-TA-1116, Comm'n Op. at 27-29 (May 1, 2020).

[redacted]

infringement). Conversely, in ruling on a request for temporary relief in *Certain Fluidized Supporting Apparatus*, the presiding administrative law judge stated that "there is a sufficient link between the alleged unfair acts and the assembled article if the importation of components of the article is an important step in the production and sale of the article." *Certain Fluidized Supporting Apparatus and Components Thereof*, Inv. Nos. 337-TA-182/188, Initial Det., 1984 WL 273788 at *55 (June 16, 1984). The administrative law judge concluded that jurisdiction existed in that investigation because the "imported components are essential and even indispensable" to the infringing beds.[14] *Id*.

More recent precedent confirms that importation of articles that do not infringe as of the time of importation may nevertheless form the basis of a violation of section 337. *Suprema*, 796 F.3d at 1348-52. Thus, for example, in *Blood Cholesterol Testing Strips*, imported test strips and meters were found to be "articles that infringe" where post-importation use of the strips and meters according to their directions infringed the asserted method claims and the imported articles had no substantial noninfringing uses. *Certain Blood Cholesterol Testing Strips and Associated Systems Containing the Same*, Inv. No. 337-TA-1116, Comm'n Op. at 27-29 (May 1, 2020); *see also Certain Beverage Dispensing Systems*, Inv. No. 337-TA-1130, Comm'n Op. at 11, 13-14 (Mar. 11, 2020) (violation found where all components of infringing system were imported, there were no

[14] The Commission reversed the administrative law judge's determination on temporary relief on the grounds that the complainant would be unable to make a showing of a domestic industry, noting that it "neither approve[d] nor disapprove[d] the other findings of the ALJ." *Certain Fluidized Supporting Apparatus and Components Thereof*, Inv. Nos. 337-TA-182/188, USITC Pub. 1667, Comm'n Op. at 25-28 (Oct. 1984).

[redacted]

noninfringing uses for any imported component, and the imported components satisfied all limitations of the asserted apparatus claims).

While *Blood Cholesterol Testing Strips* involved a respondent's own direct infringement through post-importation use rather than indirect infringement via post-importation use by others, the Commission indicated that its analysis and findings in that investigation "should not be read to limit 'articles that infringe' to only analogous situations." *Blood Cholesterol Testing Strips*, Comm'n Op. at 32. "In any future investigation in which the Commission is presented with this issue, the Commission will consider and fully assess its controlling statute, Congressional intent, the applicable precedent from the Commission's reviewing courts, and the relevant facts."[15] *Id*. at 32-33.

Leviton is accused of inducing infringement and/or contributorily infringing through importation of [redacted] that had no substantial uses other than

[15] Chair Kearns, for example, stated as follows:

> Commissioner Kearns notes that, in any future investigation in which the Commission is presented with this issue (including in the context of imported components accused of infringing an apparatus claim), he is likely to consider such factors as the nature of the imported items and what additional activity occurs in the United States, including any combinations or modifications that are made with respect to the imported articles after importation, all in light of the limitations of the asserted claims.

Blood Cholesterol Testing Strips, Comm'n Op. at 33 n.26. Commissioner Schmidtlein similarly noted:

> In any future investigation in which the Commission is presented with the issue of post-importation direct infringement by the respondent as the basis for the 337 violation, she believes it is appropriate to consider the extent, if any, to which the accused products are modified or combined with other non-accused articles after importation in order to satisfy all of the elements of the asserted claim.

Id. at 33 n.27.

[redacted]

to be assembled into complete chassis. Those chassis, labeled "Made in Mexico," were provided to customers who then used them, at least some of the time, in combinations that allegedly infringe the patents asserted in this investigation. [redacted] that Leviton formerly imported from Mexico were not "off-the-shelf" products – they had no use other than to be combined to form an accused Leviton chassis. Thus, they were not the sort of minor components that were at issue in *Cardiac Pacemakers*. Moreover, inasmuch as all of the asserted claims of the patents asserted against Leviton claim a chassis, the "imported components are essential and even indispensable" to the alleged infringement. *Fluidized Supporting Apparatus*, Initial Det. at *55. In other words, [redacted] were "integral part[s]" of the chassis as sold to Leviton customers, *see id.*, and the sale of the chassis was a direct step in the ultimate alleged infringement. Accordingly, there was a sufficient nexus between [redacted] and the alleged infringement such that the products are within the Commission's jurisdiction.

<u>Importation - Panduit and Siemon</u>

Respondents Panduit and Siemon admittedly import accused modules, while domestically manufacturing the chassis used in the combinations of chassis and modules alleged to infringe the asserted '320, '153, and '456 patents. CX-2044C (J. Stip. of Corning and Panduit re Importation) at 1 (showing importation of modules only); JX-0028C (Wagner Dep. Tr.) at 42-43, 79, 81-82, JX-0029C (Wiltjer Dep. Tr.) at 64-65; Siemon Response to Complaint Ex. A (EDIS Doc. ID No. 709242); RX-1266C (Veatch WS) Q/A 18. Yet, these respondents argue that complainant has not shown that they have imported "articles that . . . infringe" and that therefore jurisdiction under section 337 has not been established. Resps. Br. at 10.

[redacted]

Panduit and Siemon argue that the fact that they import only one of the two components that make up the accused combinations of chassis and modules divests the Commission of jurisdiction (due to failure to satisfy the importation requirement) because there is an insufficient nexus between the imported articles and the unfair methods of competition. *See* Resps. Br. at 10-15. Panduit makes this argument even though it previously stipulated that its importation of modules is sufficient to satisfy the importation requirement of section 337. *See* CX-2044C (J. Stip. of Corning and Panduit re Importation) at 2 ("For the purposes of this Investigation only, Respondent will not dispute that the importation requirement of 19 U.S.C.A. § 1337(a)(1)(B) is satisfied as to Respondent with respect to the [module] products listed in Exhibit A."). Citing pre-*Suprema* case law, Panduit and Siemon argue that complainant has not shown a nexus between their importation activity and the alleged unfair acts. *See* Resps. Br. at 10.

The argument that Panduit and Siemon make is unavailing under current Commission precedent. The question of what relationship must exist between an importation and alleged infringement is now governed by the Federal Circuit's en banc opinion in *Suprema*, which confirmed that the importation of articles that do not infringe as of the time of importation may nevertheless form the basis of a violation of section 337. *Suprema*, 796 F.3d at 1348-52. The court held that it was an appropriate exercise of the Commission's discretion to find that a violation of section 337 may be based on indirect infringement of a method claim:

> It is true that the direct infringement required for inducement . . . will typically not have taken place at the time of the importation that induces it. Yet we cannot conclude that Congress unambiguously excluded such induced infringement on the basis of the panel's reasoning.

[redacted]

Id. at 1347-48. As the court explained,

> [r]eading the statute unambiguously to require that infringement occur at the time of importation would have produced absurd results under the pre-1994 version of § 271(a). . . . At that time (before 1994), § 271(a) did not define importing a patented invention (or the offer to sell a patented invention) an infringing act. Section 271(a) only covered making, using, and selling, and those actions had to occur in the United States. 35 U.S.C. § 271(a) (1988). At least for ordinary importations involving goods that enter the United States for a later use or sale, none of the activities encompassed by the former § 271(a) would have occurred in the United States at the time of importation. If Congress meant to forbid the Commission from looking past the time of importation in defining Section 337's reach, Section 337 would not have reached even garden-variety direct infringement. Even if Section 337(a)(l)(B)'s clause covering post-importation sales allowed assessment of infringement after importation, Section 337 would not have covered the ordinary case of post-importation use without post-importation sales. We cannot attribute that result to Congress.

Id. at 1348. The court concluded, "We hold that the Commission's interpretation that the phrase 'articles that infringe' covers goods that were used by an importer to directly infringe post-importation as a result of the seller's inducement is reasonable." *Id.* at 1352-53. Under *Suprema*, therefore, the statutory phrase "articles that . . . infringe" covers chassis and module combinations that, after importation of the modules, were used by Panduit's and Siemon's customers to directly infringe as a result of Panduit's and Siemon's inducement.

As discussed above, the Commission recently applied *Suprema* in *Blood Cholesterol Testing Strips*, in which imported test strips and meters were found to be "articles that infringe" where post-importation use of the articles according to the directions provided infringed the asserted method claims, and the imported articles had no substantial noninfringing uses. The Commission Opinion further explained that "[i]n any future investigation in which the Commission is presented with this issue, the

[redacted]

Commission will consider and fully assess its controlling statute, Congressional intent, the applicable precedent from the Commission's reviewing courts, and the relevant facts." *Blood Cholesterol Testing Strips*, Comm'n Op. at 32-33.

The relevant factors identified in *Blood Cholesterol Testing Strips* all favor a determination that Panduit and Siemon have committed an unfair act within the meaning of section 337. The evidence shows that Panduit and Siemon import modules that they then induce others to use in a manner that infringes the '320, '153, and '456 patents. The nature of the imported modules is that they are one of just two custom components that together make up infringing combinations of chassis and modules. They are not off-the-shelf staple items – their sole use is to be combined with chassis in order to house and connect fiber optic cables. While there are some combinations that do not infringe the asserted patents,[16] the relevant point is that there are also combinations that do infringe, and that the imported modules are specifically designed to be used in such combinations.[17] Once the modules arrive in the United States, the only remaining

[16] Panduit's accused modules can be used with Panduit products other than the Panduit accused chassis, such as Panduit's HD Flex Zero RU Bracket and Cassette Holders, which are not accused of infringement. *See* RX-1672C (Kuffel WS) Q/A 48-52; RX-0006C (Min RWS) Q/A 251; RX-0146 (HD Flex Ordering Guide). Panduit has also developed adapters to allow its accused modules to be used with unaccused alternative systems such as the SFQ and Opticom systems. *See* RX-1672C (Kuffel WS) Q/A 50-52. Siemon's accused modules can be used in a floor mounted enclosure that cannot be mounted to a rack and therefore does not infringe any of the '320, '153, and '456 patents. *See* RX-1266C (Veatch WS) Q/A 21. However, as discussed *infra*, the modules are intended to be used, and are in fact used, in infringing assemblies.

[17] There is record evidence of this. *See* JX-0029C (Wiltjer Dep. Tr.) at 121 (explaining Panduit customer support for using accused combination); CX-0145C (Panduit HD Flex Project Charter) (setting out as the purpose of Panduit's HD Flex products the combination of the HD Flex Modules in the HD Flex Chassis); *and* CX-0180C (Siemon LightStack specifications (Nov. 2019)) at 1-2; CX-0181C (Siemon LightStack 8 specifications (Nov. 2019)) at 1-2 (both promoting accused combinations and showing

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activity needed to form the infringing combination is to insert the modules into the chassis. The accused modules are not modified in any way before installation. No further manufacturing or component assembly is needed. In fact, given the limitations of the asserted claims, it is possible to form an infringing apparatus without even attaching fiber optic cables to the combination of chassis and modules. *See* JX-0004 ('320 Patent) at 19:51-67; JX-0007 ('153 Patent) at 16:51-20:30; JX-0010 ('456 Patent) at 21:43-24:43 (asserted claims). Under the framework set forth in *Blood Cholesterol Testing Strips*, Panduit's and Siemon's import activity is sufficiently tied to the alleged infringement to qualify as an unfair act under 19 U.S.C. § 1337(a)(1)(B).

Importation - FS and Wirewerks

FS admitted in confidential exhibits attached to their responses to the complaint that they have imported accused products. *See* FS Response to Complaint Ex. A (EDIS Doc. ID No. 707984). Wirewerks agrees that it has imported accused products. *See* Resps. Br. at 16.

3. Direct Infringement

As noted, Corning asserts independent claim 1 and dependent claim 3.

For the reasons discussed below, Corning has shown by a preponderance of the evidence that Panduit, Leviton, Siemon, and FS accused combinations practice each element of asserted claims of the '320 patent, either literally or under the doctrine of equivalents. However, it has not been shown that Panduit, Siemon, and FS accused

users how to install modules in chassis to reach 144 connections per 1U); CX-0179C (Siemon Plug and Play presentation) at 1, 3-4, and 10 (promoting accused combination); CX-0173C (Siemon 4U presentation) (showing design of modules to be combined with chassis).

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combinations directly infringe the asserted claims inasmuch as they do not sell their accused chassis and modules in combination. Inasmuch as Leviton is the only respondent shown to sell accused chassis and modules in an infringing combination, only Leviton directly infringes the asserted claims. Indirect infringement is discussed, *infra*.

Asserted claims 1 and 3 read as follows:

> **1**. A fiber optic apparatus, comprising:
>
> a chassis; and
>
> a fiber optic connection equipment provided in the chassis; the fiber optic connection equipment configured to support a ***fiber optic connection density*** of at least ninety-eight (98) fiber optic connections per ***U space***, ***based on using at least one simplex fiber optic component or at least one duplex fiber optic component***.
>
> **3**. The fiber optic apparatus of claim **1**, wherein the fiber optic connection equipment is configured to support a fiber optic connection density of at least one hundred forty-four (144) fiber optic connections per ***U space***.

JX-0004 ('320 Patent) at 19:52-67 (emphasis added).

a. Issues Common to Multiple Respondents

i. "configured to support"

Asserted claims 1 and 3 do not require a chassis loaded with enough modules to make 98 or 144 connections at the time of infringement. The claim language requires only "the fiber optic connection equipment configured to support a fiber optic connection density of at least [98 or 144] fiber optic connections per U space."

The phrase "the fiber optic connection equipment" refers back to the previous element, which requires "a fiber optic connection equipment provided in the chassis."

[redacted]

This limitation is met, therefore, when a single accused module is inserted into the chassis. *See* CX-0001C (Prucnal WS) Q/A 149, 151, 153, 155. That is consistent with the use of the singular "a fiber optic connection equipment."

The claim requires that the equipment provided in the chassis is "configured to support" a fiber optic connection density. Therefore, the claim does not require that the equipment reach a particular density — only that it be configured to support such a density.

A person of ordinary skill in the art would understand that the invention in the '320 patent is a system that is designed to permit a maximum of 98 or 144 connections in a 1U space, but that it does not require that maximum density to be used from the outset or at any particular point in time. To the contrary, the type of fiber optic equipment to which the invention of the '320 patent is directed "is customized based on the application and connection bandwidth needs. . . . When additional bandwidth is needed or desired, additional fiber optic equipment can be employed or scaled in the data center to increase optical fiber port count." JX-0004 ('320 Patent) at 1:52-53, 61-63. In other words, as inventors Harley Staber and Brian Rhoney have explained, the patented system is modular and scalable — it is designed to allow customers to add connections as demand warrants. CX-0006C (Staber WS) Q/A 12; CX-0007C (Rhoney WS) Q/A 9, 24.

Consistent with this, the '320 patent specification repeatedly uses the term "configured to support" to refer to the design of the fiber optic equipment, not to particular uses. For example, it states that "the chassis may be configured to support a fiber connection density of at least ninety-eight (98), at least one hundred twenty (120) per U-space, or at least one hundred forty-four (144) fiber optic connections per U space

[redacted]

based on using at least one simplex or duplex fiber optic component." JX-0004 ('320 Patent) at 2:11-15. This describes three distinct embodiments based on the number of components that each module accommodates:

> The fiber optic equipment trays 20 in this embodiment [Figure 1] support up to four (4) of the fiber optic modules 22 in approximately the width of a 1-U space, and three (3) fiber optic equipment trays 20 in the height of a 1-U space for a total of twelve (12) fiber optic modules 22 in a 1-U space. Thus, for example, if six (6) duplex fiber optic components were disposed in each of the twelve (12) fiber optic modules 22 installed in fiber optic equipment trays 20 of the chassis 12 as illustrated in FIG.1, a total of one hundred forty-four (144) fiber optic connections, or seventy-two (72) duplex channels (i.e., transmit and receive channels), would be supported by the chassis 12 in a 1-U space. If five (5) duplex fiber optic adapters are disposed in each of the twelve (12) fiber optic modules 22 installed in fiber optic equipment trays 20 of the chassis 12, a total of one hundred twenty (2) fiber optic connections, or sixty (60) duplex channels, would be supported by the chassis 12 in a 1-U space. The chassis 12 also supports at least ninety-eight (98) fiber optic components in a 1-U space where in at least one of the fiber optic components is a simplex or duplex fiber optic component."

JX-0004 ('320 Patent) at 5:33-52. As the specification later summarizes, "[w]hen this fiber optic module 22 form factor is combined with the ability to support up to twelve (12) fiber optic modules 22 in a 1-U space, as described by the exemplary chassis 12 example above, a higher fiber optic connection density is supported and possible." *Id.* at 8:46-51; *see also id.* at 10:25-45.

Thus, the patent shows that the claimed fiber optic equipment is configured to support a certain number of connections based on how the chassis, trays, and modules are designed, not based on how many of a particular module are inserted at any point in time. Whether a product satisfies only claim 1 (which requires 98 connections per U space) or both claim 1 and claim 3 (which requires 144 connections per U space), depends on the design of the product (such as the density of the modules), not on how many modules are

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inserted at any given time, as respondents incorrectly suggest.

The specification also repeatedly uses the phrase "configured to support" to describe the fiber optic equipment's design, not its use at any given point in time. For example, and as shown above, it states that "the chassis may be configured to support a fiber connection density of at least" 98, 120, or 144 fiber optic connections per U space based on using at least one simplex or duplex fiber optic component, depending on how many adapters is contained in each module. *Id.* at 2:11-15. The abstract similarly states: "At least one of the one or more of the U space fiber optic equipment units may be configured to support particular fiber optic connection densities and bandwidth in a given 1-U space." *Id.* at Abstract. As also shown above, the specification equates "fiber optic connection density" that is "supported" with a density that is "possible." *Id.* at 8:50-51. Further, the specification uses the term "configured to support" in the same manner to refer to LC fiber optic adapters, which it describes as "configured to receive and support connections with duplex LC fiber optic connections," *id.*, at 8:64-9:1. Here, too, the specification uses the term "configured to support" to describe a design with a "possible" use, not to describe whether that possible use is employed at any particular time.

In a case cited by respondents (Resps. Br. at 38), *Aspex Eyewear, Inc. v. Marchon Eyewear, Inc.*, 672 F.3d 1335, 1348-49 (Fed. Cir. 2012), the court interpreted the phrase "adapted to" in the limitation "said arms and said pair of magnetic members adapted to extend across respective side portions of a primary spectacle frame." The court recognized that "the phrase 'adapted to' is frequently used to mean 'made to,' 'designed to,' or 'configured to,' but it can also be used in a broader sense to mean 'capable of' or 'suitable for.'" *Id.* at 1349. Based on the intrinsic evidence before it, the court adopted

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the "narrower definition." *Id.* The court's analysis thus equated "configured to" with "designed to" (the "narrower reading"). Its reasoning shows that the interpretation of the claim language depends on the intrinsic evidence.

In re Giannelli, 739 F.3d 1375 (Fed. Cir. 2014), which respondents also cite (Resps. Br. at 39), similarly links the phrase "configured to" to the design of a product, not its actual use. That case involved a patent on an exercise machine "adapted" to be used with a "pulling" motion; the PTAB had found it obvious to modify a prior art machine adapted to be used with a "pushing motion." *Id.* at 1379. Quoting *Aspex Eyewear*, the court explained that the phrase "'adapted to' is frequently used to mean 'made to,' 'designed to,' or 'configured to,'" *id.*; construed the patent before it to have that meaning; and distinguished the prior art machine because "it is not obvious to modify a machine with handles designed to be pushed to one with handles adapted to be pulled." *Id.* at 1380 (observing that using a pulling motion with the prior art machine was "contraindicated"). Here, there is ample evidence that the accused products are "designed to" support 98 or 144 connections per U space; no evidence that "modif[ication]" is required for them to do so; and no evidence that such usage is "contraindicated."

<u>Simplex and Duplex Fiber Optic Components</u>

Claims 1 and 3 further require that the fiber optic connection equipment provided in the chassis — the modules — be configured to support 98 or 144 connections per U space "based on using at least one simplex fiber optic component or at least one duplex fiber optic component." The administrative law judge determined that the claim term "based on using at least one simplex fiber optic component or at least one duplex fiber

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optic component" should be construed to mean "based on using at least one fiber optic connector comprising either one or two strands of fiber, or at least one fiber optic adapter that receives such a connector." Thus, under this claim construction, a "fiber optic component" may be either a fiber optic adapter or a fiber optic connector. *See* JX-0004 ('320 Patent) at 5:18-19. Indeed, respondents' experts recognize that usage. *See*, *e.g.*, RX-0006C (Min RWS) Q/A 55 ("A simplex component (connector or adapter) supports communication through a single optical fiber."); RX-0001C (Blumenthal WS) Q/A 45 ("[A] person of ordinary skill in the art would understand that a 'duplex' component (connector or adapter) would support no more than a two-fiber connection.").

Each of respondents' accused modules except for Panduit's contains quad LC adapters. Respondents claim that the quad LC adapters in their accused modules are not a simplex or duplex component, but are instead a "multiple fiber" component. RX-0006C (Min RWS) Q/A 54. Yet, the record shows otherwise. First, the evidence shows clearly that a person of ordinary skill would consider a quad LC adapter to be a pair of duplex adapters, or a set of four simplex adapters, side by side. *See* Prucnal Tr. 391 ("[T]he quad adapter is just two duplex adapters next to each other."). Second, it is undisputed that quad LC adapters receive only simplex LC and duplex LC connectors. Thus, the density provided by these adapters is based on using simplex or duplex components, regardless of whether the adapters themselves are construed as simplex or duplex.

<u>Quad LC Adapters</u>

In the claim construction section of the related '456 patent, the administrative law judge has determined that (1) the claim term "simplex [LC] fiber optic adapter" should be

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construed to mean "fiber optic adapter that supports a simplex [LC] connector"; and (2) the claim term "duplex [LC] fiber optic adapter" should be construed to mean "fiber optic adapter that supports a duplex [LC] connector."

As discussed in the claim construction section, a person of ordinary skill would understand that quad LC adapters are also duplex LC and simplex LC adapters because they receive duplex LC and simplex LC connectors to form duplex and simplex connections. First, quad LC adapters meet the definition of duplex LC adapters in the '320 specification: "adapters that are configured to receive and support connections with duplex LC fiber optic connectors." JX-0004 ('320 patent) at 8:67-9:1. As Dr. Min conceded at the hearing, "the only type of connectors that a quad LC adapter could accept are simplex LC connectors and duplex LC connectors." Min Tr. 825.

Second, as discussed in the claim construction section, quad LC adapters meet the definition of duplex LC adapters in the TIA-568-C standard: "mechanical device designed to align and join two duplex optical fiber connectors (plugs) to form an optical duplex connection." CX-0922C (TIA-568-C.0); *see* Prucnal Tr. 387, 389 (explaining why respondents' quad LC adapters meet the standard).

Third, as discussed in the claim construction section, quad LC adapters conform to the LC standard (FOCIS-10), and are therefore — by definition — simplex LC and duplex LC adapters. CX-0195 (FOCIS-10A) at §§ 1.1, 1.2 (explaining that FOCIS-10 defines only simplex and duplex LC adapters); Min Tr. 828 ("[T]he LC standard that you're talking about, the FOCIS 10, only describes simplex and the duplex adapters."). A person of ordinary skill would understand that any adapter called an LC adapter is one that conforms to the LC standard, and would further understand that all adapters that

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conform to the LC standard are either a simplex LC adapter or a duplex LC adapter, or both. A person of ordinary skill would therefore consider that a quad LC adapter as either four simplex LC adapters, or two duplex LC adapters, or even a combination of two simplex and one duplex adapter(s); but not some other variant, because no other recognized variant exists.

Fourth, as discussed in the claim construction section, Leviton's patent (Wang '903) and the Smrha '684 patent respondents assert as prior art both recognize quad LC adapters as two duplex LC adapters arranged side by side. CX-0159 (Wang '903) at 14:60-62 (a "quad fiber optic adapter . . . may be characterized as including two duplex fiber optic adapters . . . arranged side-by-side"); CX-0032 (Smrha '684) at 3:38-45 (describing a quad LC adapter as "four adapters 46 (two adapter pairs)"); *id.* 4:20-22.

Fifth, as discussed in the claim construction section, respondents' documents indicate that respondents' quad LC adapters comply with the FOCIS-10 standard and have "[s]tandard [i]nterfaces," meaning that they contain simplex and duplex adapter interfaces. CX-0160C (11-19 Siemon LightStack 8 Spec.) at 3; *see* RX-0291C (LC Adapter Drawings) at 1.

ii. Doctrine of Equivalents (quad LC adapters)

While it is not the usual practice to discuss infringement under the doctrine of equivalents before discussing all the merits of literal infringement, this issue is common to multiple respondents, and thus it is appropriate to do so here. For the reasons set forth below, and as Dr. Prucnal has shown, respondents' accused modules with quad LC adapters infringe under the doctrine of equivalents because any differences between the

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claimed limitations and the accused devices are insubstantial. The accused devices perform substantially the same function as modules with duplex LC adapters, in substantially the same way, to achieve substantially the same result. *See* CX-0001C (Prucnal WS) Q/A 190-193.

In the context of the asserted claims and asserted patents, a person of ordinary skill would consider any differences between quad LC adapters and duplex LC adapters "insubstantial." *Warner-Jenkinson Co. v. Hilton Davis Chem. Co.*, 520 U.S. 17, 35-36 (1997); *see Valmont Indus., Inc. v. Reinke Mfg. Co.*, 983 F.2d 1039, 1043 (Fed. Cir. 1993) (assessing substantiality of difference from the perspective of one of ordinary skill). Respondents' quad LC adapters perform substantially the same function as duplex LC adapters. Indeed, they perform an identical function, which is to receive simplex or duplex LC connectors to make simplex or duplex LC connections. *See* CX-0001C (Prucnal WS) Q/A 191; RX-0006C (Min RWS) Q/A 55, 69; RX-0008C (Lebby RWS) Q/A 83, 223; RX-0001C (Blumenthal WS) Q/A 53; JX-0016C (Kim Dep. Tr.) 188-189; and JX-0018C (Maynard Dep. Tr.) 182. The sole function of any LC adapter is to receive and support an LC connector. Thus, the fact that quad LC adapters conform to the LC standard is itself proof that they perform the identical function to duplex LC adapters.

Respondents' experts argue that "[a] quad adapter, as its name indicates, supports four fiber optic connections in a single housing," which is "twice as many communication channels of the same form as a duplex adapter," RX-0006C (Min RWS) Q/A 64; *see* RX-0008C (Lebby RWS) Q/A 216, 220-223; and that, because a quad adapter receives four fibers instead of two, it can support four channels of

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communications, whereas "[s]implex and duplex adapters cannot support that same level of communication," RX-0008C (Lebby RWS) Q/A 222. However, this "quads go to four" argument fails as a matter of law. As the Federal Circuit has held:

> infringement under the doctrine of equivalents is not precluded merely because the accused device performs functions ***in addition to*** those performed by the claimed device. . . . It is the limitations and functions of the invention described in the claims, not the elements or functions of the accused device, which establish the reference point for the doctrine of equivalents analysis.

Insta-Foam Prods., Inc. v. Universal Foam Sys., Inc., 906 F.2d 698, 702 (1990) (emphasis added). That is, merely pointing to an additional function that quad adapters could theoretically perform does not matter if they perform the claimed function in the same way as duplex adapters.

Here, the relevant claim limitation recites "fiber optic connection equipment" — the accused modules — "configured to support a fiber optic connection density" of 98 or 144 fiber optic connections per U space "based on using at least one simplex fiber optic component or at least one duplex fiber optic component." JX-0004 ('320 Patent) at 19:55-59, 19:65-66. Accordingly, equivalence turns on whether respondents' accused modules are configured to achieve a fiber optic connection density of 144 connections per U space using an equivalent type of simplex or duplex connector or adapter as a module containing a duplex adapter. It is undisputed that respondents' accused products that use quad LC adapters receive the same type of connectors as similar products with duplex LC adapters and achieve exactly the same density (144 connections per U space) using those adapters.

Respondents' experts also concede another point that supports a finding of

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equivalence: quad LC adapters were known at the time of the patents. Each of respondents' technical experts shows examples of contemporaneous documents with quad LC adapters. *See* RX-0001C (Blumenthal WS) Q/A 55, 129-136, 145; RX-0006C (Min RWS) Q/A 57; RX-0008C (Lebby RWS) Q/A 167-178, 235. It is well settled that interchangeability weighs in favor of finding infringement under the doctrine of equivalents. *See*, *e.g.*, *Warner-Jenkinson Co.*, 520 U.S. at 36 ("The known interchangeability of substitutes for an element of a patent is one of the express objective factors . . . as bearing upon whether the accused device is substantially the same as the patented invention."); *Graver Tank & Mfg. Co. v. Linde Air Prods. Co.*, 339 U.S. 605, 609 (1950); *Corning Glass Works v. Sumitomo Elec. U.S.A., Inc.*, 868 F.2d 1251, 1261 (Fed. Cir. 1989).

The evidence shows not merely that quad LC adapters were available at the time of the invention, but that respondents considered them interchangeable with duplex LC adapters when designing their accused products. For example, whereas four of the five respondents chose to use quad LC adapters, the fifth, Panduit, chose duplex LC adapters instead, as did Corning. *See* CX-0147 (Panduit HD Flex Cassettes Spec.) at 1; CX-0666 (EDGE Brochure) at 8; CX-0667 (EDGE8 Brochure) at 6. Respondent FS makes modules for its accused chassis that not only use quad LC adapters, but also duplex LC adapters. CX-0423C (FS FHX MTP-12 Cassettes Prod. Spec.) at 1 (FS product specification showing another FS Accused Module with duplex adapters); JX-0031C (Zhang Dep. Tr.) 150:21-151:1 (confirming this FS module has duplex adapters). Some respondents' experts and engineers have testified, moreover, that respondents used quad LC adapters rather than duplex LC adapters because quad adapters cost less. *See* RX-

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0006C (Min RWS) Q/A 55; JX-0016C (Kim Dep. Tr.) 194-195. This further indicates that such adapters are functionally interchangeable, and that respondents' choice between them was not driven by functional considerations.

Respondents' experts opine that quad LC adapters allow for "connection flexibility" by allowing a duplex LC connector to be inserted into any of the four "adjacent ports" of a quad LC adapter, including the two center ports, which they claim would not be possible with two duplex adapters "because each of those adapters would be separated by a housing wall." RX-0008C (Lebby RWS) Q/A 222; RX-0006C (Min RWS) Q/A 65. However, neither Dr. Lebby nor Dr. Min provides any evidentiary support for this opinion. Mr. Kim testified that he had no knowledge of any such use occurring in the real world. *See* Kim Tr. 834-837.

As Dr. Prucnal explained, though it is theoretically possible to insert a duplex LC connector into the middle two ports of a quad LC adapter, it would violate basic principles of how these products were designed and are used. Prucnal Tr. 321.[18] Respondents' quad LC adapters label each pair of ports "A/B," as specified in the FOCIS 10 standard. *E.g.*, CX-1851 at 11; CX-1853 at 11, 30. This is done to maintain proper polarity. Prucnal Tr. 296. If a duplex LC connector were inserted into the middle two ports, it would upset this standardized polarity scheme. *See* Prucnal Tr. 322. There is significant evidence that they should not be used in this way. *See*, *e.g.*, JX-0016C (Kim Dep. Tr.) 193 (the A/B labeling is "referred to as a receive and send"), 217:18-218:10

[18] Inserting a duplex adapter into the middle two ports also would reduce the utility of the quad adapter. As Dr. Min admitted on cross examination, if a duplex LC connector is inserted into the middle two ports of a quad LC adapter, the outer ports could be used only for simplex connectors, whereas using the proper ports (1/2 or 3/4) leaves the other two ports for either simplex or duplex connectors. Min Tr. 834.

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("polarity means that [on] one end you have a receive that's going out of A, and the other end you need to have a send that is A"); CX-0159 (Wang '903) at 13 (explaining that "polarity designators . . . ensure that the . . . transmit signal (Tx) at one end of the cable matches the corresponding receiver (Rx) at the other end of the cable").

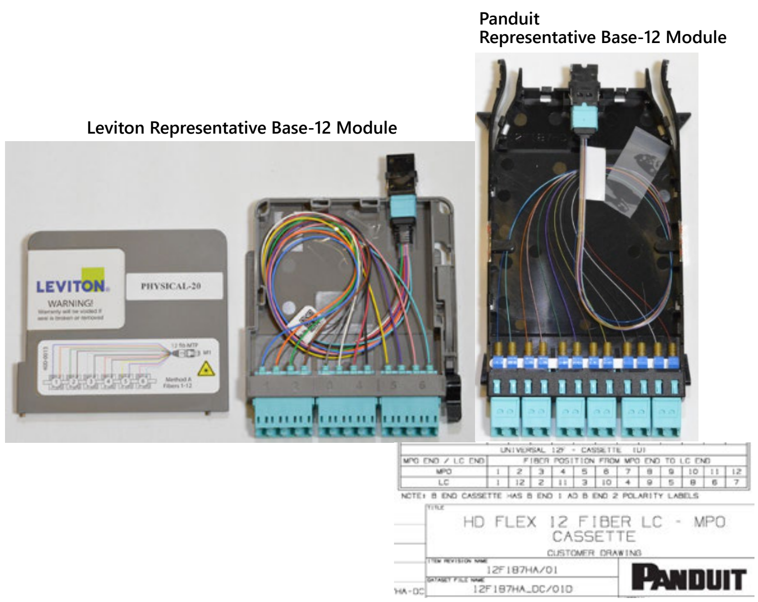
Respondents' experts also opine that the "smaller form factor" of a quad LC adapter distinguishes it functionally from a duplex LC adapter. *See* RX-0008C (Lebby RWS) Q/A 77, 231; RX-0006C (Min RWS) Q/A 65. Although quad LC adapters are a few millimeters narrower than two duplex LC adapters arranged side-by-side, this difference is irrelevant to the "function" of such adapters — to receive LC connectors. Nor does this slightly smaller form factor enable respondents' accused modules with quad LC adapters to achieve greater fiber connection density than do Corning's or Panduit's modules. To the contrary, they achieve identical density of 144 LC connections per U space.

Respondents' quad LC adapters perform the function of receiving LC connections in substantially the same way as duplex LC adapters. All of the domestic industry and accused modules use these adapters to provide 12 LC connections in a Base-12 Module, 8 LC connections in a Base-8 Module, and 24 LC connections in a Base-24 Module. All make duplex LC connections by receiving duplex connectors in the front. Further, on the interior of the module, all modules have individual fibers corresponding to each individual port of their LC adapters, individually numbered to correspond to the fibers to which these individual fibers connect in the multi-fiber MPO/MTP adapter on the rear of the module.

For example, the Leviton Representative Base-12 Module (on the left) with quad

[redacted]

LC adapters and the Panduit Representative Base-12 Module (on the right) with duplex LC adapters both have 12 individual fibers on the interior of the module that are numbered and correspond to specific fibers in the 12-fiber MTP adapters on the rear of the module, which is key to tracking and managing these connections. *See* CX-1851 (Leviton Photos Ex. H) at 14; CX-1849 (Panduit Photos Ex. F) at 23; CX-1631 (Panduit HD FLEX MPO Cassette Customer Drawing) at 1.



Dr. Min states that quad LC adapters do "not operate in substantially the same way as the claimed simplex or duplex fiber optic adapter primarily due to the differences in function." RX-0006C (Min RWS) Q/A 66. Dr. Lebby restates his opinion: "Leviton's quad adapters achieve their various functions by packing into a single form factor an adapter including four equally spaced ports, with each port designed to mate a single ferrule with another single ferrule." RX-0008C (Lebby RWS) Q/A 226. Neither Dr. Min nor Dr. Lebby addresses the fact that the form factor of the quad LC adapter does not affect how it forms LC connections or increase how many connections respondents'

[redacted]

accused modules provide.

Respondents' quad adapters achieve the same result as duplex LC adapters. Both establish LC duplex connections, which fiber harnesses then route to rear MPO or MTP adapters. CX-0001C (Prucnal WS) Q/A 191-94. Both provide the same number of LC connections per module — 12 in a Base-12 Module, 8 in a Base-8 Module, and 24 in a Base-24 Module. Both are configured to support exactly 144 LC connections in a 1U space.

Dr. Min opines that quad LC adapters have a "smaller form factor," and therefore achieve "substantially different results." However, his only support is to repeat the irrelevant fact that quad LC adapters support "twice the number of available fiber connections" as a duplex LC adapter. *See* RX-0006C (Min RWS) Q/A 67.

Dr. Lebby claims that Leviton was able to achieve a different result with quad LC adapters than it could have with duplex LC adapters — that "space savings associated with quad adapters allowed Leviton to include the front latch alongside the adapters, which ensures easy two-finger access to insert and remove Leviton cassettes, adapter plates, and splice modules." RX-0008C (Lebby RWS) Q/A 232. However, this is not a different result in terms of the claims of the '320 patent — it is the same result. *See* CX-0001C (Prucnal WS) Q/A 194.

b. Direct Infringement - Panduit

Panduit's HD FLEX Fiber product line consists of: (1) Base-8, Base-12, and Base-24 chassis, each available in 1U, 2U, and 4U sizes; and (2) Base-8, Base-12, and Base-24 modules. As shown in CX-1849 (Panduit photos) at 2, 22, and 74-75, Panduit's Base-12 chassis accept up to twelve Base-12 modules per U space, with six duplex

[redacted]

adapters per module.[19] Its Base-8 chassis accept up to six Base-8 modules per U space, with four duplex adapters per module. *Id*. at 24, 44, 69-70. Its Base-24 chassis accept two Base-24 modules per U space, with twelve duplex adapters per module. *Id*. at 46, 67, 79-80. Thus, in each case there are 144 fiber optic connections per U space. *See* CX-0001C (Prucnal WS) Q/A 85; CPX-0062 through CPX-0075 (Panduit chassis and modules).

CX-1849 (Panduit photos) at 2, 22 (depicting Base-12 products CPX-0063; CPX-0074)

Asserted claims 1 and 3 read as follows:

> **1**. A fiber optic apparatus, comprising:
>
> a chassis; and
>
> a fiber optic connection equipment provided in the chassis; the fiber optic connection equipment configured to support a ***fiber optic connection density*** of at least ninety-eight (98) fiber optic connections per ***U space***, ***based on using at least one simplex fiber optic component or at least one duplex fiber optic component***.
>
> **3**. The fiber optic apparatus of claim **1**, wherein the fiber optic connection equipment is configured to support a fiber optic connection density of at least one hundred forty-four (144) fiber optic connections per ***U space***.

[19] Panduit accused modules use two-fiber duplex adapters rather than quad adapters. *See*, *e.g.*, CPX-0074.

[redacted]

JX-0004 ('320 Patent) at 19:52-67 (emphasis added).

Dr. Prucnal testified that when combined, these Panduit accused products satisfy each element of claims 1 and 3 of the '320 patent. *See* CX-0001C (Prucnal WS) Q/A 133, 140, 148-49, 167-71; *see also* Staff Br. 69-71; Compl. Br. 73-75. The evidence supports Dr. Prucnal's testimony.

Respondents argue that Panduit accused products do not infringe based on the same "configured to support" argument discussed above in the common issues section. *See* Resps. Br. at 54-55. That discussion need not be repeated here.

Respondents argue:

> Complainant also argues that, if Complainant needs to show a specific connection density, either Panduit's marketing materials or testing of its products establishes infringement because they show a fully-loaded chassis. CPHB at 69-70. Complainant's allegations are conclusory at best and are insufficient to establish infringement. *See, e.g.*, *Kim v. ConAgra Foods, Inc.*, 465 F.3d 1312, 1319-20 (Fed. Cir. 2006); *Certain Audiovisual Components and Products Containing the Same*, Inv. No. 337-TA-837, Comm'n Op. at 20 (Mar. 26, 2014). While Complainant points to a Panduit brochure and deposition testimony discussing testing (CPHB at 69-70), neither the documents nor testimony identify the products that are pictured or that were tested. And for the testing, Mr. Wiltjer did not identify how the testing was done, what modules or chassis were used, or what connection density was achieved. *See* JX-0029C (Wiltjer Dep.) at 39:8-40:22, 42:7-12, 42:21-43:3. In fact, Mr. Wiltjer stated he did not know part numbers and did not know which products Panduit had tested. *Id*. Moreover, Complainant's own employee, Mr. Hicks, testified that "someone is probably going to get fired" if they build a data center at 100% capacity. Hicks Tr. 106:7-17. Complainant has no evidence of specific instances of direct infringement.

Resps. Br. at 55-56 (footnote omitted).

There was hearing testimony by AFL's Mr. Polidan that such fully loaded Panduit enclosures actually do exist. Polidan Tr. 193-194 ("Q. [H]ave you seen enclosures fully filled with cassettes of any of the other respondents' products here? A. Yes. Q. Which

[redacted]

ones? A. I've seen Panduit's cassettes fully loaded. I've seen Corning's cassettes fully loaded, and obviously ours."). More importantly, Panduit's accused products are "configured to support" 144 duplex connections whether or not all 144 connections are ever installed or used, and therefore read on the asserted claims. The accused combinations of Panduit products therefore infringe claims 1 and 3 of the '320 patent.

A difference between Leviton and Panduit is that while Leviton sells chassis and modules in combination, Panduit modules are sold separately from the chassis, with instructions provided to customers regarding installation of cassettes into compatible enclosures. *See* RX-0006C (Min RWS) Q/A 82; RX-0147 (HD Flex Fiber Cassette Enclosures Instructions FLEX1U and FLEX4U) at PANDUIT-ITC0001751 ("Cassette Installation (sold separately)"); RX-0148 (HD Flex Fiber Cassette Enclosures Instructions) at PANDUIT-ITC0001763 ("Cassette Installation (sold separately)"). Thus, it is customers, rather than Panduit, who assemble the chassis and modules into infringing combinations. Panduit therefore does not directly infringe the asserted claims of the '320 patent.

As discussed below in the Indirect Infringement section, however, Panduit indirectly infringes the asserted claims through its interactions with its customers.

c. Direct Infringement - Leviton

A difference between Panduit and Leviton is that while Panduit modules are sold separately from the chassis, Leviton sells chassis and modules in combination.

Leviton's accused products consist of Base-12 OPT-X UHDX chassis in 1U, 2U, and 4U sizes, as well as Base-12 and Base-24 HDX Enterprise modules. As shown in CX-1851 (Leviton photos) at 3, 23, and 25, each Leviton accused chassis accepts up to

[redacted]

twelve Base-12 modules per 1U space. Each module has three quad adapters on its front side, for a total of twelve fiber optic connections per module. The entire assembly thus supports up to 144 fiber optic connections per 1U space. The Base-24 configuration also supports up to 144 connections per 1U space. *See* CX-0001C (Prucnal WS) Q/A 98; CPX-0057 (Leviton Base-12 1U chassis); CPX-0060 (Leviton Base-12 module); CPX-0061 (Leviton Base-24 module). *See* Staff Br. at 66-67.

CX-1851 (Leviton photos) at 3, 13 (depicting CPX-0057; CPX-0060)

Asserted claims 1 and 3 read as follows:

> **1**. A fiber optic apparatus, comprising:
>
> a chassis; and
>
> a fiber optic connection equipment provided in the chassis; the fiber optic connection equipment configured to support a ***fiber optic connection density*** of at least ninety-eight (98) fiber optic connections per ***U space***, ***based on using at least one simplex fiber optic component or at least one duplex fiber optic component***.
>
> **3**. The fiber optic apparatus of claim **1**, wherein the fiber optic connection equipment is configured to support a fiber optic connection density of at least one hundred forty-four (144) fiber optic connections per ***U space***.

JX-0004 ('320 Patent) at 19:52-67 (emphasis added).

Dr. Prucnal testified that when combined, these Leviton accused products satisfy

[redacted]

each element of claims 1 and 3 of the '320 patent. *See* CX-0001C (Prucnal WS) Q/A 134, 141, 150-51, 172-76; *see also* Staff Br. 66-69; Compl. Br. 80-85. The evidence supports Dr. Prucnal's testimony.

Respondents argue that Leviton accused products do not infringe based on the same "configured to support" and "simplex" or "duplex" components arguments discussed above in the common issues section. *See* Resps. Br. at 59-60, 61-65. That discussion need not be repeated here.

Respondents also argue, "Complainant failed to prove any specific instance of Leviton making, using, or selling a Leviton Enclosure loaded with at least nine (9) Base-12 modules or at least five (5) Base-24 modules per 1RU (claim 1), let alone fully loaded with Leviton accused modules (required by claim 3)." Resps. Br. at 60.[20]

The asserted claims of the '320 patent call for a combination of a chassis and fiber optic connection equipment including at least one module that has a simplex or duplex fiber optic component. *See* JX-0004 ('320 Patent) at 19:51-59. Leviton sells such chassis and modules in combination. *See* CX-0152 (Leviton OPT-X enclosure product

[20] It is noted that the accused chassis can also support other combinations of chassis and modules, some of which would be noninfringing. In Leviton's case, the accused chassis can also be used with products, such as adapter plates, that are not accused. *See* Resps. Br. at 56; RX-0008C (Lebby RWS) Q/A 210. Respondents argue that there are numerous substantial uses for the Leviton UHDX Enclosures that do not infringe claims 1 or 3 of the '320 patent. *Id*. The concept of "substantial noninfringing uses," however, is only relevant to contributory infringement. *See* 35 U.S.C. § 271(c). In the context of direct infringement, "[i]t is well settled that an accused device that 'sometimes, but not always, embodies a claim[] nonetheless infringes." *Broadcom Corp. v. Emulex Corp*., 732 F.3d 1325, 1333 (Fed. Cir. 2013) (quoting *Bell Commc'ns Research, Inc. v. Vitalink Commc'ns Corp*., 55 F.3d 615, 622-23 (Fed. Cir. 1995)); *see also Wisconsin Alumni Research Found. v. Apple Inc.*, 905 F.3d 1341, 1349 (Fed. Cir. 2018) (finding insufficient evidence that accused product sometimes infringed). Indirect infringement is discussed, *infra*.

[redacted]

specifications) ("Enclosures shall be pre-configured or ma[d]e to order with respective adapter plates and MTP cassettes, for easy ordering with one part number."); CX-0150 (Leviton *Fiber Systems* product literature) at 12-15 (Ordering Guide: "(1) Select Enclosures & Panels . . . (2) Select Enclosure Accessories . . . (3) Select Adapter Plates OR Select MTP Cassettes . . .(4) Select Splice Trays/Modules . . . (5) Select Connectors").

There is evidence that Leviton has at least advertised such combinations, and there is no reason to believe that no Leviton customer has ever responded to those advertisements by purchasing a preloaded chassis. Prucnal Tr. 306-307 ("I've seen Leviton marketing material with preloaded chassis. And I don't know if that means offering to sell legally, but I have seen them configured that way.").

Moreover, there is sufficient circumstantial evidence that Leviton, and at least some of its customers, have fully loaded at least one accused chassis with accused modules.

First, Leviton developed its accused products specifically to meet consumer demand for 144 LC connections per 1U space, as opposed to the lower density its products already supported. *See* CX-0001C (Prucnal WS) , Q605, 619; CX-2060C (Prucnal RWS) Q/A 304-317. Leviton's [redacted] to obtain approval to develop what became the accused products lists as the [redacted] that "Leviton does not have an equivalent Ultra High Density solution to Corning's EDGE, Systimax's '360', and Ortronics' OptiMo enclosures for Data Center market." CX-0083C (6/16/15 Leviton Email) at 128; CX-0078C (6/21/11 Leviton Email) at 2; *see* JX-0016C (Kim Dep. Tr.) 43; *id.* 51-52. Leviton recognized this market as the [redacted]

[redacted]

[redacted] CX-0083C (6/16/15 Leviton Email) at 128. It acknowledged that, without a "solution" that could offer 144 connections per 1U, it had "lost" "[m]ultiple large project opportunities." *Id.* It also recognized customers' "need for higher density in one rack unit" as a result of "[r]ack space for structured connectivity due to more and more active equipments [e.g., switches and routers] being installed." *Id.*

Shortly before it released its accused chassis, Leviton developed a [redacted] for Leviton's new Ultra High Density Enclosure System. CX-0083C (6/16/15 Leviton Email) at 77. That statement described "144-F [fibers] per RU" as Leviton's [redacted] and described Leviton's [redacted] that its new "[u]ltra high density" system would "[m]aximize space usage and solve challenges with typical high-density systems." *Id.* at 78. The "typical" systems, as Mr. Kim acknowledged, were the older 72- and 96-fiber systems, JX-0016C (Kim Dep. Tr.) 138:13-17. The document further states that such "[m]aximum [d]ensity [s]aves [d]ata [c]enter [s]pace and $$ (144, 288, and 576)"; and that the new enclosure (UHD) "offers 100% more density than Opt-X, 33% more than Opt-X HD," which were the old 72- and 96-fiber systems. CX-0083C (6/16/15 Leviton Email) at 78; *see* JX-0016C (Kim Dep. Tr.) 138-139.

[redacted]

[redacted]

The same document included an "Enclosure Density Comparison" of Leviton's products offering 72, 96, and 144 connections to quantify space and cost savings from the new "144-F" product — assuming that the new product is fully loaded. *See* CX-0083C (6/16/15 Leviton Email) at 81.

Similarly, Leviton's [redacted] for its accused Ultra High Density Enclosure analyzed [redacted] compared to competing products such as EDGE. *See id.* at 138-39. That analysis explicitly stated each chassis would be "fully loaded." CX-0083C (6/16/15 Leviton Email) at 139; *see also id.* at 144 (summary of "[c]ustomer [r]equirements" stating that "most enclosures are typically fully loaded"). Similarly, Leviton's [redacted] made to help its salespeople sell products, include an [redacted] for a "Fully Loaded 1RU enclosure." *Id.* at 126; Kim Tr. 517-518 (confirming that CX-0083C (6/16/15 Leviton Email) at 126 "lists the price of a

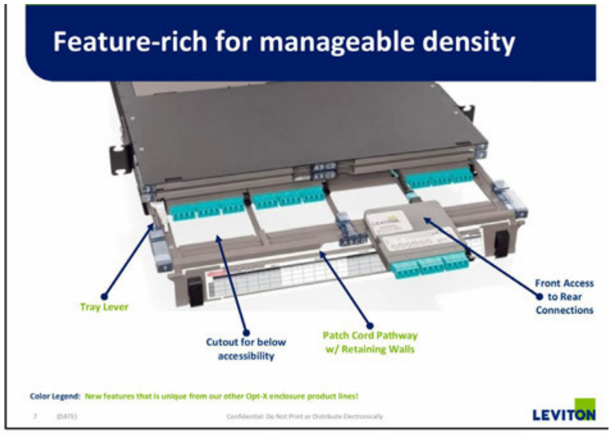
[redacted]

fully loaded 1RU enclosure”).

Second, Leviton markets its accused products to emphasize its ability to provide 144 connections per 1RU and benefits of using this higher density. After Leviton introduced its accused chassis, it created product literature stating that the new system offers “144 LC Fibers (1 RU),” describing this as “[u]ltra high density to help meet increasing network demands in data centers.” CX-0150 (Leviton Fiber Systems Prod. Literature) at 3-4. The same literature promotes the “maximum capacity” of the Leviton accused chassis and shows that it is reached when filled with 12 Leviton accused modules. *Id.* A presentation that Leviton made to a customer [redacted] likewise emphasizes “144 fibers per RU,” and contrasts it with Leviton’s 72 and 96 fiber products. CX-1602C (Leviton HDX Cassette Presentation) at 3.

Third, the record demonstrates that Leviton itself has fully loaded its accused chassis with accused modules. For example, [redacted] marketing presentation emphasizes Leviton’s “manageable density” by showing the features that make the fiber accessible even when the chassis is fully loaded. *Id.* at 6-8. One slide shows the accused Leviton chassis partially loaded with accused Leviton modules to highlight the features to help manage density. *Id.* at 7. The next slide shows the chassis fully loaded, to show that the density is manageable even when the chassis is fully loaded. *Id.* at 8.

[redacted]



Mr. Kim's testimony also indicates that Leviton loads chassis. When asked whether "customers at Leviton sometimes order the UHDX enclosure filled with cassettes", Mr. Kim responded that "we have had customer order HDX enclosure with cassettes — cassettes inserted into the enclosure." JX-0016C (Kim Dep. Tr.) 140.

Leviton also created videos further showing that it fully loads chassis and encourages customers to do so. *See* CDX-0014 (Opt-X UHDX Fiber Enclosure System Video) at 0:14-0:33, 0:52-1:06, 1:34-2:18 (formerly CPX-0024); CPX-0025 (How to Install the Opt-X UHDX Enclosure Video) at 0:28-1:02. Although Leviton objected to the admission of CPX-0024 at the hearing, the administrative law judge ruled that it would be received "as a demonstrative exhibit to help illustrate Dr. Prucnal's direct

[redacted]

testimony." Tr. 896. In that testimony, Dr. Prucnal identified CPX-0024 as an "example[ ]" of one of "Respondents' own marketing materials and videos," some of which "show the chassis fully loaded with modules." CX-0001C (Prucnal WS) Q/A 67-68. His review of those materials — among many others listed in his witness statement — supports his opinion that "Respondents go through a lot of effort to feature this density in their marketing and their documents and their manuals that all describe, very importantly and very prominently, that having this 144-connection density is an important part of the product." Prucnal Tr. 405.

It is also probable that before releasing and selling their products, Leviton confirmed that its accused modules worked properly with its accused chassis by filling the accused chassis with accused modules. Indeed, Leviton's documents show such testing occurred. A 2014 internal presentation included pictures of a loaded prototype and comments on evaluations of [redacted] and [redacted] CX-0082C (4/4/14 Leviton Email) at 9; *see id.* at 8-11 (discussing findings that trays were [redacted] that [redacted] that trays [redacted] from [redacted] and that [redacted]). It is not reasonable that Leviton's engineers assessed the [redacted] of its trays without ever fully loading them with modules.

Accordingly, the accused combinations of Leviton products directly infringe asserted claims 1 and 3 of the '320 patent.

d. Direct Infringement - Siemon

The Siemon LightStack Ultra High-Density Fiber Plug and Play system consists of Base-8 and Base-12 chassis in 1U, 2U, and 4U sizes, as well as modules in Base-8 and

[redacted]

Base-12 configurations. As shown in CX-1853 (Siemon photos) at 2 and 13, Siemon's Base-12 chassis accept up to twelve Base-12 modules per U space, with three quad adapters per module. Its Base-8 chassis accept up to six Base-8 modules per U space, with two quad adapters per module. *Id*. at 19, 26. Thus, in each case there are 144 fiber optic connections per U space. *See* CX-0001C (Prucnal WS) Q/A 106; CPX-0076 through CPX-0080 (Siemon accused products).

CX-1853 (Siemon photos) at 2, 13 (depicting Base-12 products CPX-0077; CPX-0080)

Asserted claims 1 and 3 read as follows:

> **1**. A fiber optic apparatus, comprising:
>
> a chassis; and
>
> a fiber optic connection equipment provided in the chassis; the fiber optic connection equipment configured to support a ***fiber optic connection density*** of at least ninety-eight (98) fiber optic connections per ***U space***, ***based on using at least one simplex fiber optic component or at least one duplex fiber optic component***.
>
> **3**. The fiber optic apparatus of claim **1**, wherein the fiber optic connection equipment is configured to support a fiber optic connection density of at least one hundred forty-four (144) fiber optic connections per ***U space***.

JX-0004 ('320 Patent) at 19:52-67 (emphasis added).

[redacted]

Dr. Prucnal testified that when combined, these Siemon accused products satisfy each element of claims 1 and 3 of the '320 patent. *See* CX-0001C (Prucnal WS) Q/A 135, 142, 151-53, 177-80; *see also* Staff Br. 71-73; Compl. Br. 89-90. The evidence supports Dr. Prucnal's testimony.

Respondents argue that Siemon accused products do not infringe based on the same "configured to support" and "simplex" or "duplex" components arguments discussed above in the common issues section. *See* Resps. Br. at 71-72. That discussion need not be repeated here.

As discussed above, it is the combination of chassis and modules that infringes the asserted claims of the '320 patent, not the separate components. Siemon's Mr. Veatch testified that Siemon has never sold LightStack enclosures pre-loaded with LightStack modules. RX-1266C (Veatch WS) Q/A 22-23 ("[T]hey are sold in separate packaging, and are shipped to the end customer from different facilities. Enclosures are shipped directly from Siemon's facility in Connecticut, while the modules are shipped directly from Siemon's partner in Mexico or Siemon's facility in China."). Thus, it is customers, rather than Siemon, who assemble the LightStack chassis and modules into infringing combinations. Accordingly, Siemon does not directly infringe the asserted claims of the '320 patent.

As discussed in the Indirect Infringement section below, however, Siemon indirectly infringes the asserted claims.

e. Direct Infringement - FS

FS's accused FHX Series and FHX-FCP/ FHX-C Series chassis and modules consist of a 1U chassis that in the Base-12 configuration accepts three rows of four

[redacted]

modules each, for a total of up to twelve modules per 1U space. Each Base-12 module has three quad adapters on its front side, for a total of twelve fiber optic connections per module. The entire assembly thus supports up to 144 fiber optic connections per 1U space. The Base-8 configuration also supports up to 144 connections per 1U space. *See* CX-0001C (Prucnal WS) Q/A 117; CPX-0053 (FS Base-8 1U chassis); CPX-0054 (FS Base-12 1U chassis); CPX-0055 (FS Base-8 module); CPX-0056 (FS Base-12 module).

CX-1855 (FS photos) at 2, 15 (depicting CPX-0054; CPX-0056)

Asserted claims 1 and 3 read as follows:

> **1**. A fiber optic apparatus, comprising:
>
> a chassis; and
>
> a fiber optic connection equipment provided in the chassis; the fiber optic connection equipment configured to support a ***fiber optic connection density*** of at least ninety-eight (98) fiber optic connections per ***U space***, ***based on using at least one simplex fiber optic component or at least one duplex fiber optic component***.
>
> **3**. The fiber optic apparatus of claim **1**, wherein the fiber optic connection equipment is configured to support a fiber optic connection density of at least one hundred forty-four (144) fiber optic connections per ***U space***.

JX-0004 ('320 Patent) at 19:51-67 (emphasis added).

Dr. Prucnal testified that when combined, these FS accused products satisfy each

[redacted]

element of claims 1 and 3 of the '320 patent. *See* CX-0001C (Prucnal WS) Q/A 136, 143, 154-55, 181-85; *see also* Staff Br. 62-66; Compl. Br. 93-95. The evidence supports Dr. Prucnal's testimony. However, respondents argue:

> Turning now to the "simplex" and "duplex" limitations of the asserted claims, the General Manager of FS testified that the base-8 and base-12 modules accused of infringement in this Investigation have only ever contained quad adapters. RX-0010 (Zhang WS) Q/A 8-14. Given the presence of these quad adapters, for the reasons given with regard to the other respondents, the accused FS modules do not satisfy the "simplex"/"duplex" limitations of the asserted claims of the '320 patent, either literally or under the doctrine of equivalents. RX-0006C (Min RWS) Q/A 50-76. The accused FS modules, therefore, do not directly infringe the asserted claims of the '320 patent, even if there were a cognizable act of infringement on the part of FS. *Id.* Q/A 50.

Resps. Br. at 76.

This argument was addressed above in the common issues section.

In short, in the claim construction section above, the administrative law judge construed the claim term "based on using at least one simplex fiber optic component or at least one duplex fiber optic component" should be construed to mean "based on using at least one fiber optic connector comprising either one or two strands of fiber, or at least one fiber optic adapter that receives such a connector."

The quad adapters in the FS accused products are duplex fiber optic components under the proper claim construction of the claim term "based on using at least one simplex fiber optic component or at least one duplex fiber optic component," and thus satisfy the final limitation of claim 1 of the '320 patent.

* * *

Nonetheless, as discussed below, FS does not directly infringe the asserted claims

[redacted]

of the '320 patent. The asserted claims of the '320 patent call for a combination of a chassis and fiber optic connection equipment including at least one module that has a simplex or duplex fiber optic component. *See* JX-0004 ('320 Patent) at 19:51-59 (claiming "[a] fiber optic apparatus comprising: a chassis; and a fiber optic connection equipment provided in the chassis"). It is the combination of chassis and module that infringes, not the separate components. FS's Mr. Zhang testified that FS's FHX products were "sold in separate packaging" and that FS has never sold chassis pre-loaded with modules. RX-0010 (Zhang WS) Q/A 27-28. Thus, it is customers, rather than FS, who would assemble the FHX chassis and modules into infringing combinations. Accordingly, FS does not directly infringe the asserted claims of the '320 patent. As discussed in the indirect infringement section below, however, FS indirectly infringes the asserted claims through its interactions with its customers.

4. Indirect Infringement

As noted, Corning asserts claims 1 and 3 of the '320 patent. Those claims read as follows:

> **1**. A fiber optic ***apparatus***, comprising:
>
> a ***chassis***; and
>
> a ***fiber optic connection equipment*** provided in the chassis; the fiber optic connection equipment configured to support a fiber optic connection density of at least ninety-eight (98) fiber optic connections per U space, based on using at least one simplex fiber optic component or at least one duplex fiber optic component.
>
> 3. The fiber optic apparatus of claim 1, wherein the fiber optic connection equipment is configured to support a fiber optic connection density of at least

[redacted]

one hundred forty-four (144) fiber optic connections per U space.

JX-0004 (‘320 Patent) at 19:51-67 (emphasis added).

Thus, the asserted claims of the ‘320 patent (as well as the ‘153, and ‘456 patents discussed, *infra*) disclose an apparatus consisting of two principal parts: a chassis and one or more fiber optic modules. Of the respondents accused of infringement, only Leviton sells its accused chassis and modules in combination. Panduit, Siemon, and FS each package and sell their accused chassis separately from their accused modules. Inasmuch as only a combination of chassis and modules can infringe the ‘320 patent, these three respondents have not been shown to directly infringe the ‘320 patent. Nonetheless, for the reasons discussed below, the record evidence demonstrates that Panduit, Siemon, and FS, as well as Leviton, indirectly infringe the asserted claims of the ‘320 patent by actively inducing the direct infringement of that patent by their customers.

a. Induced Infringement

Corning argues that Panduit, Leviton, Siemon, and FS induce others to infringe asserted claims 1 and 3 of the ‘320 patent. *See* Compl. Br. at 76-78, 85-88, 90-92, 95-97. The Staff agrees. *See* Staff Br. at 73-77.

Section 271(b) of the Patent Act provides: “Whoever actively induces infringement of a patent shall be liable as an infringer.” 35 U.S.C. § 271(b).

Induced infringement requires proof of two types of knowledge by the alleged inducer: knowledge of the patent in question and knowledge that the induced acts infringe the patent. *Commil*, 135 S. Ct. at 1926; *see also Global-Tech Appliances, Inc. v. SEB S.A.*, 563 U.S. 754, 766 (2011); *Microsoft*, 755 F.3d at 904 (to prove induced

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infringement, patentee must show that accused inducer took an affirmative act to encourage infringement with knowledge that the induced acts constitute patent infringement). Induced infringement requires a finding that the infringer possessed a specific intent to encourage another's infringement. *i4i*, 598 F.3d at 851.

i. Direct Infringement by Others

At the evidentiary hearing, Corning's witnesses testified that it was "common" for customers to "fully load EDGE chassis with EDGE modules," CX-0004C (Hicks WS) Q/A 25; that Corning "markets EDGE as enabling 144 single-fiber connections per 1U space precisely because data centers typically want to make as many connections as possible," *id.*; that Corning's "competitors do the same thing," *id.*; and that "[c]ustomers with large data centers typically have bay after bay, row after row, of fiber optic connection equipment, which is why high-density equipment is so important," CX-0006C (Staber WS) Q/A 12; *see also* Prucnal Tr. 405 (explaining the needs of large data centers, and adding: "The notion that the chassis wouldn't be fully populated when there's so many fibers that have to be broken out is kind of ridiculous. Maybe not all of them are fully — are full, but certainly many of them, if not most of them, are full."). Steve Polidan of former respondent AFL confirmed that, based on his 21 years of experience, he has seen chassis "completely loaded," and that he has personally seen AFL, Panduit, and Corning EDGE chassis fully loaded at customer sites. Polidan Tr. 192-194.

As shown for each respondent below, respondents' own documents provide circumstantial evidence that each respondent's accused chassis have been (a) loaded with at least one corresponding accused module, by respondents' customers; and (b) have been fully loaded to achieve their maximum density of 144 fiber optic connections per U

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space. *See Vita-Mix Corp. v. Basic Holding, Inc.*, 581 F.3d 1317, 1326 (Fed. Cir. 2009) ("Direct infringement can be proven by circumstantial evidence."); *Martek Biosciences Corp. v. Nutrinova, Inc.*, 579 F.3d 1363, 1372 (Fed. Cir. 2009) ("A patentee may prove infringement by 'any method of analysis that is probative of the fact of infringement,' and circumstantial evidence may be sufficient." (quoting *Forest Labs., Inc. v. Abbott Labs.*, 239 F.3d 1305, 1312 (Fed. Cir. 2001))); *Alco Standard Corp. v. Tenn. Valley Auth.*, 808 F.2d 1490, 1503 (Fed. Cir. 1986) ("Although the evidence of infringement is circumstantial, that does not make it any less credible or persuasive."). That evidence includes specifications, instruction manuals, videos, and similar materials showing the accused chassis fully loaded and indicating that this is a way in which they can and should be used.

Each respondent's documents also show that they tout density, and its benefits, in their marketing to customers. This significant — and consistent — evidence of how respondents market the accused products is also strong circumstantial evidence that at least some customers have fully loaded chassis. *See Bayer Healthcare, LLC v. Zoetis Inc.*, No. 12 C 00630, 2016 WL 4179087 at *29 (N.D. Ill. Aug. 8, 2016) ("Pfizer's marketing and advertising materials . . . also provide circumstantial evidence of direct infringement."). Respondents would not emphasize the benefits of fully loading in their marketing materials unless they had determined it was a feature customers wanted. In similar circumstances, courts have found "that where an alleged infringer designs a product for use in an infringing way . . . there is sufficient evidence for a jury to find direct infringement." *Toshiba Corp. v. Imation Corp.*, 681 F.3d 1358, 1365 (Fed. Cir. 2012); *see Lucent Techs., Inc. v. Gateway, Inc.*, 580 F.3d 1301, 1318 (Fed. Cir. 2009)

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(concluding that circumstantial evidence was sufficient to find direct infringement where the expert testified that "[i]t's hard to imagine that we're the only two people in the world that ever used it'" and "Microsoft . . . designed the accused products to practice the claimed invention" (alterations in original)).

Respondents, by contrast, did not offer evidence suggesting that the products they specifically designed to provide greater density of 144 connections per 1U (and that they market for that purpose) were never used by customers in that manner. None of respondents' witnesses has claimed that they or their customers have not in fact combined, or have not in fact fully loaded, their accused chassis with their respective accused modules. *See Golden Blount, Inc. v. Robert H. Peterson Co.*, 438 F.3d 1354, 1363 (Fed. Cir. 2006) (finding infringement where defendant offered no evidence that it "or any end-user ignored the instructions" teaching an infringing configuration or acted "contrary to the instructions so as to form a non-infringing configuration"). Instead, respondents' witnesses have either (somewhat implausibly) testified that they are unaware of how their customers use their products, or have wholly failed to provide testimony on this issue.

Respondents' experts, moreover, formed their opinions that respondents did not infringe without considering the evidence. Dr. Min, the noninfringement expert for Panduit, Siemon, and FS, admitted that he formed his opinion without reviewing respondent documents that Corning and Dr. Prucnal cited, Min Tr. 802-806, that he never asked respondents whether they or their customers fully loaded their accused chassis with accused modules, *id.* 806:6-807:4, and that he was not providing an opinion that there was no evidence to show that Siemon's and FS's chassis had been fully loaded,

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id. 798-800. Mr. Veatch of Siemon provided no testimony on this issue, while Mr. Zhang of FS confirmed that certain exhibits show FS chassis fully loaded with FS modules. Zhang Tr. 586-587, 589-590, 592-593, 594.

Dr. Lebby likewise did not consider relevant evidence. His list of materials considered shows that he never addressed the extensive documentation that Corning and Dr. Prucnal presented. *See* RX-0008C (Lebby RWS) Q/A 26-28 (listing materials considered). Dr. Lebby testified that he spoke to only one Leviton employee, Frank Kim, *id.* Q/A 26, but Mr. Kim testified that he is "not aware of how a customer uses our existing product in their arrangement from the patch cord out, from the cassette on the front side." JX-0016C (Kim Dep. Tr.) 193.

ii. Induced Infringement - Panduit

As discussed below, the evidence shows that Panduit induces others to infringe asserted claims 1 and 3 of the '320 patent. *See* Compl. Br. at 76-78; Staff Br. at 73-77.

Direct Infringement

As discussed above, Panduit's customers directly infringe the asserted patents. Panduit sells the accused products to customers in the United States. *See, e.g.*, CX-0146 (6/19/20 Panduit Email) (describing and showing photographs of a customer's use of Panduit accused modules with Panduit accused chassis).

Knowledge

Panduit knew of each asserted patent when it was first issued, as it concedes. CX-0361C (Panduit June 4, 2020 Rog Responses) at 140 (Interrog. No. 82); *see also, e.g.*, Kuffel Tr. 624 (testifying that he knew of certain Corning patents at least as of 2010).

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Inducing Acts

Panduit actively induced the infringement of the asserted patents by encouraging, teaching, and aiding third parties to use their accused products in an infringing device. Panduit's user instructions inform customers how to combine the accused modules and chassis in a way that infringes the asserted patents. *See, e.g.*, CX-1623 (Panduit FLEX1U, FLEX4U Installation Instructions); CX-1705 (Panduit FLEX1U, FLEX2U, & FLEX4U Installation Instructions). Panduit's promotional materials and sales efforts also encouraged users to use the accused combinations to infringe. *See, e.g.*, Min Tr. 839-40; CX-0199 (Panduit HD Flex Enclosures Spec.); JX-0029C (Wiltjer Dep. Tr.) 121:7-14; CX-0382 (Panduit HD FLEX Ordering Guide) at 3-6; CX-0146C (6/19/19 Panduit Email); CX-0145C (Panduit HD Flex Project Charter); CX-1708 (Panduit HD Flex Fiber Enclosure Spec.); CX-0147 (Panduit HD Flex Cassettes Spec.).

Dr. Prucnal testified during the hearing that customers learn to assemble the chassis and modules in infringing combinations from respondents' product literature and instructions. Prucnal Tr. 370. In addition, Ms. Mulhern conceded that Panduit's documents show, and she had "no reason to doubt" that "Panduit's customers demand a high level of technical support" before and after the sales of accused products. Mulhern Tr. 928; *see also* Mulhern Tr. 956 ("[O]ne of the things we know about this market is that the customers are very sophisticated and require . . . technical support.").

Panduit's documents expressly state that their products support 144 connections, describe the benefits of using this capacity, and inform customers how many cassettes are needed to achieve this density. *See, e.g.*, CX-0621 (Panduit Chassis Spec.) at 3 (stating that enclosures provide a "fiber capacity" of "144" in "1 RU"); CX-1623 (Panduit

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FLEX1U, FLEX4U Installation Instructions) at 3 (instructing customers to "[p]opulate an entire row" before moving to the next and "[r]epeat [the] process until all desired slots are filled"; "FLEX1U can hold up to 12 cassettes"); *id.* at 4 (illustrating cable routing for a fully populated 1U); CX-1705 (Panduit FLEX1U, FLEX2U, & FLEX4U Installation Instructions) at 8-9 (similar). No more direct instruction than this is required. *See Golden Blount, Inc.*, 438 F.3d at 1363.

iii. Induced Infringement - Leviton

As discussed below, the evidence shows that Leviton induces others to infringe asserted claims 1 and 3 of the '320 patent. *See* Compl. Br. at 85-88; Staff Br. at 73-77.

Direct Infringement

As discussed above, Leviton's customers directly infringe the asserted patents. Leviton sells the accused products to customers in the United States. *See, e.g.*, JX-0016C (Kim Dep. Tr.) 135 (naming customers who have purchased the combination).

Knowledge

Leviton knew of each asserted patent at least as of February 2020, when the complaint was filed.

Circumstantial evidence shows an earlier knowledge. The EDGE products bear labels indicating patent protection and directing users to Corning's website, which contains virtual patent marking — including all four asserted patents — regarding the EDGE products. *See, e.g.*, CPX-0043 (EDGE Base-12 Module). Further, as discussed in the Validity (Secondary Considerations) section, *infra*, Leviton's documents and

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testimony show that it had samples of Corning's products.[21] *See Suprema, Inc. v. Int'l Trade Comm'n*, 626 F. App'x 273, 281 (Fed. Cir. 2015) (attributing knowledge to infringer who was "well-aware of competitor products," the inventor's "prominence" in the market, and of a related patent); *SynQor, Inc. v. Artesyn Techs., Inc.*, 709 F.3d 1365, 1380 (Fed. Cir. 2013) (sufficient knowledge for indirect infringement when defendants acquired product samples and datasheets marked with earlier patents to which asserted patents claimed priority).

Indeed, Leviton was aware of the "proprietary" nature of EDGE's patented features by no later than 2013. *See* CX-0081C (Leviton email dated Apr. 17, 2013) at LEVITONITC1194_00003163.006.

<u>Inducing Acts</u>

Leviton actively induced the infringement of the asserted patents by encouraging, teaching, or otherwise aiding third parties to use its accused products in combination. Leviton's user instructions inform customers how to combine the accused modules and chassis to infringe the asserted patents. *See, e.g.*, Min Tr. 839-840 (testifying that respondents advertise that their accused products can be combined); Prucnal Tr. 368-69 (testifying that Leviton ordering guide CX-0150 (Leviton Fiber Systems Prod. Literature) instructs customers to purchase accused chassis preassembled with accused modules); CX-0087C (Leviton Enclosure Instructions). Leviton has instructed its users to infringe, promoted the infringing combination to its users, and actively encouraged infringing sales. *See, e.g.*, CX-0093 (Leviton HDX MTP Cassette Spec.) (promoting fully loading

[21] In developing the Leviton accused products, Mr. Kim admitted that Leviton had obtained copies of the EDGE products and analyzed them. Kim Tr. 481; JX-0016C (Kim Dep. Tr.) 35-37; CX-2060C (Prucnal RWS) Q/A 310.

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accused modules "for 144 LC fibers per RU"); CX-0086C (3/20/20 Leviton Email) (showing accused combination); CX-0083C (6/16/15 Leviton Email) at 136 (same); *id.* at 54 (marketing strategy to promote sales of accused combination); *id.* at 60 (website portal for purchasing accused combination); *id.* at 61 (listing customers Leviton encouraged to purchase accused combination); JX-0016C (Kim Dep. Tr.) 69-70 (accused chassis and modules developed for use together); *id.* at 140 (customers have ordered cassettes installed in enclosures); *id.* at 99-100, 146-147.

In addition, Dr. Prucnal testified that customers learn how to assemble the chassis and modules in infringing combinations from respondents' product literature and instructions, Prucnal Tr. 370; and Ms. Mulhern testified that customers in the relevant market require technical support, *see* Mulhern Tr. 956, supporting an inference that Leviton provided such support to its customers. *See also, e.g.*, RX-0198 (Leviton Support Catalog) at 2 (advertising data center support); RX-0212 (Leviton Catalog) at 6, 10-11 (promising customers that Leviton backs up its products ongoing support).

Respondents argue that Leviton merely describes the capabilities of the Leviton UHDX Enclosures including that they are compatible not only with Leviton accused modules, but also with other non-accused cassettes and modules. *See* Resps. Br. at 67-68. Leviton's attempt to draw a distinction between merely describing the capabilities of its accused products and wrongfully encouraging customers to use those capabilities is not persuasive. Leviton's documents make plain that it is actively promoting the benefits of using its accused products' density capabilities to their fullest, including saving rack space and corresponding expense. *See, e.g.* CX-0093 (Leviton HDX MTP Cassette Spec.).

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Leviton's claims regarding noninfringing cassettes and modules also are not persuasive. Its expert identifies only one such product with LC adapters on the front and multiple fiber MPO/MTP adapters on the rear, that product is for an unusual case of adapting a base-8 system to a base-12 enclosure. *See* RX-0008C (Lebby RWS) Q/A 207. Thus, none of the products are designed for the customer application that was the primary driver in developing and marketing the Leviton accused products — the need for 144 fiber optic simplex or duplex connections in a single U space (discussed in the Validity (Secondary Considerations) section, *infra*). In light of the sufficient evidence that Leviton makes infringing chassis and infringing modules and induces its customers to use them in infringing combinations, the fact that it also makes noninfringing modules and cassettes is irrelevant. *See Bell Commc'ns Research, Inc. v. Vitalink Commc'ns Corp.*, 55 F.3d 615, 622-23 (Fed. Cir. 1995) ("[A]n accused product that sometimes, but not always, embodies a claimed method nonetheless infringes."); *Toshiba Corp.*, 681 F.3d at 1364 (Fed. Cir. 2012) ("The existence of a substantial non-infringing use does not preclude a finding of inducement.").

iv. Induced Infringement - Siemon

As discussed below, the evidence shows that Siemon induces others to infringe asserted claims 1 and 3 of the '320 patent. *See* Compl. Br. at 90-92; Staff Br. at 73-77.

Direct Infringement

As discussed above, Siemon's customers directly infringe the asserted patents. Siemon sells the accused products to customers in the United States. *See, e.g.*, CX-0222C (Siemon [redacted] Stage 2 Presentation) (describing a design of the accused combination).

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Knowledge

Siemon knew of each asserted patent at least as of February 2020, when the complaint was filed. Siemon admitted knowledge of the the '320 patent by October 30, 2019. CX-0324C (Siemon Resp. to Corning 1st Interrogs.) at No. 70. Siemon likely had even earlier knowledge of all the asserted patents: As discussed with respect to Leviton, Corning labels its EDGE products with references to patents and directions to a website listing patents covering EDGE. Further, as discussed in the Validity (Secondary Considerations) section, *infra*, Siemon's documents and testimony show that it was aware of Corning's protection of its intellectual property, had samples of Corning's products, and possibly copied EDGE, all of which — as discussed with respect to Leviton — are evidence of knowledge of the asserted patents. JX-0019C (Nagel Dep. Tr.) 36 (admitting that Siemon was aware of Corning's patent protection on its products). Siemon also modified its products in mid-2019 in view of Corning's patents covering EDGE. *Id.* at 112, 112-113, 123-124.

Inducing Acts

Siemon actively induced the infringement of the asserted patents by encouraging, teaching, or otherwise aiding third parties to use its accused products in combination. Siemon's user instructions inform customers how to combine the accused modules and chassis to infringe the asserted patents. *See, e.g.*, Min Tr. 839-40 (testifying that respondents advertise that their accused products can be combined); CX-1791C (2/17 Siemon LightStack 4U Install Instructions). Siemon has instructed its users to infringe, promoted the infringing combination to its users, and actively encouraged infringing sales. *See, e.g.*, CX-0180C (11/19 Siemon LightStack Spec.) at 1-2 (promoting accused

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combination and showing users how to install modules in chassis to reach 144 connections per 1U); CX-0181C (11/19 Siemon LightStack 8 Spec.) at 1-2 (same for base-8 combination); CX-0179C (Siemon Plug and Play Presentation) at 1, 3-4, and 10 (promoting accused combination); CX-0173C (Siemon 4U Presentation) (same); JX-0018C (Maynard Dep. Tr.) 213 (Siemon shows customers how to install modules in chassis); 239-240.

In addition, Dr. Prucnal testified that customers learn how to assemble the chassis and modules in infringing combinations from respondents' product literature and instructions, Prucnal Tr. 370; and Ms. Mulhern testified that customers in the relevant market require technical support, *see* Mulhern Tr. 956, supporting an inference that Siemon in fact provided such support to its customers. *See also* CX-2071C (12-18-18 Siemon Email) at 12 (advertising onsite support).

Siemon argues that "[a]ll of the advertising and product sheets produced in this case show the availability of non-accused Adapter Plates in addition to the Accused Modules as potential uses for the Accused Enclosures… and none of these documents indicate a preference or direction to fill the Enclosures with LightStack Modules versus Adapter Plates." As discussed above, Siemon's documents specifically direct customers to load the accused chassis with accused modules. Any promotion of noninfringing uses does not expunge promotion of infringing uses — particularly where, as here, those infringing uses involve common applications in data centers.

v. Induced Infringement - FS

As discussed below, the evidence shows that FS induces others to infringe asserted claims 1 and 3 of the '320 patent. *See* Compl. Br. at 95-97; Staff Br. at 73-77.

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Direct Infringement

As discussed above, FS's customers directly infringe the asserted patents. FS sells the accused products to customers in the United States. *See, e.g.*, Zhang Tr. 580, 588; CX-0428C (FS Sales and Inventory Data) (listing U.S. sales of accused products); JX-0031C (Zhang Dep. Tr.) 115-116.

Knowledge

FS knew of each asserted patent at least as of February 2020, when the complaint was filed. As shown with respect to Leviton, Corning labels its EDGE products with references to patents and directions to a website listing patents covering EDGE. Further, FS possibly copied EDGE, which is evidence of knowledge of the asserted patents. For example, FS advertised its accused products as a substitute for EDGE. *See* CX-0397 (FS Tweet).

Inducing Acts

FS actively induced the infringement of the asserted patents by encouraging, teaching, or otherwise inducing third parties to use its accused products in combination. FS's user instructions inform customers how to combine the accused modules and chassis to infringe the asserted patents. *See, e.g.*, CX-0392C (FS FHX Ultra Fiber Enclosure Spec.). FS has instructed its users to infringe, promoted the infringing combination to its users, and actively encouraged infringing sales. *See, e.g.*, Min Tr. 839-40 (testifying that respondents advertise that their accused products can be combined); CX-0391 (FS FHX Enclosure Article) (promoting use of the accused combination); CX-0392C (FS FHX Ultra Fiber Enclosure Spec.) (same); CX-0397 (FS Tweet) (same); CX-0419C (FS FHX Ultra Enclosure for MTP-8 Cassette Prod. Spec.); CX-0420C (FS FHX-1UFCP Ultra

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Fiber Enclosure Prod. Spec.); CX-0421C (FS FHX MTP-12 Cassettes Spec.); CX-0422C (FS FHX MPO-LC Cassettes); CX-0423C (FS FHX MTP-12 Cassettes Prod. Spec.); CX-0424C (FS FHX MTP-8 Cassettes Spec.); CX-0425C (FS FHX MPO-8 Cassettes); CX-0426C (FS FHX Conversion Cassette Spec.).

In addition, Dr. Prucnal testified that customers learn how to assemble the chassis and modules in infringing combinations from respondents' product literature and instructions, Prucnal Tr. 370; and Ms. Mulhern testified that customers in the relevant market require technical support, *see* Mulhern Tr. 956, supporting an inference that FS in fact provided such support to its customers.

Since receiving Corning's complaint, FS has maintained an inventory of nearly 3,000 accused modules at its Delaware warehouse. JX-0031C (Zhang Dep. Tr.) 163-166; CX-0428C (FS Sales and Inventory Data). Thousands of accused cassettes and their corresponding chassis are in circulation in the United States. Even after FS admitted it knew of the patents, it continued to encourage the infringing combination, as shown by FS's online resources captured in July 2020. *See, e.g.,* CX-1515 (FS Ultra High Density Solution) (advertising the infringing combination with the accused products); CX-1520 (FS Microsoft Webpage) at 2 (promoting use of accused combination); CX-2059 (FS FHX Ultra HD User Guide); CX-2059 (FS FHX Ultra HD User Guide). Even Mr. Zhang's claim that FS has not sold infringing products "since May" fails to show there were no sales in March or April. *See* RX-0010 (Zhang WS) Q/A 31.

At least some of these online resources are hosted with United States entities; all are aimed at a United States audience, including the United States customers to whom FS has sold thousands of accused products. *See Transocean Offshore Deepwater Drilling,*

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Inc. v. Maersk Contractors USA, Inc., 617 F.3d 1296, 1309 (Fed. Cir. 2010 (holding that an offer to sell under § 271(a) occurs at the "location of the future sale that would occur pursuant to the offer"). There is also evidence that FS effectively operates the FS website that advertises and offers to sell the accused products, *see* JX-0031C (Zhang Dep. Tr.) 111 (admitting that FS itself changed the product offerings on the website); and that in any event the various FS affiliates operate as one. For example, Wei Xiang is the CEO of FS Ltd, FS, FS's five sister companies around the world, the FS affiliate that allegedly owns and operates the FS website, and oversees various affiliated companies. *See* CX-0391 (FS FHX Enclosure Article); JX-0030C (Xiang Dep. Tr.) 17-23. Mr. Zhang's testimony to the contrary is not persuasive. Zhang Tr. 582 (initially denying that he communicated with Mr. Xiang about the website, then admitting that he testified to the contrary).

The FS website does not inform customers which company supplies the products they purchase, and customers were not informed of the distinction between the affiliated companies that worked side-by-side. JX-0031C (Zhang Dep. Tr.) 74-75, 172-173. FS and its affiliates are not merely silent about their corporate distinctions, but actively obscure them. *See, e.g.*, CX-0405 (FS Opens New Warehouse) (announcing that the new operations in Delaware of FS Inc. was the second "FS" branch in the United States). Under these circumstances, FS is liable for its affiliates' conduct. *See Certain Neodymium-Iron-Boron Magnets, Magnet Alloys, and Articles Containing Same*, Inv. No. 337-TA-372, Initial Determination, at 33-34, 81 (Dec. 11, 1995) (finding that two respondents were alter egos and finding violations by both, despite only one having sold the accused products).

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b. Contributory Infringement

i. Contributory Infringement - Panduit, Leviton, and Siemon

Corning argues that Panduit, Leviton, and Siemon contributorily infringe asserted claims 1 and 3 of the '320 patent. *See* Compl. Br. at 78-80, 88-89, 92-93.

Section 271(c) of the Patent Act provides: "Whoever offers to sell or sells within the United States or imports into the United States a component of a patented machine, manufacture, combination or composition, or a material or apparatus for use in practicing a patented process, constituting a material part of the invention, knowing the same to be especially made or especially adapted for use in an infringement of such patent, and not a staple article or commodity of commerce suitable for substantial noninfringing use, shall be liable as a contributory infringer." 35 U.S.C. § 271(c).

Thus, to establish contributory infringement, the complainant must show that: (1) direct infringement exists; (2) the accused infringer had knowledge of the patent; (3) the component provided to the direct infringer has no substantial noninfringing uses; and (4); the component is a material part of the invention. 35 U.S.C. § 271(c); *Fujitsu Ltd. v. Netgear Inc.*, 620 F.3d 1321, 1326 (Fed. Cir. 2010). "[N]on-infringing uses are substantial when they are not unusual, far-fetched, illusory, impractical, occasional, aberrant, or experimental." *Vita-Mix Corp. v. Basic Holding, Inc.*, 581 F.3d 1317, 1327 (Fed. Cir. 2009). "[C]ontributory infringement requires knowledge of the patent in suit and knowledge of patent infringement." *Commil*, 135 S. Ct. at 1926.

Panduit, Leviton, and Siemon argue that they do not contributorily infringe because their accused chassis and modules have substantial noninfringing uses. There is

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evidence to support these assertions.

First, Panduit's accused modules can be used with Panduit products other than the Panduit accused chassis, such as the unaccused HD Flex Zero RU Bracket and Cassette Holders. *See* Staff Br. at 78; Resps. Br. at 58; RX-1672C (Kuffel WS) Q/A 48-52; *see also* RX-0006C (Min RWS) Q/A 251; RX-0146 (HD Flex Ordering Guide). Panduit has also developed adapters to allow its accused modules to be used with unaccused alternative systems such as the SFQ and Opticom systems. RX-1672C (Kuffel WS) Q/A 50-52.

Second, Leviton's accused UHDX Enclosures can be used with at least 64 varieties of other cassettes, 21 varieties of adapter plates, and 12 varieties of splice modules, none of which are accused of infringement. *See* Staff Br. at 78; Resps. Br. at 69; RX-0005C (Kim WS) Q/A 23-27; RX-0008C (Lebby RWS) Q/A 203-10. Complainant's expert, Dr. Prucnal, conceded at the hearing that the combination of a Leviton UHDX Enclosure with these other cassettes, adapter plates, and splice modules would be a substantial non-infringing use. Prucnal Tr. 338-339.

Third, the trays in each of the Siemon accused chassis can be filled with one or more adapter plates instead of the accused modules. *See* Staff Br. at 78-79; Resps. Br. at 73; RX-1266C (Veatch WS) Q/A 20; RX-0086C (Siemon presentation, "LightStack, Ultra High Density Plug and Play System"); RX-0006C (Min RWS) Q/A 253, 259. Moreover, Siemon's accused modules can be used in a floor mounted enclosure that cannot be mounted to a rack and therefore does not infringe any of the '320, '153, and '456 patents. RX-1266C (Veatch WS) Q/A 21.

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Accordingly, the evidence does not establish contributory infringement by Panduit, Leviton, or Siemon.

ii. Contributory Infringement - FS

Corning argues that FS contributorily infringe asserted claims 1 and 3 of the ‘320 patent. Concerning FS, Corning argues:

> As shown above, FS.com’s customers directly infringe the Asserted Patents; FS.com knew of the Asserted Patents; each FS.com Accused Chassis and Module is material to the infringing combination; and each FS.com Accused Product was specially designed for that use. Respondents concede that there are no substantial non-infringing uses. RPreHB at 79; *see also* Min Tr. 841-42.

See Compl. Br. at 98.

Respondents argue:

> As noted above, unlike direct infringement, indirect infringement has a knowledge component. FS had no knowledge of the patents asserted by Corning in this Investigation prior to receiving the subject Complaint. RX-0010 (Zhang WS) Q/A 20-21. Upon receipt of that Complaint, FS discontinued the sale of the accused products. *Id*. Q/A 17-19. Thus, to the extent that sales of the accused FS products could have led to a direct infringement by FS customers “when at least one module is inserted into the tray,” providing the requisite underlying direct infringement, no such predicate sales occurred with the knowledge requisite for indirect infringement, and Corning provides no evidence thereof. CX-0001C (Prucnal WS) Q/A155.
>
> Otherwise, to the extent Complainant somehow maintains that the FS.com website provides evidence of indirect infringement, as noted above, FS does not own or operate that website. In any event, Mr. Zhang testified that FS intended that any content regarding its accused FHX products be removed from the FS.com website once FS.com, Inc. received the Complaint in this Investigation. Zhang Tr. at 597:14-19. The only “evidence” Complainant offered to counter that testimony included a screenshot purporting to be from the FS.com website downloaded on July 7, 2020 - a document (and especially a date) that Mr. Zhang, when asked, could not authenticate. Zhang Tr. at 584:11-16.
>
> Complainant also showed Mr. Zhang a Youtube video screen shot

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> bearing a date of July 2, 2020. Zhang Tr. at 587:3-10. As with the FS.com website page, Complainant failed to authenticate the date affixed on the screen shot through Mr. Zhang. *See id.* (Mr. Zhang simply acknowledging that the date appeared on the document shown to him). At no point did Complainant offer up a witness with the knowledge to do so to lay a proper foundation for these documents, and particularly the date thereon. As the Administrative Law Judge noted, "I have yet to tell someone that their paralegal can make documents by downloading things off the Internet such as the original contract to the sale of the Brooklyn Bridge." Judge Shaw Tr. 895:16-19.

Resps. Br. at 76-77.

The Staff argues:

> FS did not present any evidence of substantial noninfringing uses, relying instead on its argument that it cannot indirectly infringe because it did not make any sales of accused products after learning of the accused patents. *See* RX-0010 (Zhang WS) Q/A 17-21. FS's chassis and modules, however, work in basically the same way as those of the other Respondents. Moreover, as discussed above, there is evidence that FS has at least continued to induce infringement by customers who had previously purchased FS accused products. In the Staff's view, therefore, FS has been shown to indirectly infringe even without proof of contributory infringement.

See Staff Br. at 78 n.22.

In view of the authentication issues involving Internet video screenshots, Corning has not established contributory infringement by FS.

C. Domestic Industry (Technical Prong)

As discussed below, the evidence shows that the Corning domestic industry products are covered by claims 1 and 3 of the '320 patent.

Asserted claims 1 and 3 read as follows:

> **1**. A fiber optic apparatus, comprising:
>
> a chassis; and
>
> a fiber optic connection equipment provided in the chassis; the fiber optic connection equipment

[redacted]

configured to support a ***fiber optic connection density*** of at least ninety-eight (98) fiber optic connections per ***U space***, ***based on using at least one simplex fiber optic component or at least one duplex fiber optic component***.

3. The fiber optic apparatus of claim **1**, wherein the fiber optic connection equipment is configured to support a fiber optic connection density of at least one hundred forty-four (144) fiber optic connections per ***U space***.

JX-0004 ('320 Patent) at 19:52-67 (emphasis added).

The Corning EDGE Solutions product line includes Base-8 and Base-12 chassis in 1U, 2U, 4U, and 5U sizes, as well as modules in Base-8 and Base-12 configurations. *Id*. Q/A 31-36; CX-0002C (Ralph WS) Q/A 36. As shown in CX-1869 (Corning EDGE photos) at 2 and 42, Corning's Base-12 chassis accept up to twelve Base-12 modules per U space, with six standard duplex adapters per module. Its Base-8 chassis accept up to six Base-8 modules per U space, with four standard duplex adapters per module. *Id*. at 17, 48. Thus, in each case there are 144 fiber optic connections per U space. *See* CX-0002C (Ralph WS) Q/A 68; CPX-0040 through CPX-0045 (Corning EDGE products).

CX-1869 (Corning EDGE photos) at 2, 42 (depicting Base-12 products CPX-0041; CPX-0043)

[redacted]

The EDGE DI Chassis with EDGE DI modules practice claims 1 and 3 of the '320 patent. These claims are directed to a fiber optic apparatus comprising a chassis, with fiber optic connection equipment provided in the chassis, configured to support at least 98 or 144 connections per U space based on using simplex or duplex fiber optic components. Complainant's technical prong expert Dr. Ralph testified that the EDGE DI Chassis is a chassis, designed to be equipped with EDGE DI modules. *See* CX-0002C (Ralph WS) Q/A 55-59; CPX-0040 (EDGE Base-8 Chassis); CPX-0041 (EDGE Base-12 Chassis); CPX-0042 (EDGE Base-8 Module); CPX-0043 (EDGE Base-12 Module); CX-1869 (Corning Photos Ex. D) at 2, 17. An EDGE DI Chassis equipped with at least one EDGE DI Module is fiber optic connection equipment provided in the chassis configured to support 144 connections per U space based on using duplex LC components, and so practices claims 1 and 3. *See* CX-0002C (Ralph WS) Q/A 67-70; Ralph Tr. 224:16-20, 226:15-20.

Respondents argue:

> Complainant failed to prove any combination of an EDGE chassis and modules that practices claims 1 or 3 of the '320 Patent. RX-0008C (Lebby RWS) Q/A 343-360. An EDGE Base-12 Chassis must be loaded with at least nine (9) EDGE Base-12 Modules per 1RU, and an EDGE Base-8 Chassis must be loaded with at least thirteen (13) EDGE Base-8 Modules, to be "configured to support . . . at least ninety-eight (98) fiber optic connections" per 1RU, as required by claim 1. RX-0008C (Lebby RWS) Q/A 347-349; Ralph Tr. 224:24-225:2, 225:14-20; *see* Section V.C. An EDGE Base-12 Chassis must be fully loaded with Base-12 Modules, and an EDGE Base-8 Chassis must be fully loaded with EDGE Base-8 Modules, to be "configured to support . . . at least one hundred forty-four (144)fiber optic connections" per 1RU, as required by claim 3. RX-0008C (Lebby RWS) Q/A 347-349; Ralph Tr. 225:3-9, 225:21-25; *see* Section V.C. Complainant did not even bother to cross-examine Respondents' expert Dr. Lebby – leaving his domestic industry opinions unchallenged.

[redacted]

Resps. Br. at 257-58 (footnote omitted).

First, Corning's witnesses testified that EDGE DI Chassis are full loaded with EDGE DI modules in some cases. For example, Mr. Hicks testified that it "is common" for customers to fully load EDGE chassis with EDGE modules, and that he has seen data center customers fully load an EDGE chassis to reach 144 LC connections in a 1U. CX-0004C (Hicks WS) Q/A 25 & 26. Mr. Hicks further explained at the hearing that he had personally seen a fully loaded EDGE chassis at a JP Morgan Chase data center in Delaware. Hicks Tr. 108-109. Similarly, Mr. Staber testified that he himself had fully loaded EDGE DI Chassis with EDGE DI modules, explaining: "[w]hen we developed EDGE, we did rigorous testing where we fully populated the chassis with modules making 144 connections, and we brought in our field engineering services group to run tests on these products." CX-0006C (Staber WS) Q/A 6. Mr. Hicks further testified:

> Customers are often purchasing many chassis at once, and you would do that only if you plan to fill at least some of them. You also would purchase a 2U or 4U chassis only if you wanted more connections than a 1U. We market EDGE as enabling 144 single-fiber connections per 1U space precisely because data centers typically want to make as many connections as possible. Our competitors do the same thing. It is . . . usually the first and most prominent feature that is advertised.

CX-0004C (Hicks WS) Q/A 25. Mr. Rhoney testified that "customers use the modularity of EDGE to scale up to a full chassis capacity over time." CX-0007C (Rhoney WS) Q/A 27. Respondents declined to cross-examine any of those witnesses.

Second, Corning's marketing materials show EDGE DI modules in an EDGE DI Chassis. *See* CX-0002C (Ralph WS) Q/A 42; Ralph Tr. 246:12-248:17; CX-0666 (EDGE Brochure); CX-0667 (EDGE8 Brochure); CPX-0013 (Pretium EDGE Solutions Video); CPX-0012 (EDGE Jumper Management Video); CPX-0011 (EDGE8 Housing

[redacted]

Features and Benefits Video).

Third, as with the accused products, the EDGE DI modules were designed to be used with the EDGE DI Chassis to achieve 144 connections per 1U space, and are marketed for that use. Mr. Hicks testified that Corning provides instructions and manuals informing customers how to use the EDGE DI Products, including how to fully load the chassis with modules. Hicks Tr. 105-106. Examples of such marketing materials include: CX-0666 (EDGE Brochure) at 8; CX-0667 (EDGE8 Brochure) at 6; CX-0652 (Corning EDGE-01U-SP Specs.) at 2; CX-0654 (Corning EDGE8-01U-SP Specs.) at 2; CX-0658 (Corning ECM-UM08-05-E6Q-ULL Specs.) at 2; CX-0653 (Corning EDGE-04U Specs.) at 3; CX-0655 (Corning EDGE8-04U Specs.) at 1.

Fourth, the documents and testimony of respondents and former respondent AFL further confirm that EDGE DI Chassis have been fully loaded with EDGE DI modules. Mr. Polidan of AFL testified that he had personally seen EDGE chassis "fully loaded" at customer sites. Polidan Tr. 193:20-194:2. Panduit's internal documents show — and its witness confirmed — that when Panduit itself purchased and analyzed the Corning EDGE DI Chassis, it fully loaded the chassis with modules. CX-0112C (Panduit Competitive Product Evaluation-3) at 15; Kuffel Tr. 632. Leviton's documents also show each size of the EDGE chassis (1, 2, and 4U) "fully patched" — that is, fully loaded. CX-0083C (6/16/15 Leviton Email) at 140.

Thus, even if Corning never directly practiced its own '320 patent, it would nevertheless satisfy the technical prong of the domestic industry requirement because its customers practice the patent. As noted, Corning advertises that EDGE chassis and modules are designed to work together and instructs its customers on how to do so. In

[redacted]

the process, Corning knowingly encourages its customers to practice the '320 patent by using its EDGE chassis and modules in combination. As Mr. Hicks testified, the customers follow Corning's instructions, thereby directly practicing claims 1 and 3 of the '320 patent. CX-0004C (Hicks WS) Q/A 25-26. This is sufficient to constitute inducement under 35 U.S.C. § 271(b).[22]

Corning therefore has satisfied the technical prong of the domestic industry requirement with respect to the '320 patent.

D. Validity of the '320 Patent

Respondents argue:

(1) the Panduit FCE1 Enclosure equipped with Panduit FAP Panels and Panduit FCX-24-10 Cassettes anticipates claims 1 and 3;

(2) Vazquez anticipates claims 1 and 3 under pre-AIA 35 U.S.C. §102(e);

(3) asserted claims 1 and 3 are rendered obvious by the Panduit FCE1 Enclosure using Panduit FAP Panels and Panduit FCX-24-10 Cassettes;

(4) asserted claims 1 and 3 are rendered obvious by a combination of Panduit products (the Panduit FMT2 enclosure and the Panduit FEAT104LC93 patch panel with duplex adapters);

(5) asserted claims 1 and 3 are rendered obvious by the combination of U.S. Patent No. 8,179,684 ("Smrha '684") (RX-0458), and a prior art product by AFL Future Access 1RU;

(6) asserted claims 1 and 3 are invalid because they are not enabled; and

[22] The technical prong may be satisfied through inducement. *Certain Endoscopic Probes for Use in Argon Plasma Coagulation Systems*, Inv. No. 337-TA-569, Initial Det. at 81 (Jan. 16, 2008) (*aff'd*, Comm'n Notice (Mar. 17, 2008) ("The standard for determining whether the complainant practices at least one claim of the asserted patent is the same as that for infringement. That is, the complainant must show that the domestic industry *either directly or indirectly* infringes at least one claim of the asserted patent.") (emphasis added); *Alloc, Inc. v. International Trade Comm'n*, 342 F.3d 1361, 1375 (Fed. Cir. 2003) ("The test for satisfying the 'technical prong' of the industry requirement is essentially same as that for infringement[.]").

[redacted]

(7) the claim term "U space" renders claims 1 and 3 indefinite.

See Resps. Br. at 77-130.

Complainant and the Staff disagree. *See* Compl. Br. at 139-61, 218-26, 228-30; Staff Br. at 85-115.

For the reasons set forth below, respondents have not shown by clear and convincing evidence that the asserted claims 1 and 2 of the '320 patent are invalid under any theory.

1. Applicable Law

One cannot be held liable for practicing an invalid patent claim. *See Pandrol USA, LP v. AirBoss Railway Prods., Inc.*, 320 F.3d 1354, 1365 (Fed. Cir. 2003). Nevertheless, each claim of a patent is presumed to be valid, even if it depends from a claim found to be invalid. 35 U.S.C. § 282; *DMI Inc. v. Deere & Co.*, 802 F.2d 421 (Fed. Cir. 1986).

A respondent that has raised patent invalidity as an affirmative defense must overcome the presumption by "clear and convincing" evidence of invalidity. *Checkpoint Systems, Inc. v. United States Int'l Trade Comm'n*, 54 F.3d 756, 761 (Fed. Cir. 1995).

a. Anticipation

Anticipation under 35 U.S.C. § 102 is a question of fact. *z4 Techs., Inc. v. Microsoft Corp.*, 507 F.3d 1340, 1347 (Fed. Cir. 2007). Section 102 provides that, depending on the circumstances, a claimed invention may be anticipated by variety of prior art, including publications, earlier-sold products, and patents. *See* 35 U.S.C. § 102 (*e.g.*, section 102(b) provides that one is not entitled to a patent if the claimed invention "was patented or described in a printed publication in this or a foreign country or in

[redacted]

public use or on sale in this country, more than one year prior to the date of the application for patent in the United States").

The general law of anticipation may be summarized, as follows:

> A reference is anticipatory under § 102(b) when it satisfies particular requirements. First, the reference must disclose each and every element of the claimed invention, whether it does so explicitly or inherently. *Eli Lilly & Co. v. Zenith Goldline Pharms., Inc.*, 471 F.3d 1369, 1375 (Fed.Cir.2006). While those elements must be "arranged or combined in the same way as in the claim," *Net MoneyIN, Inc. v. VeriSign, Inc.*, 545 F.3d 1359, 1370 (Fed.Cir.2008), the reference need not satisfy an *ipsissimis verbis* test, *In re Bond*, 910 F.2d 831, 832-33 (Fed.Cir.1990). Second, the reference must "enable one of ordinary skill in the art to make the invention without undue experimentation." *Impax Labs., Inc. v. Aventis Pharms. Inc.*, 545 F.3d 1312, 1314 (Fed.Cir.2008); *see In re LeGrice*, 49 C.C.P.A. 1124, 301 F.2d 929, 940-44 (1962). As long as the reference discloses all of the claim limitations and enables the "subject matter that falls within the scope of the claims at issue," the reference anticipates -- no "actual creation or reduction to practice" is required. *Schering Corp. v. Geneva Pharms., Inc.*, 339 F.3d 1373, 1380-81 (Fed.Cir.2003); *see In re Donohue*, 766 F.2d 531, 533 (Fed.Cir.1985). This is so despite the fact that the description provided in the anticipating reference might not otherwise entitle its author to a patent. *See Vas-Cath Inc. v. Mahurkar*, 935 F.2d 1555, 1562 (Fed.Cir.1991) (discussing the "distinction between a written description adequate to support a claim under § 112 and a written description sufficient to anticipate its subject matter under § 102(b)").

In re Gleave, 560 F.3d 1331, 1334 (Fed. Cir. 2009).

b. Obviousness

Under section 103 of the Patent Act, a patent claim is invalid "if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains."[23] 35 U.S.C.

[23] The standard for determining whether a patent or publication is prior art under section 103 is the same as under 35 U.S.C. § 102, which is a legal question. *Panduit Corp. v.*

[redacted]

§ 103. While the ultimate determination of whether an invention would have been obvious is a legal conclusion, it is based on "underlying factual inquiries including: (1) the scope and content of the prior art; (2) the level of ordinary skill in the art; (3) the differences between the claimed invention and the prior art; and (4) objective evidence of nonobviousness." *Eli Lilly and Co. v. Teva Pharmaceuticals USA, Inc.*, 619 F.3d 1329 (Fed. Cir. 2010).

The objective evidence, also known as "secondary considerations," includes commercial success, long felt need, and failure of others. *Graham v. John Deere Co.*, 383 U.S. 1, 13-17 (1966); *Dystar Textilfarben GmbH v. C.H. Patrick Co.*, 464 F.3d 1356, 1361 (Fed. Cir. 2006). "[E]vidence arising out of the so-called 'secondary considerations' must always when present be considered en route to a determination of obviousness." *Stratoflex, Inc. v. Aeroquip Corp.*, 713 F.2d 1530, 1538 (Fed. Cir. 1983). Secondary considerations, such as commercial success, will not always dislodge a determination of obviousness based on analysis of the prior art. *See KSR*, 550 U.S. at 426 (commercial success did not alter conclusion of obviousness).

"One of the ways in which a patent's subject matter can be proved obvious is by noting that there existed at the time of invention a known problem for which there was an obvious solution encompassed by the patent's claims." *KSR*, 550 U.S. at 419-20. "[A]ny need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed." *Id*.

Specific teachings, suggestions, or motivations to combine prior art may provide helpful insights into the state of the art at the time of the alleged invention. *Id*. at 420.

Dennison Mfg. Co., 810 F.2d 1561, 1568 (Fed. Cir. 1987).

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Nevertheless, "an obviousness analysis cannot be confined by a formalistic conception of the words teaching, suggestion, and motivation, or by overemphasis on the importance of published articles and the explicit content of issued patents. The diversity of inventive pursuits and of modern technology counsels against limiting the analysis in this way." *Id.* "Under the correct analysis, any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed." *Id.* A "person of ordinary skill is also a person of ordinary creativity." *Id.* at 421.

Nevertheless, "the burden falls on the patent challenger to show by clear and convincing evidence that a person of ordinary skill in the art would have had reason to attempt to make the composition or device, or carry out the claimed process, and would have had a reasonable expectation of success in doing so." *PharmaStem Therapeutics, Inc. v. ViaCell, Inc.*, 491 F.3d 1342, 1360 (Fed. Cir. 2007); *see KSR*, 550 U.S. at 416 (a combination of elements must do more than yield a predictable result; combining elements that work together in an unexpected and fruitful manner would not have been obvious).[24]

2. Anticipation

a. Panduit FCE1 Enclosure using Panduit FAP Panels and Panduit FCX-24-10 Cassettes

Respondents argue that the Panduit FCE1 Enclosure equipped with Panduit FAP

[24] Further, "when the prior art teaches away from combining certain known elements, discovery of a successful means of combining them is more likely to be nonobvious." *KSR*, 550 U.S. at 416 (citing *United States v. Adams*, 383 U.S. 39, 52 (1966)).

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Panels and Panduit FCX-24-10 Cassettes anticipates claims 1 and 3 of the '320 patent. It is argued, *inter alia*:

> There is no dispute that the Panduit FCE1 Enclosure, FCX-24-10 Cassette, and FAP Panels are all prior art to claims 1 and 3 of the '320 Patent. RX-0617C (Panduit Product Launch Dates); RX-1672C (Kuffel WS) Q/A 58. The Panduit FCE1 Enclosure was on sale no later than March 28, 2005. RX-0617C (Panduit Product Launch Dates); RX-1672C (Kuffel WS) Q/A 58. The Panduit FCX-24-10 Cassette was on sale no later than March 10, 2005. And the Panduit FAP Panel was on sale no later than November 17, 2006. RX-0617C (Panduit Product Launch Dates); RX-1672C (Kuffel WS) Q/A 58. The Panduit FCE1 Enclosure equipped with Panduit FAP Panels and Panduit FCX-24-10 Cassettes anticipates and renders obvious claims 1 and 3. *See* §§ VII.C.1.a, VII.C.1.b, *infra*.
>
> The Panduit FCE1 Enclosure equipped with Panduit FAP Panels and Panduit FCX-24-10 Cassettes anticipates claims 1 and 3. RX-0495 (2005 Panduit Product Catalog) at p. C2.22, C.22.31; *see also* RX-0001C (Blumenthal WS) Q/A 263-277.
>
> Complainant argues that a combination of three "separate" products cannot form a basis for anticipation. CPHB at 142. But, the Panduit FCE1 Enclosure's only function is to accommodate the Panduit FAP Panels and FCX-24-10 Cassettes, and thus the Panduit FCE1 Enclosure equipped with Panduit FAP Panels and Panduit FCX-24-10 Cassettes should be considered as a single "device." *See also* RX-0495 (2005 Panduit Product Catalog) at p. C2.22; RX-1672C (Kuffel WS) Q/A 53-58. Therefore, the Panduit FCE1 Enclosure equipped with Panduit FAP Panels and Panduit FCX-24-10 Cassettes is a proper anticipatory product. *Zenith Elecs. Corp. v. PDI Commc'n Sys., Inc.*, 522 F.3d 1348, 1357-59 (Fed. Cir. 2008) (analyzing TV and speaker that were designed to work together as one anticipating system); *Radware, Ltd. v. F5 Networks, Inc.*, No. 5:13-CV-02024-RMW, 2016 WL 861065, at *1 (N.D. Cal. Mar. 5, 2016) ("Radware ***argues*** that the 3DNS product and the BIG-IP product ***cannot be used to anticipate Radware's claims because in 1998, the two were separate products***, and anticipation must be based on a single reference. . . . F5 does not dispute that anticipation must be based on a single reference, but F5 argues that the 3DNS / BIG-IP system is, in fact, a single reference. . . . ***The court finds that the proffered system may constitute a single reference for anticipation purposes***. Radware's own technical expert testified that '***two modules that may be next to each other or within the same box***' could satisfy the language of Radware's claims. . . . The court understands the proffered 3DNS / BIG-IP system to be what

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> Dr. Rubin described: ***two hardware modules mounted on the same rack connected by a high-speed data connection***. Accordingly, Radware's motion to exclude the system as consisting of more than a single reference is denied.") (emphasis added).

See Resps. Br. at 87-89.

The prior art reference asserted is a combination of a Panduit chassis (the FCE1 enclosure) and two types of Panduit modules (FAP panels and FCX-24-10 cassettes).

Each of the three components qualifies as prior art to the asserted claims of the '320 patent.[25] The FCE1 Enclosure is depicted in Panduit's 2005 Product Catalog under the heading "OptiCom® QuickNet™ Rack Mount Fiber Enclosure" with part number FCE1. RX-0495 (2005 Panduit Product Catalog) at page C2.22. The catalog indicates that the enclosure is a 1U chassis that "[h]olds up to 4 cassettes, FAP or FMP adapter panels." *Id.*; CX-1863 (Prucnal Inspection Photos Ex. 2).

[25] The Panduit FCE1 enclosure was on sale no later than March 28, 2005; the FCX-24-10 cassette was on sale no later than March 10, 2005; and the FAP panel was on sale no later than November 17, 2006. *See* RX-1672C (Kuffel WS) Q/A 58; RX-0617C (Panduit product launch dates).

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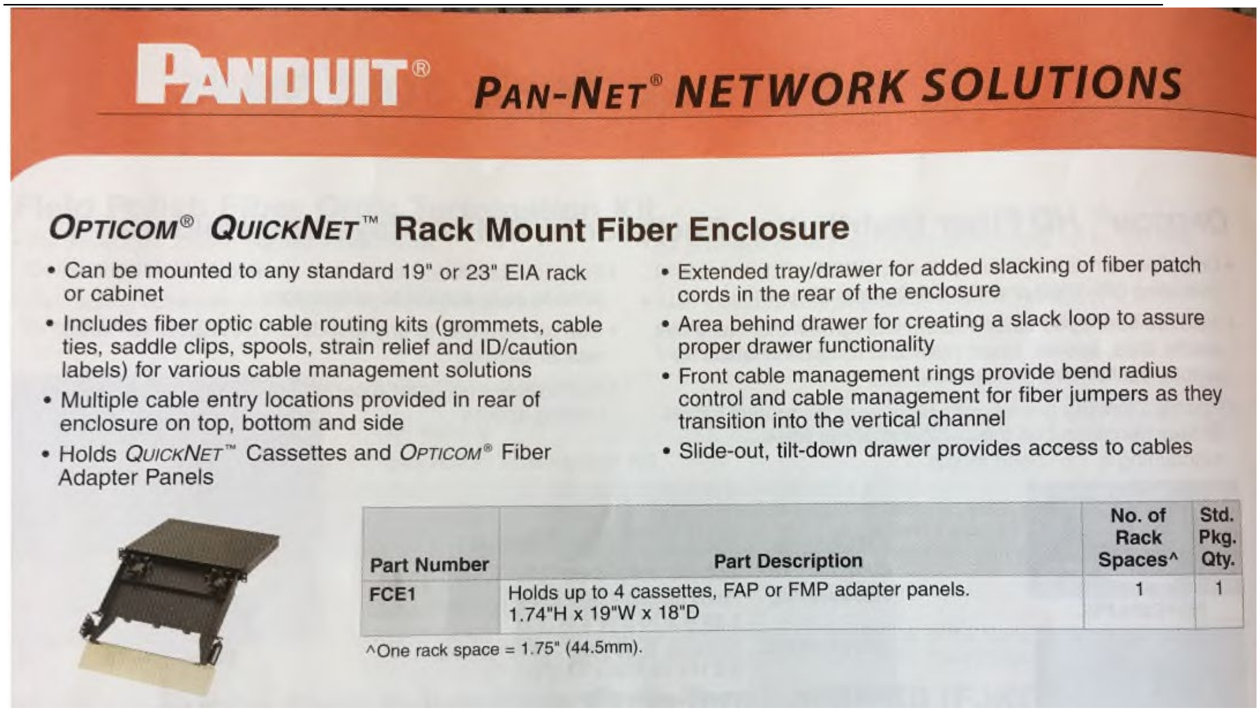

PANDUIT® PAN-NET® NETWORK SOLUTIONS

OPTICOM® QUICKNET™ Rack Mount Fiber Enclosure

- Can be mounted to any standard 19" or 23" EIA rack or cabinet
- Includes fiber optic cable routing kits (grommets, cable ties, saddle clips, spools, strain relief and ID/caution labels) for various cable management solutions
- Multiple cable entry locations provided in rear of enclosure on top, bottom and side
- Holds QUICKNET™ Cassettes and OPTICOM® Fiber Adapter Panels
- Extended tray/drawer for added slacking of fiber patch cords in the rear of the enclosure
- Area behind drawer for creating a slack loop to assure proper drawer functionality
- Front cable management rings provide bend radius control and cable management for fiber jumpers as they transition into the vertical channel
- Slide-out, tilt-down drawer provides access to cables

Part Number	Part Description	No. of Rack Spaces^	Std. Pkg. Qty.
FCE1	Holds up to 4 cassettes, FAP or FMP adapter panels. 1.74"H x 19"W x 18"D	1	1

^One rack space = 1.75" (44.5mm).

RX-0495 (2005 Panduit Product Catalog) at C2.22

The first type of Panduit module in the asserted product combination is an "FAP" panel, meaning an adapter panel with Panduit part number FAP6WBLMTP that contains six 12-fiber multi-fiber ("MPO") adapters on the front side of the panel. RX-0001C (Blumenthal WS) Q/A 246-47, 250 (physical sample of discontinued FAP panel unavailable), 252. The second module type is the Panduit QuickNet cassette, Panduit part number FCX-24-10, which contains twelve LC duplex adapters on the front side connected to two MTP adapters on the rear side. *Id.* Q/A 246-47, 253.

Respondents argue that as long as at least one multi-fiber FAP panel is included, an FCE1 chassis filled with any combination of FAP panels and/or QuickNet cassettes would support more than 144 fiber optic connections per U space, and therefore would anticipate claims 1 and 3 of the '320 patent. *See* Resps. Br. at 88-92; RX-0001C

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(Blumenthal WS) Q/A 262-77.

Dr. Blumenthal's opinion has two fundamental shortcomings. First, he relies on a combination of multiple references, and a combination cannot anticipate. *See Studiengesellschaft Kohle, m.b.H. v. Dart Indus., Inc.*, 726 F.2d 724, 726-27 (Fed. Cir. 1984) ("It is hornbook law that anticipation must be found in a single reference, device, or process."). The FCE1 enclosure, QuickNet Cassettes, and MPO panels were sold separately as distinct products. *See* CX-0021 (Panduit Pan Net Brochure) at 3. Dr. Blumenthal provides no basis for his claim that these three separate Panduit devices qualify as a single anticipating reference. *See* RX-0001C (Blumenthal WS) Q/A 243. No evidence has been adduced that these three devices are somehow components of a single device, let alone one in existence before the priority date of the '320 patent. Indeed, Dr. Blumenthal cites no evidence that this combination of devices was ever assembled in the configuration that he proposes prior to the '320 patent's priority date. *See* CX-2060C (Prucnal RWS) Q/A 354. Nor have Panduit's fact witnesses provided such evidence. *Id.* Q/A 357.

Second, asserted claims 1 and 3 recite a "fiber optic connection density of at least [98 or 144] connections per U space, based on using at least one simplex fiber optic component or at least one duplex fiber optic component." A proper reading of this claim, in light of the specification and the prosecution history, is that the entire density of 98 or 144 connections must be achieved using simplex or duplex components. Of the products in Dr. Blumenthal's combination, only the QuickNet Cassettes had simplex/duplex LC adapters on the front. *See* CX-2060C (Prucnal RWS) Q/A 348; CX-0021 (Panduit Pan Net Brochure) at 5. The MPO panels had multi-fiber MPO adapters on the front, *see* CX-

[redacted]

2060C (Prucnal RWS) Q/A 350; CX-1774 (2007 Pan Net Catalog) at 2, and any combination of those products with LC components falls outside the scope of the ‘320 patent claims. Equipment with multiple fiber components neither comprises nor is capable of receiving a simplex or duplex component, and therefore cannot be configured to a support a connection density based on at least one such simplex or duplex component. *See* CX-2060C (Prucnal RWS) Q/A 359.

That the physical combination of simplex/duplex components and multiple fiber components is technically possible is irrelevant because the patent (as confirmed by the prosecution history) teaches the use of only simplex/duplex components to achieve the claimed density. *See Giannelli*, 739 F.3d at 1380 (“physical capability alone does not render obvious that which is contraindicated”). The ‘320 patent discloses embodiments that involve either the use of simplex/duplex (LC) components, or the use of multiple fiber (MPO) components, but never both. The ‘320 patent does not include a single embodiment or any suggestion of using both simplex/duplex (LC) and multiple fiber (MPO) components together on the front side of fiber optic connection equipment. To the contrary, the patent distinguishes between these two approaches. Some embodiments, such as those in the claims, are configured to support a connection density of 98 or 144 connections per U space using LC connections. Other embodiments are configured to support a much higher connection density of 434 or 576 connections per U space using exclusively MPO connections. *See* JX-0004 (‘320 patent) at 2:7-20. Indeed, the ‘320 patent provides a specific table showing the “max” fiber density in terms of either “Duplexed LC” or MPO connections, not both:

[redacted]

Connector Type	Max Fibers per 1 RU	Max Fibers per 4 RU	Number of Connectors per 1 RU Space	Number of Connectors per 4 RU Space	Bandwidth per 1 U using 10 Gigabit Transceivers (duplex)	Bandwidth per 1 U using 40 Gigabit Transceivers (duplex)	Bandwidth per 1 U using 100 Gigabit Transceivers (duplex)
Duplexed LC	144	576	72	288	1,440 Gigabits/s.	960 Gigabits/s.	1,200 Gigabits/s.
12-F MPO	576	2,304	48	192	5,760 Gigabits/s.	3,840 Gigabits/s.	4,800 Gigabits/s.
24-F MPO	1,152	4,608	48	192	11,520 Gigabits/s.	7,680 Gigabits/s.	9,600 Gigabits/s.

JX-0004 ('320 Patent) at 19:1.

The prosecution history confirms that a combination of simplex/duplex and multi-fiber components does not practice the claims of the '320 patent. As discussed in detail in the Claim Construction section (Section V.A.4), *infra*, Corning's original application proposed additional claims for high-density configurations using multiple fiber (MPO) components, but the examiner determined these were a "patently distinct species" from the claims based on using "simplex or duplex type fiber connectors" "that were "not obvious variants of each other." *See* JX-0005 ('320 Prosecution History) at 4922. Corning elected to proceed with only the claims directed to simplex/duplex, and not multiple fiber, components. JX-0005 ('320 Prosecution History) at 5302. Respondents themselves have embraced this view. *See* CX-1987C (Leviton 6/12/20 Interrogatory Responses) at 26 ("Corning previously disclaimed the use of multiple fiber components during prosecution of the patent."); CX-2019 (Siemon 6/12/20 Interrogatory Responses) at 117; RX-0008C (Lebby RWS) Q/A 158 (describing Corning's election "a clear and unmistakable representation that the" asserted claims "did not include, and in fact excluded, multiple fiber components"). Accordingly, Dr. Blumenthal's hypothetical combination, if it had been made, would not have practiced, and thus cannot anticipate the asserted claims.

Accordingly, respondents have not shown by clear and convincing evidence that

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the combination of a Panduit FCE1 enclosure with Panduit FAP panels and FCX-24-10 cassettes anticipates asserted claims 1 and 3 of the '320 patent.

b. Vazquez '918

Respondents argue that U.S. Patent No. 8,861,918 to Vazquez (CX-1762 and RX-0459 ("Vazquez '918")) anticipates claims 1 and 3 of the '320 patent. *See* Resps. Br. 111-120. Corning and the Staff disagree. *See* Compl. Br. at 146-48; Staff Br. at 95-98.

Vazquez '918 was filed on July 31, 2008 and claims priority to U.S. Provisional App. No.60/967,798, filed on Sept. 7, 2007. *See* RX-0001C (Blumenthal WS) Q/A 332-35. The application leading to Vazquez '918 was published on March 12, 2009, and the patent issued on October 14, 2014.

The date of invention for the '320 patent is deemed to be August 29, 2008, the filing date of U.S. Provisional App. No. 61/190,538. *See* JX-0004 ('320 Patent). Thus, Vazquez '918 qualifies as prior art under pre-AIA 35 U.S.C. § 102(e), which provides that an invention is patentable unless:

> (e) the invention was described in . . . (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for the purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language[.]

35 U.S.C. § 102(e)(2).

As an initial matter, respondents' argument that Vazquez anticipates claims 1 and 3 of the '320 patent contradicts the explicit disclosures of Vazquez '918. The only disclosure in Vazquez '918 of connection density refers to Figure 1, which it describes as

[redacted]

"configured with forty eight (48) LC duplex fiber optic adapters 22 for supporting connections to ***96 optical fibers***." CX-1762 (Vazquez '918) at 5:55-58 (emphasis added). There is no disclosure in the text of the specification of any embodiment with more than 96 fiber connections.

Respondents' expert opined that the embodiment shown in Figure 14 of Vazquez '918 includes 75 duplex adapters, for a total of 150 fiber optic connections. *See* RX-0001C (Blumenthal WS) Q/A 339. His testimony, however, was based solely on a visual inspection of the drawing in Figure 14, as the specification's description of that figure is silent regarding the number of connections included. As Dr. Prucnal testified, "for Dr. Blumenthal's argument to be true, it would have to be the case that the patentees, focused as they were on the need for high-density fiber optic connections, nonetheless disclosed a configuration that offers 1.5 times as many connections as its own Figure 1, but declined to identify this density breakthrough." CX-2060C (Prucnal RWS) Q/A 452. He also testified, "[a] person of ordinary skill in the art would take the patentee at his word as to what his patent discloses, not assume that it actually discloses a more advanced configuration than described." *Id.*

Respondents' argument relies on the premise that the Vazquez '918 inventors, focused on the need for high-density fiber optic connections, implicitly disclosed configurations far denser than 96 (nearly 1.5 times as many), but declined to claim or even identify this breakthrough. Vazquez '918 is a Corning patent. Respondents' suggestion that Corning set out to create EDGE and simply missed the density already disclosed in its own patent is not credible.

Moreover, even if Dr. Blumenthal were correct that Figure 14 of Vazquez '918

[redacted]

discloses 150 connections, respondents have failed to establish that the connections in Figure 14 fit within a 1U space, as required by the asserted claims of the '320 patent.

Dr. Prucnal testified that "[t]here is not enough information in the patent to support Dr. Blumenthal's assumption." *Id.* Q/A 456. He further testified that although Figure 1 may be designed for a 1U space,

> the only evidence on which Dr. Blumenthal's conclusion rests – the drawings in the Figures – suggest that Figures 1 and Figure 14 disclose different sized panels. As shown in CDX-0005C (Prucnal Rebuttal) at 256, Figure 1 shows a panel with two rows of adapters and little space between the adapters and between the adapters and the top and bottom edges. Figure 14, by contrast, shows three rows of adapters, and more space between those adapters than in Figure 1. Both of these Figures cannot be accurate and also both show LC duplex adapters in a 1U space, and there is accordingly no basis to rely on the drawings themselves for these critical variables.

Id. Thus, neither the text nor the drawings of Vazquez '918 support respondents' argument that Figure 14 depicts fiber optic equipment with a connection density of 150 fiber optic connections per 1U space. Vazquez '918 simply shows that the disclosed inventions are designed to work within a structure of standard U-sized spaces. *See* CX-2060C (Prucnal RWS) Q/A 445, 452.

Additionally, the PTAB has rejected the argument that Vazquez '918 anticipates the '320 patent. In its October 2016 petition for *inter partes* review of the '320 patent, Panduit relied on Vazquez '918 as the first of three primary references, and the only one asserted as anticipatory. *See* CX-2063 ('320 IPR Petition).[26] The PTAB rejected

[26] The evidence shows that this was the second time the Patent Office considered Vazquez as potential prior art to the '320 patent. In its application for what became the '320 patent, Corning identified the application that would become Vazquez '918, which is a Corning patent. US 2009/0067800 A1 ("Vazquez Application"); JX-0004 ('320 patent) at 7. The Examiner did not challenge the '320 patent application based on the

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Panduit's petition as to Vazquez and declined to institute an IPR on those grounds. *Panduit Corp. v. Corning Optical Comm., LLC,* No. IPR2017-00009 at 12 (P.T.A.B. Apr. 17, 2018). In the rejection, the PTAB identified the same failure to disclose a 1U space discussed above, concluding that "the disclosure in Vazquez stating that the shelves are 1-U sized and have the standard 1.75 inch U height, is not a teaching that housing 30 is likewise 1-U sized." *Id.* at 12. Without such critical information, the PTAB concluded, it is improper to conclude that "a person of skill in the art would have understood Vazquez's disclosure of 1-U sized shelfs to be the same" as the '320 patent's claimed disclosure of 98 or 144 connections "per U-spacing using duplex components." *Id.* Indeed, Panduit's argument for anticipation by Vazquez '918 — the same argument respondents raise here — did not meet the PTAB's threshold requirement of showing a likelihood that Panduit could succeed.

Accordingly, respondents have not proven by clear and convincing evidence that Vazquez '918 anticipates any asserted claim of the '320 patent.

<u>Whether Respondents Are Estopped</u>

Complainant argues:

> In addition, the estoppel effects of the PTAB's decision bars not only Panduit, but also the other respondents from challenging claims 1 and 3 of the '320 patent using Vazquez. *See* 35 U.S.C. § 315(e)(2) ("The petitioner in an *inter partes* review . . . or the real party in interest or privy of the petitioner, may not assert . . . in a proceeding before the International Trade Commission under section 337 . . . that the claim is invalid on any ground that the petitioner raised or reasonably could have raised during that *inter partes* review."). The other respondents are "real part[ies] in interest or priv[ies]" to Panduit regarding assertion of Vazquez '918 as prior art: Respondents present only one expert witness, Dr.

Vazquez Application. *See generally* JX-0005 ('320 Prosecution History).

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Blumenthal, on the topic of invalidity; Dr. Blumenthal's witness statement makes clear that he has been retained by and is submitting testimony on behalf of respondents Panduit, Leviton, AFL, FS.com, Wirewerks, and Siemon regarding invalidity, RX-0001C (Blumenthal WS) Q/A 2; and not only is the testimony on behalf of all respondents, but it is being led by Panduit, who filed Dr. Blumenthal's witness statements. Allowing Panduit to advance the exact same invalidity ground in this Investigation as it raised in the IPR proceeding — which was already decided by the PTAB and the Federal Circuit — through its privies would cut directly against the purpose of the IPR estoppel rule.

Compl. Br. at 148-49.

Respondents argue, *inter alia*:

Complainant incorrectly argues Respondents cannot challenge the validity of '320 Patent claims 1 and 3 over Vazquez due to IPR estoppel. CPHB at 159-60. The ALJ provisionally denied Complainant's Motion *in Limine* that exclude these arguments. *See* Order No. 24 at 2 ("Complainant's Motion in Limine No. 2, entitled 'Preclusion of Respondents' Vazquez Invalidity Ground Based on IPR Estoppel' (Motion Docket No. 1194-44), is denied. Complainant is not precluded from arguing IPR estoppel in this investigation. ***It has not, however, been shown that estoppel should be applied at this time, as a threshold matter***.") (emphasis added). *See also* Complainant's Motion *in Limine* #2: Preclusion of Respondents' Vazquez Invalidity Ground Based on IPR Estoppel (Mtn. Dkt. No. 1194-0044) (Oct. 2, 2020); Respondents' Opposition to Complainant's Motion in Limine No. 2 (Oct. 9, 2020). Complainant's argument should similarly be denied post-hearing.

Complainant argues that (1) IPR estoppel applies to Panduit because Panduit filed an IPR on the '320 Patent ("the Panduit IPR"); (2) Panduit is barred from raising anticipation based on Vazquez '918 because it was "a ground that the petitioner raised" in the Panduit IPR; and (3) IPR estoppel applies to the other Respondents because they are real-parties-in-interest or privies to Panduit. CPHB at 159-60. All of these arguments lack merit.

Respondents are not estopped from arguing the '320 Patent is invalid over Vazquez '918 because (1) the Vazquez '918 ground was not instituted in the Panduit IPR and (2) the non-Panduit Respondents were not privies of Panduit in the Panduit IPR. As the ALJ correctly recognized in Order No. 24, denying Complainant's Motion *in Limine* No. 2 which raised these exact arguments, estoppel should not be applied. Order No. 24 at 2 (Oct. 16, 2020).

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> While Panduit's IPR Petition included Vazquez '918 as one of many proposed invalidity grounds, the PTAB did not institute on this ground. *See* CX-1736 ('320 FWD) at 7 (showing that the Vazquez 918 Ground was not instituted). Based on the Federal Circuit precedent when the Final Written Decision on the '320 Patent issued, estoppel only applied to grounds that were raised or reasonably could have been raised. *Shaw Indus. Grp. v. Automated Creel Sys.*, 817 F.3d 1293, 1300 (Fed. Cir. 2016) ("*Shaw*"). Where a ground was not instituted, however, the Federal Circuit held that the petitioner did not raise, nor reasonably could it have raised, that non-instituted ground during the IPR. *Id.* As Vazquez '918 was not instituted, estoppel does not apply.
>
> Even if Panduit were estopped, the other Respondents are not. For IPR estoppel to preclude the non-Panduit Respondents from arguing the Vazquez '918 invalidity ground in this Investigation, the non-Panduit Respondents must be "real part[ies] in interest or *priv[ies]* of the petitioner." 35 U.S.C. § 315(e)(2) (emphasis added). Of import to this analysis is whether the nonparty is a privy ***during the IPR***, not during subsequent district court or ITC litigation. *See Wi-Fi One, LLC v. Broadcom Corp.*, 887 F.3d 1329, 1340 (Fed. Cir. 2018); *Evolutionary Intelligence, LLC v. Sprint Nextel Corp.*, No. C-13-4513-RMW, 2014 WL 819277, at *5-6 (N.D. Cal. Feb. 28, 2014); *Finjan, Inc. v. Cisco Sys.*, No. 17-cv-00072-BLF, 2020 WL 532991, at *3 (N.D. Cal. Feb. 3, 2020). Thus, what matters is not whether they are coordinating with Panduit in this Investigation, but whether they were involved in the prior Panduit IPR. They were not, and thus estoppel does not apply.

Resps. Br. at 112-14.

The Staff argues, "even if Corning were subject to IPR estoppel, the Staff is not subject to estoppel under 35 U.S.C. § 315(e)(2)." Staff Br. at 60 n.14.

The administrative law judge agrees with the Staff's position. Inasmuch as complainant is no longer asserting any claim of the '206 patent that contains this claim term, the history of the '206 patent is only of marginal interest here. *See* Staff Br. at 60 n.14. Additionally, it has not been shown that non-Panduit respondents are real parties in interest or privies of Panduit. *See* Resps. Br. at 113-14. Thus, respondents are not estopped from arguing that Vazquez '918 anticipates the asserted claims of the '320

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patent.

3. Obviousness

a. Panduit FCE1 Enclosure using Panduit FAP Panels and Panduit FCX-24-10 Cassettes

Respondents argue that asserted claims 1 and 3 are rendered obvious by the Panduit FCE1 Enclosure using Panduit FAP Panels and Panduit FCX-24-10 Cassettes. *See* Resps. Br. at 92-95. Corning and the Staff disagree. *See* Compl. Br. 149-51; Staff Br. 98-100.

Respondents argue, *inter alia*:

> To the extent the Panduit FCE1 Enclosure using Panduit FAP Panels and Panduit FCX-24-10 Cassettes is not considered a single device, it nonetheless renders obvious claims 1 and 3. As discussed in Section VI.C.1.a, *supra*, incorporated herein by reference, the Panduit FCE1 Enclosure equipped with the Panduit FAP Panels and the Panduit FCX-24-10 Cassettes discloses all elements of claims 1 and 3.
>
> Furthermore, a POSITA would have been motivated to do this and would have reasonably expected to achieve the desired result, *i.e.*, high-density and versatile fiber optic connection equipment offering both MTP and LC connections on the front of the fiber optic connection equipment by using the Panduit FCE1 Enclosure with the Panduit QuickNet Cassettes (FCX-24-10), and the Panduit MPO/MTP Fiber Adapter Panels, which (FAP6WBLMTP) were all sold by the same company (Panduit), during the same time period, for the same applications (*e.g.*, data centers, telecommunications rooms, 19" and 23" racks and cabinets), as part of the same family of products compatible with one another. RX-0001C (Blumenthal WS) Q/A 260; RX-1672C (Kuffel WS) Q/A 56, 58; RX-0495 (2005 Panduit Product Catalog) at pp. C2.22, C.2.31.
>
> Not only were the Panduit FCE1 Enclosure, the Panduit FAP Panels, and the Panduit FCX-24-10 Cassettes all part of the same line of products, but the FCE1 Enclosure was in fact designed and advertised as an enclosure that can be used with both the Panduit FAP Panels and Panduit FCX-24-10 Cassettes. The literature for these products explains that the Panduit FAP Panels and Panduit FCX-24-10 Cassettes were designed to be used with the FCE1 Enclosure. RX-0495 (2005 Panduit

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Product Catalog) at pp. C2.22, C.2.31; *see also* RX-0001C (Blumenthal WS) Q/A 260.

Resps. Br. at 92-93.

For the reasons discussed below, respondents have not proven by clear and convincing evidence that claims 1 and 3 of the '320 patent are rendered obvious by Panduit FCE1 Enclosure using Panduit FAP Panels and Panduit FCX-24-10 Cassettes.

These products do not achieve, or disclose how to achieve, 144 connections in a 1U space based on using simplex or duplex components. Respondents have not shown how a person of skill in the art would have been motivated to combine the three separate Panduit devices. *Arctic Cat Inc. v. Bombardier Recreational Prods. Inc.*, 876 F.3d 1350, 1359 (Fed. Cir. 2017) (obviousness requires " a known reason a skilled artisan would have been motivated to combine elements to arrive at a claimed combination."). The MPO panels and QuickNet cassettes have fundamentally different architectures — the front side of the MPO panels house multiple fiber adapters, while the QuickNet Cassettes house simplex/duplex LC adapters.

Dr. Blumenthal opines that a person of ordinary skill would have been motivated to combine these different species of adapters to create "fiber optic connection equipment offering ***both MTP and LC connections*** on the front of the fiber optic connection equipment." RX-0001C (Blumenthal WS) Q/A 260 (emphasis added). The record shows that a person of ordinary skill would have had no reason to combine — and likely would have avoided combining — simplex/duplex and multi-fiber components on the front side of a rack-mounted fiber optic enclosure. *See* CX-2060C (Prucnal RWS) Q/A 367-88.

First, Dr. Blumenthal does not identify any application in a data center that would

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involve the use of both LC and MTP connectors on the front of the same chassis. *See* CX-2060C (Prucnal RWS) Q/A 354. As Dr. Blumenthal testified at the hearing, although Panduit's engineers are persons skilled in the art, there is no record evidence that any Panduit engineer ever combined these Panduit products in the manner he proposes. Blumenthal Tr. 672, 674-675, 679-680. Dr. Blumenthal likewise conceded that the only Panduit document he relies on — an excerpt from a 2005 product catalog (RX-0495 (Panduit 2005 Catalog)) — does not depict mixing and matching of simplex/duplex and multiple fiber components. Blumenthal Tr. 772-773*; see also* CX-2060C (Prucnal RWS) Q/A 372; CDX-0005C (Prucnal Rebuttal Demonstratives) at 220. Nor is there any evidence that any other respondent created or marketed such a combination. Blumenthal Tr. 679-680 (Panduit); 746 (Siemon); 748 (Leviton); CX-2060C (Prucnal RWS) Q/A 282 (AFL).

Indeed, the rest of the record — including respondents' own documents — shows affirmatively that a person of ordinary skill would have lacked a motivation to mix and match as Dr. Blumenthal suggests. All parties in this investigation advertise the density of their products in terms of either LC connections or multiple fiber connections, but not a combination of the two. *See* CX-2060C (Prucnal RWS) Q/A 369 (Corning); CX-0007C (Rhoney WS) Q/A 27 (Corning); CX-2060C (Prucnal RWS) Q/A 380-386 (FS, Leviton, Panduit, Siemon); CDX-0005C (Prucnal Rebuttal Demonstratives) at 221-236 (same). As Dr. Prucnal explains, the consistent and uniform way in which Corning and respondents describe the fiber optic densities of their products with separate categories — modules using LC-duplex connectors in one category and models using MPO or other multiple fiber components in another category — shows that customers of these products

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use the products for either LC connections or MPO connections on the front side of a chassis, but not for a mix of both types of connections. *See* CX-2060C (Prucnal RWS) Q/A 380-387.

Second, the development of respondents' accused products confirms that a person of ordinary skill would not have been motivated to mix simplex or duplex and multiple fiber components on the front side of the same enclosure. *See* Compl. Br. at 199-207. Dr. Prucnal described in depth how respondents designed their accused products to match EDGE's 144 LC connections in a 1U space despite already having products that supported up to 72 or 96 LC connections in a 1U space, as well as other MPO/MTP products. If a fiber optic enclosure relying on a mixture of simplex or duplex and multiple fiber components was practical to meet the needs of data center customers, there would have been no need for respondents to spend years developing new products. *See* CX-2060C (Prucnal RWS) Q/A 378.

Third, the development of EDGE further confirms that a person of ordinary skill would not have been motivated to mix and match simplex or duplex and multiple fiber components. Like respondents, Corning had a preexisting Plug and Play system that offered some cassettes with LC components, and others with multiple fiber components, but that achieved only up to 72 LC connections per 1U space. *Id.* Q/A 259. Despite the theoretical ability to mix these connectors and increase density, Corning's engineers — like respondents' — knew that customers want products that maximize density using only simplex/duplex LC duplex connections, and therefore spent millions of dollars and years of engineering to develop EDGE. *See* CX-2060C (Prucnal RWS) Q/A 374; CX-0007C (Rhoney WS) Q/A 27; CX-0006C (Staber WS) Q/A 9, 12.

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Accordingly, respondents have not proven by clear and convincing evidence that claims 1 and 3 of the '320 patent are rendered obvious by Panduit FCE1 Enclosure using Panduit FAP Panels and Panduit FCX-24-10 Cassettes.

b. Panduit FMT2 Enclosure using the FEAT104LC93 Patch Panel including Duplex Adapters

Respondents argue that a combination of Panduit products (the Panduit FMT2 enclosure and the Panduit FEAT104LC93 patch panel with duplex adapters) renders obvious asserted claims of the '320 patent. Corning and the Staff disagree. *See* Compl. Br. at 151-55; Staff Br. at 95-111.

Respondents argue, *inter alia*:

> A POSITA would have been motivated to use the Panduit FMT2 Enclosure with the Panduit FEAT104LC9 Panel housing the Panduit RFADJLCZBU adapters. RX-0001C (Blumenthal WS) Q/A 291. A POSITA would have had a reasonable expectation of success and would have reasonably expected to achieve a desired result provided by the high-density and versatile fiber optic connection equipment. *Id*. at 292. Also, the Panduit FMT2 Enclosure, Panduit FEAT104LC93 patch panel, and Panduit Duplex LC Adapters (e.g., Panduit Part No. RFADJLCZAQ, RFADJLCZBU) were all sold by the same company (Panduit), during the same time period, for the same applications (e.g., data centers, telecommunications rooms, 19" and 23" racks and cabinets). RX-1672C (Kuffel WS) Q/A 66, 71, 72. In fact, the Panduit FEAT104LC93 Patch Panel came equipped with the Panduit Duplex LC Adapters RFADJLCZBU. RX-1672C (Kuffel WS) Q/A 71, 72. Yet, Complainant argues that the Panduit FEAT Panel has not been shown used with or designed to be used with FTM2 Enclosure ("the bodily incorporation argument"). CPHB at 151. Complainant is wrong.
>
> ***First***, this argument is contrary to the well-established case law that the prior art inventions need not be physically combinable to render a claim obvious. *Allied Erecting & Dismantling Co. v. Genesis Attachments, LLC*, 825 F.3d 1373, 1381 (Fed. Cir. 2016). "The test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference . . . but rather whether a skilled artisan would have been motivated to combine the

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> teachings of the prior art references to achieve the claimed invention." *Id.* (internal quotation marks and citations omitted); *Panduit Corp. v. Corning Optical Commc'ns LLC*, Case IPR2016-01703, Paper No. 38 (PTAB Feb. 27, 2018), *aff'd by Corning Optical Commc'ns LLC v. Panduit Corp.*, 774 Fed. Appx. 681 (2019). Therefore, Complainant's arguments focused on actual physical compatibility of the products are irrelevant because the inquiry is whether a POSITA would have been motivated to use a 2RU patch panel, such as the Panduit FEAT Patch Panel, with a 2RU enclosure, such as the Panduit FMT2 Enclosure that was designed to accommodate 2RU patch panels, and not whether the two products are physically combinable. *In re Etter*, 756 F.2d 852, 859 (Fed. Cir. 1985) (*en banc*) ("Etter's assertions that Azure cannot be incorporated in Ambrosio are basically irrelevant, the criterion being not whether the references could be physically combined but whether the claimed inventions are rendered obvious by the teachings of the prior art as a whole.").
>
> ***Second***, the products are compatible with each other, and a POSITA would be motivated to use the standardized 2RU Panduit enclosure with the standardized 2RU Panduit Patch Panel. RX-0495 (2005 Panduit Product Catalog) at p. C2.23; RPX-0022; RX-1672C (Kuffel WS) Q/A 65-73; RX-0001C (Blumenthal WS) Q/A 278, 283-285; Blumentahl Tr. at 686:11-18.

Resps. Br. at 97-98.

Each of these components (the Panduit FMT2 enclosure, the Panduit FEAT104LC93 patch panel, and duplex adapters) qualifies as prior art. The Panduit FMT2 enclosure was on sale no later than December 31, 2005; the FEAT104LC9 patch panel was on sale no later than April 16, 2007; and the RFADJLCZBU and RFADJLCZAQ LC duplex adapters used in that patch panel were on sale no later than December 31, 2005. *See* RX-1672C (Kuffel WS) Q/A 72; RX-0617C (Panduit product launch dates).

According to Panduit's 2005 catalog, the FMT2 fiber optic enclosure was a 2U enclosure that "mount[ed] to any standard EIA 19 rack or cabinet." RX-0495 (Panduit 2005 product catalog) at C2.23. It was designed to "mount behind Panduit modular patch

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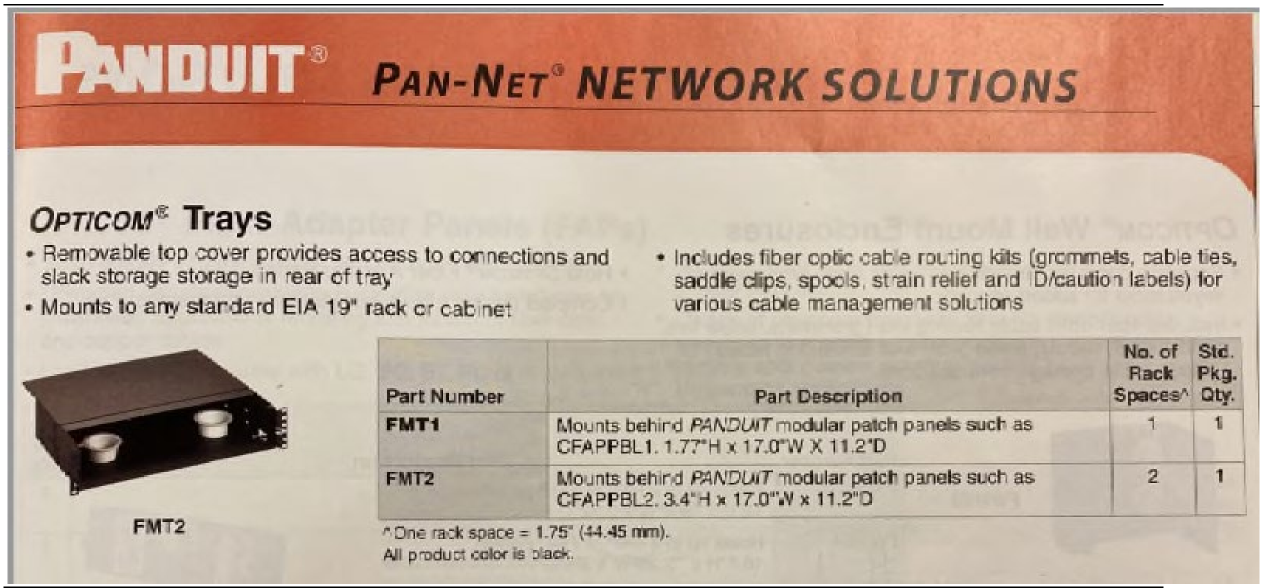
panels such as CFAPPBL2." *Id.*; *see also* CX-0021 (Panduit Pan Net Brochure) at 4; CPX-0084 (FMT2 enclosure).



PANDUIT® PAN-NET® NETWORK SOLUTIONS

OPTICOM® Trays

- Removable top cover provides access to connections and slack storage storage in rear of tray
- Mounts to any standard EIA 19" rack or cabinet
- Includes fiber optic cable routing kits (grommets, cable ties, saddle clips, spools, strain relief and ID/caution labels) for various cable management solutions

FMT2

Part Number	Part Description	No. of Rack Spaces^	Std. Pkg. Qty.
FMT1	Mounts behind *PANDUIT* modular patch panels such as CFAPPBL1. 1.77"H x 17.0"W X 11.2"D	1	1
FMT2	Mounts behind *PANDUIT* modular patch panels such as CFAPPBL2. 3.4"H x 17.0"W x 11.2"D	2	1

^One rack space = 1.75" (44.45 mm).
All product color is black.

RX-0495 (2005 Panduit Product Catalog) at C2.23: FMT2 Enclosure

Modular patch panels were frameworks for holding fiber optic adapters and were designed to attach to the front of an enclosure such as the FMT2. The Panduit Product Catalog identifies modular patch panel CFAPPBL2 as a panel designed to attach to the FMT2. RX-0495 (Panduit 2005 product catalog) at C2.23.

Respondents, however, rely instead on a different modular patch panel not identified in the product catalog, the FEAT104LC93. RX-0001C (Blumenthal WS) Q/A 285. The FEAT104LC93 was a 2U patch panel that held up to 104 LC duplex adapters in a 2U space, arranged in four rows of 26 adapters per row. *Id.* Q/A 286; CPX-0085 (FEAT104LC9 patch panel); CPX-0082 (Panduit duplex LC adapters). This would translate to 52 duplex adapters per 1U space with two connections each, for a maximum total of 104 fiber optic connections per 1U space. This would be more than the 98

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connections claimed in claim 1, but less than the 144 connections claimed in claim 3 of the '320 Patent. The FEAT104LC93 panels were sold with LC duplex adapters installed, specifically Panduit's RFADJLCZBU LC adapters. RX-0001C (Blumenthal WS) Q/A 287-88; RX-1672C (Kuffel WS) Q/A 66.

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RX-0573C (FEAT104LC9 patch panel) at 2

For the reasons discussed below, respondents have not shown by clear and convincing evidence that claims 1 and 3 are rendered obvious by the Panduit FMT2 enclosure using the FEAT104LC93 patch panel including duplex adapters.

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With regard to claim 1, there is no evidence of any motivation to combine these two Panduit products. Even if there were, the resulting combination would not satisfy each limitation of claim 1 because the "fiber optic connection equipment" would not be "provided in the chassis." CX-2060C (Prucnal RWS) Q/A 422; *see* JX-0004 ('320 Patent) at 19:54. With regard to claim 3, the alleged combination would not read on the asserted claim for the additional reasons that it would not be "configured to support a fiber optic connection density of at least one hundred forty-four (144) fiber optic connections per U space." JX-0004 at 19:64-67.

Respondents' obviousness argument is unpersuasive because there is not a clear and convincing evidence that one of ordinary skill in 2008 would have been motivated to combine the FMT2 enclosure with the FEAT104LC93 patch panel. Dr. Blumenthal testified that a person of ordinary skill in the art would have been motivated to do this and would have reasonably expected to achieve the desired result, *i.e.*, high-density and versatile fiber optic connection equipment, because the products were all sold by the same company during the same time period, "for the same applications (*e.g.*, data centers, telecommunications rooms, 19" and 23" racks and cabinets), as part of the same family of products compatible with one another." RX-0001C (Blumenthal WS) Q/A 292. Noting that the FMT2 enclosure is a standardized 2RU size and that the FEAT104LC9 panel is a standardized 2RU size fiber panel designed to be used with a 2U enclosure, he concluded, without supporting evidence, that one of ordinary skill would necessarily have been motivated to use the two products together. *Id*. Q/A 293. This analysis assumes that the two products are, in fact, compatible with one another.

Respondents have not shown that a person skilled in the art would have, or even

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could have, used the FEAT Panel with the FMT2 enclosure. As Dr. Prucnal testified, "Panduit's own documents do not advertise the FMT2 and FEAT Panel together, but instead teach away from this combination, by marketing the FMT2 as compatible with other panels." CX-2060C (Prucnal RWS) Q/A 411.

Panduit's Chief Engineer Mr. Kuffel testified about the features of the FMT2 enclosure and the FEAT panel, but did not testify at any point that they were either compatible in theory or combined in practice. *See* RX-1672C (Kuffel WS) Q/A 59-72. At the hearing, Mr. Kuffel conceded that the products were not designed to be used together, and could not have been used together as sold. *See* Kuffel Tr. 640-641. Even if a person of ordinary skill obtained both products, the fact that they were plainly not meant to work together would discourage such a person from pursuing the combination. Indeed, Mr. Kuffel testified that a person of ordinary skill would have needed to grind off the mounting hardware from the FMT2 enclosure or drill corresponding holes in the FEAT panel. *Id.* at 651-652. At the hearing, Dr. Blumenthal agreed that modifications were required for real-life use. *See* Blumenthal Tr. 686. He gave no opinion what such a modification would entail, why a person of ordinary skill would attempt it, or the predictability of the combination post-modification. He even agreed that he "th[ought]" Panduit's engineers "would not combine" those products when developing a high-density fiber optic enclosure to compete with EDGE. *Id.* at 688.

Without the support of either documentary evidence or testimony from a Panduit witness, Dr. Blumenthal's opinion that it would have been obvious to combine the two products does not rise to the level of clear and convincing evidence.

Moreover, Panduit's advertisements made clear that the FMT2 chassis and FEAT

[redacted]

panel were not meant to be used together. The product specification sheet for the FMT2 enclosure states that the FMT2 is designed to be used with a different patch panel, the CFAPPBL2. *See* CX-1739C (Panduit OptiCom Panel and Tray Spec.). Mr. Kuffel confirmed that point during his cross examination. Kuffel Tr. 642. Nowhere does the product specification suggest that the FMT2 enclosure is compatible with the FEAT panel or any other panel — it does not even mention patch panels other than those in the CFAPPBL series. *See id.*; CX-2060C (Prucnal RWS) Q/A 402. The product specification also states that the maximum number of fibers it supports in a 2U rack space is 192 (corresponding with the CFAPPBL2 panel), not 208 (the FEAT Panel). CX-2060C (Prucnal RWS) Q/A 402; CDX-0005C (Prucnal Rebuttal Demonstratives) at 242. From those facts, a person of ordinary skill looking for a patch panel to use with the FMT2 enclosure would conclude that the FMT2 enclosure is neither designed for nor compatible with the FEAT panel.

Even if respondents had been able to show a motivation to combine the FMT2 enclosure and the FEAT panel, the resulting combination would not render claim 3 of the '320 patent obvious because it would only support a maximum of 104 fiber optic connections in a 1U space, not the 144 connections required by the claim. *See* RX-0573C (FEAT104LC9 patch panel) at 2 (showing 208 connections in a 2U space); RX-0001C (Blumenthal WS) Q/A 286. To create a combination that would read on the additional limitation of dependent claim 3, Dr. Blumenthal had to devise a hypothetical new patch panel, one that was never manufactured by Panduit, that contains 288

[redacted]

connections in a 2U space.[27]

While acknowledging that the actual FEAT104LC93 panel "provides a fiber optic connection density of 208 in two rack units, which is 104 'per U space[,]'" Dr. Blumenthal opined that "using the hole size of the FOCIS 10 Manual RX-0464 (TIA/EIA FOCIS 10 Standard) and hole spacing of Dayton-Rodgers Specification RX-0929 (Dayton-Rodgers Specification)," "[i]t would have been obvious for a person of ordinary skill in the art to modify Panduit FEAT104LC9 patch panel to hold for example 72 duplex LC adapters" per U space, thereby providing 144 connections per U space. RX-0001C (Blumenthal WS) Q/A 313-14. He testified that inasmuch as the adapters in the FEAT104LC93 are mounted vertically, a person of ordinary skill in the art would have had to rearrange the adapters horizontally in order to fit 72 adapters per U space. *Id*. Q/A 320.

> Specifically, a person of ordinary skill would have used the teaching of [U.S. Patent No. 6,362,422] to decrease the space between adaptor ports. A person of ordinary skill would have used the teaching of the Panduit Opticom connector modules or FAB12WBULCZ adapter panel to rotate the LC adapter position by 90 degrees. And in result, a person of ordinary

[27] Panduit identified this absence as a "gap" in its product offerings, even though the products on which Dr. Blumenthal's opinion relies were all available at that time. *Id.* at 700-701. Mr. Kuffel acknowledged as much in his testimony regarding the Panduit project team that would ultimately engage in a multi-year development effort to create a product that matched EDGE. *See*, *e.g.*, Kuffel Tr. 606-607 (Panduit's 4U enclosure only capable of 288 connection; it was a "problem" that Corning had twice the density) (discussing CX-0102C (Panduit Prod. Charter)); *id.* 617 (as of April 2010, "Panduit's products only supported 48 channels or 96 fibers in a 1U") (discussing CX-0103C (4/19/2010 Panduit Res. Meeting Minutes)). Dr. Blumenthal's theory about the hypothetical motivation of a person of ordinary skill to combine the Panduit prior art leads to the implausible conclusion that Panduit's real-world engineers, individuals of ordinary or greater skill in the art, misunderstood their own products. *See* CX-2060C (Prucnal RWS) Q/A 416, 440.

[redacted]

> skill after having decreased the spacing between ports of the Panduit FEAT104LC9 and rotated the LC adapter position by 90 degrees would have had a reasonable expectation of success to increase the number of fibers per U space and bandwidth per U space.

Id. Q/A 322. Dr. Blumenthal presented a complex series of equations demonstrating how to determine the number of duplex adapters that could fit in a 1U space following these modifications, and concluded that the final result would be 150 fiber optic connections per U space, sufficient to read on claim 3 of the '320 Patent. *Id*. Q/A 323-29.

This complicated path to modifying the existing FEAT104LC93 to create a hypothetical new product never contemplated by Panduit is neither "clear" nor "convincing." Moreover, Dr. Blumenthal's reasoning is flawed if for no other reason than the fact that duplex adapters are wider than the holes used to secure them in a metal frame such as a patch panel. CX-2060C (Prucnal RWS) Q/A 426 ("Dr. Blumenthal assumes a hole size of 0.522" wide by 0.384" high, but he does not account for the protrusions and ridges of LC adapters that extend beyond the width of the LC adapter hole size."); RX-0464 (TIA/EIA FOCIS 10 Standard) at RX-0464.0007 (standard applies only to the holes that LC adapters must fit into; "[f]ully dimensioned components are not within the scope or intent of FOCIS 10A."). Dr. Blumenthal's equations, all of which are based on hole width rather than adapter width, are therefore inaccurate indicators of how many adapters could fit on a FEAT104LC93 panel, however reconfigured.[28]

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[28] Indeed, the PTAB already rejected Panduit's prior attempt to rely on substantively identical mathematical calculations based on several of these same flaws. In rejecting Panduit's 2016 *inter partes* review challenge, that Panduit initiated, the PTAB found that Panduit had failed to account for the actual size and usage of LC adapters, "such as the overall size and shape of the adapter, its mounting arrangement, or spacing between adapters," as well as the "need[] to provide access to the adapters . . . in an actual system." CX-1736 (320 IPR Final Decision) at 24, 26; *see also* CX-2060C (Prucnal

[redacted]

Accordingly, respondents have not shown by clear and convincing evidence that claims 1 and 3 of the '320 patent are rendered obvious by the Panduit FMT2 enclosure using the FEAT104LC93 patch panel including duplex adapters.

c. Smrha '684 in combination with AFL Future Access

Respondents argue that asserted claims 1 and 3 are rendered obvious by the combination of U.S. Patent No. 8,179,684 ("Smrha '684") (RX-0458), and a prior art product by AFL Future Access 1RU. *See* Resps. Br. at 120-30. Corning and the Staff disagree. *See* Compl. Br. at 155-61; Staff Br. at 104-08.

Respondents argue, *inter alia*:

> A POSITA would have been motivated to combine Smrha '684 with Future Access 1 RU. RX-0001C (Blumenthal WS) Q/A 346-349, 356, 387-389. Smrha '684 teaches that there was a known demand for increased density and improvements in access, cable management, and other features for fiber optic panels. For at least these reasons, a POSITA would have readily modified the fiber optic panels of Smrha '684 so as to increase the density of fiber optic connections within a single U space beyond ninety-six by stacking the modules even higher than two as taught by Future Access 1 RU. *Id*. And a POSITA would also have a reasonable expectation of success in doing so. *Id*. Furthermore, both Smrha '684 and Future Access 1 RU relate to fiber optic panels and both have a sliding tray upon which independently slidable modules are supported. *Id*.
>
> Smrha '684 discloses a panel having fiber optic modules stacked two high and providing at least ninety-six connections in the panel. *See* RX-0001C (Blumenthal WS) Q/A 346-349, 356. But Smrha '684 goes further and teaches that other numbers of adapters can be created and that the arrangement, including stacking, of the fiber optic modules can be modified as well. *Id*. Although a POSITA would already understand that Smrha '684's modules could be stacked higher than the two shown in its figures, Future Access 1 RU confirms this by teaching that the modules can be vertically stacked at least three high on a slidable drawer within a panel. Future Access 1RU shows that three modules can be successfully

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RWS) Q/A 436-37.

[redacted]

stacked within a panel and with one RU space. Future Access 1 RU also indicates that three SC adapters can be successfully stacked within a chassis and one RU space as well – even leaving room along the height of the space in the chassis or panel for other components. RX-0001C (Blumenthal WS) Q/A 387-389; RX-0004 Q/A 23-24; RDX-0004.2. And Future Access 1 RU also teaches that this can be done within one RU space or one rack unit. *See* RX-0001C (Blumenthal WS) Q/A 346-349; RX-0525C (Future Access Drawings); RDX-0004C; RDX-0001.110; Nieves Tr. 553:5-13, 557:24-558:17.

> Future Access 1 RU included a tray that would slide in and out of its 1 RU panel. *See* RX-0001C (Blumenthal WS) Q/A 355; RX-0525C (Future Access Drawings); RDX-0004C; RDX-0001.110. A POSITA would have readily modified the fiber optic panels of Smrha '684 so as to increase the density of fiber optic connections within a single U space beyond ninety-six by stacking the modules even higher than two as taught by Future Access 1 RU. RX-0001C (Blumenthal WS) Q/A 356-361. A POSITA would have understood that these adapters could be successfully provided in the chassis of Smrha '684 at the claimed densities for at least the reason of Future Access 1 RU. *Id*. Q/A 360; RX-0458 (Smrha '684) at 12:7-13.

Resps. Br. at 122-23.

<u>Future Access 1 RU</u>

Respondents identify a "Future Access 1 RU" product design by AFL as prior art that discloses three fiber optic modules stacked together, thereby supplying the element missing from Smrha '684 by demonstrating that it was possible to stack three modules rather than just two. They offer drawings of a fiber optic panel that was created and offered for sale to [redacted] in 2007. RX-0525C (Future Access drawings). Dr. Blumenthal testified that a version of this product was installed in Gresham, Oregon in 2007. RX-0001C (Blumenthal WS) Q/A 350. AFL employee Mr. Nieves testified that :

> In response to [redacted] RFP of [redacted] 2007, we offered for sale a product having three splitter modules stacked horizontally inside an enclosure or panel that would fit into a 1 RU space, or U space, as is well

[redacted]

> known in the industry. The splitter modules, which used the module from our 1x32 splitter module, could be either 1x4 or 1x8 and were mounted in a slidable tray.

RX-0004C (Nieves WS) Q/A 5. He also testified about the installation of a modified version of the Future Access product at a multi-dwelling unit community in Oregon. *Id*. Q/A 25-37. As installed, the product contained only one splitter module, not three, although Mr. Nieves claimed that there would have been room to install up to two more splitter modules. *Id*. Q/A 33; RX-0518 (Oregon installation photos) at AFL-ITC-00002786. Based on this testimony, Dr. Blumenthal opined that:

> Although a POSITA would already understand that Smrha '684's modules could be stacked higher than the two shown in its figures, Future Access 1 RU confirms this by teaching that the modules can be vertically stacked at least three high on a slidable drawer within a panel. And Future Access 1 RU also teaches that this can be done within one RU space or one rack unit.

RX-0001C (Blumenthal WS) Q/A 356. And, although the Future Access 1 RU product did not contain more than 96 fiber optic connections, Dr. Blumenthal reasoned that

> [e]ach horizontal layer of adapters in Smrha '684 provides 48 connections so that two layers provide the 96 connections as I previously mentioned. A third layer would provide a total of 144 connections. A POSITA would have reason to believe that these adapters could be successfully provided in the chassis of Smrha '684 at the claimed densities for at least the reason of Future Access 1 RU.

Id. Q/A 360.

Respondents have not shown by clear and convincing evidence that the AFL Future Access 1 RU design depicted in RX-0525C is prior art to the '320 patent. The design drawings themselves are marked as confidential, and therefore are not "printed publications" that could qualify as prior art. *See* 35 U.S.C. § 102(b). Respondents assert that the design shown reflects the product offered for sale to Verizon, but as Dr. Prucnal

[redacted]

testified, the documents "do not show a manufactured product, only a conceptual drawing." CX-2060C (Prucnal RWS) Q/A 469. If the Future Access product is prior art at all, the relevant version is the one that was "known or used by others in this country" in 2007, not the concept shown in the confidential drawings. *See* 35 U.S.C. § 102(a).

As Mr. Nieves testified, the version of the product actually installed in 2007 was different from the drawings – it contained only one splitter module, not three. RX-0004C (Nieves WS) Q/A 33; RX-0518 (Oregon installation photos); Nieves Tr. 548-549.

While AFL may have intended to attempt to install a triple stack of modules in the Future Access product at the time of the conceptual drawings, there is no evidence that it ultimately succeeded in doing so before the date of invention for the '320 Patent. *See* CX-2060C (Prucnal RWS) Q/A 470 ("[U]ntil at least a prototype is built, it is not clear that a concept will work as expected; it is therefore not clear whether AFL could have actually built a product based on its conceptual model.").[29]

<u>Smrha '684</u>

Smrha '684 was filed on October 7, 2008, issued on May 15, 2012, and claims priority to a provisional application filed on October 29, 2007. RX-0458. It is therefore prior art to the '320 Patent. *See* 35 U.S.C. § 102(e)(2).

As an initial matter, respondents fail to show that a person of ordinary skill would

[29] *See* Nieves Tr. 549 ("Q. To your knowledge when was the first publicly available installation of a Future Access RU enclosure that actually had three splitter modules installed in it? When did that take place, if at all? A. I don't know that because the way this product resulted to Verizon was that they would buy the RU panel and then they would purchase the splitter modules individually. So as you can see, they can put up to three. And the density depended upon how many MDU tenants they wanted to turn on with their fiber service. So this was a field trial. So they had one cassette there. And I don't recall if they were going to add the second and the third modules there.").

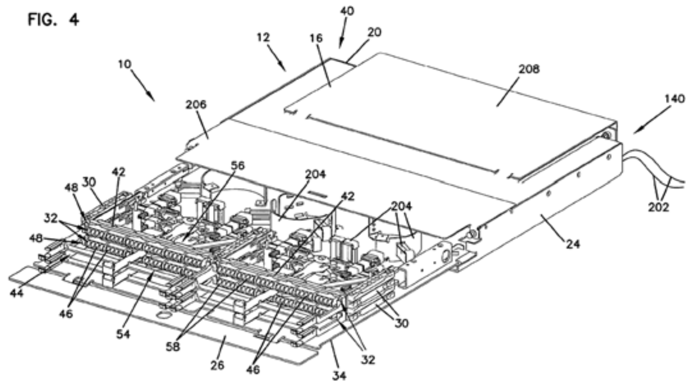
[redacted]

have used Smrha '684 as a starting point for solving the problem to which the '320 patent is directed. To the contrary, as Dr. Prucnal has shown, Smrha '684 would be a highly improbable — and ultimately futile — starting point because it does not disclose critical information regarding its dimensions, and because of distinctive architecture that makes it unsuitable to the modifications that would be needed to satisfy the asserted claims. *See* CX-2060C (Prucnal RWS) Q/A 481.

Smrha '684 discloses a fiber optic connection enclosure that may be mounted on a rack. As shown in its Figure 4 below, it discloses a chassis 12 with two horizontal layers of adapter packs 32 that slide on separate mounting guides 30 that in turn are mounted on a single sliding drawer 34. *See id.* Q/A 462, 505. The adapter packs are designed to be installed on the mounting guides 30 when the drawer is in an open position (as shown in Figure 4 below), and then remain installed during use when the drawer 34 is closed. *See id.* Opening the drawer and removing the adapter packs is not done to establish connections since "[o]perative use and access to the adapter packs 32 is instead provided by the sliding movement of the packs 32 relative to, and without, the sliding movement of the drawer 34." CX-0032 (Smrha '684) at 9:43-45. Smrha '684 also states that "each adapter pack 32 contains six blocks 58 having four adapters 46 for a total of 96 frontward connection locations and rearward connection locations 56." CX-0032 (Smrha '684) at 4:20-22.

[redacted]

FIG. 4



Smrha ‘684 does not disclose the dimensions of chassis 12, provide any indication that it is designed for a 1-U sized space, or even indicate it is mountable in standard 19- or 23-inch equipment racks (and if so which). *See* CX-2060C (Prucnal RWS) Q/A 463-64, 500. Smrha ‘684’s only reference to a “rack” is: “Because of the access design of the present arrangement, the amount of space utilized on racks and cabinets is minimized.” CX-0032 (Smrha ‘684) at 12:7-13. In any event, a person of ordinary skill could not learn from reading Smrha ‘684 the most important piece of information for purposes of solving the problem of the ‘320 patent — the height, in Rack Unit spaces. CDX-0005C (Prucnal Rebuttal Demonstratives) at 259, 464. Indeed, Smrha ‘684 provides even less indication that it is 1U-sized than Vazquez ‘918 (which at least mentioned U-sized shelves). Indeed, Dr. Blumenthal conceded at the hearing that Smrha ‘684 “does not disclose the size of the chassis or the apparatus it discusses,” Blumenthal Tr. 732, though he opined it was possible to estimate its size based on the figures.

<u>Motivation to Combine Smrha ‘684 with AFL Future Access</u>

Given Smrha ‘684’s failure to disclose a U-space or any dimensions, a person of ordinary skill in the art would not only lack motivation to start with Smrha ‘684 to solve the problem of the ‘320 patent, but also would lack the motivation to combine Smrha

[redacted]

‘684 with AFL Future Access.

AFL Future Access was a product line of fiber-optic splitter modules that could be used in various types of enclosures. *See* RX-0001C (Blumenthal WS) Q/A 352. Dr. Blumenthal describes a splitter module as one that “can be used to split the light signal from a single fiber into multiple lights signals [sic].” *Id.* Q/A 353. One of the supposed enclosures for these modules was a 1U chassis. *Id.* Q/A 352. When used together, this 1U chassis could accommodate three Future Access splitter modules stacked vertically on a tray. *Id.* Q/A 355. The chassis also supported separate SC fiber optic adapters, which is another type of standardized simplex/duplex component. *Id.* Q/A 352, 355. Dr. Blumenthal’s image of this configuration is shown below. RDX-0001C (Blumenthal Demonstratives) at 110.

[redacted]

As is immediately apparent, AFL Future Access had a fundamentally different architecture than Smrha ‘684. Other than the fact that they are both fiber optic enclosures that receive fiber optic connections, there are no apparent design similarities. Smrha ‘684 contains two horizontal stacks of adapter packs that are mounted on a complex framework that allows each pack to move independently in and out of the chassis, while

[redacted]

AFL Future Access has three vertically stacked modules inserted independently and designed to remain fixed. *See* CX-2060C (Prucnal RWS) Q/A 468, 508. The simplex/duplex adapters in Smrha '684 are located on the movable adapter packs, while in AFL Future Access they are separately mounted and fixed to a separate structure.

Despite these different architectures, Dr. Blumenthal opines that "Future Access 1 RU . . . teach[es] that the modules can be vertically stacked at least three high on a slidable drawer within a panel." RX-0001C (Blumenthal WS) Q/A 356. He further opines that a person of ordinary skill would have been motivated to modify "the fiber optic panels of Smrha '684 so as to increase the density of fiber optic connections within a single U space beyond ninety-six by stacking the modules even higher than two as taught by Future Access 1 RU," because Smrha '684 "teaches that there was a known demand for increased density and improvements in access, cable management, and other features for fiber optic panels." *Id.* Q/A 358.

The suggestion that Future Access teaches that a third row of adapter packs could be added to Smrha '684 simply because Future Access has three vertical rows of adapters or modules contradicts the teachings of both references and flies in the face of the real world evidence. Neither of these references achieved more than 96 fiber connections. That failure alone shows that their creators did not possess the knowledge to achieve the density of EDGE. CX-2060C (Prucnal RWS) 476, 484. Smrha '684 expressly states that "notwithstanding advances made in the art, there is a continuous need for further improvement of high-density termination panels and associated methods." Given this existing motivation, if the inventors of Smrha '684 could have increased density simply by adding a third row of their structure, they would have done so.

[redacted]

Dr. Blumenthal's opinion also ignores the real-world evidence of what AFL did when it sought to match the EDGE features. *See* CX-2060C (Prucnal RWS) Q/A 509. As Dr. Prucnal has shown, when AFL's engineers set out to solve this problem, they did not think to modify Future Access in the ways Dr. Blumenthal suggests (or at all); instead, they started from scratch and built a new system guided by the EDGE design. *See* CX-2060C (Prucnal RWS) Q/A 476. Dr. Blumenthal admitted as much during his cross examination. Blumenthal Tr. 741-742.

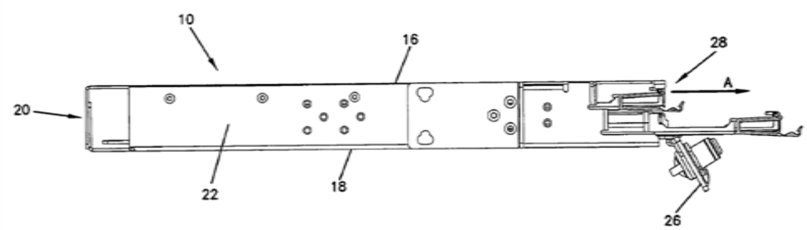
Dr. Blumenthal also does not show how a third adapter pack could be added to Smrha '684, whether the framework in Smrha '684 could support such an addition, and whether the result would fit within a 1U space. *See* CX-2060C (Prucnal RWS) Q/A 483, 486-87. He was questioned on these precise points at the hearing, and he did not offer any meaningful analysis. He simply asserted (without explanation) that the hardware within the Smrha'684 chassis "could be reduced and slowed down." Blumenthal Tr. 735. Such conclusory testimony is inadequate as a matter of law. *See ActiveVideo Networks, Inc. v. Verizon Commc'ns, Inc.*, 694 F.3d 1312, 1327 (Fed. Cir. 2012) (rejecting expert invalidity opinion as "conclusory and factually unsupported" where "[t]he expert failed to explain how specific references could be combined, which combination(s) of elements in specific references would yield a predictable result, or how any specific combination would operate or read on the asserted claims.").

It is not apparent from Dr. Blumenthal's testimony where in Smrha '684 there is room for the additional adapter packs, rails, and hardware needed to support a third row of connections. He first testified that he did not "consider it necessary" to analyze Smrha's figures to ascertain where a third level of adapter packs might fit, Blumenthal

[redacted]

Tr. 736-737, even though he purported to determine the size of Smrha'684's enclosure — which he conceded was not disclosed in the patent — only by studying those very same figures. *See id.* at 733-734. Then, confronted with the figures, Dr. Blumenthal offered an explanation for how the figures show there was room for a third layer of adapter packs. Specifically, he opined there was "room for another one of these adapter packs, as depicted in this patent, atop the existing adapter pack where the arrow 28 is pointing" in Figure 3 of the patent. Blumenthal Tr. 738. Figure 3 is shown below.

FIG. 3



CX-0032 (Smrha '684) at 5.[30]

As the above figure makes clear, there is no room in Smrha '684 for a third row of adapter packs. The patentee did not leave a third of the chassis empty, and for good reason. The patent states (as Dr. Blumenthal recognizes) that "[d]emand for greater telecommunications services has promoted the increase in circuit densities of termination panels," and there is "a continuous need for further improvement of high-density

[30] In another part of his testimony, Dr. Blumenthal opined that a third row of adapter packs could fit beneath the two adapter packs disclosed by Smrha '684. Blumenthal Tr. 737. That new suggestion is equally unsubstantiated and inconsistent with his expert report, *see id.* at 726, 738, and with his direct witness statement, *see* RX-0001C (Blumenthal WS) Q/A 356 ("Although a POSITA would already understand that Smrha '684's modules could be stacked ***higher*** than the two shown in its figures, Future Access 1 RU confirms this by teaching that the modules can be vertically stacked at least three high on a slidable drawer within a panel.") (emphasis added).

[redacted]

termination panels and associated methods." *Id.* at 26; RX-0001C (Blumenthal WS) Q/A 347. It would have made no sense for the inventor of Smrha '684 to have recognized a need for greater density and then simply left the chassis only two-thirds full.

* * *

Accordingly, respondents have not proven by clear and convincing evidence that claims 1 and 3 of the '320 patent are rendered obvious by Smrha '684 in combination with AFL's Future Access product design.

d. Secondary Considerations (All Patents)[31]

For the reasons discussed below, Corning has adduced evidence of secondary considerations indicating that the asserted claims of the '320 patent are not obvious. *See* Compl. Br. at 207-17; Staff Br. at 108-11.

Respondents disagree. *See* Resps. Br. at 254-57. Respondents argue, *inter alia*:

> Complainant also claims that there must have been copying because competitors looked at, and analyzed the DI products, relying mainly on a "competitor analysis" of EDGE products performed by Panduit. Kuffel Tr. 605:8-16; Blumenthal Tr. 721:4-7. But this was one of several analyses that Panduit performed on the products of various companies. Kuffel Tr. 653:6-19. Such analyses are to understand the strength of the competition and do not show any copying. Blumenthal Tr. 721:8-14, 721:19-722:1; JX-0033C (Hicks Dep. Tr.) 87-92 (Corning also obtains competitor products for competitive intelligence including teardowns and photographs).
>
> Moreover, Respondents' chassis and modules, including *e.g.*, Leviton Enclosures and Leviton Accused Modules, are substantially different from the DI products and include quad adapters and critical ease-of-use functionality that are not found in the DI products. RX-0005C (Kim WS) Q/A 31; RX-0008C (Lebby RWS) Q/A 75, 82-87. *See also supra* Section VI.B.2.a.ii. Complainant does not point to a shred of

[31] Inasmuch as the four asserted patents are related, the parties did not brief the secondary considerations separately for each patent. *See* Joint Outline at 5-9.

[redacted]

> evidence that Leviton copied Corning and there is none.
>
> Complainant also fails to establish that products embodying the alleged inventions of the Asserted Claims have been any more commercially successful than products that do not embody those inventions. RX-0001C (Blumenthal WS) Q/A 370-371, 586-587, 719-720. Complainant also has not established that any alleged success is a direct result of the claimed invention. RX-0009C (Blumenthal RWS) Q/A 23-24. Complainant has not performed any economic analysis of commercial success apart from naked sales numbers. *See Kansas Jack, Inc. v. Kuhn*, 719 F.2d 1144, 1151 (Fed. Cir. 1983) (rejecting evidence of alleged commercial success that only reported number of units sold without providing any evidence of market share, growth in market share over time, replacement of earlier units sold by others, and no evidence of a nexus).
>
> Finally, Complainant fails to establish any long-felt but unresolved need for the alleged inventions. RX-0001C (Blumenthal WS) Q/A 372-373, 452-453, 588-589, 721. Complainant also fails to establish any praise or awards, professional skepticism, unexpected results, or teaching away from those alleged inventions. RX-0001C (Blumenthal WS) Q/A 374-376, 454-456, 590-592, 722-724; RX-0009C (Blumenthal RWS) Q/A 15-26.

See Resps. Br. at 256-57.

<u>Overview</u>

The asserted claims manifest the "objective indicia of non-obviousness" that the Federal Circuit has called "often . . . the most probative and cogent evidence in the record." *WBIP, LLC v. Kohler Co.*, 829 F.3d 1317, 1328 (Fed. Cir. 2016) (quoting *Stratoflex, Inc. v. Aeroquip Corp.*, 713 F.2d 1530, 1538 (Fed. Cir. 1983)). Evidence of this kind helps to "guard against slipping into use of hindsight," *Graham v. John Deere Co. of Kansas City*, 383 U.S. 1, 36 (1966) (internal quotation marks omitted).

As discussed below, the evidence shows that EDGE's patented features helped it to meet a long-felt need for accessible density, achieve results that its designers did not expect, overcome skepticism and succeed where others had failed, enjoy commercial

[redacted]

success, and receive industry praise.

As Dr. Prucnal explains, to apply the traditional objective indicia to EDGE's patented features, it is necessary to tie those features to the benefits that EDGE achieves by practicing the asserted claims, which he groups into the three categories of density, accessibility, and modularity. *See* CX-0001C (Prucnal WS) Q/A 564-565; *see also id.* Q/A 567 (explaining that EDGE achieved those benefits through its "novel design" incorporating "sliding trays and front-and-rear accessible modules").[32]

Dr. Prucnal further considered how the asserted claims related to the three major benefits of EDGE that he had three EDGE's three major benefits, as follows:

- claims 1 and 3 of the '320 patent, and claims 11, 19 and 27 of the '456 patent, read specifically on achieving a certain number of fiber optic connections in a U space, CX-0001C (Prucnal WS) Q/A 570;
- claims 21 and 28 of the '456 patent, and claims 1 and 23 of the '153 patent, read on features that improve accessibility, such as sliding trays holding modules and features that guide tray and module movement *id.* Q/A 571; and
- claims 11 and 27 of the '456 patent, and (formerly asserted) claim 14 of the '206 patent, read on features of modules and features guiding and allowing their installation and movement, which help to protect fibers from damage or excessive bending, *id.* Q/A 572.

All the asserted claims either fit into this categorization or depend from claims that fit

[32] Testimony from Corning's fact witnesses supports this identification of density, accessibility, and modularity as the three main benefits achieved by EDGE's innovative design. *See* CX-0004C (Hicks WS) Q/A 12 (Corning "introduced 'evolved density' so data-center operators could make more fiber optic connections in the same space, and in a more accessible way," and that "the EDGE products are "growth enabled" because data-center operators can use a system of modules to increase the number of connections to meet their specific requirements"); *id.* Q/A 55 ("[W]e were the first to provide high density and accessibility in a plug-and-play system."); CX-0006C (Staber WS) Q/A 12 (EDGE "provide[d] greater density for LC-based connections than any system that existed at the time" and was also "designed to be . . . modular"); *id.* Q/A 16 (similar, and also discussing the need for "good finger access").

[redacted]

into this categorization.[33] Accordingly, by showing that EDGE's achievement of unprecedented density, accessibility, and modularity helped it to succeed, Dr. Prucnal's analysis shows that the asserted claims demonstrate objective indicia of non-obviousness.

Long-Felt Need

Patented features' ability to meet a long felt but unsolved need is well-recognized evidence of non-obviousness. Here, the testimony of Corning's witnesses showed that before the invention of EDGE, "Corning's and other competitors' products offered a maximum of 96 LC fiber connections within a standard Rack Unit space, and most products in the marketplace offered only 72." *See* CX-0007C (Rhoney WS) Q/A 11; *see also* CX-0004C (Hicks WS) Q/A 15; CX-0006C (Staber WS) Q/A 16; CX-0001C (Prucnal WS) Q/A 557. Mr. Kuffel further confirmed at the hearing that as of early 2010, "Panduit was supporting 48 channels, 96 fibers . . . in a 1RU." Kuffel Tr. 610-611.

Corning's witnesses also testified that pre-EDGE products had "other shortcomings in terms of providing accessibility (e.g. good finger spacing), modular growth, and in protecting fibers during finger access." CX-0006C (Staber WS) Q/A 16; *see* CX-0007C (Rhoney WS) Q/A 11 (explaining that "customers . . . wanted greater density but also wanted more usability than" offered by "existing solutions in the market," including "better accessibility to connectors"). Respondents' witnesses have similarly testified to "market feedback" demanding the "highest amount of connectors" with "hand accessibility," JX-0018C (Maynard Dep. Tr.) 43-45, and that "more density . .

[33] Dr. Prucnal's categorization refers to claim 1 of the '153 patent, which is no longer asserted; and to claim . However, their patented features are still at issue in claims that remain asserted. For example, the patented features of claim 14 of the '206 patent, *see* CX-0001C (Prucnal WS) Q/A 572, are incorporated in claims 22 and 23, which depend from claim 14.

[redacted]

. save[s] money," but can make it "difficult to have access with your hands to those connections," JX-0016C (Kim Dep. Tr.) 57, 139.

The evidence shows that, beginning in 2007, Corning conducted a lengthy process to identify unmet customer needs through market research and to develop, though brainstorming and design, new products to meet those needs. *See* CX-0006C (Staber WS) Q/A 18-19 (describing Corning's market research "to obtain the 'voice of customer' " and "five-stage development process" for EDGE); CX-0007C (Rhoney WS) Q/A 12 ("many workshop and brainstorming sessions with large groups of engineers from different backgrounds"); CX-0001C (Prucnal WS) Q/A 578-581 (discussing documentation of Corning's efforts to ascertain customers' needs and to develop EDGE to meet those needs). After months of work, Corning's engineers settled on the design concept that became EDGE: unprecedented density of 144 LC connections per U space, employing sliding trays, removable modules, and related features (such as rails, guides, and latches) to enable access, and a modular structure that helped to protect fibers. *Id.* Q/A 586; *see* CX-1459C (Pretium EDGE Presentation) (documenting the process of creating EDGE).

<u>Unexpected Results</u>

Corning set a goal of achieving "at least 96 LC fiber optic connections per U space." CX-0006C (Staber WS) Q/A 17; CX-0822C (NGDC Concept Review) at 11 (listing ">48 ports," or 96 connections using duplex adapters, as the "[t]arget" for a "1U Modular Design"). Ultimately, EDGE exceeded that goal by 50%, achieving 144 LC connections. *See* CX-0006C (Staber WS) Q/A 24 ("[W]e ultimately developed a system that provided 144 connections and blew the competition away.").

[redacted]

Similarly, Corning quantified its accessibility goal as a 20% reduction in installation time. *Id.*; *see* CX-0913C (Corning EDGE Review Meeting '148 IPR) at 60 ("target value proposition" including "20% faster network deployment" over "the current [Plug and Play] product solution set"). Ultimately, EDGE nearly doubled that, reducing installation time by 36%. *See* CX-0006C (Staber WS) Q/A 24. Contemporaneous documents confirm that Corning measured a "36% time reduction" and congratulated its designers on "exceeding . . . target values." *See* CX-0915C (Corning EDGE Time/Motion Study '148 IPR) at 14. The installers attributed the "reduce[d] . . . time" to the patented feature of "ability to load the modules from the back of the housing" and praised the "new latching features and back of housing installation." *Id.* at 21.

Skepticism and Prior Failure

Expressions of skepticism came from Corning's own employees, *see* CX-0788C (9/25/08 Corning E-mail) at 1 (EDGE's "density" was "scary"); and from customers who doubted whether that EDGE could "achieve high density without compromising accessibility," CX-0006C (Staber WS) Q/A 25; *see also* CX-0939C (Recent VOC Feedbacks) at 2-3 (reporting "[m]any concerns" about "congestion . . . for a fully loaded rack" and "[s]ome concerns" about "1U hand access"). Panduit also criticized or reported customers criticizing EDGE as [redacted]-0098 (Corning LANscape Pretium EDGE Solution: Competitive Prod. Q&A) at 4; for having [redacted] CX-0097C (1/9/12 Panduit Email), and for a [redacted] CX-0101C (Corning LANscape Pretium EDGE Solutions Competitive Prod. Info Summary Presentation), at 7. Those criticisms targeting EDGE's patented features as unworkable undermine

[redacted]

respondents' present assertions that those features would obviously work. *See* CX-0001C (Prucnal WS) Q/A 600.

Examples of prior failures included some from EDGE's own inventors, who tried "a number of different concepts, many of which didn't end up working." CX-0007C (Rhoney WS) Q/A 13 (failed "concept for modules that moved in a telescoping manner"); CX-0819C (NGDC Weekly Meeting) at 23 (failed designs including the "telescoping modules" and a "rear mounted sliding shelf"). Even after EDGE's launch, several respondents experienced design failures when trying to make competing products. *See, e.g.,* JX-0016C (Kim Dep. Tr.) 51 (Leviton at first "[redacted]"); JX-0019C (Nagel Dep. Tr.) 38 (concept involving backward-sliding trays that "burnt a lot of time" and "really wasn't practical"); *see also* CX-0001C (Prucnal WS) Q/A 604-06.

<u>Commercial Success</u>

When launched, EDGE received an "overwhelmingly positive" response, including "large market adoption quickly." CX-0007C (Rhoney WS) Q/A 15; *see* CX-0006C (Staber WS) Q/A 25 ("Initial demand exceeded our supply, and customers were willing to pay a premium over our next-best selling data center products . . . ."). Corning's contemporaneous documents confirm that it charged a "15% price premium" for EDGE over Corning's previous solution and still made unusually strong early sales with rapid growth. *See* CX-0927C (Houghton Award Nominations) at 2; CX-0001C (Prucnal WS) Q/A 610. Today, "EDGE is the leading plug-and-play solution in the United States," allowing Corning to capture "[redacted] . . . of the data-center market as a whole, and a greater share if you look just at high-density solutions." *See* CX-0004C

[redacted]

(Hicks WS) Q/A 23; Q/A 55 (EDGE has had a "lot of success" because Corning was "the first to provide high density and accessibility in a plug-and-play system"); CX-1000C (Corning Chassis Sales Data) and CX-0973C (Corning Module and Assembly Sales Data).

Respondents' internal documents also acknowledge that EDGE — and, specifically, EDGE's patented features — succeeded. For example, in 2011, [redacted]" CX-0116C (Panduit Market Spec. Requirements) at 2; [redacted], [redacted] CX-0083C (6/16/15 Leviton Email) at 128; and in or around 2017, AFL identified a "require[ment]" for "a platform that can effectively compete with benchmarks" including EDGE and Leviton's accused product, because "data center customers demand high density connectivity solutions that offer flexibility in terms of deployment and ease of use," CX-0341C (AFL HD Platform Gate 3) at 2.

Respondents' marketing documents further show that they sell the accused products by advertising the same benefits that EDGE's patented features provide — density, accessibility, and modularity. For example, Panduit sells HD Flex by promoting its "higher . . . density," a "fully modular solution," and "access to connections from front or rear," CX-0199 (Panduit HD Flex Enclosures Spec.) at 1; and Siemon sells LightStack by pointing to its "ultra high density 144 fibers per 1U (LC interface)," its "[f]ixed design with sliding trays and innovative features" that offered "High Density AND Unmatched

Accessibility," and its "[r]ear module insertion and removal," CX-0179C (Siemon Plug and Play Presentation) at 5.

Industry Praise

EDGE has also received significant praise for its benefits of density, accessibility, and modularity. Corning's customers praised EDGE, *see* CX-0001C (Prucnal WS) Q/A 623 (citing examples), and Corning won awards for EDGE in 2013, 2014, 2016, CX-0006C (Staber WS) Q/A 26 (explaining that these awards recognized "the accessible density and other features achieved by the EDGE system").

Respondents' internal documents also recognized EDGE's competitive strength. One Panduit employee, [redacted] in showing that [redacted] CX-0143C (5/29/15 Panduit Email) at 1; *see id.* at 9 (describing [redacted] and [redacted]. Panduit [redacted] CX-0131C (6/19/13 Panduit Email) at 34; *see* CX-0114C ([redacted]) at 21 (describing the [redacted], including that it (1) is [redacted] (2) uses [redacted] (3) [redacted] (4) has [redacted] and (5) [redacted]). Siemon similarly credited EDGE, compared to

[redacted]

"[redacted]" products, with "[redacted]," "[redacted]" and "[redacted]"; and observed that EDGE's "[redacted]" CX-0164C (Siemon NPD PRS) at 21.

<u>Copying</u>

Respondents argue, "Complainant does not point to a shred of evidence that Leviton copied Corning and there is none." Resps. Br. at 257.

The Staff argues:

> Finally, Complainant asserts that Respondents attempted to counteract EDGE's success by copying EDGE's patented features. *See* CX-0001C Q/A 628. Dr. Prucnal cited numerous examples of Respondents engaging in competitive analyses of Corning's EDGE products, as well as monitoring of Corning's patents covering EDGE. *Id*. Q/A 625-26, 631-35. However, competitive benchmarking and attempts to ensure that a product design does not infringe another's patents do not necessarily constitute "copying." In the Staff's view, this final secondary consideration is, at best, a neutral factor in assessing nonobviousness. All other objective indicia, however, tend to weigh against a finding that any of the asserted patent claims are invalid for obviousness.

See Staff Br. at 110-11.

Corning argues that there is "ample evidence that competitors copied EDGE." Compl. Br. at 214. In support, Corning cites Mr. Hicks' testimony:

> [Respondents'] products look just like EDGE. Among other things, they have chassis that fit in the U space with sliding trays and modules. When we launched EDGE, it was a unique solution with completely different features from anything else on the market. But, after EDGE launched, competitors introduced products that look the same with almost identical features to EDGE.

CX-0004C (Hicks WS) Q/A 62.

[redacted]

Corning argues:

> Dr. Prucnal walks through the sequence of events for Panduit specifically, explaining that Panduit ordered and tested a copy of EDGE, [redacted] and ultimately developed its Accused HD Flex Product that achieved the same accessibly density as EDGE using the same structure. See CX-0001C (Prucnal WS) Q/A 632-633.
>
> That analysis was confirmed by hearing testimony in which Mr. Kuffel conceded that during its process Panduit [redacted] using [redacted], Kuffel Tr. 621:10:13; and admitted it was "possible" that Panduit [redacted] id. at 622:11-16; though he preferred to refer to them as [redacted] rather than [redacted] id. at 622:17-23. Dr. Blumenthal similarly conceded that Panduit's documents showed it [redacted] and that [redacted] Blumenthal Tr. 718:20-23 (discussing CX-0114C, at 9).

Compl. Br. at 215.

As the Staff noted, however, "competitive benchmarking and attempts to ensure that a product design does not infringe another's patents do not necessarily constitute 'copying.'" The administrative law judge agrees. On the whole, this secondary consideration is a neutral factor in assessing nonobviousness.

<u>EDGE's Patented Features</u>

Respondents dispute the link between EDGE's success and its patented features. For example, respondents argue, *inter alia*:

> Complainant also has not established that any DI product or accused product is coextensive with the any specific alleged invention claimed in any claim of any Asserted Patent and cannot, therefore, rely on a rebuttable presumption of nexus. In fact, Complainant contends that the DI products and accused products have succeeded based only on a combination of features, including connection density, accessibility, and modularity that are not all addressed by any single claim of any specific

[redacted]

> Asserted Patent. For example, the DI products and accused products include numerous significant features that are *not* claimed in: (1) the '320 Patent, including *e.g.*, fiber optic equipment tray(s), fiber optic modules, fiber optic module guides, a fiber optic cable management clips, and rear-removable functionality for the modules, RX-0001C (Blumenthal WS) Q/A 368-369; (2) the '456 Patent, including *e.g.*, a fiber optic connection density of at least 144 fiber optic connections per 1RU (claims 11-16, 21), fiber optic cable management clips, and rear-removable functionality for the modules, *id.* Q/A 448-449; (3) the '153 Patent, including *e.g.*, fiber optic connection density of 98 or 144 connections per 1RU space, *id.* Q/A 584-585; and (4) the '206 Patent, including *e.g.*, fiber optic equipment tray(s), fiber optic connection density of 98 or 144 fiber optic connections per 1RU space, and a fiber optic cable management clips, *id.* Q/A 717-718. Moreover, Complainant contends that the DI products and accused products embody ***different*** alleged inventions claimed in ***different*** Asserted Patents that claim ***different*** alleged inventions. That by itself, precludes Complainant from relying on a rebuttable presumption of nexus. *See Fox Factory, Inc. v. SRAM, LLC*, 944 F.3d 1366, 1373-74 (Fed. Cir. 2019), *cert. denied*, No. 20-158, 2020 WL 5883383 (U.S. Oct. 5, 2020).[34]

See Resps. Br. at 254-55.

In general, Corning may establish a "prima facie case of nexus" between a successful product and the claims of an asserted patent by showing "that [the product] practices the . . . patent" and that the "product was commercially successful," *Crocs*, 598 F.3d at 1310-11, or manifests other indicia of non-obviousness. Once a prima facie case is established, it then becomes respondents' burden by "presenting evidence that shows the proffered objective evidence was 'due to extraneous factors other than the patented invention.'" *WBIP*, 829 F.3d at 1329 (quoting *Demaco*, 851 F.2d at 1393); *see also* *Demaco*, 851 F.2d at 1394 ("A patentee is not required to prove as part of its prima facie

[34] The PTAB rejected similar nexus arguments in its Final Written Decision finding claims 1-20 of a patent related to the '320, '456, and '153 Patents. RX-1393 (Final Written Decision of IPR of '148 Patent). For example, the PTAB determined that there was not sufficient evidence to show that the Corning EDGE product and alleged copy (Panduit product) are coextensive with any patent claim and that Corning arguments on commercial success, long-felt need, recognition of a problem, and failure of others actually relate to *another* patent. *Id.* at RX-1393.0035-38.

[redacted]

case that the commercial success of the patented invention is *not* due to factors other than the patented invention.").

Corning has shown as part of its affirmative domestic industry case, relying on the opinion of Dr. Ralph, that the EDGE products practice the asserted patents. Those patents describe preferred embodiments that match EDGE, and include figures that depict EDGE's modules and chassis. In addition, much of the evidence supporting Corning's showing of objective indicia points specifically to EDGE's characteristics of density, accessibility, and modularity, which are benefits derived from EDGE's patented features. *See* CX-0001C (Prucnal WS) Q/A 564-72. Thus, Corning has made a prima facie case tying EDGE's success and other indicia of non-obviousness to claimed features.

Dr. Blumenthal has offered an opinion that objective indicia are not present, but in that opinion he does not cite or discuss the evidence that Corning has put forward, even though much of it was cited in Corning's contention interrogatories, which he purportedly reviewed in preparing his opinion. *See* RX-0001C (Blumenthal WS) Q/A 368-377, 448-457, 584-593, 717-725; *but see* Blumenthal Tr. 714-715 (equivocating on whether he "actually looked at" the evidence cited by Dr. Prucnal). Instead, for each asserted patent, Dr. Blumenthal cites the claims of each other asserted patent and asserts that Corning has not shown that particular indicia are attributable to one patent rather than the others. *See id.* Q/A 369, 449, 585, 718. This approach would make it impossible to use indicia where a product embodies the claims of multiple patents, and that is not the law. Instead, in cases "[w]here a product embodies claims from two patents," it is sufficient for the patentee to show that "the claims of both patents generally cover the same invention." *Fox Factory, Inc. v. SRAM, LLC*, 944 F.3d 1366, 1377 (Fed.

[redacted]

Cir. 2019) (citing *WIBP* and similar cases), *cert. denied*, No. 20-158 (Oct. 5, 2020). Here, the asserted claims "generally cover" EDGE, and so its success is evidence in favor of each.

In his testimony, Dr. Blumenthal also opined that some features of EDGE were disclosed in other patents invalidated in previous *inter partes* review proceedings (and not asserted here), and that EDGE's success might be attributable to those features. Furthermore, those previous patents, like the asserted patents, "generally cover[ed]" EDGE, *Fox Factory*, 944 F.3d at 1377, so they do not defeat a presumption of nexus to the asserted patents. Moreover, the previously invalidated patents were broader because they did not claim the density of the asserted claims of the '320 and '456 patents or other features found in the '153 and '206 patents. The Patent Office upheld the '320 patent against Panduit's *inter partes* challenge and declined to review the '206 patent (as discussed in the Validity sections for the '320 and '206 patents).

* * *

Accordingly, Corning has adduced evidence of secondary considerations indicating that the asserted claims of the '320 patent are not obvious.

4. Enablement

Respondents argue that asserted claims 1 and 3 are invalid because they are not enabled. *See* Resps. Br. at 77-85. Corning and the Staff disagree. *See* Compl. Br. at 218-26; Staff Br. at 111-15.

Respondents argue, *inter alia*:

> Claims 1 and 3 of the '320 Patent are invalid because they are not enabled. RX-0001C (Blumenthal WS) Q/A 206-214. The enablement

[redacted]

> requirement "prevents both inadequate disclosure of an invention and overbroad claiming that might otherwise attempt to cover more than was actually invented." *MagSil Corp. v. Hitachi Global Storage Techs., Inc.*, 687 F.3d 1377, 1381 (Fed. Cir. 2012). Thus, a patentee invites additional scrutiny when it chooses to use open-ended claim language, *e.g.*, limitations claiming "at least" some threshold quantity but lacking any express upper bound. Complainant chose to use exactly that formulation for the alleged inventions claimed in claims 1 and 3 of the '320 Patent.
>
> Claim 1 requires that "the fiber optic connection equipment is configured to support a fiber optic connection density of ***at least ninety-eight (98) fiber optic connections per U space***, based on using at least one simplex fiber optic component or at least one duplex fiber optic component." JX-0004 ('320 Patent) at 19:54-59 (emphasis added). Claim 3 requires that "the fiber optic connection equipment is configured to support a fiber optic connection density of ***at least one hundred forty-four (144) fiber optic connections per U space***," based on using at least one simplex fiber optic component or at least one duplex fiber optic component. *Id*. at 19:64-67 (emphasis added). There is no dispute that claims 1 and 3 are open-ended because they include an expressly stated lower bound but do not include an expressly stated upper bound. RX-0001C (Blumenthal WS) Q/A 207; CX-2060C (Prucnal RWS) Q/A 177; CPHB at 222; SPHB at 110.
>
> Accordingly, claims 1 and 3 are valid if and only if (1) they have an inherent upper limit and (2) the specification enables a POSITA to approach that limit. *Andersen Corp. v. Fiber Composites, LLC*, 474 F.3d 1361, 1376-77 (Fed. Cir. 2007). Claims 1 and 3 do not satisfy that standard and are therefore invalid.

Resps. Br. at 77-78.

For the reasons discussed below, respondents have not proven by clear and convincing evidence that claims 1 and 3 of the '320 patent do not satisfy the enablement requirement of 35 U.S.C. § 112.

Respondents fail to show that any asserted claims are invalid for lack of enablement. Under former 35 U.S.C. § 112 ¶ 1 (2006) (now § 112(a)), a patent must describe the invention "in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains . . . to make and use the same." This requires

[redacted]

"teach[ing] those skilled in the art how to make and use the full scope of the claimed invention without 'undue experimentation." *McRO, Inc. v. Bandai Namco Games Am. Inc.*, 959 F.3d 1091, 1100 (Fed. Cir. 2020) (quoting *ALZA Corp. v. Andrx Pharm., LLC*, 603 F.3d 935, 940 (Fed. Cir. 2010)). As with other challenges to patent validity, respondents bear the burden to show lack of enablement by clear and convincing evidence. *See Cephalon, Inc. v. Watson Pharm., Inc.*, 707 F.3d 1330, 1336 (Fed. Cir. 2013).

Respondents' enablement challenges in this case almost entirely concern claim limitations that feature open-ended ranges, such as the limitation of '320 claims 1 and 3 that recite "fiber optic connection density of at least 98" or "at least 144 fiber optic connections per U space." JX-0004 ('320 Patent) at Claims 1, 3. These ranges are open-ended because the claim terms express a lower limit but no upper limit. An enablement challenge to a claim containing a range of this kind is governed by *Andersen Corp. v. Fiber Composites, LLC*, 474 F.3d 1361 (Fed. Cir. 2007):

> [O]pen-ended claims are not inherently improper; as for all claims their appropriateness depends on the particular facts of the invention, the disclosure, and the prior art. They may be supported if there is an inherent, albeit not precisely known, upper limit and the specification enables one of skill in the art to approach that limit.

Id. at 1376-77. Accordingly, respondents must show either that there is no inherent upper limit on the claims they challenge, or that the specification does not teach a person of skill to approach that limit without undue experimentation. Further, as the Federal Circuit's decision in *McRO* makes clear, an enablement challenge requires "specific identification of products or processes that were or may be within the scope of the claims

[redacted]

and were allegedly not enabled." 959 F.3d at 1101; *see id.* at 1104. Respondents have not made the showing required.

"a fiber optic connection density of at least 98" or "at least 144 fiber optic connections per U space" ('320 patent, claims 1, 3)

Existence of an Inherent Upper Limit

The evidence shows an inherent upper limit on fiber optic connection density per U space based on using simplex or duplex components. The existence of such a limit is, in a sense, trivial: a U space is a finite amount of space, and each fiber takes up space, so only a finite number of fibers can be connected in a U space. *See* CX-2060C (Prucnal RWS) at, *e.g.,* Q/A 188, 223-224. However, as a person of ordinary skill would know, there are more pressing constraints on the number of connections per U space than fiber size. Those constraints include the size of fiber optic connectors, adapters, and cables, *see id.* Q/A 188-197; the need for technicians to access fiber optic connections to install, use, and maintain fiber optic connection equipment, *see id.* Q/A 198-204; and the need to protect fibers and ensure an appropriate bend radius, *see id.* Q/A 205-211.

First, as to the physical size of the equipment, a person of ordinary skill would recognize from the '320 patent and from general background knowledge, that the '320 patent claims recite physical structure that takes up space. *See* JX-0004 ('320 Patent) at Claims 1, 3 ("fiber optic connection equipment provided in [a] chassis"; "at least one simplex or duplex fiber optic component"). The '320 patent specification explains that "increasing the number of optical fiber ports can require more equipment rack space in a data center," *id.* at 1:64-65, and discusses in detail the limits imposed by space constraints, *see id.* at 2:10-25, 4:36-42, 5:38-67, 8:38-51, 10:25-46, 11:42-12:4, 12:40-

[redacted]

13:21, 14:5-34, 15:29-56, 16:58-17:19, 19-20 (table). Indeed, a primary focus of the specification is to disclose the physical constraints on making fiber optic connections in a U space and the techniques that push as close as possible to those inherent limits. Witnesses from both Corning and respondents agreed that there is a limit on the number of connections that can fit into a U or 4U space using simplex and duplex LC components. JX-0034C (Rhoney Dep. Tr.) 180:16-20; JX-0017C (Kuffel Dep. Tr.) 138-139; Kuffel Tr. 613-614, 617-618.

Second, the need for technician access to the equipment imposes a further limit on "what a person skilled in the art would understand to be workable," *Ralston Purina Inc.*, 772 F.2d 1570, 1576 (Fed. Cir. 1985). The '320 patent specification refers to operations expressly performed by hand, *see* JX-0004 ('320 Patent) at 6:54-57 (disclosing a "lever [that] can easily be squeezed into [a] finger hook . . . by a thumb and finger"), alongside many other "pulling," "pushing" and "releasing" operations that, in context, a person of skill would understand to be manual. *See id.* at 6:5-8, 6:13-18, 6:18-20, 6:29-30, 6:39-41, 6:41-44, 6:51-54, 6:67-7:3, 7:24-29; CX-2060C (Prucnal RWS) Q/A 200; *see also* Prucnal Tr. 974:5-7 ("[I]t's not just density, but also accessibility, for example, that would determine what's achieved."); *id.* at 988:13-14 (whether "densities are usable[ ] . . . would take into account finger access").

Dr. Blumenthal also recognizes the importance of accessibility, RX-0009C (Blumenthal RWS) Q/A 366, as do other witnesses. As Mr. Rhoney explained, "[j]ust having density is not going to cut it," and some of Corning's attempted designs that preceded EDGE "ultimately did not succeed because we ignored some of the other attributes like modularity and accessibility." JX-0034C (Rhoney Dep. Tr.) 177; *see*

[redacted]

Hicks Tr. 104 (describing EDGE's "sliding trays" that create "the ability to get access to the . . . modules" as a "key value proposition of the EDGE solution").

Third, the need to protect fibers and ensure an appropriate bend radius is also discussed in the '320 patent specification, *see* JX-0004 ('320 Patent) at 9:59-63, 19:36-40; was discussed by Dr. Prucnal at the hearing, *see* Prucnal Tr. 1040 (explaining that "[f]iber optics requires avoiding breakage, having not too sharp a bend radius or losing a lot of light"); and was discussed by a number of other witnesses. *See* JX-0016C (Kim Dep. Tr.) 56-57; JX-0017C (Kuffel Dep. Tr.) at 68-69, 109; Kuffel Tr. 630 [redacted] *see also id.* at 635 ([redacted].

The existence of a limit on the number of fiber optic connections per U space, from the perspective of a person of skill, is further shown by one respondent's own attempts, and the attempt of respondents' expert, to calculate such a limit. As Dr. Prucnal explains, [redacted] *See* CX-2060C (Prucnal RWS) Q/A 192 (discussing, *e.g.*, CX-0103C ([redacted]); *see* Kuffel Tr. 613-614. Panduit again attempted to calculate such a limit in its unsuccessful *inter partes* review challenge to the '320 patent. *See* CX-2060C (Prucnal RWS) Q/A 435 (discussing CX-1736 (320 IPR Final Decision)). Dr. Blumenthal himself attempted to calculate such a limit in his analysis here. *See id.* Q/A 184; RX-0001C (Blumenthal WS) Q/A 314.

[redacted]. That uncertainty goes to whether the

[redacted]

limit is "precisely known," which it "need not be." *Andersen Corp.*, 474 F.3d at 1376-77. Panduit's and Dr. Blumenthal's calculations establish at a minimum that persons of ordinary skill agree some inherent limit exists, even if such persons may disagree about exactly what the limit is.

<u>Ability To Approach the Inherent Upper Limit</u>

Respondents bear the burden to show that the challenged claims are not enabled, and they must show that the specification does not "enable[] one of skill in the art to approach" the inherent upper limit, *Andersen Corp.*, 474 F.3d at 1366. To make that showing, respondents must come forward with clear and convincing evidence of "specific . . . products or processes that were or may be within the scope of the claims and were allegedly not enabled." *McRO*, 959 F.3d at 1101. They have failed to produce that necessary proof.

Corning (although it does not carry the burden) has presented evidence that the teachings of the '320 patent, embodied in the EDGE products and respondents' infringing products, enable a person of skill to approach the inherent upper limit on fiber optic connection density in a U space using simplex or duplex connections. That includes Dr. Prucnal's testimony explaining that:

- although there is substantial market pressure to achieve greater accessible density, there is no evidence of any marketed product exceeding EDGE's density since the time of EDGE's invention in August 2008, *see id.* CX-2060C (Prucnal RWS) Q/A 214;
- Respondents reviewed EDGE while designing their accused products and converged on similar designs that match, but do not exceed, its density, even where [redacted] *see id.* Q/A 215 (quoting CX-0103C (4/19/2010 [redacted]));

[redacted]

- [redacted] *see id.* Q/A 216; and

- EDGE's inventor Brian Rhoney testified that, in his opinion, EDGE comes "'really close to that theoretical limit with LC connectivity of 144 fiber connections in a 1U space,'" *id.* Q/A 217 (quoting JX-0034C (Rhoney Dep. Tr.) 181).

Based on those facts, Dr. Prucnal gives a persuasive opinion that "the disclosures of the '320 patent enable a person of ordinary skill to approach the inherent upper limit on the open-ended range claimed by claims 1 and 3." CX-2060C (Prucnal RWS) Q/A 212; *see* Kuffel Tr. 617-618 [redacted]

Dr. Blumenthal opines that "[s]ince the alleged inventions of the '456 Patent, adapters with smaller footprints allowing for much greater densities [than LC adapters] have been developed and used in fiber optic equipment." RX-0001C (Blumenthal WS) Q/A 209. He opines that such "later-developed adapters were not known, and the densities achievable with those later-developed adapters could not be reached, as of the time of the alleged inventions of the '320 Patent." *Id.* The only specific example to which he points is the Mini-Duplex Connector ("MDC") and its associated adapters. *See id.* Q/A 203-205, 212-215; RX-0073 ("unveil[ing]" of MDC in February 2019). Respondents' arguments relying on MDC connectors and adapters fail for three reasons.

First, the state of the art for enablement purposes is assessed as of the priority date of the patent — here, August 2008 — and no later. The governing rule was set forth by Judge Markey in *In re Hogan*, 559 F.2d 595, 605 (C.C.P.A. 1977):

[redacted]

> [I]f appellants' 1953 application provided sufficient enablement, considering all available evidence (whenever that evidence became available) of the 1953 state of the art, i.e., of the condition of knowledge about all art-related facts existing in 1953, then the fact of that enablement was established for all time and a later change in the state of the art cannot change it.

Id. at 605; *see Chiron Corp. v. Genentech, Inc.*, 363 F.3d 1247, 1254 (Fed. Cir. 2004); *see also Amgen Inc. v. Sanofi*, 872 F.3d 1367, 1374-75 (Fed. Cir. 2017). Indeed, Dr. Blumenthal conceded under examination by the Staff that he "didn't know that something could become unenabled" based on events that occurred after the priority date. Blumenthal Tr. 763-764. Yet, relying on his testimony, respondents criticize Corning because its specifications did not mention later-developed adapters "not known" at the time of the specification. *E.g.*, RX-0001C (Blumenthal WS) Q/A 209. That is the exact use of post-priority evidence — criticism of an inventor for failing to do the "impossible," *Chiron*, 363 F.3d at 1254 — that *Hogan* prohibits.

Respondents argued that *MagSil Corp. v. Hitachi Global Storage Techs.*, 687 F.3d 1377 (Fed. Cir. 2012), allowed the use of post-priority evidence to show lack of enablement. *See* Resps. Br. 83-84. To the contrary, *MagSil* acknowledged that "[t]he enablement determination proceeds as of the effective filing date of the patent." 687 F.3d at 1380. In that case, moreover, the claims covered certain changes in electrical resistance of "'at least 10%,'" *id.* at 1381; and as of the priority date, the specification taught "a maximum change in resistance of only 11.8%," *id.* at 1382; but during prosecution, the inventors recognized an "upper limit" of a "100% resistive change," *id.*, far beyond what the specification taught. The Federal Circuit also referred to even higher changes (exceeding 600%) achieved years later, which the patent-holder sought to claim,

[redacted]

and criticized that as overreaching. *See id.* at 1384. However, *MagSil* did not consider whether — and certainly did not hold that — if the patent had taught how to approach the known upper limit on resistance changes as of its priority date, it would have become invalid when later advances made greater changes feasible, as respondents suggest here.

Second, even if later-invented adapters were relevant evidence about enablement (which they are not), respondents have failed to show that the patent does not enable their use. As *McRO* explains, a genuine enablement challenge

> routinely involve[s] concrete identification of at least some embodiment or embodiments asserted not to be enabled — including what particular products or processes are or may be within the claim, so that breadth is shown concretely and not just as an abstract possibility, and how much experimentation a skilled artisan would have to undertake to make and use those products or processes.

959 F.3d at 1100 (citing *In re Wands*, 858 F.2d 731, 737 (Fed. Cir. 1988)). Here, Dr. Blumenthal gives no opinion on "how much experimentation a skilled artisan would have to undertake to make," *id.*, a version of EDGE that would use later-adopted adapters. He opines that inasmuch as such adapters were not disclosed in the specification, it necessarily does not disclose their making and use. Those conclusory statements do not meet respondents' burden.

More generally, the '320 patent does not claim particular adapters, but specifies the use of simplex and duplex components. It teaches and claims certain aspects of a system that achieves unprecedented density combined with accessibility and fiber protection. *See* CX-0001C (Prucnal WS) Q/A 50-57. Dr. Blumenthal does not opine, and respondents have not shown any evidence, that it would require undue

[redacted]

experimentation to adapt the system taught in the specifications of the asserted patents to use MDC adapters instead of the LC and MPO adapters expressly disclosed.

Third, and similarly, respondents have not proposed any "concrete identification," *McRO*, 959 F.3d at 1100, of a product that is not enabled because it uses later-invented adapters. The accused products do not — they use LC adapters to achieve exactly the 144 connections per U space that the '320 patent specification teaches. Dr. Blumenthal opines that "the use of MDC adapters would allow a person of ordinary skill in the art to achieve up to 432 fiber optic connections per 1RU space using simplex or duplex adapters," RX-0001C (Blumenthal WS) at, *e.g.*, Q/A 203, 212, but gives no opinion at all about how much experimentation would be required to achieve a 432-fiber result, and whether such experimentation would be "undue" under the multi-part standard of *Wands*. Mere "'conclusory statements' regarding the amount of experimentation necessary" are insufficient to carry the "burden of establishing lack of enablement by clear and convincing evidence," *Takeda Pharm. Co. v. Zydus Pharms. Am., Inc.*, 743 F.3d 1359, 1369 (Fed. Cir. 2014). Here, respondents fail to present even a conclusory opinion applying the appropriate legal standard.

*   *   *

Accordingly, respondents have not proven by clear and convincing evidence that claims 1 and 3 of the '320 patent fail to satisfy the enablement requirement of 35 U.S.C. § 112.

5. Indefiniteness ("U space")

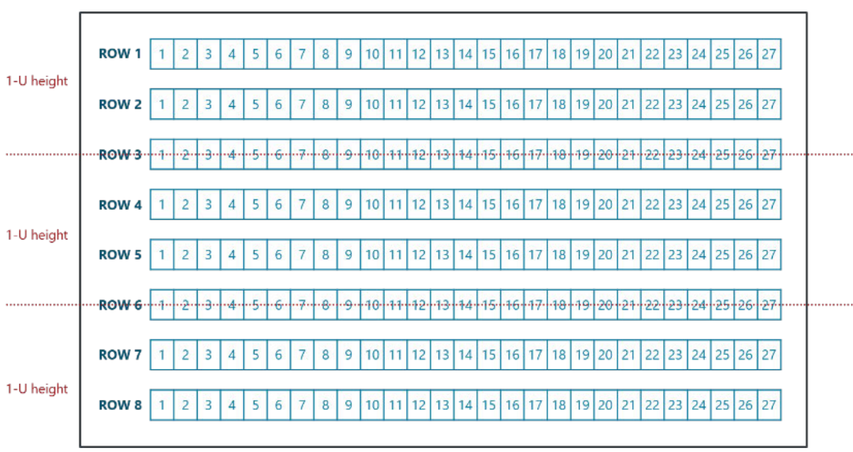
Respondents argue that the claim term "U space" renders claims 1 and 3

[redacted]

indefinite. *See* Resps. Br. at 85-87. Corning and the Staff disagree. *See* Compl. Br. at 228-30; Staff Br. at 55.

Respondents argue, *inter alia*:

> The term "U space" renders claims 1 and 3 of the '320 Patent and claims 11, 12, 14, 15, 16, 19 and 21 of the '456 Patent indefinite under any construction. *See* RX-0001C (Blumenthal WS) Q/A 215-230. The term "***per***" in the claims 1 and 3 of the '320 Patent, and claims 11 and 19 of the '456 Patent, introduces ambiguity that renders these claims indefinite because a POSITA would not be able to determine the claim scope. *Id*; *see also* RDX-0001.73-74.
>
> The specification discusses fiber optic connection density "***in*** a 1-U space." JX-0004 ('320 Patent) at 10:28-46; JX-0010 ('456 Patent) at 10:49-62; *see also* RDX-0001.75. Yet, claims 1 and 3 of the '320 Patent, and claims 11 and 19 of the '456 Patent recite fiber optic connection density "***per*** U space." JX-0004 ('320 Patent) at Claims 1-3; JX-0010 ('456 Patent) at Claims 11, 19; *see also* RDX-0001.73-74.
>
> For example, claim 3 of the '320 Patent recites "one hundred forty-four (144) fiber optic connections ***per U space***." A POSITA be unable to determine whether the claim would include a density of 432 connections (3X144) in situations where there is not 144 connections ***in any given 1-U space*** would fall within the claim scope. *See* RX-0001C (Blumenthal WS) Q/A 227-230; *see also* RDX-0001.76. The example in RDX-0001.76 is 3-U high, with 8 rows and 27 duplex adapters per row, resulting in 432 connections, but no single U-space contains 144 connections:



> The different meaning of the two terms – "in" and "per" – is irreconcilable. RX-0001C (Blumenthal WS) Q/A 227-230. The 432 connections in RDX-0001.76 in a 3-U height could imply that there are

[redacted]

> 144 connections ***per*** U space; however, that contradicts the specification, which refers to connections ***in*** a "given 1-U space," implying that all 144 connections fit within a given 1-U space. Even if we assumed "***per***" means "***in***" (it does not), the example in RDX-0001.76 would not satisfy claim 3 because Row 3 and Row 6 adapters are not within any given 1-U space. *See* RX-0001C (Blumenthal WS) Q/A 227-230.
>
> Thus, a POSITA would not be able to determine with reasonable certainty what the word "per" means. *Id.* A POSITA would have no way to determine whether "per" required each and every U space to have 144 connections and, therefore, would not be able to determine the scope of claim 3 with reasonable certainty. The same is true for claim 1 of the '320 Patent and claims 11, 12, 14, 16, 19, and 21 of the '456 Patent.

See Resps. Br. at 85-86.

For the reasons discussed below, respondents have not proven by clear and convincing evidence that the claim term "U space" (claimed in asserted claims 1 and 3 of the '320 patent and in asserted claims 11, 19, and 27 of the '456 patent) is indefinite under 35 U.S.C. § 112.

Respondents argue that the use of the term "per" in the phrase "per U space" renders the term indefinite — even though they did not seek construction of the term "per" in the parties' Joint Claim Construction Statement.

Respondents' argument rests on a contrast between the phrase "per U space" (which appears in the claims) and the phrase "in a U space" (which appears in the specification). *See* RX-0001C (Blumenthal WS) Q/A 225. They argue that the phrase "in a U space" means that the claimed density of connections must fit in a single U space, but that the phrase "per U space" permits an average to be calculated for a multiple U-space embodiment. *Id.* Q/A 229. They postulate a hypothetical device that achieves a density of (for example) 432 connections across 3 U spaces, but less than 144 connections in any single U space, because some adapters fall on dividing lines between

[redacted]

U spaces. *Id.* Q/A 228.

The word "per" is not indefinite in context, and a person of skill would be reasonably certain that respondents' hypothetical device does not infringe the '320 or '456 patents. As Dr. Prucnal explains, the word "per" does not have a specific technical meaning in the field of fiber optics, so a person of ordinary skill would understand it to have its ordinary, non-technical meaning, which is "'with respect to every member of a specified group' or 'for each.'" CX-2060C (Prucnal RWS) Q/A 242-245 (quoting CX-1535 (Webster's Third) at 7). In some contexts, such as "average income per capita," the word "per" can mean an average. In other contexts, such as a direction to take medicine "twice per day," the word can mean a minimum (or maximum) for each element of a group. *Id.* Q/A 246.

Here, the claims and specification show that the second meaning (a minimum, not an average) is intended. In the '320 and '456 patent claims, the word "per" is used as part of the phrases "at least 98 . . . per U space" and "at least 144 . . . per U space." When "at least" is combined with "per," it indicates that a minimum (rather than an average) is being stated. Dr. Prucnal gives an illustration based on a study showing that in 2015 American households had, on average, 2.3 televisions. *See id.* Q/A 247 (discussing CX-1534 (EIA Today in Energy). Based on this study, he explains, it would be correct to say that Americans had 2.3 televisions "per" household — the average — but not correct to say that Americans had "at least" 2.3 televisions "per" household, because most households had only 1 or 2 televisions. *See id.* That reading of the limitation "at least . . . per" is reinforced by the specification. As both experts agree, *compare* RX-0001C (Blumenthal WS) Q/A 225 *with* CX-2060C (Prucnal RWS) Q/A

[redacted]

248, the '320 and '456 patent specifications consistently describe the number of connections achieved "in a U space," which indicates that the number must be achieved for each U space the device takes up.

Thus, applying the phrase "at least . . . per" to respondents' hypothetical product, a person of skill would say with reasonable certainty that it does not have "at least" 144 connections "per" U space. By assumption, some U spaces do not have 144 connections.

* * *

Accordingly, respondents have not shown by clear and convincing evidence that the claim term "U space" (claimed in asserted claims 1 and 3 of the '320 patent and in asserted claims 11, 19, and 27 of the '456 patent) is indefinite under 35 U.S.C. § 112.

V. U.S. Patent No. 10,444,456

U.S. Patent No. 10,444,456, entitled "High Density and Bandwidth Fiber Optic Apparatuses and Related Equipment and Methods," was filed on April 5, 2019 and issued on October 15, 2019. JX-0010 ('456 Patent). The '456 patent is assigned to Corning. JX-0012 ('456 Patent Assignment Record). The '456 patent is related to and shares a specification with the '320 and '153 patents. The '456 patent states, "The technology of the disclosure relates to fiber optic connection density and bandwidth provided in fiber optic apparatuses and equipment." JX-0010 at 1:33-35. The '456 patent has a total of 30 claims, of which Corning asserts independent claims 11 and 27 and dependent claims 12, 14-16, 19, 21, and 28. *See* Compl. Br. at 8.

As discussed below, the evidence shows that (1) the asserted claims of the '456 patent are infringed by the accused products; (2) complainant has satisfied the technical

[redacted]

prong of the domestic industry requirement; and (3) the asserted claims are not invalid.

The asserted claims of the '456 patent (and the claims from which they depend) read:

> **11**. A fiber optic apparatus, comprising:
>
> a chassis configured to be disposed in an equipment rack, the chassis comprising front and rear ends that are spaced apart from one another in a longitudinal direction, and comprising opposite first and second ends that are spaced apart from one another in a lateral direction that extends crosswise to the longitudinal direction;
>
> a plurality of fiber optic equipment trays supported by the chassis and extendable relative to the chassis in the longitudinal direction; and
>
> a plurality of fiber optic modules configured to be installed in the plurality of fiber optic equipment trays, wherein each fiber optic module of the plurality of fiber optic modules comprises a front side, a rear side, an internal chamber, a plurality of first fiber optic adapters disposed through the front side, at least one second fiber optic adapter disposed through the rear side, and a plurality of optical fibers disposed within the internal chamber and extending from the at least one second fiber optic adapter to the plurality of first fiber optic adapters;
>
> wherein each fiber optic equipment tray of the plurality of fiber optic equipment trays is configured to receive multiple fiber optic modules of the plurality of fiber optic modules;
>
> wherein the plurality of fiber optic equipment trays and the plurality of fiber optic modules are configured to support a fiber optic connection density of at least ninety-eight (98) fiber optic connections per U space of the chassis, based on using a simplex fiber optic adapter or a duplex fiber optic adapter as each fiber optic adapter of the plurality of first fiber optic adapters; and·
>
> wherein a U space comprises a height of 1.75 inches and comprises a width of 19 inches or 23 inches.

[redacted]

12. The fiber optic apparatus of claim **11**, wherein the plurality of first fiber optic adapters is disposed through at least eighty-five percent (85%) of a width of the front side of at least one fiber optic module of the plurality of fiber optic modules.

14. The fiber optic apparatus of claim **11**, wherein for each fiber optic module of the plurality of fiber optic modules, each fiber optic adapter of the plurality of first fiber optic adapters comprises a simplex LC fiber optic adapter or a duplex LC fiber optic adapter, and wherein the at least one second fiber optic adapter comprises at least one multi-fiber push-on (MPO) fiber optic adapter.

15. The fiber optic apparatus of claim **11**, wherein each fiber optic equipment tray of the plurality of fiber optic equipment trays is configured to receive a single row of multiple fiber optic modules of the plurality of fiber optic modules.

16. The fiber optic apparatus of claim **11**, wherein each fiber optic module of the plurality of fiber optic modules is configured to be locked into place in a fiber optic equipment tray of the plurality of fiber optic equipment trays.

18.[35] The fiber optic apparatus of claim **11**, wherein the plurality of fiber optic equipment trays comprises three fiber optic equipment trays per U space of the chassis.

19. The fiber optic apparatus of claim **18**, wherein the plurality of fiber optic equipment trays and the plurality of fiber optic modules are configured to support a fiber optic connection density of one hundred forty-four (144) fiber optic connections per U space of the chassis, based on using a simplex fiber optic adapter or a duplex fiber optic adapter as each fiber optic adapter of the plurality of first fiber optic adapters.

20.[36] The fiber optic apparatus of claim **11**, wherein:

each fiber optic equipment tray of the plurality of fiber optic equipment trays comprises first, second, and third module guide members extending upward from a bottom of the fiber optic equipment tray; and

[35] Claim 18 is not asserted.

[36] Claim 20 is not asserted.

[redacted]

each fiber optic equipment tray of the plurality of fiber optic equipment trays is configured to receive a first fiber optic module of the plurality of fiber optic modules between the first and second module guide members, and the fiber optic equipment tray is configured to receive a second fiber optic module of the plurality of fiber optic modules between the second and third module guide members.

21. The fiber optic apparatus of claim **20**, wherein for each fiber optic equipment tray of the plurality of fiber optic equipment trays, each module guide member of the first, second, and third module guide members comprises a locking feature configured to cooperate with a fiber optic module of the first or second fiber optic modules to prevent movement of the fiber optic module relative to the fiber optic equipment tray.

27. A fiber optic apparatus, comprising:

a chassis configured to be disposed in an equipment rack, the chassis comprising front and rear ends that are spaced apart from one another in a longitudinal direction, and comprising opposite first and second ends that are spaced apart from one another in a lateral direction that extends crosswise to the longitudinal direction;

a plurality of fiber optic equipment trays supported by the chassis and extendable relative to the chassis in the longitudinal direction; and

a plurality of fiber optic modules configured to be installed in the plurality of fiber optic equipment trays, wherein each fiber optic module of the plurality of fiber optic modules comprises a front side, a rear side, an internal chamber, a plurality of first fiber optic adapters disposed through the front side, at least one second fiber optic adapter disposed through the rear side, and a plurality of optical fibers disposed within the internal chamber and extending from the at least one second fiber optic adapter to the plurality of first fiber optic adapters;

wherein each fiber optic equipment tray of the plurality of fiber optic equipment trays is configured to receive multiple fiber optic modules of the plurality of fiber optic modules;

[redacted]

wherein the chassis defines a 4-U space, in which a U space comprises a height of 1.75 inches and comprises a width of 19 inches or 23 inches; and

wherein the plurality of fiber optic equipment trays and the plurality of fiber optic modules are configured to support a fiber optic connection density of five hundred seventy-six (576) fiber optic connections in the 4-U space of the chassis, based on using a simplex fiber optic adapter or a duplex fiber optic adapter as each fiber optic adapter of the plurality of first fiber optic adapters.

28. The fiber optic apparatus of claim **27**, wherein the plurality of first fiber optic adapters is disposed through at least eighty-five percent (85%) of a width of the front side of at least one fiber optic module of the plurality of fiber optic modules.

JX-0010 ('456 Patent) at 21:43-24:43.

A. Claim Construction

1. A Person of Ordinary Skill in the Art

As noted in the '320 patent section of this initial determination, the administrative law judge finds that a person of ordinary skill in the art with respect to the four asserted patents is a person who has at least a bachelor's degree in mechanical engineering, materials science, or a related field, and at least two years of experience in fiber optic equipment.

2. "fiber optic connection density"

Pursuant to Ground Rule 6.d, the parties filed a joint claim construction chart on June 1, 2020. *See* Joint Chart. As shown in that chart, the parties have agreed on the construction of the following claim term that appears in certain asserted claims of the '456 patent. Below is a chart showing the parties' proposed claim construction.

[redacted]

Claim Term	Asserted Claims	Agreed-Upon Construction
"fiber optic connection density"	'456: 11, 19, 27	"number of fiber optic connections that can be made to the front side of the fiber optic equipment"

See Joint Chart at 3-4; Resps. Br. at 53; Staff Br. at 46-47.

The claim term "fiber optic connection density" appears in asserted claims 11, 19, and 27 of the '456 patent. The parties have agreed to construe that claim term as "number of fiber optic connections that can be made to the front side of the fiber optic equipment." *See* Joint Chart; Resps. Br at 53; Staff Br at 46-47.

Accordingly, as argued by the parties, the administrative law judge adopts the joint proposed claim construction and has determined that the claim term "fiber optic connection density" should be construed to mean "number of fiber optic connections that can be made to the front side of the fiber optic equipment."

3. "U space"

The claim term "U space" appears in asserted claims 1 and 3 of the '320 patent and in asserted claims 11, 19, and 27 of the related '456 patent. Below is a chart showing the parties' proposed claim constructions.

Complainant and the Staff	Respondents
Plain and ordinary meaning, an example of which is "a rack unit, which is a standardized measurement of 1.75 inches (44.45mm) in height within a standardized 19-inch rack or 23-inch rack.	'320 patent: § 112 (indefinite); if not indefinite, then "space comprising a height of 1.75 inches and width of 19 or 23 inches." '456 patent: "space comprising a height of 1.75 inches and width of 19 or 23 inches";

[redacted]

	otherwise §112 (indefinite)

See Staff Br. at 54-55 (citing Joint Chart at 5); Compl. Br. at 44-46; Resps. Br. at 45-47.

For the reasons discussed in the claim construction section of the '320 patent, the administrative law judge has determined that the claim term "U space" that appears in the asserted claims of the '456 patent should be given its "plain and ordinary meaning, an example of which is a rack unit, which is a standardized measurement of 1.75 inches (44.45mm) in height within a standardized 19-inch rack or 23-inch rack."

4. "simplex [LC] fiber optic adapter" and "duplex [LC] fiber optic adapter"

The claim terms "simplex [LC] fiber optic adapter(s)" and "duplex [LC] fiber optic adapter(s)" appear in asserted claims 11, 14, 19, and 27 of the '456 patent. Below is a chart showing the parties' proposed claim constructions.

Complainant	Respondents	Staff
"A fiber optic adapter that supports a simplex [LC] connector"	"device that receives [LC] connectors to support no more than a single-fiber connection"	"fiber optic component that receives a connector [of intermateability standard type LC] in a single-fiber connection"
"A fiber optic adapter that supports a duplex [LC] connector"	"device that receives [LC] connectors to support no more than a two-fiber connection"	"fiber optic component that receives a connector [of intermateability standard type LC] in a one- or two-fiber connection"

See Joint Chart at 2; Compl. Br. at 31-42; Resps. Br. at 26-32; Staff Br. at 56-57.

For the reasons discussed below, the administrative law judge has determined that (1) the claim term "simplex [LC] fiber optic adapter" should be construed to mean "fiber optic adapter that supports a simplex [LC] connector"; and (2) the claim term "duplex

[redacted]

[LC] fiber optic adapter" should be construed to mean "fiber optic adapter that supports a duplex [LC] connector."

Complainant's proposed construction is consistent with the Staff's proposal to construe the phrases as a "fiber optic component that receives a connector in a single-fiber connection" and a "fiber optic component that receives a connector in a one- or two-fiber connection." *Id.* There is no material difference between the two proposed constructions. When an adapter receives a simplex connector, it forms a one-fiber connection; and when an adapter receives a duplex connector, it forms a two-fiber connection. The Staff's construction adds the additional fact that a duplex adapter can receive a simplex as well as a duplex connector.

The claims of the '456 patent focus on the type of connectors that an adapter can receive and the corresponding connections that it forms, rather than on the number of connectors it can receive and the connections it cannot form. Claims 11, 19, and 27 refer to simplex and duplex adapters in specifying a particular "fiber optic connection density," which the parties agree means the "number of fiber optic connections that can be made to the front side of the fiber optic equipment." Joint Chart at 3-4. In determining that number, a person of ordinary skill would be concerned with how many fiber connectors could be inserted on the front side, not whether those connectors were received by duplex adapters standing alone or combined in a single block to form a quad adapter. As discussed below, such a person would understand that a quad adapter is identical to a pair of duplex adapters in the context of fiber optic connection density.

Respondents argue that the claims distinguish between "simplex" and "duplex" adapters:

[redacted]

> The claims also distinguish between "simplex" and "duplex" adapters despite that both can support a simplex connector. *Id.* at claims 11, 14, 19, 27, 28; Prucnal Tr. 290:11-14, 290:19-21; Ralph Tr. 209:11-17. The difference between "simplex" and "duplex" adapters is the maximum number of fiber connections that they support, *i.e.*, the maximum number of fibers that they can connect. RX-0008 (Lebby RWS) Q/A 148. Respondent's construction captures this distinction by specifying that a "simplex" adapter supports "no more than a *single-fiber* connection" and a "duplex" adapter supports "no more than a *two-fiber* connection." By contrast, Complainant's constructions render superfluous the reference to "duplex" adapters because *both* "simplex" and "duplex" adapters are "a fiber optic adapter that supports a simplex connector." *See Akzo Nobel Coatings, Inc. v. Dow Chemical Co.*, 811 F.3d 1334, 1340 (Fed. Cir. 2016).

Resps. Br. at 27-28.

The claims refer to simplex and duplex adapters separately, but do not distinguish them. Nor would such a distinction make sense because, as a person of ordinary skill would know, a duplex adapter is two simplex adapters side-by-side. CX-0001C (Prucnal WS) Q/A 166. That a simplex adapter supports one simplex connector and a duplex adapter supports two simplex connectors (either individually or joined in a duplex connector) is of no consequence, because it does not affect density. That both simplex and duplex adapters are "a fiber optic adapter that supports a simplex connector" does not "render superfluous the reference to 'duplex fiber optic adapters'" in the claims as argued by respondents, but instead reflects the well understood overlap between a simplex and duplex adapter.

Moreover, the '456 specification defines a duplex adapter in terms of the type of connectors that adapter can receive and the connections made with those connectors. *See* CX-2060C (Prucnal RWS) Q/A 45; CX-0001C (Prucnal WS) Q/A 26-27. The specification defines duplex LC fiber optic adapters as adapters that are "configured to

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receive and support connections with duplex LC fiber optic connectors." JX-0010 ('456 Patent) at 9:19-22; *see* 9:63-10:10 (similar); 5:58-67, 10:52-11:4, 14:36-64, 15:61-16:22, 17:25-53. The specification further notes that duplex LC adapters "support single or duplex fiber connections and connectors." *Id.* at 9:67-10:1. A one-fiber or simplex connection generally permits communication in one direction at a time, and so may be used either to send or receive information. A two-fiber or duplex connection permits communication in two directions at the same time, and can be used to send and to receive information simultaneously. *See, e.g.*, CX-0001C (Prucnal WS) Q/A 26, 164, 175, 178, 183; CX-2060C (Prucnal RWS) Q/A 33, 45.

The specification also contrasts duplex adapters with a "multi-fiber MPO fiber optic adapter," which it defines as an adapter "equipped to establish connections to multiple optical fibers (e.g., either twelve (12) or twenty-four (24) optical fibers)." JX-0010 ('456 Patent) at 9:29-31. This is another example of the specification defining a fiber optic adapter based on the type of connector it receives and corresponding connections it can form, rather than on the number of fibers it receives. As a person of ordinary skill in the art would understand, an MPO adapter would support either 12 or 24 fibers depending solely on the type of MPO connector that was used — the MPO adapter is identical regardless of the number of fibers used in the connector. *See* CX-0001C (Prucnal WS) Q/A 318; CX-0683 (FOCIS-5).

The specification also distinguishes simplex and duplex components from multiple fiber components based on density. A table in the specification shows that the "max fibers per 1RU" is 144 using "duplexed LC" compared to 576 using "12-[fiber] MPO" and 1,152 using "24-[fiber] MPO." JX-0010 ('456 Patent) at 19-20 table. The

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same table shows that the number of "connectors per 1RU" is 72 with duplexed LC and 48 with either 12 or 24 fiber MPO, demonstrating the centrality of connector types in understanding the distinction between adapter types and the density achievable by each respective type.

Additionally, the prosecution history shows that simplex and duplex fiber optic adapters are defined by the type of connectors they receive. As noted above, during prosecution of the '320 patent, Corning originally asserted two sets of claims. One set claimed densities based on simplex or duplex components, and the second claimed much higher densities based on multifiber components. *See* JX-0005 ('320 Prosecution History) at 6-7 (former claims 13 and 26). The examiner issued a Restriction Requirement finding that the Application

> contains claims directed to the following ***patentably distinct species***: A) high density fiber optic connection apparatus or method based on ***simplex or duplex type fiber connectors***; and B) high density fiber optic connection apparatus or method based on ***multiple fiber or MPO connectors***.

JX-0005 ('320 Prosecution History) at 4922 (emphasis added). These "species are independent and distinct ***because they involve different types of fiber connectors***" that "are not obvious variants of each other." *Id.* (emphasis added). Such "different types of optical fiber connectors . . . conventionally have different structures and are not likely to be covered within common prior art references." *Id.* Thus, the examiner distinguished between the species based on the "types of fiber connectors" these different species of fiber optic components use.

Responding to the Restriction Requirement, Corning elected Species A (simplex/duplex), and reserved the right to pursue claims directed to Species B (multiple

[redacted]

fiber). Corning accordingly withdrew claims that recited the use of multiple fiber components. *Id.* at 5302. Those withdrawn claims recited much higher densities, which would indicate to a person of ordinary skill that the reference to "multiple fiber" adapters and components referred to the use of that term in the art as involving connectors with multiple fibers (typically 12 or more) in a single ferrule. *See* JX-0005 ('320 Prosecution History) at 6-7 (former claims 13 and 26); CX-0001C (Prucnal WS) Q/A 34.

Respondents argue that "Complainant disclaimed any interpretation of 'simplex' or 'duplex' adapter that would encompass adapters that received connectors to support more than a two-fiber connection, *i.e.*, that connect more than two optical fibers." *See* Resps. Br. at 30.

Corning surrendered claims reciting multiple-fiber adapters or components. Yet, respondents are incorrect, however, that such terms would be understood as "more than two-fiber adapters or components," a term that has no significance in the art. Resps. Br. at 30. As the examiner's Restriction Requirement, the withdrawn claims, and the specification make plain, multiple fiber adapters and components are distinguished based on the type of connectors that are used, which involve multiple fibers in a single ferrule. *See* Prucnal Tr. 394-395; CX-0001C (Prucnal WS) Q/A 34, 318.

Industry standards and other extrinsic evidence support Corning's and the Staff's constructions, as discussed below.

Industry Standards

Industry standards can assist a finder of fact to assess how a person of ordinary skill in the art would assess disputed claim terms. *See Vizio, Inc. v. Int'l Trade Comm'n*, 605 F.3d 1330, 1337 (Fed. Cir. 2010) ("Moreover, we agree with the Commission that

[redacted]

the fact that the MPEG–2 standard was the standard used for digital television broadcasts in the United States at the time of the filing of the patent itself suggests that one of ordinary skill in the art would understand the disputed claim terms of the ′ 074 patent to refer to the MPEG–2 standard.”). Here, there are two relevant industry standards.

First, TIA-568-C, *Generic Telecommunications Cabling for Customer Premises*, is a general industry standard for fiber optic connection equipment. Its glossary defines a duplex fiber optic adapter as a “mechanical device designed to align and join two duplex optical fiber connectors (plugs) to form an optical duplex connection.” CX-0922C (TIA-568-C.0) at 16. It defines a duplex connector, in turn, as a “remateable device that terminates two fibers and mates with a duplex receptacle.” *Id.* at 17. The TIA-568-C standard also defines a multiple fiber adapter (or “array” adapter) as a “mechanical device designed to align and join two array optical fiber connectors (plugs) to form an optical array connection”; and an “array” connector — which, the standard itself states , can also be called a “multi-fiber connector” — as a “single ferrule connector that contains multiple optical fibers arranged in a row or in rows and columns.” *Id.* at 16. Thus, for both duplex adapters and multiple fiber adapters, the TIA-568-C standard defines these adapters solely in terms of the types of connectors they receive. *See* CX-0001C (Prucnal WS) Q/A 30; 164-66; 186; Prucnal Tr. 386-389 (discussing TIA 568-C). Thus, it is undisputed that respondents’ quad LC adapters meet this industry standard definition of a duplex LC adapter.

Second, the industry standard that governs the particular type of simplex/duplex adapter at issue supports Corning’s and Staff’s proposed construction. The TIA standard known as FOCIS 10 defines standardized LC connectors and adapters. *See* CX-0195

[redacted]

(FOCIS-10A). To designate an adapter or connector as "LC" is to say that it complies with the FOCIS 10 standard. *Id.* at 7. FOCIS 10 defines only simplex and duplex connectors and adapters. *Id.* at 9; CX-0001C (Prucnal WS) Q/A 191. Further, it shows that a duplex adapter is merely two simplex adapters arranged side by side. *Compare* CX-0195 (FOCIS-10A) at 15, 17 (figures "2.2.1a" and "2.2.1b" define "[s]implex . . . adapter interface[s]") *with id.* at 19 ("[e]ach of the units in the duplex adapter shall comply with all of the dimensions of figure 2.2.1a or 2.2.1b"); Prucnal Tr. 392. This contradicts respondents' claim that an adapter cannot simultaneously be both duplex and simplex.

FOCIS 10 does not define any "quad" LC adapter. *See* CX-0001C (Prucnal WS) Q/A 191. Thus, if a quad adapter qualifies as an LC adapter — as respondents' quad adapters do — it can do so only by meeting the specification for a simplex LC adapter (as a set of four such adapters), a duplex LC adapter (as a set of two), or both. Just as a duplex LC adapter is also two simplex LC adapters, a quad adapter is merely two duplex LC adapters or four simplex LC adapters. *See* CX-0001C (Prucnal WS) Q/A 176, 186; Prucnal Tr. 391:6-19, 392:21-393:8.

There is a difference between a quad LC adapter and a duplex LC adapter in terms of the plastic housing. A quad LC adapter consists of two duplex LC adapters in a single molding. However, that is irrelevant to whether a person of ordinary skill would consider a quad LC adapter distinct from a simplex or duplex LC adapter. FOCIS 10 states that "fully dimensioned components are not within [its] scope or intent" CX-0195 (FOCIS-10A) at 7, meaning that the plastic housing surrounding a simplex or duplex adapter is irrelevant to whether it is a simplex or duplex adapter under the LC standard.

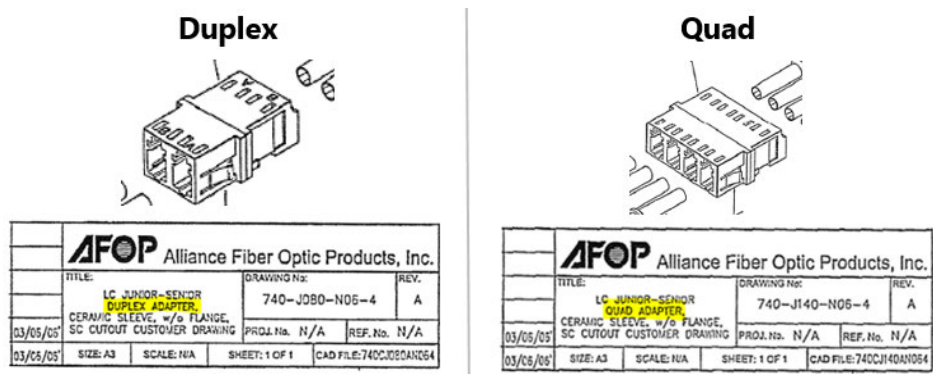
[redacted]

See CX-0001C (Prucnal WS) Q/A 176, 186; Prucnal Tr. 391:4-5 ("[T]he connector dimensions are what's important, not the plastic.").

<u>Product Catalogs</u>

Respondents argue:

> The extrinsic evidence supports Respondents' proposed construction. *See* RX-0008C (Lebby RWS) Q/A 165-178; RX-0001C (Blumenthal WS) Q/A 128-136. For example, Alliance Fiber Optics Products (AFOP), a Corning affiliate, created and distributed technical drawings for "duplex" and "quad" adapters:



RX-0291C (Multimode AC Adapter Drawings)
at RX-0291C.0002, RX-0291C.0003

> Both adapters received and supported simplex and duplex connectors. But AFOP identified the adapter that supported up to a *two-fiber* connection a "*Duplex* Adapter," and identified the adapter that supported up to a *four-fiber* connection a "*Quad* Adapter." *See also* RX-0005C (Kim WS) Q/A 31-33; RPX-0029 (AFOP Duplex Adapter); RPX-0030 (AFOP Quad Adapter).

Resps. Br. at 30-31.

The product catalogs show both duplex LC and quad LC adapters, but the fact that these are distinct things in terms of their plastic housing is irrelevant to whether a quad LC adapter is also a simplex and duplex LC adapter. These catalogs do not

[redacted]

"describe" these adapters in any way; they merely display them. Nowhere do these catalogs call quad adapters "multi-fiber" or "multiple fiber." A number of them specifically describe quad adapters as "LC," which supports Corning's position *See* CX-2060C (Prucnal RWS) Q/A 69-75 (discussing respondents' catalogs).

Indeed, one catalog that respondents cite — RX-0325 (Tyco Fiber Optic Products) — shows the opposite of what they claim. It contains separate sections for "Single Fiber/Duplex Products" and "Multi-Fiber Products." *Id.* at 0001. The listing for quad adapters that respondents cite is contained in the section for single fiber/duplex products, not the section for multiple fiber products. *See id.* at 44. This is a clear example of how a person of ordinary skill would recognize quad LC adapters as simplex/duplex, not multiple fiber, components.

<u>Other Patents</u>

Other patents in the field of art provide additional support for Corning's and Staff's proposed constructions. *See Foster v. Hallco Mfg. Co., Inc.*, 119 F.3d 16, 1997 WL 419391, at *6 (Fed. Cir. 1997) (accepting other patents as extrinsic evidence of claim meaning).

First, U.S. Patent No. 10,502,903 to Wang et al. is a Leviton patent for a fiber optic adapter. CX-0159 (Wang '903). The patent describes embodiments using both duplex LC adapters and quad LC adapters. Wth respect to the quad adapter embodiment, it explains that a "quad fiber optic adapter may be characterized as ***including two duplex fiber optic adapters 402A and 402B arranged side-by-side***." CX-0159 (Wang '903) at 14:58-67 (emphasis added); *see* CX-0001C (Prucnal WS) Q/A 61.

Second, U.S. Patent No. 8,179,684 to Smrha — which respondents assert as prior

[redacted]

art against the '320 and '456 patents — likewise describes a quad adapter as two duplex adapters and four simplex adapters. *See* CX-0032 (Smrha '684) . Smrha '684 describes modules (called adapter packs) that have six quad adapters (called adapter blocks) in a row. It states that "each adapter block 58 include[es] four adapters 46 (two adapter pairs)." *Id.* at 3:44-45.

<u>Respondents' Documents</u>

Respondents' documents further confirm that a person of ordinary skill would view quad adapters as simplex or duplex adapters. First, [redacted] RX-0291C (Leviton Adapter Multimode LC Spec.) at 1 [redacted]

Second, Leviton's specification sheet for its accused modules contains a section entitled "Standards Compliance" that indicates that Leviton's quad LC adapters comply with "ANSI/TIA-604-10 (LC) for connector intermateability" — that is, FOCIS 10. CX-0093 (Leviton HDX MTP Cassette Spec.) at 1.

Third, Siemon's product for its accused chassis describes the quad LC adapters in the accused modules as having "standard interfaces," which a person of ordinary skill in the art would understand as a the duplex and simplex LC interfaces in the FOCIS 10 standard. CX-0180C (11/19 Siemon LightStack Spec.) at 3. CX-0160C (11/19 Siemon LightStack 8 Spec.) is a product specification for one of the Siemon Accused Modules

[redacted]

(the LightStack 8) that contains two quad LC adapters. The document describes these adapters as "4 duplex LCs."

5. "internal chamber"

The claim term "internal chamber" appears in asserted claim 11 of the '456 patent. Below is a chart showing the parties' proposed claim constructions.

Complainant and the Staff	Respondents
"the enclosed space between the main body and the cover of a fiber optic module, bounded by the front and rear sides of the main body"	"an area between a front side and a rear side of the fiber optic module"

Joint Chart at 6; Compl. Br. at 46-47; Resps. Br. at 47-50; Staff Br. at 57-58.

For the reasons discussed below, the administrative law judge has determined that the claim term "internal chamber" should be construed to mean "the enclosed space between the main body and the cover of a fiber optic module, bounded by the front and rear sides of the main body."

The dispute with regard to this term is whether the internal chamber is required to have a cover. Respondents argue that "a POSITA would not have understood that the 'internal chamber' is enclosed or that it is enclosed by a cover." Resps. Br. at 50. Complainant and the Staff take the position that the specification defines the boundaries of the "internal chamber" with reference to a cover, and that it is therefore enclosed. *See* Compl. Br. at 46-47; Staff Br. at 57-58; CX-0001C (Prucnal WS) Q/A 238. The specification provides:

> The fiber optic module **22** is comprised of a main body **90** receiving a cover **92**. An internal chamber **94** (FIG. 11) disposed inside the main body **90** and the cover **92** and is configured to receive or retain optical fibers or a fiber optic cable harness, as will be described in more detail below. The

[redacted]

main body **90** is disposed between a front side **96** and a rear side **98** of the main body **90**.

JX-0010 ('456 Patent) at 9:11-13, fig. 11.

It further states that "FIG. 11 illustrates the fiber optic module **22** in an exploded view with the cover **92** of the fiber optic module **22** removed to illustrate the internal chamber **94** and other internal components of the fiber optic module **22**." *Id.* at 9:44-47. In other words, the internal chamber **94** is bounded by the front and rear sides of the main body **90**, by the floor of the main body **90** below, and by the cover **92** above. Complainant's expert Dr. Prucnal testified that this construction comports with the understanding of one of ordinary skill in the art, who would know that "a module is intended to house fiber optic cables, and that because it is critical to protect those cables from the elements and any disruption, the module would contain a covered internal chamber in which to house the cables." CX-0001C (Prucnal WS) Q/A 238.

The enclosure requirement follows from the ordinary meaning of the claims and is confirmed by the specification. In ordinary non-technical usage, the word "chamber" means "'an enclosed or compartmented space designed for some specialized purpose.'" CX-2060C (Prucnal RWS) Q/A 167 (quoting CX-1535 (Webster's Third) at 6)). The claims of the related '206 patent are consistent with and reinforce that ordinary meaning, by referring to a "main body defining an internal chamber" and a "plurality of optical fibers disclosed in the internal chamber." JX-0001 ('206 Patent) at, *e.g.*, claim 14.

Both the '206 and '456 specifications repeatedly state (and show in figures) that the internal chamber has a cover. *See* JX-0001 ('206 Patent) at 2:65-67, 8:20-26, 8:58-9:9, 9:33-43, 9:52-63 & Figs. 10A-11, 14-17, 19, 20, 22, 23; JX-0010 ('456 Patent) at

[redacted]

9:5-19, 9:44-62 & Figs. 10A-11, 14-17, 19, 20, 22, 23. The specifications further explain that it is important to protect fibers and to maintain an appropriate bend radius, which are the functions that an enclosure serves. *See, e.g.*, JX-0001 ('206 Patent) at 9:24-32; *see also* JX-0010 ('456 Patent) at 10:12-19 (similar).

6. "width of the front side of [the] fiber optic module"

The claim term "width of the front side of [the] fiber optic module" appears in asserted dependent claims 12 and 28 of the '456 patent. The parties' proposed constructions are:

Complainant	Respondents	Staff
"the width of the side of the module that when inserted faces the front of the chassis, excluding any module rail guides or protrusions that are used to insert the module into the chassis or remove it from the chassis."	"width of the front side of the fiber optic module including areas dedicated to latches, sidewalls, flanges, and other nonadapter functions" Otherwise indefinite.	"the width of the side of the module that when inserted faces the front of the chassis, excluding any module rail guides or protrusions, *e.g.*, the dimension identified as "W_2" in Figure 13 of the '456 and '206 Patents"

See Joint Chart at 4; Compl. Br. at 47-50; Resps. Br. at 41-45; Staff Br. at 58-62.

For the reasons discussed below, the administrative law judge has determined that the claim term "width of the front side of [the] fiber optic module" should be construed to mean "the width of the side of the module that when inserted faces the front of the chassis, excluding any module rail guides or protrusions that are used to insert the module into the chassis or remove it from the chassis."

The phrase "width of the front side" should be construed as Corning proposes: to mean "the width of the side of the module that when inserted faces the front of the

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chassis, excluding any module rail guides or protrusions that are used to insert the module into the chassis or remove it from the chassis." Joint Chart at 4.

Corning's and the Staff's proposed constructions are similar. Their proposals exclude "any module rail guides or protrusions." The Staff proposes adding a reference to "the dimension identified as 'W_2' in Figure 13 of the '456 and '206 Patents." These two proposals are not materially different. Respondents' proposal, however, would not exclude rails or rail guides and would add the phrase "including areas dedicated to latches, sidewalls, flanges, and other nonadapter functions." *Id.* That proposal is incorrect, especially as respondents' experts apply it to include rails. *See, e.g.,* RX-0001C (Blumenthal WS) Q/A 153-155.

The '456 patent specification "acts as a dictionary," *Phillips*, 415 F.3d at 1321 (internal quotation marks omitted), by defining the "width of the front side" to exclude rails and similar protrusions from the module sides. That specification, referring to Figure 13, JX-0010 ('456 Patent) at 10:20, discloses the "width W_1 of the front opening 126," *id.* at 10:25-26, comparing it to two other defined widths: "width W_2 of the front side 96 of the main body 90 of the fiber optic module 22," *id.* at 10:35-36; and "[w]idth W_3, the overall width of the fiber optic module 22," *id.* at 10:39-40. The variables W_1, W_2, and W_3 and numbered items 22, 90, 96, and 126 each correspond to notations in Figure 13. *See* CX-2060C (Prucnal RWS) Q/A 124; CDX-0005C (Prucnal Rebuttal Demonstratives) at 24.[37] The specification also discloses "module rails 28A, 28B disposed on each side 102A, 102B of the fiber optic module 22." *Id.* at 9:34-35. Figure

[37] Dr. Prucnal's witness statement and demonstrative discuss the '206 specification, noting that the '456 specification contains "essentially the same" language and figures. *See* CX-2060C (Prucnal RWS) Q/A 124-127, 136-38.

[redacted]

13 shows that the module rails 28A and 28B are included in W_3 (the "overall width of the fiber optic module") but not in W_2 (the "width of the front side"). JX-0010 ('456 Patent) at Fig. 13; *see* CDX-0005C (Prucnal Rebuttal Demonstratives) at 24.

The function of measuring the width of the front side further supports excluding rails. *See Cohesive Techs., Inc. v. Waters Corp.*, 543 F.3d 1351, 1368 (Fed. Cir. 2008) (in construing claim "we ask what function" a limitation "plays in the operation of the claimed apparatus"). The parties agree that "fiber optic connection density," which the '456 patent seeks to maximize, means the "number of fiber optic connections that can be made to the front side of the fiber optic equipment," Joint Chart at 3. With that goal in mind, it follows to distinguish the "width of the front side," which is W_2, and which includes only those parts of the module that take up precious space on the front side, from the "overall width of the fiber optic module," which is W_3, and which includes parts of the module that do not take up such space. The rails are part of W_3 but not part of W_2 because, when the module is installed, the rails fit into rail guides in the trays and take up no additional space on the front side. *See* JX-0010 ('456 Patent) at 6:20-23, 9:34-35; *id.* at Fig. 5; CX-2060C (Prucnal RWS) Q/A 132-38.

The different embodiment depicted in Figures 16 to 18 does not suggest otherwise. That embodiment is an "alternate fiber optic module" that is "designed to fit across two sets of module rail guides." JX-0010 ('456 Patent) at 13:50-56. According to the specification, the alternate module has "widths W_1 and W_2" that "are the same as in the fiber optic module 22 illustrated in FIG. 13." *Id.* at 14:42-43. There is no discussion of a width W_3, and Figure 18 also appears to define W_2 differently than Figure 13, by including the module rails. A person of ordinary skill would rely on the more detailed

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definition and description provided for Figure 13 and would interpret Figure 18 as incorporating that earlier disclosure rather than changing or conflicting with it. *See* CX-2060C (Prucnal RWS) Q/A 126-27.

Respondents rely on statements from the prosecution history of the '206 patent, and Panduit's unsuccessful *inter partes* review of that patent, to argue that Figure 18, rather than Figure 13, should control. *See* Resps. Br. at 43-45. However, the doctrine of prosecution disclaimer, on which respondents rely, requires a "clear and unmistakable disavowal" of claim scope, *Schindler Elevator Corp. v. Otis Elevator Co.*, 593 F.3d 1275, 1285 (Fed. Cir. 2010), and none is present here. During prosecution, the examiner cited a piece of prior art ("Rapp '274") that had two large flanges and a latch on its front side. The flanges and the latch, unlike module rails 28A and 28B from the specification, took up substantial space on the front side of the module. *See* CX-2060C (Prucnal RWS) Q/A 130-31 (discussing CDX-0005C, at 28). Corning cited Figure 18 to distinguish Rapp '274, but could have just as well cited Figure 13 — the flanges and latch of Rapp '274 would have been part of width W_2 using either description. *See id.* Q/A 132. Neither the examiner nor Corning mentioned rails or suggested that the flanges or latch of Rapp '274 resembled rails. None of this amounts to a clear and unmistakable disclaimer.

The *inter partes* review proceedings on which respondents rely (*see* Resps. Br. at 43-45) similarly do not support their position. Corning's briefing in the '206 IPR stated explicitly that "the overall width of the module, W_3, can be larger than the width of just the front side of the module because, as shown in [Figure 13], structure like side rails can protrude out from the sides of the modules"; and that "[b]ecause these rails are not part of the 'front side' of the module body, the '206 patent does not include them in the 'width of

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the front side.'" RX-0512 ('206 IPR Prelim. Resp.) at 26. Corning also distinguished Rapp '274 on the basis that Rapp's flanges and latch are part of its front side, *see id.* at 11, 17, 31, 33 — but, for the reasons already given, that distinction was fully consistent with Corning's claim construction position regarding rails, which it advanced in the same brief. *See* CX-2060C (Prucnal RWS) Q/A 133-35.

Respondents' argument concerning indefiniteness is discussed in the Validity section, *infra*.

B. Infringement Analysis of the '456 Patent

As noted, Corning asserts independent claims 11 and 27 and dependent claims 12, 14-16, 19, 21, and 28. For the reasons discussed below, Corning has shown by a preponderance of the evidence that respondent's accused products infringe independent claims 11 and 27, and dependent claims 12, 14-16, 19, 21, and 28, of the '456 patent.

1. Accused Products

The accused products consist of chassis, modules, and combinations thereof. There are three categories of accused products, Base-8, Base-12, and Base-24, which are defined by the number of fiber connections available per module. First, a Base-8 module supports eight fiber connections, and a Base-8 chassis supports eighteen Base-8 modules per 1U space. *See* CX-0001C (Prucnal WS) Q/A 63. Second, a Base-12 module supports twelve fiber connections, and a Base-12 chassis supports twelve Base-12 modules per 1U space. *Id*. Finally, a Base-24 module supports twenty-four fiber connections, and a Base-24 chassis supports six Base-24 modules per 1U space. *Id*. In each case, there are a

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total of 144 connections available in a 1U space; the difference in the three categories is in the number of modules needed to fill that space.

Within each category, there are three chassis sizes: 1U, 2U, and 4U, which refer to the chassis height. *Id*. Apart from the total height, these types are materially the same for each respondent. *Id*. That is, the fiber optic connection density for a 1U chassis from a given respondent is the same as the density for a 2U or 4U chassis from that respondent. *Id*. Q/A 64. Complainant argues that therefore "for each Respondent, and within each fiber connectivity configuration (Base-12, Base-8, and Base-24), a 1U chassis is representative of a 2U chassis and a 4U chassis for purposes of the asserted patents." *Id*.; *see also* CX-2042 (Compl. & Siemon Stip. Re Representative Accused Prods.) (stipulating that within each of the three categories, Siemon's 1U chassis is representative of its 2U and 4U chassis for purposes of the asserted patents).

Complainant has offered a complete list of representative accused products for each respondent, along with the group of accused products represented by each such product, through the testimony of Dr. Prucnal. *See* CX-0001C (Prucnal WS) Q/A 62; CDX-0013 (Prucnal list of accused products).

Not all respondents market all types of accused products. The following describes the accused products allegedly imported and/or sold in the United States by each respondent:

[redacted]

Summary of Accused Products

Respondent	Brand	Chassis			Module		
		Base-8	Base-12	Base-24	Base-8	Base-12	Base-24
FS	FHX	1U	1U		X	X	
Leviton	OPT-X		1U/2U/4U			X	X
Panduit	HD FLEX	1U/2U/4U	1U/2U/4U	1U/2U/4U	X	X	X
Siemon	LightStack	1U/2U/4U	1U/2U/4U		X	X	

See Staff Br. at 20.

a. Panduit

The Panduit accused products are marketed as "HD FLEX Fiber" enclosures and cassettes. The accused Panduit chassis fall into three categories (Base-8, Base-12, and Base-24), and are available in three sizes (1U, 2U, and 4U). The accused Panduit modules are available in three configurations (Base-8, Base-12, and Base-24). *See* CX-0001C (Prucnal WS) Q/A 85; CPX-0062 (Panduit Base-8 1U chassis); CPX-0063 (Panduit Base-12 1U chassis); CPX-0065 (Panduit Base-24 1U chassis); CPX-0073 (Panduit Base-8 module); CPX-0074 (Panduit Base-12 module); CPX-0075 (Panduit Base-24 module).

b. Leviton

The Leviton accused products are marketed under the names "OPT-X UHDX Enclosures" and "HDX Enterprise Cassettes." The accused Leviton enclosures are all Base-12 chassis, available in three sizes (1U, 2U, and 4U). The accused Leviton modules are available in two configurations (Base-12 and Base-24). Both the Base-12 and the

[redacted]

Base-24 modules are used with the Leviton Base-12 chassis. *See* CX-0001C (Prucnal WS) Q/A 98; CPX-0057 (Leviton Base-12 1U chassis); CPX-0060 (Leviton Base-12 module); CPX-0061 (Leviton Base-24 module).

c. Siemon

The Siemon accused products are marketed under the name "LightStack Ultra High-Density Fiber Plug and Play system." The accused Siemon chassis fall into two categories (Base-8 and Base-12) and are available in three sizes (1U, 2U, and 4U). The accused Siemon modules are available in Base-8 and Base-12 configurations. *See* CX-0001C (Prucnal WS) Q/A 106; CPX-0076 (Siemon Base-8 1U chassis); CPX-0077 (Siemon Base-12 1U chassis); CPX-0078 (pre-Aug. 2019 version of Siemon Base-12 1U chassis); CPX-0079 (Siemon Base-8 module); CPX-0080 (Siemon Base-12 module).

d. FS

The FS accused products are marketed under the names "FHX Series" and "FHX-FCP/ FHX-C Series" and include both chassis and modules. The accused FS chassis fall into two categories (Base-8 and Base-12) and are available in just one size (1U). The accused FS modules are available in Base-8 and Base-12 configurations. *See* CX-0001C (Prucnal WS) Q/A 117; CPX-0053 (FS Base-8 1U chassis); CPX-0054 (FS Base-12 1U chassis); CPX-0055 (FS Base-8 module); CPX-0056 (FS Base-12 module).

2. Direct and Indirect Infringement

As noted, Corning asserts independent claims 11 and 27 and dependent claims 12, 14-16, 19, 21, and 28 of the '456 patent. Asserted claims 11-12, 14-16, 19, and 21 of the '456 patent are asserted against FS. These claims and claims 27 and 28 are asserted against Panduit and Siemon. Leviton is accused of infringing claims 11, 14-16, 19,

[redacted]

and 27. *See* Compl. Br. at 98-109; CX-0001C (Prucnal) Q/A 196.

For the reasons discussed below, Corning has shown by a preponderance of the evidence that Panduit, Leviton, Siemon, and FS accused combinations practice each element of asserted claims of the '456 patent. However, it has not been shown that Panduit, Siemon, and FS accused combinations directly infringe the asserted claims inasmuch as they do not sell their accused chassis and modules in combination. Inasmuch as Leviton is the only respondent shown to sell accused chassis and modules in an infringing combination, only Leviton directly infringes the asserted claims. Indirect infringement is discussed, *infra*.

a. Issues Common to Multiple Respondents

Asserted claims 11 and 27 of the '456 patent read:

> **11**. A fiber optic apparatus, comprising:
>
> a chassis configured to be disposed in an equipment rack, the chassis comprising front and rear ends that are spaced apart from one another in a longitudinal direction, and comprising opposite first and second ends that are spaced apart from one another in a lateral direction that extends crosswise to the longitudinal direction;
>
> a ***plurality of fiber optic equipment trays*** supported by the chassis and extendable relative to the chassis in the longitudinal direction; and
>
> a ***plurality of fiber optic modules*** configured to be installed in the ***plurality of fiber optic equipment trays***, wherein each fiber optic module of the ***plurality of fiber optic modules*** comprises a front side, a rear side, an internal chamber, a plurality of first fiber optic adapters disposed through the front side, at least one second fiber optic adapter disposed through the rear side, and a plurality of optical fibers disposed within the internal chamber and

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extending from the at least one second fiber optic adapter to the plurality of first fiber optic adapters;

wherein each fiber optic equipment tray of the ***plurality of fiber optic equipment trays*** is configured to receive multiple fiber optic modules of the ***plurality of fiber optic modules***;

wherein the ***plurality of fiber optic equipment trays*** and the ***plurality of fiber optic modules*** are configured to support a fiber optic connection density of at least ninety-eight (98) fiber optic connections per U space of the chassis, ***based on using a simplex fiber optic adapter or a duplex fiber optic adapter as each fiber optic adapter of the plurality of first fiber optic adapters***; and·

wherein a U space comprises a height of 1.75 inches and comprises a width of 19 inches or 23 inches.

14. The fiber optic apparatus of claim **11**, wherein for each fiber optic module of the plurality of fiber optic modules, each fiber optic adapter of the plurality of first fiber optic adapters comprises ***a simplex LC fiber optic adapter or a duplex LC fiber optic adapter***, and wherein the at least one second fiber optic adapter comprises at least one multi-fiber push-on (MPO) fiber optic adapter.

19. The fiber optic apparatus of claim **18**, wherein the plurality of fiber optic equipment trays and the plurality of fiber optic modules are configured to support a ***fiber optic connection density of one hundred forty-four (144) fiber optic connections per U space*** of the chassis, based on using a simplex fiber optic adapter or a duplex fiber optic adapter as each fiber optic adapter of the plurality of first fiber optic adapters.

27. A fiber optic apparatus, comprising:

a chassis configured to be disposed in an equipment rack, the chassis comprising front and rear ends that are spaced apart from one another in a longitudinal direction, and comprising opposite first and second ends that are spaced apart from one another in a lateral direction that extends crosswise to the longitudinal direction;

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a ***plurality of fiber optic equipment trays*** supported by the chassis and extendable relative to the chassis in the longitudinal direction; and

a ***plurality of fiber optic modules*** configured to be installed in the ***plurality of fiber optic equipment trays***, wherein each fiber optic module of the ***plurality of fiber optic modules*** comprises a front side, a rear side, an internal chamber, a plurality of first fiber optic adapters disposed through the front side, at least one second fiber optic adapter disposed through the rear side, and a plurality of optical fibers disposed within the internal chamber and extending from the at least one second fiber optic adapter to the plurality of first fiber optic adapters;

wherein each fiber optic equipment tray of the ***plurality of fiber optic equipment trays*** is configured to receive multiple fiber optic modules of the ***plurality of fiber optic modules***;

wherein the chassis defines a 4-U space, in which a U space comprises a height of 1.75 inches and comprises a width of 19 inches or 23 inches; and

wherein the ***plurality of fiber optic equipment trays*** and the ***plurality of fiber optic modules*** are configured to support a fiber optic connection density of five hundred seventy-six (576) fiber optic connections in the 4-U space of the chassis, ***based on using a simplex fiber optic adapter or a duplex fiber optic adapter as each fiber optic adapter of the plurality of first fiber optic adapters***.

JX-0010 (‘456 Patent) (emphasis added).

Although the ‘456 patent claims the same density as the ‘320 patent, the claim language differs in two main respects.

First, whereas the ‘320 patent recites a “fiber optic connection density of at least [98 or 144] fiber optic connections per U space of the chassis, based on using at least one simplex fiber optic component or at least one duplex fiber optic component,” the ‘456 patent recites density “based on using a simplex fiber optic adapter or a duplex fiber optic

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adapter as each fiber optic adapter of the plurality of first fiber optic adapters" on the front of the module. JX-0010 ('456 Patent), Claims 11, 27. Dependent claim 14 further specifies that such adapters are "a simplex LC fiber optic adapter or a duplex LC fiber optic adapter." *Id.*, Claim 14.

Second, whereas the '320 patent required only "a fiber optic connection equipment" — that is a single module — in the chassis "configured to support" the claimed densities, the '456 patent claims require a "plurality of fiber optic modules configured to support" the claimed density of at least 98 fiber optic connections. Like claim 3 of the '320 patent, claim 19 of the '456 patent recites a density of 144 fiber optic connections per U space — but it recites exactly that number, not "at least" 144 as in claim 3 of the '320 patent.

i. Respondents' Quad LC Adapters

Given that the asserted claims of the '456 patent recite a density based on the use of a simplex or duplex fiber optic adapter, as opposed to a simplex or duplex fiber optic component (which may be either an adapter or connector), respondents' accused modules with quad LC adapters do not infringe these claims based solely on the fact that these adapters receive simplex or duplex LC connectors, as is the case with claims 1 and 3 of the '320 patent. That is, however, irrelevant. In the Claim Construction section above, the administrative law judge determined that (1) the claim term "simplex [LC] fiber optic adapter" should be construed to mean "fiber optic adapter that supports a simplex [LC] connector"; and (2) the claim term "duplex [LC] fiber optic adapter" should be construed to mean "fiber optic adapter that supports a duplex [LC] connector."

In the Claim Construction section, after discussing the claim language and the

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specification, the administrative law judge stated the following concerning the industry standard, *inter alia*:

> First, TIA-568-C, *Generic Telecommunications Cabling for Customer Premises*, is a general industry standard for fiber optic connection equipment. Its glossary defines a duplex fiber optic adapter as a "mechanical device designed to align and join two duplex optical fiber connectors (plugs) to form an optical duplex connection." CX-0922C (TIA-568-C.0) at 16. It defines a duplex connector, in turn, as a "remateable device that terminates two fibers and mates with a duplex receptacle." *Id.* at 17. The TIA-568-C standard also defines a multiple fiber adapter (or "array" adapter) as a "mechanical device designed to align and join two array optical fiber connectors (plugs) to form an optical array connection"; and an "array" connector — which, the standard itself states , can also be called a "multi-fiber connector" — as a "single ferrule connector that contains multiple optical fibers arranged in a row or in rows and columns." *Id.* at 16. Thus, for both duplex adapters and multiple fiber adapters, the TIA-568-C standard defines these adapters solely in terms of the types of connectors they receive. CX-0001C (Prucnal WS) Q/A 30; 164-66; 186; Prucnal Tr. 386:14-389:20 (discussing TIA 568-C). Thus, it is undisputed that respondents' quad LC adapters meet this industry standard definition of a duplex LC adapter.
>
> Second, the industry standard that governs the particular type of simplex/duplex adapter at issue supports Corning's and Staff's proposed construction. The TIA standard known as FOCIS 10 defines standardized LC connectors and adapters. *See* CX-0195 (FOCIS-10A). To designate an adapter or connector as "LC" is to say that it complies with the FOCIS 10 standard. *Id.* at 7. FOCIS 10 defines only simplex and duplex connectors and adapters. *Id.* at 9; CX-0001C (Prucnal WS) Q/A 191. Further, it shows that a duplex adapter is merely two simplex adapters arranged side by side. *Compare* CX-0195 (FOCIS-10A) at 15, 17 (figures "2.2.1a" and "2.2.1b" define "[s]implex . . . adapter interface[s]") *with id.* at 19 ("[e]ach of the units in the duplex adapter shall comply with all of the dimensions of figure 2.2.1a or 2.2.1b"); Prucnal Tr. 392:6-20. This contradicts respondents' claim that an adapter cannot simultaneously be both duplex and simplex.
>
> FOCIS 10 does not define any "quad" LC adapter. CX-0001C (Prucnal WS) Q/A 191. Thus, if a quad adapter qualifies as an LC adapter — as respondents' quad adapters do — it can do so only by meeting the specification for a simplex LC adapter (as a set of four such adapters), a duplex LC adapter (as a set of two), or both. Just as a duplex LC adapter is also two simplex LC adapters, a quad adapter is merely two duplex LC

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adapters or four simplex LC adapters. CX-0001C (Prucnal WS) Q/A 176, 186; Prucnal Tr. 391:6-19, 392:21-393:8.

See Section V.A.4, *supra*.

Thus, respondents' quad LC adapters are themselves properly understood as simplex or duplex LC adapters.

ii. Accused Chassis with Accused Modules

As noted above, the claims of the '456 patent require a "plurality of fiber optic modules" — together with a "plurality of fiber optic equipment trays" — "configured to support" the claimed fiber optic connection densities. Thus, the claims require at least two accused modules in an accused chassis. Respondents argue, as they did with respect to the '320 patent, that "configured to support" requires a mostly or fully loaded chassis. For the same reasons discussed with respect to the '320 patent, that is incorrect.

b. Direct and Indirect Infringement - Panduit

For the reasons discussed below, Corning has shown by a preponderance of the evidence that Panduit's accused combinations practice each element of asserted claims 11, 12, 14-16, 19, 21, 27, and 28 of the '456 patent. *See* Compl. Br. at 100-05; CX-0001C (Prucnal WS) Q/A 200-03, 205, 209-10, 214-16, 226, 229-30, 237-40, 247-52, 271, 273, 277-81, 284-85, 292, 294, 298-307, 316-19, 322-23, 330-31, 334-35, 342-43, 347-48, 357-59, 363-65, 375-77, 382-85, 394-98, 401-02, 407, 410-11, 416-19. However, it has not been shown that those accused combinations directly infringe the asserted claims inasmuch as Panduit does not sell its accused chassis and modules in combination.

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Direct Infringement

Independent Claim 11

The only dispute with respect to claim 11 involves respondents' argument that this claim requires evidence of a fully loaded chassis. *See* Resps. Br. at 130-36. This is the same argument Panduit made with respect to the '320 patent and found to be incorrect.

Dependent Claim 12

Claim 12 recites: "The fiber optic apparatus of claim 11, wherein the plurality of first fiber optic adapters is disposed through at least eighty-five percent (85%) of a width of the front side of at least one fiber optic module of the plurality of fiber optic modules."

The administrative law judge determined that the claim term "width of the front side of [the] fiber optic module" should be construed to mean "the width of the side of the module that when inserted faces the front of the chassis, excluding any module rail guides or protrusions that are used to insert the module into the chassis or remove it from the chassis."

Dr. Prucnal's analysis of the accused modules used Panduit's detailed technical measurements of these modules, which he confirmed by taking his own measurements. He found that the Panduit Base-12 Module has six spaces on the face of the module for inserting six LC duplex adapters; that each of these spaces measures 13.08 mm; and that, collectively, these six spaces occupy a width of 78.48 mm. *See* CX-0001C (Prucnal WS) Q/A 306; CX-1679C (Panduit HDFE MPO Cassette Base Drawing). He also found that the front side of the Panduit Base-12 module is 88.00 mm excluding side protrusions and 93.22 mm including side protrusions. *See* CX-0001C (Prucnal WS) Q/A 306. He thus

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found that Panduit's adapters take up 89% of the front side of the module excluding protrusions (correct construction) and 84% of the front side of the module including protrusions (respondents' proposed construction).

Dr. Prucnal found that the Panduit Base-8 Module has three spaces on the front side of the module for inserting four duplex LC adapters that total 51.46 mm. *See* CX-0001C (Prucnal WS) Q/A 307; CX-1735C (Panduit LC - MPO Cassette Drawing). He further found that, according to Panduit's documents, the front side is 55.38 mm excluding side protrusions and 60.50 mm including side protrusions. *See* CX-0001C (Prucnal WS) Q/A 307; CX-1735C (Panduit LC - MPO Cassette Drawing). He thus found that, using Panduit's own documents, the adapters take up 92.9% of the front side of the module excluding protrusions (correct construction) and 85% of the front side of the module including protrusions (respondents' proposed construction). *See* CX-0001C (Prucnal WS) Q/A 307.[38]

Respondents argue that Dr. Min found that the Panduit Base-12 Module does not infringe claim 12 when "excluding protrusions," Resps. Br. at 133-34, but that is incorrect. Dr. Min found no infringement when including protrusions in the measurement of the front side (respondents' proposed construction), but offered no

[38] Dr. Prucnal acknowledged that using his own measurements (as opposed to Panduit's), the adapters take up only 84.6% of the front side under Respondents' proposed constructions, but he explained that Panduit's measurements are more likely to be reliable and should therefore be preferred. CX-0001C (Prucnal WS) Q/A 307. Regardless, 84.6% rounds to 85%. *See Viskase Corp. v. Am. Nat'l. Can Co.*, 261 F.3d 1316, 1320 (Fed. Cir. 2001) (observing the "standard scientific convention" of rounding "when a number has not been carried to the next mathematically significant figure"); *Noven Pharms., Inc. v. Actavis Labs. UT, Inc.*, C.A. No. 15-249-LPS, 2016 WL 3625541, at *3, 5 (D. Del. July 5, 2016) (construing the term "15 mg/cm^2" as having a "plain and ordinary meaning . . . of greater than or equal to 14.5 mg/cm^2 and less than 15.5 mg/cm^2").

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opinion under the correct construction that exclude protrusions. *See* RX-0006C (Min RWS) Q/A 165. Respondents appear to concede this. *See* Resps. Br. at 133 ("Under at least Respondents' construction, Complainant will be unable to establish that Panduit's Accused Products infringe claims 12 and 28").

Respondents argue the Panduit Base-8 Module does not infringe "excluding protrusions," Resps. Br. at 134, but that is again incorrect. The percentage they cite (84.6%) relies on Dr. Prucnal's measurements including side protrusions (respondents' construction), as both Dr. Prucnal's and Dr. Min's testimony make clear. *See* CX-0001C (Prucnal WS) Q/A 307; RX-0006C (Min RWS) Q/A 166. Dr. Prucnal's testimony shows that Panduit's modules infringe under the correct claim construction because the adapters take up 92.4% of the front side, *see* CX-0001C (Prucnal WS) Q/A 307. Dr. Min gives no contrary opinion.

<u>Dependent Claims 14-16, 19, and 21</u>

Dependent claims 14-16, 19, and 21, all of which depend from claim 11, require modules with an LC-to-MPO connection (claim 14), horizontal rows of modules (claim 15), and modules that can be locked in place (claims 16 and 21). *See* JX-0010 ('456 Patent) at 22:21-36, 22:63-23:3. Claim 19 requires 144 connections per U space. *Id.* at 22:42-49. Respondents do not dispute that all of the Panduit accused combinations satisfy the additional limitations of claims 14-16 for the reasons set forth in Dr. Prucnal's testimony. *See* CX-0001C (Prucnal WS) Q/A 322-23, 334-35, 347-48. Thus, inasmuch as the Panduit accused combinations are found to infringe claim 11, then they infringe claims 14-16 as well.

Respondents dispute that Panduit's accused products infringe claim 19 on the

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same grounds as they dispute infringement of claim 11 and found to be incorrect. *See* Resps. Br. at 131-32. Panduit also infringes claim 21, which recites:

> The fiber optic apparatus of claim 20, wherein for each fiber optic equipment tray of the plurality of fiber optic equipment trays, each module guide member of the first, second, and third module guide members comprises a locking feature configured to cooperate with a fiber optic module of the first or second fiber optic modules to prevent movement of the fiber optic module relative to the fiber optic equipment tray.

As the '456 specification indicates, a person of ordinary skill would understand that the plain meaning of a module guide member is a component of the fiber equipment tray that establishes individual openings into which fiber optic modules may be inserted. *See* JX-0010 ('456 Patent) at 6:20-42, 14:31-35, 15:46-60; CX-0001C (Prucnal WS) Q/A 376.

Dr. Prucnal demonstrated that each tray in the Panduit Base-12, Base-8, and Base-24 Chassis has five, seven, and four module guide members, respectively. *See* CX-0001C (Prucnal WS) Q/A 383. In each Chassis, these module guide members are molded plastic components that are integrated with the tray and extend upward from the bottom of the tray toward the top of the chassis. *See* CX-0001C (Prucnal WS) Q/A 383; CX-0382 (Panduit HD FLEX Ordering Guide) at 3; CX-1705 (Panduit FLEX1U, FLEX2U, & FLEX4U Installation Instructions); JX-0017C (Kuffel Dep. Tr.) 428-434. The guide members on the trays form four, six, and two channels, respectively, into which Panduit Base-12, Base-8, and Base-24 Modules may be inserted.

Dr. Prucnal also explained in detail how each representative Panduit module is configured to be locked into place in a fiber optic equipment tray, based on Panduit's documents and witness testimony, as well as Dr. Prucnal's own examination of the accused products. *See* CX-0001C (Prucnal WS) Q/A 348; CX-1623 (Panduit FLEX1U,

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FLEX4U Installation Instructions); CX-1705 (Panduit FLEX1U, FLEX2U, & FLEX4U Installation Instructions); JX-0017C (Kuffel Dep. Tr.) 238-241, 354-355, 431-434; *see* CX-1849 (Panduit Photos Ex. F) at 22, 44, 67.

Dr. Min's contrary opinions are unpersuasive. He opines first that "[w]ith respect to the front portion of the tray, Dr. Prucnal does not identify what the specific 'locking feature' is in the module guides." RX-0006 (Min RWS) Q/A 177. This is an improper attempt to import a limitation into the claim. Claim 21 does not require a locking feature in the front portion of the tray — the claim requires "a locking feature configured to cooperate with a fiber optic module of the first or second fiber optic modules to prevent movement of the fiber optic module relative to the fiber optic equipment tray," but does not specify where on the module guide that locking feature must be located. The specification, moreover, contains embodiments of a locking feature on the rear of the module guides. *See* JX-0010 ('456 Patent) at 6:64-7:7.

Dr. Min opines that, although Dr. Prucnal "asserts that the combination of the rear stop and metal spring clip limits the movement of the cassette," Dr. Prucnal does not "explain how the combination of the rear stop and the metal spring clip satisfy the 'a locking feature' requirement of claim 21." RX-0006C (Min RWS) Q/A 177. Dr. Min later appears to opine that "multiple components" cannot be "the single 'locking feature." *Id.* Q/A 179. A person of ordinary skill would not understand "a feature" to be limited to a single component, and Dr. Min provides no evidence to suggest otherwise. *See IGT v. Glob. Gaming Tech., Inc.*, No. CV-S-94-601-HDM (LRL), 1997 WL 361610, at *2 (D. Nev. Feb. 18, 1997) ("a single claim element in a patent may be found by combining multiple components in the accused device"), *aff''d in part, vacated in part*, 194 F.3d

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1339 (Fed. Cir. 1999).

Independent Claim 27 and Dependent Claim 28

Respondents dispute that Panduit's accused products infringe claim 27 on the same grounds as they dispute infringement of claim 11. *See* Resps. Br. at 131-32. Respondents dispute that Panduit's accused products infringe claim 28 on the same grounds as they dispute infringement of claim 12, *id.* at 133-34, and found to be incorrect.

* * *

Corning has shown by a preponderance of the evidence that Panduit's accused combinations practice each element of asserted claims of the '456 patent. However, it has not been shown that those accused combinations directly infringe the asserted claims inasmuch as Panduit does not sell its accused chassis and modules in combination.

Indirect Infringement

For the same reasons discussed in the Indirect Infringement section of the '320 patent, Panduit indirectly infringes the asserted claims of the '456 patent.

c. Direct and Indirect Infringement - Leviton

For the reasons discussed below, Corning has shown by a preponderance of the evidence that Leviton's accused combinations practice each element of asserted claims 11, 14-16, 19, and 27 of the '456 patent. *See* Compl. Br. at 105-06; CX-0001C (Prucnal WS) Q/A 200-03, 206, 209-10, 217-19, 226, 231-32, 237-40, 253-58, 271, 274, 277-81, 286-87, 292, 295, 298-303, 316-19, 324-25, 330-31, 336-37, 342-43, 349-50, 357-59, 366-68, 394-98, 403-04, 407, and 412-13.

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<u>Direct Infringement</u>

<u>Independent Claim 11</u>

Leviton's only dispute with respect to claim 11 involves respondents' argument that this claim requires evidence of a fully loaded chassis and that Leviton's quad LC adapters are not simplex or duplex adapters. These are the same arguments made with respect to the '320 patent, and found to be incorrect.

<u>Dependent Claims 14-16, and 19</u>

The remaining dependent claims asserted against Leviton, all of which depend from claim 11, require modules with an LC-to-MPO connection (claim 14), horizontal rows of modules (claim 15), modules that can be locked in place (claim 16), and 144 connections per U space (claim 19). *See* JX-0010 ('456 Patent) at 22:21-36, 22:42-49, 22:63-23:3. Respondents do not dispute that the Leviton accused products satisfy the additional limitations of claims 14-16, for the reasons set forth in Dr. Prucnal's testimony. *See* CX-0001C (Prucnal WS) Q/A 324-25, 336-37, 349-50. Thus, inasmuch as the Leviton accused combinations are found to infringe claim 11, then they infringe claims 14-16 as well.

<u>Independent Claim 27</u>

Respondents dispute that the Leviton accused products practice this claim on the same grounds as they dispute infringement of claim 11. Thus, inasmuch as the Leviton accused combinations are found to infringe claim 11, then they infringe claims 14-16 as well.

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Accordingly, the accused combinations of Leviton products directly infringe the asserted claims of the '456 patent.

Indirect Infringement

For the same reasons discussed in the Indirect Infringement section of the '320 patent, Leviton indirectly infringes the asserted claims of the '456 patent.

d. Direct and Indirect Infringement - Siemon

For the reasons discussed below, Corning has shown by a preponderance of the evidence that Siemon's accused combinations practice each element of the asserted claims 11, 12, 14-16, 19, 21, 27, and 28 of the '456 patent. *See* Compl. Br. at 106-08; CX-0001C (Prucnal WS) Q/A 200-03, 207, 209-10, 220-22, 226, 233-34, 237-40, 259-64, 271, 275, 277-81, 288-89, 292, 296, 298-303, 308-11, 326-27, 338-39, 351-54, 369-71, 375-77, 386-89, 394-98, 405-06, 407, 414-18, 420. However, it has not been shown that Siemon's accused combinations directly infringe the asserted claims inasmuch as Siemon does not sell its accused chassis and modules.

Direct Infringement

Independent Claim 11

Siemon's only dispute with respect to claim 11 involves respondents' argument that this claim requires evidence of a fully loaded chassis and that Siemon's quad LC adapters are not simplex or duplex adapters. These are the same arguments made with respect to the '320 patent, and found to be incorrect.

Dependent Claim 12

For the Siemon Base-12 Module, Dr. Prucnal's detailed analysis found that it has three spaces on the face of the module for inserting three quad LC adapters; that each of

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these spaces measures 26.00 mm according to Siemon's documents; and that, collectively, these three spaces occupy a width of 72.00 mm. *See* CX-0001C (Prucnal WS) Q/A 310; CX-0183C (Siemon Cassette Base 12 Drawing). He also found that, according to Siemon's documents, the front side of the Siemon Base-12 module is 91.24 mm excluding side protrusions and 94.04 mm including side protrusions. *See* CX-0001C (Prucnal WS) Q/A 310. He thus found that the adapters in Siemon's Base-12 module take up 85.5% of the front side of the module excluding protrusions and 82.9% of the front side of the module including protrusions, and therefore infringe under at least Staff's proposed construction. *See* CX-0001C (Prucnal WS) Q/A 310.

For the Siemon Base-8 Module, Dr. Prucnal found that it has two spaces on the face of the module for inserting two quad LC adapters, and that each of these spaces measures 26.03 mm according to Siemon's documents, for a total of 52.06 mm. *See* CX-0001C (Prucnal WS) Q/A 311; CX-1790C (Siemon Cassette Base 8 Drawing). He further found that Siemon's documents showed the front side of the Representative Siemon Base-8 Module is 58.78 mm excluding side protrusions and 62.00 mm including side protrusions. *See* CX-0001C (Prucnal WS) Q/A 311. He thus found that using Siemon's documents, the adapters take up 88.5% of the front side of the module excluding protrusions and 84% of the front side of the module including protrusions, and therefore infringe under at least Staff's proposed construction.

Respondents argue that Siemon does not infringe "because the front openings on Siemon's Fiber Optic Modules do not constitute 85% of the width of the front side of the module." *See* Resps. Br. at 144. However, claim 12 does not recite a "front opening" (a claim limitation used in the ''206 patent). It instead recites that "the plurality of first

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fiber optic adapters is disposed through at least eighty-five percent (85%) of a width of the front side." Siemon provides no basis to conflate the space through which the adapters are disposed with a front opening, nor any supporting expert opinion. Dr. Min does not dispute Dr. Prucnal's measurements.

Dependent Claims 14-16, 19, and 21

Dependent claims 14-16, 19, and 21 require modules with an LC-to-MPO connection (claim 14), horizontal rows of modules (claim 15), and modules that can be locked in place (claims 16 and 21). *See* JX-0010 ('456 Patent) at 22:21-36, 22:63-23:3. Claim 19 requires 144 connections per U space. *Id*. at 22:42-49. Respondents do not dispute that all of the Siemon accused combinations satisfy the additional limitations of these claims for the reasons that Dr. Prucnal set forth in his testimony. *See* CX-0001C (Prucnal WS) Q/A 326-27, 338-39, 351-54, 369-71, 386-89. Thus, inasmuch as the Siemon accused combinations are found to infringe claim 11, then they infringe claims 14-16, 19, and 21 as well.

Independent Claim 27 and Dependent Claim 28

Respondents concede that the Siemon accused products practice the limitations of claim 27 and 12, except for the same arguments regarding the density limitations they make with respect to claims 11 and 12, respectively, and found to be incorrect.

* * *

Corning has shown by a preponderance of the evidence that Siemon's accused combinations practice each element of asserted claims of the '456 patent. However, it has not been shown that those accused combinations directly infringe the asserted claims

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inasmuch as Siemon does not sell its accused chassis and modules in combination.

Indirect Infringement

For the same reasons discussed in the Indirect Infringement section of the '320 patent, Siemon indirectly infringes the asserted claims of the '456 patent.

e. Direct and Indirect Infringement - FS

For the reasons discussed below, Corning has shown by a preponderance of the evidence that FS's accused combinations practice each element of asserted claims 11, 12, 14-16, 19, 21, 27, and 28 of the '456 patent. *See* Compl. Br. at 108-09; CX-0001C (Prucnal WS) Q/A 200-03, 208-10, 222-226, 235-40, 265-71, 276-81, 290-92, 297-303, 312-19, 328-31, 340-43, 355-59, 372-77, 390-93. However, it has not been shown that FS's accused combinations directly infringe the asserted claims inasmuch as FS does not sell its accused chassis and modules in combination.

Direct Infringement

FS and its customers directly infringe claims 11, 12, 14-16, 19, and 21 of the '456 Patent through the FS accused products.

Independent Claim 11

FS's only dispute with respect to claim 11 concerns respondents' argument that this claim requires evidence of a fully loaded chassis and that FS quad LC adapters are not simplex or duplex adapters. *See* Resps. Br. at 148-50. These are the same arguments made with respect to the '320 patent, and fail for the same reasons described above.

Dependent Claim 12, 14-16, 19, and 21

The remaining dependent claims asserted against FS, all of which depend from claim 11, require modules with an LC-to-MPO connection (claim 14), horizontal rows of

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modules (claim 15), and modules that can be locked in place (claims 16 and 21). *See* JX-0010 ('456 Patent) at 22:21-36, 22:63-23:3. Claim 19 requires 144 connections per U space. *Id*. at 22:42-49. Respondents do not dispute that all of the FS accused products satisfy each of these additional limitations for the reasons set forth in Dr. Prucnal's testimony. *See* CX-0001C (Prucnal WS) Q/A 328-29, 340-41, 355-56, 372-74, 390-93. Thus, inasmuch as the the FS accused combinations are found to infringe claim 11, then they infringe claims 14-16, 19, and 21 as well.

* * *

Corning has shown by a preponderance of the evidence that FS's accused combinations practice each element of asserted claims of the '456 patent. However, it has not been shown that those accused combinations directly infringe the asserted claims inasmuch as FS does not sell its accused chassis and modules in combination.

<u>Indirect Infringement</u>

For the same reasons discussed in the Indirect Infringement section of the '320 patent, FS indirectly infringes the asserted claims of the '456 patent.

C. Domestic Industry (Technical Prong)

Corning and the Staff argue that the evidence shows that the Corning domestic industry products are covered by asserted claims of the '456 patent. *See* Compl. Br. at 233-34; Staff Br. at 161-62. Respondents argue, "Complainant failed to prove any combination of an EDGE chassis and modules that practice claims 11, 12, 14-16, 19, 21, 27, or 28 of the '456 Patent." *See* Resps. Br. at 259-61.

As discussed below, the evidence shows that the Corning domestic industry

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products are covered by asserted independent claims 11 and 27 and dependent claims 12, 14-16, 19, 21, and 28 of the '456 patent.

The EDGE DI Chassis together with the EDGE DI Modules practice asserted claims 11, 12, 14-16, 19, 21, 27, 28 of the '456 patent. Claim 11 requires a fiber optic apparatus comprising a chassis with a plurality of extendable equipment trays, a plurality of modules with fiber optic adapters on the front and rear, and requires that the equipment trays be configured to receive multiple modules, and that the connection equipment be configured to support a density of at least 98 connections per U space based on using simplex or duplex adapters. JX-0010 ('456 Patent), Claim 11. Dr. Ralph's testimony shows that the EDGE DI Chassis, using at least two EDGE DI Modules (a plurality of modules), satisfies the structural features and density required by claim 11. *See* CX-0002C (Ralph WS) Q/A 73-96; CX-1869 (Corning Photos Ex. D) at 2, 9, 17, 24, 42-43, 45-51; CPX-0040 (EDGE Base-8 Chassis); CPX-0041 (EDGE Base-12 Chassis); CPX-0042 (EDGE Base-8 Module); CPX-0043 (EDGE Base-12 Module).

Respondents make only one argument against the technical prong for the '456 patent, and it is identical to their argument for the '320 patent: that Corning has failed to show specific instances of EDGE DI Chassis fully loaded with EDGE DI Modules. *See* Resps. Br. at 259-61. For the same reasons discussed above with respect to the '320 patent, this argument is rejected.

Respondents do not separately dispute that the EDGE DI Chassis with EDGE DI Modules satisfies the additional asserted claims of the '456 patent.

As Dr. Ralph testified, the EDGE products satisfy the additional claims for the reasons described below.

[redacted]

<u>Claim 12</u>: The EDGE DI Modules have adapters disposed through at least 85% of the width of the front side of the module. CX-0002C (Ralph WS) Q/A 97-102.

<u>Claim 14</u>: The EDGE DI Modules have duplex LC adapters on the front side and MTP adapters on the rear side. CX-0002C (Ralph WS) Q/A 103-104.

<u>Claim 15</u>: Each tray in the EDGE DI Chassis is configured to receive a single row of multiple EDGE DI Modules. CX-0002C (Ralph WS) Q/A 105-107.

<u>Claim 16:</u> Each EDGE DI Module is configured to be locked into place in the trays of the EDGE DI Chassis. CX-0002C (Ralph WS) Q/A 108-109.

<u>Claim 19</u>: The EDGE DI Chassis has three trays that accept EDGE DI Modules and are configured to support 144 fiber optic connections per U space based on using simplex or duplex fiber optic adapters. CX-0002C (Ralph WS) Q/A110-113.

<u>Claim 21:</u> The EDGE DI Chassis has module guide members with locking features configured to receive EDGE DI Modules. CX-0002C (Ralph WS) Q/A 114-117.

<u>Claims 27:</u> The 4U EDGE DI Chassis is configured the same way as the EDGE DI Chassis but has 12 equipment trays and is configured to support 576 fiber optic connections per U space based on using simplex or duplex adapters. CX-0002C (Ralph WS) Q/A 118-135; *see also* CPX-0044 (EDGE Base-8 4U Chassis); CPX-0045 (EDGE Base-12 4U Chassis).

<u>Claim 28:</u> For the same reasons as in claim 12, the EDGE DI Modules when used with the EDGE 4U DI Chassis have adapters disposed through at least 85% of the width of the front side of the module. CX-0002C (Ralph WS) Q/A 136-137.

Accordingly, Corning has satisfied the technical prong of the domestic industry requirement with respect to the '456 patent.

D. Validity of the '456 Patent

As noted, Corning asserts independent claims 11 and 27 and dependent claims 12, 14-16, 19, 21, and 28 of the '456 patent.

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Respondents argue that the following 11 different combinations render obvious all asserted claims of the '456 patent:

1. asserted claim 11 is obvious over Smrha '684 (RX-0458) in view of Niazi '209 (RX-0442) and AFL Future Access 1RU (RX-0525C (Future Access drawings));
2. asserted claim 12 is obvious in view of Smrha '684 in view of Niazi '209, and AFL Future Access 1RU;
3. asserted claim 12 is obvious in view of Smrha '684 in view of Niazi '209, AFL Future Access 1RU, and Panduit SFQ Cassette;
4. asserted claim 14 is obvious over Smrha '684 in view of Niazi '209 and AFL Future Access 1RU;
5. asserted claim 15 is obvious over Smrha '684 in view of Niazi '209 and AFL Future Access 1RU;
6. asserted claim 16 is obvious over Smrha '684 in view of Niazi '209 and AFL Future Access 1RU;
7. asserted claim 19 is obvious over Smrha '684 in view of Niazi '209 and AFL Future Access 1RU;
8. asserted claim 21 is obvious over Smrha '684 in view of Niazi '209 and AFL Future Access 1RU;
9. asserted claim 28 is obvious in view of Smrha '684 in view of Niazi, Future Access 1 RU, Verdiell (RX-0462 (U.S. Patent No. 7,452,236 to Verdiell)) and Panduit SFQ cassette (CPX-0083) (*see* RX-0574C (Panduit SFQ Cassette drawing); RX-0576C (Panduit Quick Net Catalog (SFQ Series)));
10. asserted claim 27 is obvious over Smrha '684 in view of Niazi, Future Access 1RU, and Verdiell; and
11. asserted claim 28 is obvious in view of Smrha '684 in view of Niazi, Future Access 1 RU, and Verdiell.

Additionally, respondents argue:

12. asserted claim 11 of the '456 patent is invalid because the full scope of the claims is not enabled;
13. the claim term "U space" renders asserted claims 11, 12, 14, 15, 16, 19 and 21 indefinite; and
14. the claim term "width of the front side of [the] fiber optic module" is indefinite, rendering asserted claims 12 and 28 invalid.

[redacted]

See Resps. Br. at 150-85.

Corning and the Staff disagree. *See* Compl. Br. at 161-73, 226-30; Staff Br. at 162-72.

For the reasons discussed below, respondents have not shown by clear and convincing evidence that the asserted independent claims 11 and 27 and dependent claims 12, 14-16, 19, 21, and 28 of the '456 patent are invalid.

1. Obviousness

Respondents argue that the following 11 different combinations render obvious all asserted claims of the '456 patent:

1. asserted claim 11 is obvious over Smrha '684 (RX-0458) in view of Niazi '209 (RX-0442) and AFL Future Access 1RU (RX-0525C (Future Access drawings));
2. asserted claim 12 is obvious in view of Smrha '684 in view of Niazi '209, and AFL Future Access 1RU;
3. asserted claim 12 is obvious in view of Smrha '684 in view of Niazi '209, AFL Future Access 1RU, and Panduit SFQ Cassette;
4. asserted claim 14 is obvious over Smrha '684 in view of Niazi '209 and AFL Future Access 1RU;
5. asserted claim 15 is obvious over Smrha '684 in view of Niazi '209 and AFL Future Access 1RU;
6. asserted claim 16 is obvious over Smrha '684 in view of Niazi '209 and AFL Future Access 1RU;
7. asserted claim 19 is obvious over Smrha '684 in view of Niazi '209 and AFL Future Access 1RU;
8. asserted claim 21 is obvious over Smrha '684 in view of Niazi '209 and AFL Future Access 1RU;
9. asserted claim 28 is obvious in view of Smrha '684 in view of Niazi, Future Access 1 RU, Verdiell (RX-0462 (U.S. Patent No. 7,452,236 to Verdiell)) and Panduit SFQ cassette (CPX-0083) (*see* RX-0574C (Panduit SFQ Cassette drawing); RX-0576C (Panduit Quick Net Catalog (SFQ Series)));
10. asserted claim 27 is obvious over Smrha '684 in view of Niazi,

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Future Access 1RU, and Verdiell; and

11. asserted claim 28 is obvious in view of Smrha '684 in view of Niazi, Future Access 1 RU, and Verdiell.

See Resps. Br. at 170-85.

Corning and the Staff disagree. *See* Compl. Br. at 161-73; Staff Br. at 162-73.

For the reasons discussed below, respondents have not shown by clear and convincing evidence that the 11 different combinations render obvious all asserted claims of the '456 patent.

Respondents argue that Smrha '684, in combination with AFL Future Access and Niazi '209, renders asserted claims 11, 14, 15, 16, 19, 20, and 21 of the '456 patent obvious. They further argue that these combinations, together with Panduit SFQ cassette, render claim 12 obvious; that these combinations, together with Verdiell '236, render claims 27 and 28 obvious; and that these combinations, together with Verdiell '236 and the Panduit SFQ cassette, render claim 28 obvious.

As discussed below, respondents have failed to demonstrate that a person of ordinary skill would have been motivated to combine these references, or that doing so would have yielded predictable results. They also lack clear and convincing evidence that these references, even if combined, would disclose the limitations of the '456 patent asserted claims.

a. Smrha '684 as the starting point

Respondents have failed to show that a person of ordinary skill would have been motivated to solve the problem of the '456 patent — accessible, practicable high density in a fiber optic enclosure for a data center environment — by combining Smrha '684 with

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the other references on which respondents rely. As discussed extensively for the '320 patent in the Validity section above, a person of ordinary skill would not have used Smrha '684 as a starting point for solving the problem solved by the '456 patent because it fails to provide the critical dimensions — fiber connections in a 1-U space — necessary to make modifications that would predictably increase density. *See* CX-2060C (Prucnal RWS) Q/A 481.

To show obviousness, Smrha '684 is a poor starting point not merely for the specific density recited in the '456 patent, but also for the modularity at the heart of the claimed design to achieve that density. As discussed above with respect to the '320 patent, the adapters in Smrha '684 are not contained in removable modules, but in fixed adapter packs, such that 48 duplex adapters (providing 96 connections) are installed at all times. A person of ordinary skill looking to solve the problem of a high-density, modular system would not start with a non-modular system, which would make development unpredictable. Indeed, before EDGE, the prior art taught away from independently removable modules because excessive movement could damage the fibers, especially in a dense system. *See* CX-2060C (Prucnal RWS) Q/A 267; CX-0006C (Staber WS) Q/A 25. A person of ordinary skill would not have converted a non-modular fiber enclosure like Smrha '684 to a modular one in the pursuit of greater density.

Dr. Blumenthal opines that a person of ordinary skill would be motivated to start with Smrha '684 because it describes a "continuous need for further improvement of high-density termination panels and associated methods." *See* CX-0032 (Smrha '684) at 1:28-30; RX-0001C (Blumenthal WS) Q/A 387, 399, 404, and 436. The specific problem solved by the '456 patent is accessible, modular, and scalable density, not

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simply forcing more connections into a box. *See TQ Delta, LLC v. CISCO Sys., Inc.*, 942 F.3d 1352, 1362 (Fed. Cir. 2019) (holding that an expert must "explain why a person of ordinary skill in the art would have combined elements from specific references ***in the way the claimed invention does***") (emphasis added).

b. Smrha '684 with AFL Future Access

As discussed above for the '320 patent, a person of ordinary skill would lack the motivation to combine Smrha '684 with AFL Future Access. These references have fundamentally different and incompatible architectures that make any supposed teachings of AFL Future Access inapplicable to Smrha '684. Like Smrha '684 itself, AFL Future Access does not disclose a modular system with removable modules, does not disclose modules with simplex/duplex adapters, and specifically discloses connections fixed in the enclosure.

c. Smrha '684 with Niazi '209

As discussed below, respondents have not shown that a person of ordinary skill would have been motivated to combine Smrha '684 with Niazi '209. The examiner reviewed Niazi '209 before issuing the '456 patent. *See* JX-0011 ('456 Prosecution History) at 11379. Dr. Blumenthal nonetheless opines that after modifying Smrha '684 in view of AFL Future Access to add a third row of adapters packs, a person of ordinary skill would further redesign this system in view of Niazi '209 to place each row of adapter packs onto its own separate, extendable tray. *See* RX-0001C (Blumenthal WS) Q/A 403-404. As there is no motivation for the first step, there also is no motivation for the second.

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First, Niazi '209 is not analogous art to the '456 patent. It is neither from the same "field of endeavor" nor "reasonably pertinent to the particular problem" of the '456 patent, which is creating fiber optic equipment with high density, accessibility, modularity, and scalability. *In re Klein*, 647 F.3d 1343, 1348 (Fed. Cir. 2011) (quoting *In re Bigio*, 381 F.3d 1320, 1325 (Fed. Cir. 2004)). As Dr. Blumenthal concedes, Niazi '209 is a patent application disclosing a computer chassis for housing modules of a computer system. *See* CX-2060C (Prucnal RWS) Q/A 510 and 512. A person of ordinary skill would not be motivated to combine a system for computer motherboard storage with a system for fiber optic equipment. They are separate fields. *See id.*

Dr. Blumenthal explained that Niazi '209 describes computer equipment for use "in the data center environment." *See* Blumenthal Tr. 782. Data centers include a wide range of equipment that spans many different fields of art. *See* CX-2060C (Prucnal RWS) Q/A 512. A person of ordinary skill would not find a motherboard storage system to be reasonably pertinent to building high-density fiber optic equipment that is accessible, modular, and scalable. That is particularly true because high-density fiber optic connection equipment must support many precise connections of fragile fibers. *Id.*; Prucnal Tr. 1040 (explaining that architecture for computer motherboards is "electronic technology highly optimized for slim profile, very robust in terms of the temperature, mechanical vibration, and the ability to even lay things right on top of each other" while "[f]iber optic packaging is very special" due to the fragility of the fibers and the risk of attenuation).

Second, the architectures of Niazi '209 and Smrha '684 are incompatible. Niazi '209 discloses a system for storing computer motherboards on stacked trays with separate

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drawers for other components. *See* CX-2060C (Prucnal RWS) Q/A 510-11; Prucnal Tr. 1040-1042. Smrha '684 shows a chassis with two horizontal layers of adapter packs that slide on a mounting framework that sits on a bottom drawer. *See* CX-2060C (Prucnal RWS) Q/A 510. The drawer in Smrha '684, which Dr. Blumenthal identifies as the claimed tray, collectively pulls out all the adapter packs to facilitate installation; the sliding adapter pack assembly, by contrast, enables separate rows and columns of adapters to be accessed individually, when accessing those adapters. *See* CX-0032 (Smrha '684) at 3:28-32 and Figs. 2 & 3; CX-2060C (Prucnal RWS) Q/A 515. Additional drawers would simply take up space in which adapter packs could be disposed, or in which space for finger access could be provided, without providing any density advantage. *Id.*

Third, Smrha '684 teaches away from the multi-drawer system of Niazi '209. In Smrha '684, the purpose of having one drawer is to facilitate access to all of the adapter packs at the same time during installation, and the purpose of the sliding adapter pack assembly is to facilitate access to individual adapter packs. *See* CX-2060C (Prucnal RWS) Q/A 515. A system with multiple trays would require users to pull out more drawers for installation than just the one. *Id.* As shown by respondents' development of the accused products, these are complex designs that require considerable engineering, particularly to support both high density and accessibility. *Id.*

d. Analysis of the Asserted Claims

The 11 different combinations argued by respondents are discussed below on a claim by claim basis.

[redacted]

i. Claim 11

Respondents argue that asserted claim 11 is obvious over Smrha '684 in view of Niazi '209 and AFL Future Access 1RU.

plurality of fiber equipment trays

Respondents have not shown that Smrha '684 in combination with Niazi '209 discloses "a plurality of fiber optic equipment trays supported by the chassis and extendable relative to the chassis in the longitudinal direction." Dr. Blumenthal concedes that Smrha '684 discloses only one tray, not a plurality. *See* RX-0001C (Blumenthal WS) Q/A 418; CX-2060C (Prucnal RWS) Q/A 517. He opines that the computer trays in Niazi '209 supply the teaching to alter the architecture of Smrha '684 to place each row of adapter packs on a separate tray, rather than on a framework attached to a single tray. *See* CX-2060C (Prucnal RWS) Q/A 517. As discussed above, Niazi '209 discloses a different and inconsistent approach to housing equipment that a person of ordinary skill would not seek to incorporate in the Smrha '684 design. *Id.*

fiber optic modules configured to be installed in trays

Smrha '684 in combination with Niazi '209 also does not disclose "a plurality of fiber optic modules configured to be installed in the plurality of fiber optic equipment trays." Smrha '684 discloses a different architecture where the adapter packs are installed into independent mounting structures so that they can be accessed without touching the tray. *See* CX-2060C (Prucnal RWS) Q/A 518; CX-0032 (Smrha '684) at 9:28-45 (stating that the adapter pack movement should not be linked to the movement of the tray). Niazi '209 does not disclose modules in a high-density fiber optic system. *See* CX-2060C (Prucnal RWS) Q/A 518-19. Niazi '209 does not disclose fiber optic

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equipment trays and instead discloses trays for computer equipment storage. Even if Niazi '209 disclosed the limitations missing from Smrha '684, as discussed above, a person of ordinary skill would not be motivated to solve the problem solved by the '456 patent with these references in the way respondents claim.

density of 98 or 144 fiber connections per 1U

Smrha '684 does not disclose "a fiber optic connection density of at least ninety-eight (98) fiber optic connections per U space of the chassis." As discussed above for the '320 patent, Smrha '684 discloses 96 fiber optic connections but no space within which that number is achieved, and AFL Future Access also does not disclose this density. *See* CX-2060C (Prucnal RWS) Q/A 520.

ii. Claim 12: Module Density

Respondents argue that asserted claim 12 is obvious in view of Smrha '684 in view of Niazi '209, and AFL Future Access 1RU; and asserted claim 12 is obvious in view of Smrha '684 in view of Niazi '209, AFL Future Access 1RU, and Panduit SFQ Cassette.

Claim 12 is directed to the density of the modules in the '456 patent, and recites that "the plurality of first fiber optic adapters is disposed through at least eighty-five percent (85%) of a width of the front side of at least one fiber optic module of the plurality of fiber optic modules." Inasmuch as Smrha '684 does not disclose the modules of the '456 patent, and does not disclose the dimensions of its adapter packs, Dr. Blumenthal relies on the Panduit SFQ Cassette to supply these features. *See* CX-2060C (Prucnal RWS) Q/A 526, 530; RX-0576C (Panduit SFQ Catalog) and RX-0575C

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(Panduit SFQ Cassette Drawing). However, the Panduit SFQ is not prior art: it was not available until February 2009, whereas the priority date of the '456 patent is August 2008.[39]

In any event, Dr. Blumenthal has not shown whether, why, or how a person of ordinary skill would have replaced the Smrha '684 adapter packs with this cassette. *See* CX-2060C (Prucnal RWS) Q/A 529. The Panduit SFQ Cassette has a distinctive wedge shape designed to be pulled from the rear of a patch panel, but the adapter packs of Smrha '684 are a framework assembly that slides within mounting guides, contains its own cable routing elements, and teaches away from module removal. *See* CX-2060C (Prucnal RWS) Q/A 529. Each Panduit SFQ Cassette contains 12 adapters — in contrast to 24 adapters in each adapter pack of Smrha '684. *Id.* A person of ordinary skill would have no reason to redesign the adapter packs of Smrha '684 to accommodate the smaller Panduit SFQ Cassettes, which do not comprise framework assemblies but instead have different mounting structures designed to work with a different enclosure system. *Id.*;

[39] Respondents argue that claims 12 and 28 are not entitled to the same priority date as the other asserted claims because they are not disclosed in the '538 Application to which the '456 patent claims priority. *See* Resps. Br. at 171-72. The '538 Application discloses that each shelf fits into the width of a 1U space (which is 19 inches) and has 24 ports, permitting a fiber count as high as 48 per shelf. It includes detailed figures, including Figures 4A, 4B, 5A, and 5B, showing how this is done. *See* RX-0060 ('538 Application) at 8. This disclosure enables a person of ordinary skill to practice the other asserted claims of the '320, '153, and '456 patents — that is, to make a functioning version of EDGE. The claims disclose making modules in which the front opening takes up at least 85% of the width of the front side, as is the case for EDGE and for each of the accused products. The Staff states that it agrees with Dr. Prucnal that "the later priority date has not been established by clear and convincing evidence" and that "it is not necessary to resolve the issue because there are other reasons to conclude that the combination of the SFQ Cassette with Smrha '684 does not render claim 12 invalid." Staff Br. at 168. The administrative law judge agrees with Corning and the Staff that the later priority date has not been established by clear and convincing evidence. Nonetheless, Panduit SFQ Cassette is discussed on the merits here.

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RX-0001C (Blumenthal WS) Q/A 411; RX-1672C (Kuffel WS) Q/A 75.

Further, as Mr. Kuffel testified, the Panduit SFQ Cassette was designed for a system that could support up to only 96 LC connections in a 1U space. *See* RX-1672C (Kuffel WS) Q/A 75. He further conceded that Panduit redesigned their cassettes when developing Panduit's accused product, the HD Flex, because the "geometries" of the SFQ cassettes indicated that Panduit could not achieve a density of 144 connections per U space "using those form factors." Kuffel Tr. 655. Thus, a person in the industry did not believe that the Panduit SFQ Cassette could or would work in a system designed to achieve the density of the '456 patent.

Dr. Blumenthal's testimony also has not shown that the Panduit SFQ Cassette discloses the additional limitation of claim 12. The claim requires calculating the ratio of the spaces through which the front adapters are disposed to the width of the front side of the Panduit SFQ Cassette, which must be greater or equal to 85%. *See* CX-2060C (Prucnal RWS) Q/A 531-32. Instead of comparing the space for adapters with the front side of the cassette, Dr. Blumenthal compares it to the front opening — that is, the space for the adapters plus any unused spaces between those adapters in the opening. *Id.* (discussing RX-0001C (Blumenthal WS) Q/A 434-35) Inasmuch as he measures the wrong thing, Dr. Blumenthal has not shown disclosure of this limitation. *Id.*

Additionally, Dr. Blumenthal's measurements are unreliable. *See* CX-2060C (Prucnal RWS) Q/A 532. Dr. Blumenthal cites "3.883 inches" as the measurement for the space through which the adapters are disposed, but it is not clear how he reaches this number. *Id.* The number he uses for the width of the front opening — "3.951 inches" — is at odds with the number used in his expert report, which was 3.798 inches. *Id.* Thus,

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his conclusions cannot be verified due to reliance on ambiguous, multiple measurements. *Id.; see Wasica Fin. GmbH v. Cont'l Auto. Sys., Inc.*, 853 F.3d 1272, 1284 (Fed. Cir. 2017) (ambiguous references cannot anticipate a claim).

iii. Claim 14

Respondents argue that asserted claim 14 is obvious over Smrha '684 in view of Niazi '209 and AFL Future Access 1RU.

Claim 14 depends from claim 11. Claim 14 recites:

> **14**. The fiber optic apparatus of claim **11**, wherein for each fiber optic module of the plurality of fiber optic modules, each fiber optic adapter of the plurality of first fiber optic adapters comprises a simplex LC fiber optic adapter or a duplex LC fiber optic adapter, and wherein the at least one second fiber optic adapter comprises at least one multi-fiber push-on (MPO) fiber optic adapter.

JX-0010 ('456 Patent), Claim 14.

For claim 14, Dr Prucnal explains, "As I explained earlier, Dr. Blumenthal has failed to demonstrate that Smrha '684 in combination with AFL Future Access and Niazi '209 satisfy Claim 11; this proposed combination fails to satisfy Claim 14 for the same reasons." CX-2060C (Prucnal RWS) Q/A 534. The administrative law judge agrees.

iv. Claim 15: Row of Modules in Each Tray

Respondents argue that asserted claim 15 is obvious over Smrha '684 in view of Niazi '209 and AFL Future Access 1RU.

Claim 15 depends from claim 11. Claim 15 recites fiber optic trays "configured to receive a single row of multiple fiber optic modules." Dr. Blumenthal opines it would be obvious to modify Smrha '684 to place each row of adapter packs on its own tray, in view of Niazi '209. *See* RX-0001C (Blumenthal WS) Q/A 410. As shown above for

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claim 11, he has failed to establish any basis for that fundamental redesign of Smrha '684. *See* CX-2060C (Prucnal RWS) Q/A 536-538.

v. Claim 16: Locking Feature

Respondents argue that asserted claim 16 is obvious over Smrha '684 in view of Niazi '209 and AFL Future Access 1RU.

Claim 16 depends from claim 11. Claim 16 recites fiber optic modules "configured to be locked into place in a fiber optic equipment tray." As shown above, Dr. Blumenthal has not shown that Smrha '684 alone or in combination with Niazi '209 and AFL Future Access discloses a plurality of fiber optic equipment trays or modules configured to be installed in trays. *See* CX-2060C (Prucnal RWS) Q/A 540. Dr. Blumenthal has not shown the claimed locking feature in Smrha '684. As Dr. Prucnal demonstrates, the Smrha '684 adapter packs are not configured to lock into the sliding tray. *Id.* They instead lock into either a rearward or forward slot in mounting guides. The disclosed interaction is thus between the adapter packs and the mounting guides that support them, not between the modules and the tray, as claim 16 requires. *See* CX-2060C (Prucnal RWS) Q/A 540; CX-0032 (Smrha '684) at 3:30-32, 9:43-45, and 10:26-31.

vi. Claim 19: Density

Respondents argue that asserted claim 19 is obvious over Smrha '684 in view of Niazi '209 and AFL Future Access 1RU.

Claim 19 depends from unasserted claim 18 which depends from claim 11. Claim 19 requires a fiber optic connection density of exactly 144 connections per U space of the chassis, "based on using a simplex fiber optic adapter or a duplex fiber optic adapter as

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each fiber optic adapter of the plurality of first fiber optic adapters." As shown above, Dr. Blumenthal has not shown that Smrha '684 in view of Niazi '209 or AFL Future Access renders obvious a density of even 98 connections within a U space. It follows that those references do not render obvious the greater density of 144 connections. *See* CX-2060C (Prucnal RWS) Q/A 542, 544-45.

vii. Claim 21: Module Guide

Respondents argue that asserted claim 21 is obvious over Smrha '684 in view of Niazi '209 and AFL Future Access 1RU.

Claim 21 depends from claim 20, which requires fiber optic equipment trays with module guides configured to receive multiple fiber optic modules. As shown above, the drawer in Smrha '684 does not receive fiber optic modules, but instead pulls out stacked mounting guides that support adapter packs at the time of initial installation. *See* CX-2060C (Prucnal RWS) Q/A 546. Neither Niazi '209 nor AFL Future Access discloses a redesign of Smrha '684 to install each layer of adapter packs on a fiber optic equipment tray. *See id.* Claim 21 also requires that each module guide comprise "a locking feature configured to cooperate with a fiber optic module of the first or second fiber optic modules to prevent movement of the fiber optic module relative to the fiber optic equipment tray." Dr. Blumenthal opines that Smrha '684 renders this additional limitation obvious. As shown above for claims 11 and 16, he has not shown that Smrha '684 alone or in combination discloses either a plurality of fiber optic equipment trays or a locking feature to prevent movements of the module relative to the tray.

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viii. Claim 27

Respondents argue that asserted claim 27 is obvious over Smrha '684 in view of Niazi, Future Access 1RU, and Verdiell.

Claim 27 is similar to claim 11, but requires a chassis configured for a 4-U space, and a proportional increase in density from 144 in a 1U space to 576 in a 4-U space. Thus, respondents have not shown that Smrha '684 alone or in combination satisfies this claim for all the reasons discussed above. To address the 4U limitations, Dr. Blumenthal adds U.S. Patent No. 7,452,236 to Verdiell (RX-0462 (Verdiell '236)), which he opines would suggest to a person of ordinary skill how to expand Smrha '684 for a 4-U space. *See* CX-2060C (Prucnal RWS) Q/A 552 and 555. Verdiell '236 discloses a system for interconnecting "rack-mounted electronic components such as rack mounted computer servers." *See* RX-0462 (Verdiell '236) at 2:17-26; *see also* CX-2060C (Prucnal RWS) Q/A 553. It discloses equipment that spans multiple U spaces in a standard 19-inch rack-mount system "spaced apart in 1.75 inch increments referred to as 'units' (sometimes written as 'U')." RX-0462 (Verdiell '236) at 1:29-32; CX-2060C (Prucnal RWS) Q/A 553.

<u>Motivation to combine Smrha '684 with Verdiell '236</u>

Respondents, relying on the testimony of Dr. Blumenthal, provide insufficient evidence to show why a person of ordinary skill would combine Verdiell '236 with Smrha '684, how it could be combined, and whether there would be a reasonable expectation of success. *See* CX-2060C (Prucnal RWS) Q/A 554. Indeed, their purposes and structures are too different to suggest a reason for combination. *Id.* Verdiell '236, like Niazi '209, concerns computer equipment, which is not analogous art to the '456

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patent. In any event, as shown above, Smrha '684 does not disclose its dimensions, so a person of ordinary skill would not know how to adapt Smrha '684 to multiple U spaces even after studying Verdiell '236. *See* CX-2060C (Prucnal RWS) Q/A 554; CDX-0005C (Prucnal Rebuttal Demonstratives) at 268.

4-U Space

Respondents do not show that Smrha '684 in combination with any reference discloses a 4-U space. As set forth above, Smrha '684 does not disclose dimensions, much less a 4U space. *See* CX-2060C (Prucnal RWS) Q/A 556. Combining the alleged 4-U disclosure of Verdiell '236 with the dimensionless Smrha '684 would have an unpredictable result. *Id.* Dr. Blumenthal has not shown any reason why the features that disclose more than a 1-U size in those references would apply to Smrha '684, any reason why a person of ordinary skill would choose to combine those features to produce Smrha '684 in a 4-U space, or any reason why such a combination would have a predictable result. *Id.*

First, Dr. Blumenthal relies on Verdiell '236 to provide the 4-U size, but that reference discusses equipment designed for multiple U spaces, which is structurally different and technically easier to design than the structure required by the '456 patent: a chassis that is complete in a 1-U space but can be multiplied to achieve that same structure four times — *i.e.*, akin to four stacked 1-U chassis to make a 4-U chassis. *Id.*

Second, as shown above, Dr. Blumenthal has not shown that a person of ordinary skill would combine Niazi '209 or AFL Future Access with Smrha '684. *See* CX-2060C (Prucnal RWS) Q/A 558. That same analysis applies to the 4-U chassis and its features recited in claim 27. *Id.*

[redacted]

Third, Dr. Blumenthal has not shown that, even if Smrha '684 disclosed a device that fits into a 1-U size (which it does not), the architecture in Smrha '684 is scalable to a 4-U size; how that would be accomplished; or what the results (including connection density) would be. *Id.* This is far from obvious, particularly inasmuch as Smrha '684 contains only a single drawer that supports a framework for sliding adapter packs that move within stacked mounting guides. *Id.*

Density

As discussed above, Dr. Blumenthal has not shown that Smrha '684, alone or in combination with Niazi '209 or AFL Future Access, discloses a density of 144 fiber optic connections per U space. *See* CX-2060C (Prucnal RWS) Q/A 559. Inasmuch as claim 27 simply applies that same density to a chassis that is four times taller (4-U instead of 1-U), the same analysis applies here. *Id.* In addition, as discussed above, Dr. Blumenthal has not explained how or why a person of ordinary skill would seek to change the size of Smrha '684, with or without these references, to a 1-U size and multiply its system to fill a 4-U space with at least 576 connections. *Id.*

ix. Claim 28: Module Density

Respondents argue that asserted claim 28 is obvious in view of Smrha '684 in view of Niazi '209, AFL Future Access 1 RU, Verdiell '236; and Smrha '684 in view of Niazi '209, AFL Future Access 1 RU, Verdiell '236 and Panduit SFQ cassette.

Claim 28 depends from claim 27. Smrha '684 in view of Niazi '209, AFL Future Access 1 RU, Verdiell '236 fails to satisfy claim 28 for the same reasons as for claim 27 discussed above.

Additionally, claim 28 mirrors claim 12 except that it applies to the modules for

[redacted]

the 4-U chassis of claim 27, rather than the 1-U chassis of claim 11. Dr. Blumenthal's analysis of claim 28 is the same as his analysis of claim 12. *See* CX-2060C (Prucnal RWS) Q/A 562-63 ("Dr. Blumenthal has failed to show that Smrha '684 combined with other references discloses claim 12, and Dr. Blumenthal therefore fails to demonstrate this combination discloses claim 28 for the same reasons.").

2. Enablement

Respondents argue that "Claim 11 of the '456 Patent is invalid because the full scope of the claims is not enabled." *See* Resps. Br. 150-55. Corning and the Staff disagree. *See* Compl. Br. at 226-27; Staff Br. at 171-72.

Respondents argue, *inter alia*:

> Claim 11 of the '456 Patent is invalid because the full scope of the claims is not enabled. RX-0001C (Blumenthal WS) Q/A 195-205. The enablement requirement "prevents both inadequate disclosure of an invention and overbroad claiming that might otherwise attempt to cover more than was actually invented." *MagSil*, 687 F.3d at 1381. Thus, a patentee invites additional scrutiny when it chooses to use open-ended claim language, *e.g.*, limitations claiming "at least" some threshold quantity but lacking any express upper bound. Complainant choose to use exactly that formulation for the alleged invention claimed in claim 11 of the '456 Patent.
>
> Claim 11 requires that "the plurality of fiber optic modules are configured to support a fiber optic connection density of ***at least ninety-eight (98) fiber optic connections per U space of the chassis***, based on using a simplex fiber optic adapter or a duplex fiber optic adapter as each fiber optic adapter of the plurality of first fiber optic adapters." JX-0010 ('456 Patent) at 22:1-7 (emphasis added). There is no dispute that claim 11 is open-ended because it includes an expressly stated lower bound, but does not include an expressly stated upper bound. RX-0001C (Blumenthal WS) Q/A 196; CX-2060C (Prucnal RWS) Q/A 228; Prucnal Tr. 972:10-15; *see also* CPHB at 229.
>
> Accordingly, claim 11 is valid if and only if (1) it has an inherent upper limit and (2) the specification enables a POSITA to approach that limit. *Andersen LLC*, 474 F.3d at 1376-77. Claim 11 does not satisfy that

[redacted]

standard, and is therefore invalid.

Resps. Br. at 150.

For the reasons discussed below, respondents have not shown by clear and convincing evidence that claim 11 of the '456 patent does not satisfy the enablement requirement of 35 U.S.C. § 112.

Claim 11 of the '456 patent, like claims 1 and 3 of the '320 patent, contains an open-ended range reciting "a fiber optic connection density of at least ninety-eight (98) fiber optic connections per U space."

Asserted claim 11 of the '456 patent reads:

> **11**. A fiber optic apparatus, comprising:
>
> a chassis configured to be disposed in an equipment rack, the chassis comprising front and rear ends that are spaced apart from one another in a longitudinal direction, and comprising opposite first and second ends that are spaced apart from one another in a lateral direction that extends crosswise to the longitudinal direction;
>
> a plurality of fiber optic equipment trays supported by the chassis and extendable relative to the chassis in the longitudinal direction; and
>
> a plurality of fiber optic modules configured to be installed in the plurality of fiber optic equipment trays, wherein each fiber optic module of the plurality of fiber optic modules comprises a front side, a rear side, an internal chamber, a plurality of first fiber optic adapters disposed through the front side, at least one second fiber optic adapter disposed through the rear side, and a plurality of optical fibers disposed within the internal chamber and extending from the at least one second fiber optic adapter to the plurality of first fiber optic adapters;
>
> wherein each fiber optic equipment tray of the plurality of fiber optic equipment trays is configured to

[redacted]

receive multiple fiber optic modules of the plurality of fiber optic modules;

wherein the plurality of fiber optic equipment trays and the plurality of fiber optic modules are configured to support ***a fiber optic connection density of at least ninety-eight (98) fiber optic connections per U space*** of the chassis, based on using a simplex fiber optic adapter or a duplex fiber optic adapter as each fiber optic adapter of the plurality of first fiber optic adapters; and·

wherein a U space comprises a height of 1.75 inches and comprises a width of 19 inches or 23 inches.

JX-0010 ('456 Patent) (emphasis added).

Respondents' enablement challenge to '456 patent claim 11 is substantially similar to their enablement challenge to '320 patent claims 1 and 3.

Thus, without repeating the entire analysis, certain portions are reproduced below:

> Respondents fail to show that any asserted claims are invalid for lack of enablement. Under former 35 U.S.C. § 112 ¶ 1 (2006) (now § 112(a)), a patent must describe the invention "in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains . . . to make and use the same." This requires "teach[ing] those skilled in the art how to make and use the full scope of the claimed invention without 'undue experimentation." *McRO, Inc. v. Bandai Namco Games Am. Inc.*, 959 F.3d 1091, 1100 (Fed. Cir. 2020) (quoting *ALZA Corp. v. Andrx Pharm., LLC*, 603 F.3d 935, 940 (Fed. Cir. 2010)). As with other challenges to patent validity, respondents bear the burden to show lack of enablement by clear and convincing evidence. *See Cephalon, Inc. v. Watson Pharm., Inc.*, 707 F.3d 1330, 1336 (Fed. Cir. 2013).
>
> Respondents' enablement challenges in this case almost entirely concern claim limitations that feature open-ended ranges, such as the limitation of '320 claims 1 and 3 that recite "fiber optic connection density of at least 98" or "at least 144 fiber optic connections per U space." JX-0004 ('320 Patent) at Claims 1, 3. These ranges are open-ended because the claim terms express a lower limit but no upper limit. An enablement challenge to a claim containing a range of this kind is governed by *Andersen Corp. v. Fiber Composites, LLC*, 474 F.3d 1361 (Fed. Cir. 2007):

[redacted]

> [O]pen-ended claims are not inherently improper; as for all claims their appropriateness depends on the particular facts of the invention, the disclosure, and the prior art. They may be supported if there is an inherent, albeit not precisely known, upper limit and the specification enables one of skill in the art to approach that limit.
>
> *Id.* at 1376-77. Accordingly, respondents must show either that there is no inherent upper limit on the claims they challenge, or that the specification does not teach a person of skill to approach that limit without undue experimentation. Further, as the Federal Circuit's decision in *McRO* makes clear, an enablement challenge requires "specific identification of products or processes that were or may be within the scope of the claims and were allegedly not enabled." 959 F.3d at 1101; *see id.* at 1104. Respondents have not made the showing required.

Section IV.D.4, *supra*.

For the '320 patent, the administrative law judge found existence of an inherent upper limit and ability to approach the inherent upper limit. For the same reasons explained for the '320 patent, the undersigned finds existence of an inherent upper limit and ability to approach the inherent upper limit for claim 11 of the '456 patent. *See id.*

Independent of that analysis, in addition, claim 11 and the specification of the '456 patent contain additional language showing the inherent limits on the number of fiber-optic connections that can be achieved per U space. Claim 11 recites additional structural elements, including "a plurality of fiber optic equipment trays" that are "extendable relative to the chassis in the longitudinal direction"; "a plurality of fiber optic modules configured to be installed in the fiber optic equipment trays"; and the ability to install "multiple fiber optic modules" in each tray. JX-0010 ('456 Patent), Claim 11. A person of ordinary skill would recognize that those elements take up space and can support only a finite number of connections. *See* CX-2060C (Prucnal RWS) Q/A 231.

[redacted]

The specification of the '456 patent also contains statements, like those of the '320 patent, disclosing the limiting effects of physical size, the need for access, and the need to protect fibers by maintaining an appropriate bend radius. *See* JX-0010 ('456 Patent) at 1:66-2:1, 2:16-32, 5:44-6:15, 9:5-31, 10:49-11:16, 12:15-42, 13:4-12, 22:47, 14:36-64, 15:61-16:23, 17:25-53, 19-20 (table) (density); *id.* at 6:43-46, 6:52-56, 6:59-63, 6:65-7:7, 7:17-20, 7:49-52 (access); *id.* at 10:15-19, 19:60-62 (fiber protection).

Moreover, claim 19 of the '456 patent is enabling for the alternative reason that it does not claim a range. *See* 35 U.S.C. § 282(a) (declaring dependent claims presumptively valid even if they depend from invalid independent claims); *Shelcore, Inc. v. Durham Indus., Inc.*, 745 F.2d 621, 624 (Fed. Cir. 1984) (applying presumption). That claim recites "a fiber optic connection density of one hundred forty-four (144) fiber optic connections per U space of the chassis." JX-0010 ('456 Patent) at Claim 19. Respondents have not shown that the '456 specification fails to enable the specific 144-fiber embodiment of claim 19.

3. Indefiniteness

a. "width of the front side of [the] fiber optic module" ('456 patent, claims 12, 28)

Respondents argue that asserted dependent claims 12 and 28 of the '456 patent are indefinite under 35 U.S.C. § 112. *See* Resps. Br. 156-57. Corning and the Staff disagree. *See* Compl. Br. at 227-28; Staff Br. at 60-62.

Respondents argue:

> The term "width of the front side of [the] fiber optic module" appears in the claims 12 and 28 of the '456 Patent. JX-0010 ('456 Patent). As discussed above in Section V.D, *supra*, Respondents contend that a POSITA would interpret "width of the front side of [the] fiber optic

[redacted]

module," as used in claims 12 and 28 of the '456 Patent, to mean "width of the front side of the fiber optic module including areas dedicated to latches, sidewalls, flanges, and other non-adapter functions." RX-0001C (Blumenthal WS) Q/A 233. If that construction is not adopted, then a POSITA would find this claim term to be indefinite, rendering claims 12 and 28 of the '456 Patent invalid. *Id.* This is because a POSITA cannot ascertain with reasonable certainty the scope of the meaning of the term "width of the front side of the fiber optic module" as used in those claims. *Nautilus, Inc. v. Biosig Instruments, Inc.*, 134 S. Ct. 2120, 2124 (2014).

Specifically, a POSITA would review the figures and specification of the '456 Patent and find they provide inconsistent definitions for "W2," the measurement of the width of the front side of the module, making it impossible to determine the proper scope of the claimed meaning of "width of the front side" as used in the '456 Patent. RX-0001C (Blumenthal WS) Q/A 234. As shown in Figure 13 (annotated) of the '456 Patent above, "W2" is the width of the front side 202 of the main body 210 of the module. JX-0010 ('456 Patent) at Fig. 13 10:33-36. The W2 measurement of the front side of the module in Figure 13 omits the module's rails, labeled 28A in this figure. In contrast, Figure 18 of the '456 Patent's measurement of the front side of the module, W2, includes the rails 165A and 165B on the side of the module. JX-0010 ('456 Patent) at 14:65-15:14. It is readily apparent from a comparison of Figures 13 and 18 of the '456 Patent, the measurement protocol for W2 in Figure 18 is inconsistent with Fig. 13. *See* RX-0001C (Blumenthal WS) Q/A 234; § V.D, *supra*. The differences in the measurement protocols for the front side of the modules from Figures 13 and 18 are facially irreconcilable, and the asserted claims do not provide any context for which embodiment should be used. *Id.*

Because of these inconsistencies, a POSITA reading claims 12 and 28 in the context of the specification of the '456 Patent would not understand how to determine whether the plurality of first fiber optic adapters is disposed through "at least eighty-five percent (85%) of a width of the front side of at least one fiber optic module," as required by the claims. RX-0001C (Blumenthal WS) Q/A 238. Specifically, as Dr. Blumenthal testified, following the measurement guidelines in Figure 13 will lead to a different result than following the measuring guidelines in Figure 18, so the 85% threshold may be met using one measuring method, but not the other. *Id.* Dr. Blumenthal illustrated this problem with a simple mathematical example. Consider a situation where a plurality of first fiber optic adapters is disposed through a 8.5 cm opening referenced as "WA" and the width of the front side of a fiber optic module as measured according to the method of Figure 13 (omitting the rails) is 10 cm, which is referenced as "W_13", and the width of the front side of a

[redacted]

> fiber optic module as measured according to the method of Figure 18 (including the rails) is 12 cm, which is referenced as "W_18". In those examples, the Fig. 13 measurement protocol results in fiber optic adapters disposed through 85% of the width of the front side (WA (8.5 cm)/W_13 (10.0 cm) * 100% = 85%). In contrast, using the Fig. 18 measuring protocol results in fiber optic adapters through 70.08% of the front side (WA (8.5 cm)/W_18 (12 cm) * 100% = 70.08 %). RX-0001C (Blumenthal WS) Q/A 239. Using the Fig. 13 measuring protocol will satisfy the 85% requirement of the claims, but using the Fig. 18 protocol will not. For these reasons, a POSITA would not be able to determine with any certainty whether claims 12 and 28 are infringed, thereby rendering claims 12 and 28 indefinite.

Resps. Br. at 156-57.

For the reasons discussed below, respondents have not shown by clear and convincing evidence that asserted dependent claims 12 and 28 of the '456 patent are indefinite under 35 U.S.C. § 112.

Under former 35 U.S.C. § 112 ¶ 2 (2006) (now § 112(b)), a patent must "conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention." This statutory language requires "a patent's claims, viewed in light of the specification and prosecution history, [to] inform those skilled in the art about the scope of the invention with reasonable certainty." *Nautilus, Inc. v. Biosig, Instruments, Inc.*, 572 U.S. 898, 910 (2014). "Reasonable certainty" does not require "absolute precision." *Id.* at 910. As with other challenges to patent validity, respondents bear the burden to show indefiniteness by clear and convincing evidence. *See BASF Corp. v. Johnson Matthey Inc.*, 875 F.3d 1360, 1365 (Fed. Cir. 2017).

The claim term "width of the front side of [the] fiber optic module" appears in asserted dependent claims 12 and 28 of the '456 patent. The parties' proposed

[redacted]

constructions are:

Complainant	Respondents	Staff
"the width of the side of the module that when inserted faces the front of the chassis, excluding any module rail guides or protrusions that are used to insert the module into the chassis or remove it from the chassis."	"width of the front side of the fiber optic module including areas dedicated to latches, sidewalls, flanges, and other nonadapter functions" Otherwise indefinite.	"the width of the side of the module that when inserted faces the front of the chassis, excluding any module rail guides or protrusions, *e.g.*, the dimension identified as "W_2" in Figure 13 of the '456 and '206 Patents"

See Joint Chart at 4; Compl. Br. at 47-50; Resps. Br. at 41-45; Staff Br. at 58-62.

In the Claim Construction section for the '456 patent, the administrative law judge determined that the disputed claim term "width of the front side of [the] fiber optic module" should be construed to mean "the width of the side of the module that when inserted faces the front of the chassis, excluding any module rail guides or protrusions that are used to insert the module into the chassis or remove it from the chassis."

The reasoning is shown below:

> The '456 patent specification "acts as a dictionary," *Phillips*, 415 F.3d at 1321 (internal quotation marks omitted), by defining the "width of the front side" to exclude rails and similar protrusions from the module sides. That specification, referring to Figure 13, JX-0010 ('456 Patent) at 10:20, discloses the "width W_1 of the front opening 126," *id.* at 10:25-26, comparing it to two other defined widths: "width W_2 of the front side 96 of the main body 90 of the fiber optic module 22," *id.* at 10:35-36; and "[w]idth W_3, the overall width of the fiber optic module 22," *id.* at 10:39-40. The variables W_1, W_2, and W_3 and numbered items 22, 90, 96, and 126 each correspond to notations in Figure 13. *See* CX-2060C (Prucnal RWS) Q/A 124; CDX-0005C (Prucnal Rebuttal Demonstratives) at 24.[40] The specification also discloses "module rails 28A, 28B disposed on each

[40] Dr. Prucnal's witness statement and demonstrative discuss the '206 specification, noting that the '456 specification contains "essentially the same" language and figures. *See* CX-2060C (Prucnal RWS) Q/A 124-127, 136-38.

[redacted]

side 102A, 102B of the fiber optic module 22." *Id.* at 9:34-35. Figure 13 shows that the module rails 28A and 28B are included in W_3 (the "overall width of the fiber optic module") but not in W_2 (the "width of the front side"). JX-0010 ('456 Patent) at Fig. 13; *see* CDX-0005C (Prucnal Rebuttal Demonstratives) at 24.

The function of measuring the width of the front side further supports excluding rails. *See Cohesive Techs., Inc. v. Waters Corp.*, 543 F.3d 1351, 1368 (Fed. Cir. 2008) (in construing claim "we ask what function" a limitation "plays in the operation of the claimed apparatus"). The parties agree that "fiber optic connection density," which the '456 patent seeks to maximize, means the "number of fiber optic connections that can be made to the front side of the fiber optic equipment," Joint Chart at 3. With that goal in mind, it follows to distinguish the "width of the front side," which is W_2, and which includes only those parts of the module that take up precious space on the front side, from the "overall width of the fiber optic module," which is W_3, and which includes parts of the module that do not take up such space. The rails are part of W_3 but not part of W_2 because, when the module is installed, the rails fit into rail guides in the trays and take up no additional space on the front side. *See* JX-0010 ('456 Patent) at 6:20-23, 9:34-35; *id.* at Fig. 5; CX-2060C (Prucnal RWS) Q/A 132-38.

The different embodiment depicted in Figures 16 to 18 does not suggest otherwise. That embodiment is an "alternate fiber optic module" that is "designed to fit across two sets of module rail guides." JX-0010 ('456 Patent) at 13:50-56. According to the specification, the alternate module has "widths W_1 and W_2" that "are the same as in the fiber optic module 22 illustrated in FIG. 13." *Id.* at 14:42-43. There is no discussion of a width W_3, and Figure 18 also appears to define W_2 differently than Figure 13, by including the module rails. A person of ordinary skill would rely on the more detailed definition and description provided for Figure 13 and would interpret Figure 18 as incorporating that earlier disclosure rather than changing or conflicting with it. *See* CX-2060C (Prucnal RWS) Q/A 126-127.

Respondents rely on statements from the prosecution history of the '206 patent, and Panduit's unsuccessful *inter partes* review of that patent, to argue that Figure 18, rather than Figure 13, should control. *See* Resps. Br. at 43-45. However, the doctrine of prosecution disclaimer, on which respondents rely, requires a "clear and unmistakable disavowal" of claim scope, *Schindler Elevator Corp. v. Otis Elevator Co.*, 593 F.3d 1275, 1285 (Fed. Cir. 2010), and none is present here. During prosecution, the examiner cited a piece of prior art ("Rapp '274") that had two large flanges and a latch on its front side. The flanges and the latch, unlike

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module rails 28A and 28B from the specification, took up substantial space on the front side of the module. *See* CX-2060C (Prucnal RWS) Q/A 130-31 (discussing CDX-0005C, at 28). Corning cited Figure 18 to distinguish Rapp '274, but could have just as well cited Figure 13 — the flanges and latch of Rapp '274 would have been part of width W_2 using either description. *See id.* Q/A 132. Neither the examiner nor Corning mentioned rails or suggested that the flanges or latch of Rapp '274 resembled rails. None of this amounts to a clear and unmistakable disclaimer.

The *inter partes* review proceedings on which respondents rely (*see* Resps. Br. at 43-45) similarly do not support their position. Corning's briefing in the '206 IPR stated explicitly that "the overall width of the module, W_3, can be larger than the width of just the front side of the module because, as shown in [Figure 13], structure like side rails can protrude out from the sides of the modules"; and that "[b]ecause these rails are not part of the 'front side' of the module body, the '206 patent does not include them in the 'width of the front side.'" RX-0512 ('206 IPR Prelim. Resp.) at 26. Corning also distinguished Rapp '274 on the basis that Rapp's flanges and latch are part of its front side, *see id.* at 11, 17, 31, 33 — but, for the reasons already given, that distinction was fully consistent with Corning's claim construction position regarding rails, which it advanced in the same brief. *See* CX-2060C (Prucnal RWS) Q/A 133-135.

Respondents' argument concerning indefiniteness is discussed in the validity section, *infra*.

Section V.A.6, *supra*.

Thus, the proper construction of the disputed term excludes "any module rail guides or protrusions." A person of ordinary skill would be reasonably certain that (1) the specification's clear reference to Figure 13 in defining the "width of the front side," JX-0010 at 10:25-36; and (2) the distinction drawn in Figure 13 between W1, W2, and W3; combined with (3) the clear statement that the width defined in Figure 18 is "the same as" the width in Figure 13, *id.* at 14:42-43, show that the exclusion of the rails in Figure 13 is the best guide to the meaning of the patent. *See* Section V.A.6, *supra*; CX-2060C (Prucnal RWS) Q/A 124-127.

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Even if respondents' competing argument concerning Figure 18 is a "plausible construction" of the patent, that does not show indefiniteness. *Nevro Corp. v. Bos. Sci. Corp.*, 955 F.3d 35, 41 (Fed. Cir. 2020) ("[t]he test is not merely whether a claim is susceptible to differing interpretations" because "[s]uch a test would render nearly every claim term indefinite").

Accordingly, respondents have not shown by clear and convincing evidence that asserted dependent claims 12 and 28 of the '456 patent are indefinite under 35 U.S.C. § 112.

b. "U space" ('320 Patent, Claims 1, 3; '456 Patent, Claims 11, 19)

Respondents argue:

> The term "U space" renders claims 11, 12, 14, 15, 16, 19 and 21 of the '456 Patent indefinite irrespective of whether Respondents', Complainant's, or Staff's construction is adopted or whether the term is afforded a plain and ordinary meaning as explained in detail in Section VI.B.2, *supra*, which is incorporated here by reference.

See Resps. Br. at 155-56. Corning and the Staff disagree. *See* Compl. Br. at 228-30; Staff Br. at 55.

The above is respondents' entire argument on this issue. The administrative law judge found (in the Validity section for the '320 patent) that respondents have not proven by clear and convincing evidence that the claim term 'U space' (claimed in asserted claims 1 and 3 of the '320 patent and in asserted claims 11, 19, and 27 of the '456 patent) is indefinite under 35 U.S.C. § 112." *See* Section IV.D.5, *supra*. The full discussion need not be repeated here. *See id.*

* * *

[redacted]

Accordingly, respondents have not shown by clear and convincing evidence that the asserted independent claims 11 and 27 and dependent claims 12, 14-16, 19, 21, and 28 of the '456 patent are invalid.

VI. U.S. Patent No. 10,120,153

U.S. Patent No. 10,120,153, entitled "Independently Translatable Modules and Fiber Optic Equipment Trays in Fiber Optic Equipment," was filed on January 23, 2017 and issued on November 6, 2018. JX-0007 ('153 Patent). The '153 patent is assigned to Corning. JX-0009 ('153 Patent Assignment Record). The '153 patent is related to, and shares a specification with the '320 and '456 patents. The '153 patent states, "The technology of the disclosure relates to fiber optic modules for fiber optic equipment. The fiber optic modules can be included in fiber optic equipment rack and/or trays." JX-0007 at 2:4-6. The '153 patent has a total of 29 claims of which Corning asserts independent claim 23 and dependent claims 9, 16, and 26. *See* Compl. Br. at 8.

As discussed below, the evidence shows that (1) the asserted claims of the '153 patent are infringed by the accused products; (2) complainant has satisfied the technical prong of the domestic industry requirement; and (3) the asserted claims are not invalid.

A. Claim Construction

1. A Person of Ordinary Skill in the Art

As noted in the '320 patent section of this initial determination, the administrative law judge finds that a person of ordinary skill in the art with respect to the four asserted patents is a person who has at least a bachelor's degree in mechanical engineering, materials science, or a related field, and at least two years of experience in fiber optic

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equipment.

2. "a front end with at least one fiber optic routing element that comprises successive material sections extending frontward, upward, and rearward, respectively"

The claim term "a front end with at least one fiber optic routing element that comprises successive material sections extending frontward, upward, and rearward, respectively" appears in asserted independent claim 23 of the '153 patent.[41] Below is a chart showing the parties' proposed claim constructions.

Claim Term	Asserted Claims	Agreed-Upon Construction
"a front end with at least one fiber optic routing element that comprises successive material sections extending frontward, upward, and rearward, respectively"	'153: 23	"a front end of the fiber optic equipment tray having at least one flange comprising successive sections extending frontward, upward, and rearward that guides optical fibers to either the left or the right"

See Staff Br. at 46-47 (citing Joint Chart at 3-4; RX-0001C (Blumenthal WS) Q/A 109-10).

Asserted claim 23 reads as follows:

> **23**. A fiber optic apparatus, comprising:
>
> a chassis configured to be disposed in an equipment rack, the chassis comprising opposite front and rear ends that are spaced apart from one another in a longitudinal direction, and comprising opposite first and second ends that are spaced apart from one another in a lateral direction that extends crosswise to the longitudinal direction;

[41] The claim term also appears in independent claim 1 which is not asserted. Asserted claims 9 and 16 depend from claim 1.

[redacted]

a guide system configured to be disposed within the chassis;

a plurality of fiber optic equipment trays arranged in a stacked configuration and configured to slidably engage within the guide system, wherein each fiber optic equipment tray of the plurality of fiber optic equipment trays comprises ***a front end with at least one fiber optic routing element that comprises successive material sections extending frontward, upward, and rearward, respectively***, to permit optical fibers to be routed to either left or right portions of the plurality of fiber optic equipment trays toward the first and second ends of the chassis; and

a plurality of fiber optic modules configured to be received by the plurality of fiber optic equipment trays, wherein each fiber optic module of the plurality of fiber optic modules is independently movable in the longitudinal direction relative to each fiber optic equipment tray of the plurality of fiber optic equipment trays;

wherein each fiber optic module of the plurality of fiber optic modules comprises a front end, a rear end, an interior, a plurality of first fiber optic adapters disposed through the front end, at least one second fiber optic adapter disposed through the rear end, and at least one optical fiber disposed within the interior and establishing at least one optical connection between the at least one second fiber optic adapter and at least one first fiber optic adapter of the plurality of first fiber optic adapters;

wherein for at least one fiber optic module of the plurality of fiber optic modules, the at least one second fiber optic adapter comprises a higher connection density than each first fiber optic adapter of the plurality of first fiber optic adapters;

wherein each fiber optic equipment tray of the plurality of fiber optic equipment trays is configured to receive multiple fiber optic modules of the plurality of fiber optic modules; and

wherein the plurality of fiber optic equipment trays and the plurality of fiber optic modules are configured

[redacted]

to permit the plurality of fiber optic modules to be removable from a front of the plurality of fiber optic equipment trays, and releasably removable from a rear of the plurality of fiber optic equipment trays.

- JX-0007 (‘153 Patent) (emphasis added).

The parties have agreed to construe the above claim term as “a front end of the fiber optic equipment tray having at least one flange comprising successive sections extending frontward, upward, and rearward that guides optical fibers to either the left or the right.” *See* Joint Chart at 2; Compl. Br. at 110; Resps. Br. at 53-54; Staff Br. at 46-47.

Accordingly, as argued by the parties, the administrative law judge adopts the joint proposed claim construction and has determined that the claim term “a front end with at least one fiber optic routing element that comprises successive material sections extending frontward, upward, and rearward, respectively” should be construed to mean “a front end of the fiber optic equipment tray having at least one flange comprising successive sections extending frontward, upward, and rearward that guides optical fibers to either the left or the right.”

The parties’ arguments concerning the meaning of a non-claim word “flange” is discussed in the context of infringement and the technical prong of the domestic industry requirement, *infra*. *See* Compl. Br. at 110; Resps. Br. at 53-54.

B. Infringement Analysis of the ‘153 Patent

As noted, Corning asserts independent claim 23 and dependent claims 9, 16, and 26. Corning asserts claims 9, 16, 23, and 26 against Panduit and FS, and asserts claims 9 and 23 against Siemon’s pre-August 2019 products. For the reasons discussed below, Corning has shown by a preponderance of the evidence that Panduit’s, Siemon’s, and

[redacted]

FS's accused products infringe the '153 patent.

1. Accused Products

The accused products consist of chassis, modules, and combinations thereof. There are three categories of accused products, Base-8, Base-12, and Base-24, which are defined by the number of fiber connections available per module. First, a Base-8 module supports eight fiber connections, and a Base-8 chassis supports eighteen Base-8 modules per 1U space. CX-0001C (Prucnal WS) Q/A 63. Second, a Base-12 module supports twelve fiber connections, and a Base-12 chassis supports twelve Base-12 modules per 1U space. *Id*. Finally, a Base-24 module supports twenty-four fiber connections, and a Base-24 chassis supports six Base-24 modules per 1U space. *Id*. In each case, there are a total of 144 connections available in a 1U space; the difference in the three categories is in the number of modules needed to fill that space.

Within each category, there are three chassis sizes: 1U, 2U, and 4U, which refer to the chassis height. *Id*. Apart from the total height, these types are materially the same for each respondent. *Id*. That is, the fiber optic connection density for a 1U chassis from a given respondent is the same as the density for a 2U or 4U chassis from that respondent. *Id*. Q/A 64. Complainant argues that therefore "for each Respondent, and within each fiber connectivity configuration (Base-12, Base-8, and Base-24), a 1U chassis is representative of a 2U chassis and a 4U chassis for purposes of the asserted patents." *Id*.; *see also* CX-2042 (Compl. & Siemon Stip. Re Representative Accused Prods.) (stipulating that within each of the three categories, Siemon's 1U chassis is representative of its 2U and 4U chassis for purposes of the asserted patents).

Complainant has offered a complete list of representative accused products for

[redacted]

each respondent, along with the group of accused products represented by each such product, through the testimony of Dr. Prucnal. CX-0001C (Prucnal WS) Q/A 62; *see* CDX-0013 (Prucnal list of accused products).

Not all respondents market all types of accused products. The following describes the accused products allegedly imported and/or sold in the United States by each respondent:

<u>Summary of Accused Products</u>

Respondent	Brand	Chassis			Module		
		Base-8	Base-12	Base-24	Base-8	Base-12	Base-24
FS	FHX	1U	1U		X	X	
Panduit	HD FLEX	1U/2U/4U	1U/2U/4U	1U/2U/4U	X	X	X
Siemon	LightStack	1U/2U/4U	1U/2U/4U		X	X	

See Staff Br. at 20.

a. Panduit

The Panduit accused products are marketed as "HD FLEX Fiber" enclosures and cassettes. The accused Panduit chassis fall into three categories (Base-8, Base-12, and Base-24), and are available in three sizes (1U, 2U, and 4U). The accused Panduit modules are available in three configurations (Base-8, Base-12, and Base-24). *See* CX-0001C (Prucnal WS) Q/A 85; CPX-0062 (Panduit Base-8 1U chassis); CPX-0063 (Panduit Base-12 1U chassis); CPX-0065 (Panduit Base-24 1U chassis); CPX-0073 (Panduit Base-8 module); CPX-0074 (Panduit Base-12 module); CPX-0075 (Panduit Base-24 module).

[redacted]

b. Siemon

The Siemon accused products are marketed under the name "LightStack Ultra High-Density Fiber Plug and Play system." The accused Siemon chassis fall into two categories (Base-8 and Base-12) and are available in three sizes (1U, 2U, and 4U). The accused Siemon modules are available in Base-8 and Base-12 configurations. *See* CX-0001C (Prucnal WS) Q/A 106; CPX-0076 (Siemon Base-8 1U chassis); CPX-0077 (Siemon Base-12 1U chassis); CPX-0078 (pre-Aug. 2019 version of Siemon Base-12 1U chassis); CPX-0079 (Siemon Base-8 module); CPX-0080 (Siemon Base-12 module).

c. FS

The FS accused products are marketed under the names "FHX Series" and "FHX-FCP/ FHX-C Series" and include both chassis and modules. The accused FS chassis fall into two categories (Base-8 and Base-12) and are available in just one size (1U). The accused FS modules are available in Base-8 and Base-12 configurations. *See* CX-0001C (Prucnal WS) Q/A 117; CPX-0053 (FS Base-8 1U chassis); CPX-0054 (FS Base-12 1U chassis); CPX-0055 (FS Base-8 module); CPX-0056 (FS Base-12 module).

2. Direct and Indirect Infringement

As noted, Corning asserts independent claim 23 and dependent claims 9, 16, and 26. Corning asserts claims 9, 16, 23, and 26 against Panduit and FS, and asserts claims 9 and 23 against Siemon's pre-August 2019 products.

For the reasons discussed below, Corning has shown by a preponderance of the evidence that Panduit, Siemon (pre-August 2019 products), and FS accused combinations practice each element of asserted claims of the '153 patent, either literally or under the doctrine of equivalents. However, it has not been shown that Panduit, Siemon, and FS

[redacted]

accused combinations directly infringe the asserted claims inasmuch as they do not sell their accused chassis and modules in combination. Nonetheless, Corning has shown that those accused combinations indirectly infringe the asserted claims, discussed, *infra*.

The asserted claims of the '153 patent (and the claims from which they depend) read as follows:

> **1**.[42] A fiber optic apparatus, comprising:
>
> a chassis configured to be disposed in an equipment rack, the chassis comprising opposite front and rear ends that are spaced apart from one another in a longitudinal direction, and comprising opposite first and second ends that are spaced apart from one another in a lateral direction that extends crosswise to the longitudinal direction;
>
> a guide system configured to be disposed within the chassis;
>
> at least one fiber optic equipment tray configured to slidably engage within the guide system, the at least one fiber optic equipment tray comprising a front end with at least one fiber optic routing element that comprises successive material sections extending frontward, upward, and rearward, respectively, to permit optical fibers to be routed to either left or right portions of the at least one fiber optic equipment tray toward the first and second ends of the chassis; and
>
> a plurality of fiber optic modules configured to be received by the at least one fiber optic equipment tray, wherein each fiber optic module of the plurality of fiber optic modules is independently movable in the longitudinal direction relative to the at least one fiber optic equipment tray, and wherein each fiber optic module of the plurality of fiber optic modules comprises a front end, a rear end, an interior, a plurality of first fiber optic adapters disposed through the front end, at least one second fiber optic adapter disposed through the rear end,

[42] Claim 1 is not asserted.

[redacted]

and at least one optical fiber disposed within the interior and establishing at least one optical connection between the at least one second fiber optic adapter and at least one first fiber optic adapter of the plurality of first fiber optic adapters.

6.[43] The fiber optic apparatus of claim **1**, wherein the at least one fiber optic equipment tray comprises a plurality of fiber optic equipment trays.

9. The fiber optic apparatus of claim **6**, wherein:

each fiber optic equipment tray of the plurality of fiber optic equipment trays is configured to receive multiple fiber optic modules of the plurality of fiber optic modules; and

the plurality of fiber optic equipment trays and the plurality of fiber optic modules are configured to permit each fiber optic module of the plurality of fiber optic modules to be removable from a front of the plurality of fiber optic equipment trays, and releasably removable from a rear of the plurality of fiber optic equipment trays.

16. The fiber optic apparatus of claim **1**, wherein at least one fiber optic module of the plurality of fiber optic modules comprises a locking latch comprising a lateral protrusion configured to prevent the at least one fiber optic module from moving rearward relative to the at least one fiber optic equipment tray, the locking latch being actuatable by a user from a rear of the at least one fiber optic module to enable removal of the at least one fiber optic module from a rear of the at least one fiber optic equipment tray.

23. A fiber optic apparatus, comprising:

a chassis configured to be disposed in an equipment rack, the chassis comprising opposite front and rear ends that are spaced apart from one another in a longitudinal direction, and comprising opposite first and second ends that are spaced apart from one another in a lateral direction that extends crosswise to the longitudinal direction;

[43] Claim 6 is not asserted.

[redacted]

a guide system configured to be disposed within the chassis;

a plurality of fiber optic equipment trays arranged in a stacked configuration and configured to slidably engage within the guide system, wherein each fiber optic equipment tray of the plurality of fiber optic equipment trays comprises a front end with at least one fiber optic routing element that comprises successive material sections extending frontward, upward, and rearward, respectively, to permit optical fibers to be routed to either left or right portions of the plurality of fiber optic equipment trays toward the first and second ends of the chassis; and

a plurality of fiber optic modules configured to be received by the plurality of fiber optic equipment trays, wherein each fiber optic module of the plurality of fiber optic modules is independently movable in the longitudinal direction relative to each fiber optic equipment tray of the plurality of fiber optic equipment trays;

wherein each fiber optic module of the plurality of fiber optic modules comprises a front end, a rear end, an interior, a plurality of first fiber optic adapters disposed through the front end, at least one second fiber optic adapter disposed through the rear end, and at least one optical fiber disposed within the interior and establishing at least one optical connection between the at least one second fiber optic adapter and at least one first fiber optic adapter of the plurality of first fiber optic adapters;

wherein for at least one fiber optic module of the plurality of fiber optic modules, the at least one second fiber optic adapter comprises a higher connection density than each first fiber optic adapter of the plurality of first fiber optic adapters;

wherein each fiber optic equipment tray of the plurality of fiber optic equipment trays is configured to receive multiple fiber optic modules of the plurality of fiber optic modules; and

wherein the plurality of fiber optic equipment trays and the plurality of fiber optic modules are configured

[redacted]

to permit the plurality of fiber optic modules to be removable from a front of the plurality of fiber optic equipment trays, and releasably removable from a rear of the plurality of fiber optic equipment trays.

25. The fiber optic apparatus of claim **23**, further comprising a plurality of module guides associated with the plurality of fiber optic equipment trays, wherein the chassis comprises a rear section, and a rear portion of each module guide of the plurality of module guides defines at least one guide channel that is open on a rear end thereof to permit the plurality of fiber optic modules to be inserted into the plurality of module guides from the rear section of the chassis and to be guided toward the front end of the chassis.

26. The fiber optic apparatus of claim **25**, wherein each fiber optic module of the plurality of fiber optic modules comprises a locking latch that is configured to prevent the fiber optic module from moving rearward relative to a fiber optic equipment tray of the plurality of fiber optic equipment trays, and that is actuatable by a user from a rear of the fiber optic module to enable removal of the fiber optic module from the fiber optic equipment tray.

JX-0007 ('153 Patent) at 16:51-20:30.

a. Issues Common to Multiple Respondents

All asserted claims of the '153 patent recite: "a front end with at least one fiber optic routing element that comprises successive material sections extending frontward, upward, and rearward, respectively." JX-0007 ('153 Patent), Claims 1 and 23.

Asserted claim 23 reads as follows:

23. A fiber optic apparatus, comprising:

a chassis configured to be disposed in an equipment rack, the chassis comprising opposite front and rear ends that are spaced apart from one another in a longitudinal direction, and comprising opposite first and second ends that are spaced apart from one another in a lateral direction that extends crosswise to the longitudinal direction;

a guide system configured to be disposed within the chassis;

[redacted]

a plurality of fiber optic equipment trays arranged in a stacked configuration and configured to slidably engage within the guide system, wherein each fiber optic equipment tray of the plurality of fiber optic equipment trays comprises ***a front end with at least one fiber optic routing element that comprises successive material sections extending frontward, upward, and rearward, respectively***, to permit optical fibers to be routed to either left or right portions of the plurality of fiber optic equipment trays toward the first and second ends of the chassis; and

a plurality of fiber optic modules configured to be received by the plurality of fiber optic equipment trays, wherein each fiber optic module of the plurality of fiber optic modules is independently movable in the longitudinal direction relative to each fiber optic equipment tray of the plurality of fiber optic equipment trays;

wherein each fiber optic module of the plurality of fiber optic modules comprises a front end, a rear end, an interior, a plurality of first fiber optic adapters disposed through the front end, at least one second fiber optic adapter disposed through the rear end, and at least one optical fiber disposed within the interior and establishing at least one optical connection between the at least one second fiber optic adapter and at least one first fiber optic adapter of the plurality of first fiber optic adapters;

wherein for at least one fiber optic module of the plurality of fiber optic modules, the at least one second fiber optic adapter comprises a higher connection density than each first fiber optic adapter of the plurality of first fiber optic adapters;

wherein each fiber optic equipment tray of the plurality of fiber optic equipment trays is configured to receive multiple fiber optic modules of the plurality of fiber optic modules; and

wherein the plurality of fiber optic equipment trays and the plurality of fiber optic modules are configured to permit the plurality of fiber optic modules to be removable from a front of the plurality of fiber optic

[redacted]

equipment trays, and releasably removable from a rear of the plurality of fiber optic equipment trays.

JX-0007 (‘153 Patent) (emphasis added).

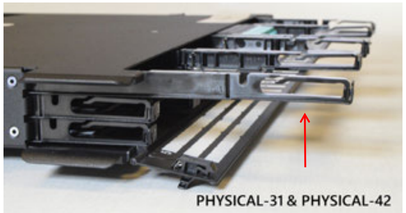
As discussed in the claim construction section above, the parties have agreed to construe that claim term as “a front end of the fiber optic equipment tray having at least one flange comprising successive sections extending frontward, upward, and rearward that guides optical fibers to either the left or the right.” *See* Joint Chart at 2; Compl. Br. at 110; Resps. Br. at 53-54; Staff Br. at 46-47. Indeed, the administrative law judge adopted the joint proposed claim construction and determined that the claim term “a front end with at least one fiber optic routing element that comprises successive material sections extending frontward, upward, and rearward, respectively” should be construed to mean “a front end of the fiber optic equipment tray having at least one flange comprising successive sections extending frontward, upward, and rearward that guides optical fibers to either the left or the right.”

i. Respondents’ Fiber Optic Routing Elements

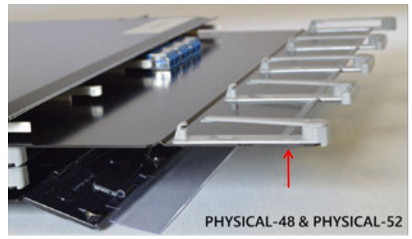
Panduit, Siemon, and FS each designed a slightly different fiber optic routing element, but each is the same across each respondent’s accused products. Images of these three fiber routing elements are shown below. Each satisfies the elements of the claims.

[redacted]

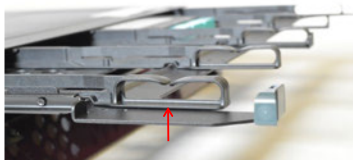
Representative Panduit Base-12 Combination



Representative Siemon Base-12 Combination



Representative FS.com Base-12 Combination



CX-1849 (Panduit Photos Ex. F) at 4; CX-1853 (Siemon Photos Ex. J) at 3; CX-1855 (FS Photos Ex. L) at 3

First, each respondent's fiber routing element consists of a molded plastic component that is attached to the front end of the tray through thermal welding, or by permanent snap features. CX-0001C (Prucnal WS) Q/A 442-45. In each case, therefore, the tray comprises the routing element — that is, the fiber routing element is an integrated part of the tray. *Id.*

Second, each respondent's fiber routing element comprises a flange. As Dr. Prucnal explains, a person of ordinary skill would understand that "[a] flange is simply an extension from a main body." *Id.* Q/A 438. Each respondent's fiber routing elements is an extension from the main body of the tray. *Id.* Q/A 442-45.

Third, each respondents' fiber routing elements consist of successive material sections extending frontward, upward, and rearward, respectively, which enables the routing element to hook around the fiber optic cables to hold them in place and facilitate management of the cables at the front of the tray and chassis. *Id.* The material sections comprising this shape are successive in that there is no intermediate material section in the fiber routing element between the elements that extend frontward, upward, and rearward, respectively. *Id.*

[redacted]

Fourth, each respondent's fiber routing element guides optical fibers to either the left or the right of the tray or chassis. *Id*. As the specification states, the purpose of the fiber routing element is "to allow optical fibers to be routed therein to either the left or right of the tray to the sides 340, 342 of the chassis." JX-0007 ('153 Patent) at 15:60-62. Respondents' documents show their fiber routing elements being used for this purpose. *See* CX-1622 (Panduit HD Flex Fiber Cabling System Brochure) at 6; CX-0087 (Leviton Enclosure Instructions) at 9; CX-0179C (Siemon Plug and Play Presentation) at 6; CX-0180C (11/19 Siemon LightStack Spec.) at 1; CPX-0021 (FHX Ultra HD Fiber Enclosure User Guide Video) at 1:27; JX-0031C (Zhang Dep. Tr.) 154, 156 (confirming this for the FS accused chassis).

Respondents argue that respondents' accused products do not directly infringe the asserted claims of the '153 patent. It is argued, *inter alia*:

> Complainant asserts that Panduit, Siemon, and FS each infringe at least some of the Asserted Claims (claims 9, 16, 23, and 26) of the '153 Patent. Each of these claims, directly or through dependency, recites "a front end with at least one fiber optic routing element that comprises successive material sections extending frontward, upward, and rearward, respectively." See JX-0007 ('153 Patent), cls. 1, 23; RX-0006C (Min RWS) Q/A 87 (citing RDX-0006C.31-33 (153 Pat. Asserted Claims)). The parties have agreed to a construction for this term as "a front end of the fiber optic equipment tray having at least one flange comprising successive sections extending frontward, upward, and rearward that guides optical fibers to either the left or the right," the parties disagree on what the accused products must have in order to infringe the asserted claims. RX-0006C (Min RWS) Q/A 88-93; CX-0001C (Prucnal WS) Q/A 438.
>
> Respondents' accused products do not infringe the agreed-upon construction for two reasons. First, under the parties' construction, the claim recites a flange that extends from the main body of the tray and comprises successive sections extending frontward, upward and rearward. Min. Tr. 858:11-19; CX-0001C (Prucnal WS) Q/A 438. None of the accused products practice this limitation. Second, Complainant's expert, Dr. Prucnal, asserts that under the agreed-upon construction, the accused

[redacted]

fiber optic routing element must be an integrated component on the front end of the fiber optic equipment tray, which is also not true for any of the accused products.

Resps. Br. at 185.

Respondents argue that respondents' accused products do not include a "flange."

It is argued, *inter alia*:

> The parties agree that a "flange" must include ***successive*** sections extending frontward, upward, and rearward from the tray. *See* RX-0006C (Min RWS) Q/A 89; CX-0001C (Prucnal WS) Q/A 438. Thus, the "fiber optic routing element" must have a specifically-shaped flange extending from the front of the tray, and routing elements that differ in form are excluded.
>
> This is further established by the prosecution history. RPHB at 186-87. Complainant's original claim language did not include the "successive" or "respectively" limitations. JX-0008C ('153 Prosecution History) at 150. Because the claim did not specify any particular, successive order, the Examiner rejected claim 1 as anticipated by U.S. Patent No. 5,511,144 to Hawkins ("Hawkins '144"), which included a "jumper radius control guides 8" that were structures disposed on, and attached to, the ***top*** of the front portion of the tray. RX-0006C (Min RWS) Q/A 89. To overcome Hawkins '144, Corning added the terms "successive" and "respectively." RPHB at 186-87; JX-0008 ('153 FH) at 138. The experts agree that "successive" means the material sections comprising the fiber optic routing element must proceed in a specific order, with no intervening segments. Min Tr. 858:18-19; CX-0001C (Prucnal WS) Q/A 438. As amended, the flange cannot be on top of the tray, it must extend frontward before extending upward. Min. Tr. 858:11-19.
>
> To support its amendment, Corning cited four figures: Figures 3, 6, 7, and 9. JX-0008 ('153 FH) at 138. As Dr. Prucnal recognized, each figure shows a fiber optic routing element that is a flange that extends from the front of the tray forward, then upward, and then rearward. Prucnal Tr. 360:2-8; 360:23 – 361:1; 361:5 – 362:2; *see also* RX-0006C (Min RWS) Q/A 91; *see also* RDX-006C.38 (Panduit D-Rings). Consistent with the amended claim language, none of these figures show a routing element on top of the tray itself. JX-0007 ('153 Pat.) at Figs. 3, 6, 7, 9; Prucnal Tr. 360:2-8; 360:23 – 361:1; 361:5 – 362:2; RX-0006C (Min RWS) Q/A 92-93. While the '153 Patent includes figures that show "fiber routing guides" 336, like Hawkins '144's jumper radius control guides,

[redacted]

> that are disposed on top of the tray itself, Corning did not identify these figures to support its amendment. RX-0006C (Min RWS) Q/A 93; JX-0008 (‘153 FH) at 138.
>
> Thus, the claimed “fiber optic routing element” does not encompass all potential cable management elements that can be used to route fiber optic cables. Rather, Corning intentionally limited it, disclaiming routing guides disposed on top of the tray, and sought to claim only fiber optic routing elements that took on a specific shape; extending frontward from the front of the tray and then extending upward and rearward. *See also* CX-0001C (Prucnal WS) Q/A 440 (“during prosecution, Corning distinguished the routing element in the prior art (in particular, the Hawkins reference) based on its ‘orientation’ or shape, not based on how it was integrated with a tray”). In all of Respondents’ accused products, however, the purported fiber optic routing element is disposed on top of the tray and does not extend from the front of the tray in successive segments starting with frontward and continuing upward and rearward.

Resps. Br. at 186-87.

Respondents’ arguments rely on improper attempts to import limitations into the claims and the parties’ construction — particularly the word “flange,” which does not appear in the claims. Corning consented to the use of the term “flange” in the parties’ agreed construction based on how that term is used in the patent and the art generally. Respondents, however, have sought to reinterpret that term in ways that significantly change its meaning.

First, Dr. Min opines that respondents’ fiber routing elements are not a “flange” because they are not a “part of the tray,” but instead are “attached to the front of the tray.” RX-0006C (Min RWS) Q/A 88-89, 103, 117, 122. However, there is no requirement in the claims that the flange must be formed as part of the tray rather than as “a separately molded object attached to the tray.” *Id.* Q/A 88. It is improper to import such a limitation into the claim, even if all the embodiments in the specification matched

[redacted]

respondents' description. *See Liebel-Flarsheim Co. v. Medrad, Inc.*, 358 F.3d 898, 906 (Fed. Cir. 2004). Here, moreover, additional embodiments — indeed, preferred embodiments — show a fiber routing element that is not "part of the tray" but is in fact a "separately molded object attached to the tray." The embodiment in Figure 3, for example, shows a fiber routing element that is comprised of "fiber routing tray 36" that "is attached to the main tray portion 44 via hinge mechanisms in the form of hinges 46A, 46B disposed on each end 48A, 48B of the main tray portion." JX-0007 ('153 Patent) 7:24-29. This embodiment is shown below:

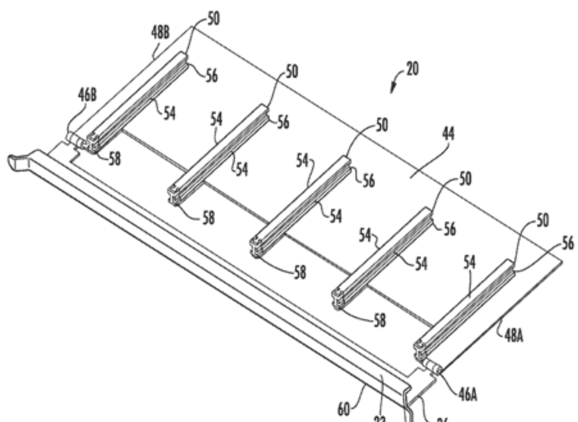


FIG. 3

Nor does the use of the term "flange" in the specification support respondents' position. Respondents' experts opine that the terms appears only once in the '153 patent. *See* RX-0006C (Min RWS) Q/A 95 (reading the '153 patent to define "flange" in terms of the U-shaped flange in Figure 33); RX-0008C (Lebby RWS) Q/A 130 (similar). In fact, as Dr. Prucnal explains, it appears twice. Prucnal Tr. 372-73 (explaining that the '153 patent uses the term "flange" to identify two unrelated structures). It first appears in discussing Figure 17, where the term "flange" is used to describe the end of a plunger

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that is inserted into a hole: "The bracket 160 contains a series of apertures 162 that are adapted to receive flanges 164 from plungers 166." JX-0007 ('153 Patent) at 12:32-34:

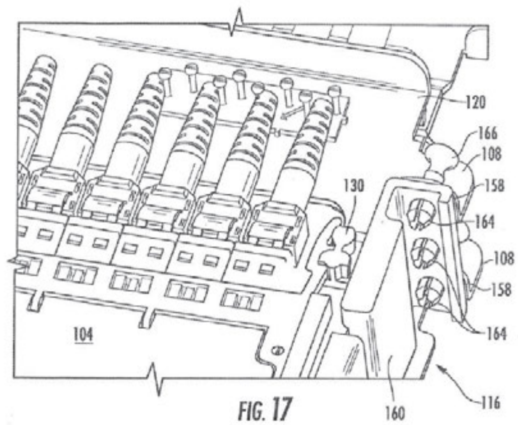

FIG. 17

The term flange then again appears in Figure 33, which describes a "U-shaped flange" that is formed on the front of module guide tray, which in turn is attached to a fiber optic equipment tray by a hinge. Although this flange is formed as part of the module guide tray, it is clearly a different embodiment from the claimed flange — among other reasons, its U shape is not facing in the claimed direction, but instead has open portion facing upwards rather than rearward as the claims recite. Thus, there is no factual basis for respondents to claim that the Figure 33 embodiment of a flange should be read into the claims.

Respondents' attempt to interpret the term "flange" narrowly is also inconsistent with respondents' own use of that term. Panduit's product specification for its accused chassis, for example, describes as an "integral . . . flange" the mounting brackets that are separate components that can be attached to the chassis (via screws) to mount the chassis it in an equipment rack:

[redacted]

technical information

Mounting:	Integral mounting flange for installation in 19" wide EIA-310 racks
Material:	Steel and plastic

CX-0199 (Panduit HD Flex Enclosures Spec.) at 1. Panduit's description of its own mounting flange as "integral" means that the flange can be attached to the chassis, not that they are part of the structure of the chassis. As Panduit's installation instructions show, these mounting flanges are attached to the side of the chassis via screws, and can be attached in different positions:

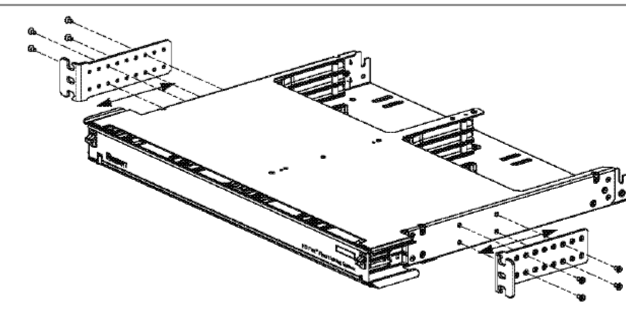

Figure 2

CX-1705 (Panduit FLEX1U, FLEX2U, & FLEX4U Installation Instructions) at 2. Thus, Panduit's own use of the term "flange" in the real world conflicts with respondents' position that a "flange" cannot be separately attached. *See* Resps. Br. at 185-87.

Dr. Min also relies on several general-usage dictionaries to support his opinion that "a person of ordinary skill of the art would understand that a 'flange' in the '153 patent is its ordinary meaning of a rib, rim, or other integral projection of an object for strengthening, guiding, or providing a means to connect the object to another object." RX-0006 (Min RWS) Q/A 88. These lay dictionaries are entitled to little weight given the technical nature of the term at issue and the evidence that persons of skill would not

[redacted]

consider the term "flange" to be limited in the way Dr. Min suggests. *See AFG Indus., Inc. v. Cardinal IG Co.*, 239 F.3d 1239, 1247-48 (Fed. Cir. 2001); *Anderson v. Int'l Eng'g & Mfg., Inc.*, 160 F.3d 1345, 1348-49 (Fed. Cir. 1998); *see Vanderlande Indus. Nederland BV v. Int'l Trade Comm'n,* 366 F.3d 1311, 1321 (Fed. Cir. 2004).

Second, Dr. Min opines that respondents' fiber routing elements are not flanges because they "are not made out of the same material of the tray." RX-0006C (Min RWS) Q/A 103-04, 117, 122. There is no requirement in the claims that the fiber routing element be of the same material as the rest of the tray. Nor is this contained in the parties' agreed construction, as Dr. Min conceded on cross examination. Min Tr. 846.

The specification likewise contains no indication that the fiber routing element must be made of the same material as the tray. To the contrary, in describing the Figure 3 embodiment, the specification states that "fiber routing tray 36" that is attached to the main tray "is formed from sheet metal or other material that is bent on top of itself in a U-shape on the front end 60 of the fiber routing tray." JX-0007 ('153 Patent) at 8:12-15 (emphasis added). Thus, the specification simply does not have any disclosure concerning the material of the claimed routing element. As Dr. Prucnal explains, moreover, a person of ordinary skill would know that fiber optic connection equipment for data centers often uses a blend of metal and molded plastic components. CX-0001C (Prucnal WS) Q/A 438, 505.

Third, Dr. Min opines that during prosecution of the '153 patent, "Corning disclaimed cable management structures that are disposed on and attached to the front of the tray and that do not include 'successive material sections extending frontward, upward, and rearward, respectively' (*i.e.*, that are not flanges of the front of the tray

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itself) in order to secure issuance of the '153 patent." RX-0006C (Min RWS) Q/A 89. Yet, during prosecution, Corning distinguished the routing element in prior art based on its "orientation" or shape, not based on its integration with a tray. Response to Office Action Mailed Apr. 10, 2017, in JX-0008 ('153 Prosecution History) at 143. Thus, the prosecution history is not relevant to how the fiber routing element integrates with the tray or what material comprises it.

Specifically, during prosecution, the examiner cited U.S. Patent No. 5,511,144 ("Hawkins '144") as anticipating the fiber routing guide claimed in the '153. According to the examiner, Hawkins '144 discloses a fiber optic apparatus with chassis, trays, and "at least one fiber routing element (8) that comprises material sections extending frontward, upward and rearward (see Fig. 6) to permit optical fibers to be routed to either left or right portions of the tray towards first and second ends of the chassis." JX-0008 ('153 Prosecution History) at 97; *see also id.* at 142 (reproducing Hawkins '144 Fig. 6). In response, Corning amended claim 1: "the at least one fiber optic tray comprising a front end with at least one fiber optic routing element that comprises successive material sections extending frontward, upward, and rearward, respectively, to permit optical fibers to be routed…." JX-0008 ('153 Prosecution History) at 150. Corning then argued that the "jumper radius control guides" in Hawkins '144 did not anticipate the '153 routing guide claims because they "include an upwardly-extending material having an arc-shaped uniform cross-section that curves to one side," and "fail to include 'successive material sections extending frontward, upward, and rearward, respectively.'" JX-0008 ('153 Prosecution History) at 143.

In subsequent PTO rejections, the examiner did not cite Hawkins '144 for its fiber

[redacted]

routing element, but instead cited U.S. Patent No. 6,944,389 to Giraud, a Corning-owned patent, which provided a circular fiber routing element. JX-0008 (‘153 Prosecution History) at 10152. This rejection was later overcome by a terminal disclaimer so that Corning could avoid a double-patenting rejection, but Corning did not concede the propriety of the rejection and so did not speak to the anticipatory nature of Giraud’s fiber routing guide. *See id.* at 11383. As a result, the only way Corning narrowed the fiber routing element was by adding the words “successive” and “respectively” and traversing the Hawkins ‘144 “orientation” or shape as failing to have successive frontward, upward, and rearward sections. That falls short of the “clear and unmistakable disavowal of scope during prosecution,” *Purdue Pharma L.P. v. Endo Pharms. Inc.*, 438 F.3d 1123, 1136 (Fed Cir. 2006), required by the doctrine of prosecution history disclaimer.

ii. Doctrine of Equivalents (Fiber Optic Routing Elements)

While it is not the usual practice to discuss infringement under the doctrine of equivalents before discussing all the merits of literal infringement, this issue is common to multiple respondents, and thus it is appropriate to do so here. For the reasons set forth below, and as Dr. Prucnal has shown, the fiber optic routing elements of respondents’ accused products (discussed in detail immediately above) infringe under the doctrine of equivalents because any differences between the claimed limitations and the accused devices are insubstantial. The accused devices perform substantially the same function as the patented feature in substantially the same way to achieve substantially the same result. *See* CX-0001 (Prucnal WS) Q/A 503-06.

First, the fiber optic routing elements on the respondents’ accused chassis perform

[redacted]

substantially the same function as the claimed fiber optic routing elements. Each manages optical fiber by routing cables to the left or right side of each tray, *see* CX-0001C (Prucnal WS) Q/A 442-45, just like the fiber routing element as described in the specification: "The module guide tray 332 may contain a U-shaped flange 338 to allow optical fibers to be routed therein to either the left or right of the tray to the sides 340, 342 of the chassis 302." *See* JX-0007 ('153 patent) at 15:59-62.

Second, the fiber routing elements in respondents' accused chassis perform this function in substantially the same way as the claimed fiber optic routing elements — through an element with successive sections extending frontward, upward, and rearward. Despite superficial differences, all the elements share the key common design attributes described in the Asserted Claims: successive sections extending frontward, upward, and rearward, creating a shape that hooks around bundles of cables to keep them in place. *See* CX-0001C (Prucnal WS) Q/A 442-45. Although Dr. Min opines that respondents' fiber routing elements are a distinct component from the tray, he did not explain why that matters. A person of ordinary skill would understand that high-density fiber optic connection equipment uses a mix of metal and molded plastic components, which can be attached in various ways. *See* CX-0001C (Prucnal WS) Q/A 438, 505.

Third, the fiber routing elements in respondents' accused chassis achieve the same result as the claimed fiber optic routing elements. All achieve efficient cable management in the front of the chassis. *See* CX-0001C (Prucnal WS) Q/A 442, 444-445. This is the same as the purpose of the fiber routing element described in the '153 patent: "Even with fiber optic equipment tray pull out capabilities, a need still exists to improve access to optical components in a fiber optic equipment tray as well as provide neat

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routing and organization of jumper connections." JX-0007 ('153 patent) at 2:48-52.

Dr. Min opines that Dr. Prucnal's "same function" showing "oversimplifies the function of the claimed fiber optic routing element, which a POSITA would understand to have at least two additional functions": (1) "protection or shielding for the fiber optic wiring," and (2) "provide increased structural integrity for the cabling in the fiber optic routing tray." RX-0006C (Min RWS) Q/A 98. He opines that respondents' fiber routing elements fail to perform these two additional functions. *Id.* Q/A 108, 109 (Panduit), 116-18 (FS), 125-27 (Siemon). He is misguided on both points.

There is no basis to attribute "protection" or "structural integrity" functions to the claimed fiber routing element. What matters for purposes of the doctrine of equivalents test are the functions recited in the claims. *See Crown Packaging Tech., Inc. v. Rexam Beverage Can Co.*, 559 F.3d 1308, 1312 (Fed. Cir. 2009). Neither of Dr. Min's two functions is recited in the claims or the parties' construction or even described in the specification. To the contrary, Dr. Min infers these functions from the figures of the patent, which he opines show "a lip of sheet metal" that "provides protection or shielding for the fiber optic wiring," and he claims that Figure 3 — which shows a separate fiber routing tray attached to a main tray — indicates that a fiber routing element "provide[s] increased structural integrity for the cabling." RX-0006C (Min RWS) Q/A 98. It is improper to read functions into the claims based on "a few specification statements or figures." *Computer Docking Station Corp. v. Dell, Inc.*, 519 F.3d 1366, 1374 (Fed. Cir. 2008).

Moreover, respondents' fiber routing elements do perform both of the asserted additional functions. The whole purpose of these elements is to ensure that the fiber is

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not damaged when trays or modules are moved from the chassis. That is protecting the wiring. Further, these elements hold the wiring, and therefore provide increased structural integrity.

With respect to some respondents, Dr. Min opines that fiber routing elements perform additional functions. As to Panduit, he opines that the element "allow[s] the fiber optic wires to be more gradually routed." RX-0006C (Min RWS) Q/A 100. As to Siemon, he opines that it provides a "front grab bar . . . to serve as a handle to allow the tray to be pulled out and pushed in." *Id.* Q/A 125. The fact that these elements provide a function in addition to the claimed element is of no legal consequence in a doctrine of equivalents analysis. *See Insta-Foam Prods.*, 906 F.2d at 702.

Finally, Dr. Min opines that respondents' fiber optic routing elements achieve different results than the claimed elements. However, Dr. Min's opinion relies on unsupported claims about the results achieved by of the '153 patent's fiber routing element, based on inferences from the figures of the patents. RX-0006C (Min RWS) Q/A 114, 125-27. The characteristics of the fiber routing element that Dr. Min purports to extract from the figures are not in the claims or even the specification, and it is improper to import them.

b. Direct and Indirect Infringement - Panduit

For the reasons discussed below, Corning has shown by a preponderance of the evidence that Panduit's accused combinations practice each element of asserted claims 9, 16, 23, and 26 of the '153 patent. *See* Compl. Br. at 120-25; Staff Br. at 122-25,127; CX-0001C (Prucnal WS) Q/A 422-26, 428, 432, 434, 438-40, 442, 448-49, 456, 459-60, 466, 468, 472-73, 475, 477-82, 484, 488, 492, 496, 503-06. However, it has not been shown

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that Panduit's accused combinations directly infringe the asserted claims inasmuch as Panduit does not sell its accused chassis and modules in combination.

Respondents argue that Corning has not shown that Panduit's accused combinations infringe the asserted claims of the '153 patent. *See* Resps. Br. at 185-88, 191-200.

i. Direct Infringement

Unasserted Independent Claim 1

Corning does not assert independent claim 1. Asserted claims 9 and 16 depend from claim 1. Respondents concede that Panduit's accused products practice these limitations, except for the fiber optic routing element discussed above in the common issues section. *See* Resps. Br. at 185-88.

Respondents argue, *inter alia*:

> The Panduit Accused Products do not include a cable management element that extends frontward from the front of the tray and then upward and rearward. RPHB at 188. Instead, the Panduit Accused enclosures have a plastic molded D-ring component—a separable component from the tray itself—that is disposed on and either snapped into, or screwed into the front of the tray. RX-0006C (Min RWS) Q/A 103-105; RDX-0006C.38 (Panduit D-Rings). These D-ring components do not first extend frontward from the front of the tray. RX-0006C (Min RWS) Q/A 103-105. In fact, they do not extend frontward from the tray at all. Instead, the D-rings sit on top of the tray and are located behind the front lip of the tray. *Id*. Thus, the Panduit D-rings do not satisfy the requirement that the fiber optic routing element consist of a flange Because the Panduit D-rings do not include the required flange extending from the front of the tray and comprising successive material sections extending frontward, upward, and rearward. As a "fiber optic routing element" is recited in each of the asserted claims, either directly or through dependency, the Panduit Accused Products do not infringe the asserted claims of the '153 Patent. *Id*. Q/A 105.

See Resps. Br. at 187-88.

[redacted]

Respondents argue, *inter alia*:

> The Panduit Accused Products do not include a fiber optic routing element that is an "integrated component on the front end of the fiber tray" because Panduit's D-rings are on rails designed to be easily removed from the tray. RPHB at 188; RX-0006C (Min RWS) Q/A 103-105; *id*. Q/A 33-34; RX-1672C (Kuffel WS) Q/A 35-40; RDX-0010C.2 (Kuffel Demonstratives). For example, the D-ring in the second-generation HD Flex chassis is located on a rail that can be removed via screws or by snapping it out of the tray. RX-1672C (Kuffel WS) Q/A 37-40.
>
> For the rails that can be snapped in and out, the HD Flex Installation Guide (RX-1297) teaches customers how to easily install and remove them. *Id*. Q/A 37. These steps include "[d]epress latch upward from underneath," "[g]rip by finger rail grips," "[p]ush rail to the left," and "[l]ift rail up and away from enclosure." RX-1297.0011 (HD Flex Installation Instructions). The steps are virtually identical to the removal steps that Dr. Prucnal has testified establish that a cable management element is not integral to the tray and is thus not the recited "fiber optic routing element." Specifically, Dr. Prucnal testified that a cable management element is easily removable if you need to "grip the clip, depress the clip, push the clip in the proper orientation, and lift the clip." Prucnal Tr. 996:7-16. But that is the exact situation with the second-generation HD Flex products, so these products do not infringe the asserted claims of the '153 Patent.
>
> If more was needed, the D-ring in the Panduit Accused Products is also not an integrated component because it is a different material that is simply disposed on top of the tray. RX-0006C (Min RWS) Q/A 101-105. Again, this is what Corning disclaimed during prosecution and Corning cannot now try to recapture components that were disclaimed. Accordingly, Panduit's accused products do not infringe the asserted claims of the '153 Patent.

See Resps. Br. at 192-93.

This argument was discussed above in the common issues section.

<u>Dependent Claim 9</u>

Respondents concede that Panduit's accused products practice this claim. *See* Resps. Br. at 185-88.

[redacted]

Dependent Claim 16

Respondents argue, *inter alia*:

> The Panduit Accused Products do not infringe claims 16 and 26 of the '153 Patent because they do not include a "locking latch." *See* JX-0008 ('153 Patent) cls. 16, 26. Dr. Prucnal's analysis is conclusory and does not specifically allege how the Panduit Accused Products satisfy this limitation. *See* CX-0001C (Prucnal WS) Q/A 499. Instead, Dr. Prucnal cites back to claim 9 without any additional analysis. RX-0006C (Min RWS) Q/A 144. Claim 9 does not recite a locking latch and instead relates to modules being removed from the front and releasably removable from the rear. JX-0008 ('153 Patent) cl. 9. Dr. Prucnal's analysis for claim 9 asserts that "the Combinations of the front and rear stop features [in the Accused Products] capture both the front and rear protrusion rails, holding the module in place." CX-0001C (Prucnal WS) Q/A 460. But Dr. Prucnal never explains how these features satisfy the claimed "locking latch" as recited in claims 16 and 26. RX-0006C (Min RWS) Q/A 146-48.

See Resps. Br. at 194.

Asserted claim 16 reads as follows:

> **16**. The fiber optic apparatus of claim **1**, wherein at least one fiber optic module of the plurality of fiber optic modules comprises a ***locking latch*** comprising a lateral protrusion configured to prevent the at least one fiber optic module from moving rearward relative to the at least one fiber optic equipment tray, the ***locking latch*** being actuatable by a user from a rear of the at least one fiber optic module to enable removal of the at least one fiber optic module from a rear of the at least one fiber optic equipment tray.

JX-0007 ('153 Patent) (emphasis added).

Asserted claim 26 reads as follows:

> **26**. The fiber optic apparatus of claim **25**, wherein each fiber optic module of the plurality of fiber optic modules comprises a ***locking latch*** that is configured to prevent the fiber optic module from moving rearward relative to a fiber optic equipment tray of the plurality of fiber optic equipment trays, and that is actuatable by a user from a rear of the fiber optic module to enable removal of the fiber optic module from the fiber optic equipment tray.

JX-0007 ('153 Patent) (emphasis added).

[redacted]

Claim 16 requires modules that comprise "a locking latch comprising a lateral protrusion" that prevents the module "from moving rearward" and that can be "actuatable by a user from a rear of" the module to enable module removal from the rear of the tray. Panduit's accused module has a locking latch that holds the module in place to prevent rearward movement and that "is actuatable by a user from the rear of the module" — meaning the user can disengage the latch. CX-0001C (Prucnal WS) Q/A 460; CDX-0001C (Prucnal Direct) at 468-73. The specification shows the claimed locking latch 78 on the module in Figure 4, describing it as follows:

> A locking feature in the form of a locking latch 78 and a protrusion 80 (Fig. 4) engage a complementary protrusion in the tray channel 54 . . . . The locking latch 78 is disengaged by pushing it inward towards the fiber optic module 22 to release the protrusion 80 from the tray channel 54.

JX-0007 ('153 Patent) 9:5-15. Figure 4 is shown below:

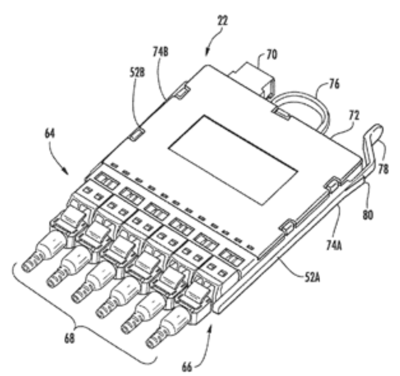

FIG. 4

Dr. Prucnal provided extensive analysis and supporting evidence to show that Panduit's accused modules contain a locking latch that satisfies each of these requirements. *See* CX-0001C (Prucnal WS) Q/A 348, 460, 475, 499. Each Panduit accused module has triangle-shaped protrusion rails on the back left and right sides of the module. When these modules are inserted from the rear side of the chassis, the rear

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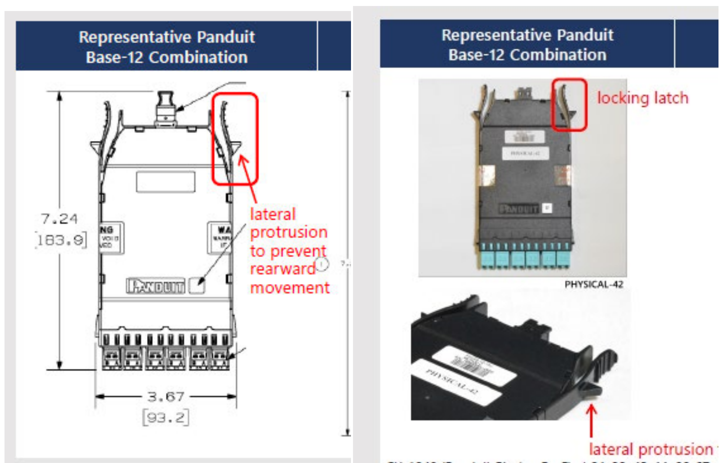
protrusion rails are compressed until they clear a rear stop feature, and snap into place, capturing the rear protrusion rails under the stop. To remove a module from the rear of the tray, tabs on the back of the module are depressed to disengage the stop feature and allow the module to be pulled from the rear. Dr. Prucnal identified these features as the claimed locking latch with a protrusion, as shown below (CDX-0001C, at 468-69):



Dr. Min opines that Dr. Prucnal "fails to establish how the" identified features "satisfy the recited 'locking latch,'" but does not explain what he believes is missing. RX-0006C (Min RWS) Q/A 147. Dr. Min then opines that "even if" the features Dr. Prucnal identifies "create the claimed 'locking latch' . . .at least when the cassette is installed from the front of the tray, the cassette is held in place by a spring clip located toward the front of the tray, and releasing it does not require a user to actuate anything." *Id.* Q/A 148. The claimed feature is a latch that prevents rearward movement of the module and allows the module to be released from the rear of the chassis. Thus, what happens when the cassette is inserted into the front of the chassis is irrelevant.

<u>Independent Claim 23</u>

Respondents concede that the Panduit accused products practice these claims,

[redacted]

except for the fiber optic routing element discussed above. *See* Resps. Br. at 185-88.

Dependent Claim 26

Respondents argue, *inter alia*:

> The Panduit Accused Products do not infringe claim 26 of the '153 Patent. Claim 26 recites "a rear portion of each module guide of the plurality of module guides defines at least one guide channel that is open on a rear end thereof to permit the plurality of fiber optic modules to be inserted into the plurality of module guides from the rear section of the chassis and to be guide toward the front end of the chassis." JX-0008 ('153 Patent) cl. 26; RX-0006C (Min RWS) Q/A 133-135. The Panduit Accused Chassis do not have a guide channel. RX-0006C (Min RWS) Q/A 133-135. Additionally, any dividers in the tray are not used to guide the Modules from the rear to the front. While they may act like barriers, they do not permit the Modules to be guided to the front of the Accused Chassis. *Id.*; RX-1672 (Kuffel) Q/A 42.

See Resps. Br. at 193-94.

Non-asserted claim 25 and asserted claim 26 read as follows:

> **25**. The fiber optic apparatus of claim **23**, further comprising a plurality of module guides associated with the plurality of fiber optic equipment trays, wherein the chassis comprises a rear section, and a rear portion of each module guide of the plurality of module guides ***defines at least one guide channel that is open on a rear end thereof to permit the plurality of fiber optic modules to be inserted into the plurality of module guides from the rear section of the chassis and to be guided toward the front end of the chassis***.
>
> **26**. The fiber optic apparatus of claim **25**, wherein each fiber optic module of the plurality of fiber optic modules comprises a ***locking latch*** that is configured to prevent the fiber optic module from moving rearward relative to a fiber optic equipment tray of the plurality of fiber optic equipment trays, and that is actuatable by a user from a rear of the fiber optic module to enable removal of the fiber optic module from the fiber optic equipment tray.

JX-0007 ('153 Patent) (emphasis added).

Claim 26 recites a locking latch, which Panduit's accused products practice, for the reasons set forth above with respect to claim 16.

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Claim 26 depends from claim 25, which recites module guides that "define[s] at least one guide channel that is open on a rear end thereof to permit the plurality of fiber optic modules to be inserted into the plurality of module guides from the rear section of the chassis and to be guided toward the front end of the chassis." JX-0007 ('153 Patent) 20:18-22. The '153 patent explains what it means for the module guides to be open on a rear end as recited in claim 25:

> Also as shown in Fig. 3 and as illustrated in more detail in Fig. 4, the module rail guides 50 are configured such that the tray channels 54 are ***open on a rear end*** 56 of the module rail guides 50. This allows the fiber optic modules 22 to be ***rear-installable into the fiber optic equipment trays 20 from the rear section 26 of the chassis 12***.

JX-0007 ('153 Patent) at 7:57-63 (emphasis added). The relevant question with respect to this limitation is whether the accused modules are rear-installable into a fiber optic tray.

Dr. Prucnal has provided extensive analysis and supporting evidence to show that Panduit's accused modules can be inserted into the rear of the fiber optic equipment trays of each of these respondents' accused chassis. Panduit's accused Base-12, Base-8, and Base-24 modules can be inserted into the rear of their accused Base-12, Base-8, and Base-24 chassis, respectively. *See* CX-0001C (Prucnal WS) Q/A 499-500; CDX-0001C (Prucnal Demonstratives) Q/A 580-81. Rear insertion is possible because each pair of laterally spaced module guides in the fiber optic equipment trays creates a guide channel that is open to the rear end of the chassis into which each of the respective modules can be inserted. *See id.* Q/A 500. Further, when these modules are inserted from the rear, they are guided toward the front end of the chassis in the module guides. *See id.* Dr. Prucnal explained that he confirmed this by his use and analysis of the products, and

[redacted]

based on respondents' documents and testimony. *See id.* Q/A 460, 465, 500, 502.

Respondents' expert Dr. Min opines that Panduit's accused products do not infringe this claim because they do not have "at least one guide channel that is open on a rear end." Dr. Min concedes that the accused modules can be inserted into the channels in the module guides from the rear of the chassis. RX-0006C (Min RWS) Q/A at 134-35. He opines that when a Panduit accused module is inserted from the rear "the cassette is not 'guided' in any 'module guides' from the rear to the front of the tray" because "there is space between the cassette and the tray dividers as the cassette is moved within the tray" such that "if the cassette touches a divider on one side of the tray when it is being inserted from the rear of the enclosure, it will not be touching the divider on the other side of the tray." RX-0006C (Min RWS) Q/A 135. To adopt that view would import limitations into the claims, by opining "guiding" a module as permitting no space between the module and the module guide. Furthermore, Dr. Min erroneously relies on testimony from Mr. Kuffel about the relationship between the module and tray dividers when installed from the front, but Claim 26 is directed to rear installation. *See* RX-0006C (Min RWS) Q/A 135 (citing RX-1672C (Kuffel WS) Q/A 42 (describing insertion of "a Panduit HD Flex cassette into the front of a Panduit HD Flex enclosure")).

Claim 26 contains no "minimum space" requirement, and none is suggested by the specification. When a Panduit accused module is inserted into an enclosure and touches one side of a module rail and not the other, it is because it is being inserted at an angle. If the module is pushed, the divider guide will straighten it out, until it reaches a parallel position between the guides and is locked in place. Mr. Kuffel, confirmed this in his deposition:

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> THE WITNESS: "[T]he rear of the cassette is dropped into the tray, to the bottom of the tray. It is then pushed back. And it is sort of sloppy. And towards the rear there is a feature that it stops on, relative to one of the dividers. It may be skewed, so it will hit one side and then touch the other. And then at that point you have to — because the cassette is skewed, it is not parallel to the tray. You press it in. . . .
>
> Q: Is there some mechanism that keeps the cassette when it is in the tray from moving from left to right?
>
> A: In the home position there may be, which is the final position. There may be some areas that control the position, in the final position.

See JX-0017C (Kuffel Dep. Tr.) 429-431. Thus, the module guides in the Panduit accused products ensure that when a module is inserted from the rear, it always stays within those guides.

ii. Indirect Infringement

The evidence demonstrates that Panduit accused combinations infringe asserted claims 9, 16, 23, and 26 of the '153 patent. Panduit, however, does not sell its products in combinations. In each case, the modules are packaged separately from the chassis. RX-0006C (Min RWS) Q/A 82. Thus, it is customers, rather than Panduit, who assemble the accused chassis and modules into infringing combinations.

Accordingly, Panduit does not directly infringe the asserted claims of the '153 patent. The evidence shows that Panduit indirectly infringe, for the reasons discussed in the Indirect Infringement section of the '320 patent, *supra*.

c. Direct and Indirect Infringement - Siemon

For the reasons discussed below, Corning has shown by a preponderance of the evidence that Siemon's accused combinations (prior to August 2019) practice each element of the asserted claims 9 and 23 of the '153 patent. *See* Compl. Br. at 125-26;

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Staff Br. at 125-27; CX-0001C (Prucnal WS) Q/A 422-26, 430, 432, 436, 438-40, 444, 452-53, 456, 461-63, 466, 470, 472-73, 477-82, 485, 489, 493-94, and 496, 503-06. However, it has not been shown that those accused combinations directly infringe the asserted claims inasmuch as Siemon does not sell its accused chassis and modules in combination.

Respondents argue that Corning has not shown that Siemon's accused combinations (prior to August 2019) infringe the asserted claims of the '153 patent. *See* Resps. Br. at 185-87, 188-91, 191-92, 193, 194-200.

Although Dr. Min opined that Siemon's prior design is no longer made or sold, and that it was "apparently never imported," RX-0006C (Min WRS) Q/A 119, Siemon's Mr. Veatch contradicted Dr. Min, testifying that in at least the first half of 2019 Siemon did sell its pre-August 2019 design to customers in the United States, Veatch Tr. 463-465.

i. Direct Infringement

<u>Unasserted Independent Claim 1</u>

Respondents concede that the Siemon accused products practice these limitations, except for the fiber optic routing element discussed above. *See* Resps. Br. at 185-87.

<u>Dependent Claim 9</u>

Corning concedes that the currently produced Siemon Accused Chassis does not practice this claim. *See* Compl. Br. at 125-26. However, respondents concede that the pre-August 2019 products did. *See* Resps. Br. at 185-87.

Indeed, Siemon's Mr. Veatch testified that "[o]riginally our enclosures had latches on the front end of the enclosure that allowed modules to be removed from the

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front of the enclosure. However, Siemon redesigned the product in August 2019 to remove these front latches. In the redesigned enclosures, modules cannot be removed from the front of the enclosure." *See* RX-1266C (Veatch WS) Q/A 14; *see also* RX-0006C (Min RWS) Q/A 149-51; Veatch Tr. 463.

Independent Claim 23

Respondents concede that the pre-August 2019 Siemon accused products practice these claims, except for the fiber optic routing element discussed above. *See* Resps. Br. at 185-87.

ii. Indirect Infringement

The evidence demonstrates that the Siemon accused combinations (prior to August 2019) infringe claims 9 and 23. Siemon, however, does not sell its products in combinations. In each case, the modules are packaged separately from the chassis. *See* RX-1266C (Veatch WS) Q/A 22-23. Thus, it is customers, rather than Siemon, who assemble the accused chassis and modules into infringing combinations.

Accordingly, Siemon does not directly infringe the asserted claims of the '153 patent. The evidence shows that they indirectly infringe, for the reasons discussed in the Indirect Infringement section of the '320 patent, *supra*.

d. Direct and Indirect Infringement - FS

For the reasons discussed below, Corning has shown by a preponderance of the evidence that FS's accused combinations practice each element of asserted claims 9, 16, 23, and 26 of the '153 patent. *See* Compl. Br. at 126-27; Staff Br. at 115-22, 127; CX-0001C (Prucnal WS) Q/A 422-26, 431-32, 437-40, 445, 454-56, 464-66, 471-73, 476-82,

[redacted]

486, 490, 495-96, 501-02, 503-06. However, it has not been shown that FS's accused combinations directly infringe the asserted claims inasmuch as FS does not sell its accused chassis and modules in combination.

Respondents argue that Corning has not shown that FS's accused combinations infringe the asserted claims of the '153 patent. *See* Resps. Br. at 185-87, 191, 193, 194-200.

i. Direct Infringement

Unasserted Independent Claim 1

Respondents concede that the FS accused products practice this claim, except for the fiber optic routing element discussed above. *See* Resps. Br. at 185-87.

Dependent Claims 9 and 16

The evidence shows that the FS accused products infringe asserted dependent claims 9 and 16. Asserted claim 9 of the '153 patent depends from claim 6, which depends from unasserted independent claim 1.

Unasserted claim 6 and asserted claim 9 read as follows:

> **6**. The fiber optic apparatus of claim **1**, wherein the at least one fiber optic equipment tray comprises a plurality of fiber optic equipment trays.
>
> **9**. The fiber optic apparatus of claim **6**, wherein:
>
> each fiber optic equipment tray of the plurality of fiber optic equipment trays is configured to receive multiple fiber optic modules of the plurality of fiber optic modules; and
>
> the plurality of fiber optic equipment trays and the plurality of fiber optic modules are configured to permit each fiber optic module of the plurality of fiber optic modules to be removable from a front of the plurality of fiber optic equipment trays, and

[redacted]

releasably removable from a rear of the plurality of fiber optic equipment trays.

Claim 6 adds the limitation that there must be more than one fiber optic equipment tray in the claimed apparatus. JX-0007 ('153 Patent) at 17:32-34. Claim 9 adds two new limitations: (1) each tray must be configured to receive multiple fiber optic modules; and (2) each module must be both removable from the front of a tray and "releasably removable" from the rear of a tray. *Id*. at 17:42-53. There is uncontested evidence that FS accused products satisfy these additional limitations. The FS accused chassis contain three trays per U space, and modules inserted in those chassis can be removed from the front or releasably removed from the rear after disengaging a locking latch. *See* Resps. Br. at 185-87; CPX-0054 (FS Base-12 chassis); CX-1855 (FS photos) at 2; CX-0589 (FHX Module installation instructions) at 2; CX-0001C (Prucnal WS) Q/A 464-65; CDX-0001C (Prucnal demonstratives) at 440-45.

Asserted claim 16 reads as follows:

> **16**. The fiber optic apparatus of claim **1**, wherein at least one fiber optic module of the plurality of fiber optic modules comprises a locking latch comprising a lateral protrusion configured to prevent the at least one fiber optic module from moving rearward relative to the at least one fiber optic equipment tray, the locking latch being actuatable by a user from a rear of the at least one fiber optic module to enable removal of the at least one fiber optic module from a rear of the at least one fiber optic equipment tray.

JX-0007 ('153 Patent) at 18:31-39.

The evidence that the FS accused modules satisfy this limitation is also uncontested. *See* Resps. Br. at 185-87; CPX-0055 (FS Base-8 module); CPX-0056 (FS Base-12 module); CX-0001C (Prucnal WS) Q/A 476; *see* CDX-0001C (Prucnal demonstratives) at 474-79.

[redacted]

Accordingly, the FS accused combinations practice asserted claims 9 and 16.

Independent Claim 23

Respondents concede that the FS accused products practice this claim, except for the fiber optic routing element discussed above. *See* Resps. Br. at 185-87.

Dependent Claim 26

Asserted claim 26 depends from claim 25, which depends from independent claim 23.

Asserted independent claim 23 reads as follows:

> **23**. A fiber optic apparatus, comprising:
>
> a chassis configured to be disposed in an equipment rack, the chassis comprising opposite front and rear ends that are spaced apart from one another in a longitudinal direction, and comprising opposite first and second ends that are spaced apart from one another in a lateral direction that extends crosswise to the longitudinal direction;
>
> a guide system configured to be disposed within the chassis;
>
> a plurality of fiber optic equipment trays arranged in a stacked configuration and configured to slidably engage within the guide system, wherein each fiber optic equipment tray of the plurality of fiber optic equipment trays comprises ***a front end with at least one fiber optic routing element that comprises successive material sections extending frontward, upward, and rearward, respectively***, to permit optical fibers to be routed to either left or right portions of the plurality of fiber optic equipment trays toward the first and second ends of the chassis; and
>
> a plurality of fiber optic modules configured to be received by the plurality of fiber optic equipment trays, wherein each fiber optic module of the plurality of fiber optic modules is independently movable in the longitudinal direction relative to

[redacted]

each fiber optic equipment tray of the plurality of fiber optic equipment trays;

wherein each fiber optic module of the plurality of fiber optic modules comprises a front end, a rear end, an interior, a plurality of first fiber optic adapters disposed through the front end, at least one second fiber optic adapter disposed through the rear end, and at least one optical fiber disposed within the interior and establishing at least one optical connection between the at least one second fiber optic adapter and at least one first fiber optic adapter of the plurality of first fiber optic adapters;

wherein for at least one fiber optic module of the plurality of fiber optic modules, the at least one second fiber optic adapter comprises a higher connection density than each first fiber optic adapter of the plurality of first fiber optic adapters;

wherein each fiber optic equipment tray of the plurality of fiber optic equipment trays is configured to receive multiple fiber optic modules of the plurality of fiber optic modules; and

wherein the plurality of fiber optic equipment trays and the plurality of fiber optic modules are configured to permit the plurality of fiber optic modules to be removable from a front of the plurality of fiber optic equipment trays, and releasably removable from a rear of the plurality of fiber optic equipment trays.

JX-0007 (‘153 Patent) (emphasis added).

Unasserted claim 25 and asserted claim 26 read as follows:

25. The fiber optic apparatus of claim **23**, further comprising a plurality of module guides associated with the plurality of fiber optic equipment trays, wherein the chassis comprises a rear section, and a rear portion of each module guide of the plurality of module guides defines at least one guide channel that is open on a rear end thereof to permit the plurality of fiber optic modules to be inserted into the plurality of module guides from the rear section of the chassis and to be guided toward the front end of the chassis.

26. The fiber optic apparatus of claim **25**, wherein each fiber optic module of the plurality of fiber optic modules comprises a locking latch that is configured to prevent the fiber optic module

[redacted]

> from moving rearward relative to a fiber optic equipment tray of the plurality of fiber optic equipment trays, and that is actuatable by a user from a rear of the fiber optic module to enable removal of the fiber optic module from the fiber optic equipment tray.

JX-0007 (‘153 Patent).

As shown, claim 26 depends from claim 25, which depends from independent claim 23. Claim 25 adds a plurality of module guides in the fiber optic equipment trays, the guides having an open rear portion that enables users to insert modules into the module guides from the rear of the chassis toward the front end of the chassis. JX-0007 (‘153 Patent) at 20:14-22. Claim 26 adds a locking latch on each module configured to prevent the module from moving rearward in a tray and “actuatable by a user from a rear of the fiber optic module” to enable removal of the module from the tray. *Id*. at 20:23-30.

The FS accused chassis have multiple module guides that form channels into which accused modules can be inserted from the rear of the chassis. CX-1855 (FS photos) at 17; CX-0418C (FS FHX Ultra Fiber Enclosure specification) at 3; CX-0419C (FS FHX Ultra Enclosure for MTP-8 Cassette specification) at 3; CX-0001C (Prucnal WS) Q/A 502. As noted above, FS accused modules can be removed from the rear of an accused chassis after disengaging a locking latch on the module. CX-1855 (FS photos) at 17; CX-0589 (FHX Module installation instructions) at 2; CX-0001C (Prucnal WS) Q/A 501; *see* CDX-0001C (Prucnal demonstratives) at 591-96.

Accordingly, the FS accused combinations practice asserted claim 26.

ii. Indirect Infringement

The evidence demonstrates that the FS accused combinations infringe asserted claims 9, 16, 23, and 26 of the ‘153 patent. FS, however, does not sell its products in

[redacted]

combinations. In each case, the modules are packaged separately from the chassis. *See* RX-0010 (Zhang WS) Q/A 27-28. Thus, it is customers, rather than FS, who assemble the accused chassis and modules into infringing combinations.

Accordingly, FS does not directly infringe the asserted claims of the '153 patent. The evidence shows that FS indirectly infringe, for the reasons discussed in the Indirect Infringement section of the '320 patent, *supra*.

C. Domestic Industry (Technical Prong)

As discussed below, the evidence shows that the Corning domestic industry products are covered by asserted claims 9, 16, 23, 26 of the '153 patent.

The EDGE DI Chassis together with the EDGE DI Modules practice asserted claims 9, 16, 23, 26 of the '153 patent. As discussed throughout the claim construction and infringement sections for the '153 patent above, asserted claim 23 is an independent claim directed to a fiber optic apparatus comprising a chassis, a guide system engaging multiple equipment trays with fiber optic routing elements, a plurality of independently movable modules with higher-density adapters on the rear than on the front, and a tray configuration allowing multiple modules to be removed from the front and rear. *See* JX-0007 ('153 Patent), Claim 23.

Claims 9 and 16 depend from claim 1, and along with claim 26, add a locking latch that enables module removal. *Id.* at Claims 9, 16, 26. Dr. Ralph testified that the EDGE DI Chassis and EDGE DI Modules satisfy these claims with its structure of three trays in the chassis that have fiber routing elements and allow for modules to be latched and removed from the front and rear. *See* CX-0002C (Ralph WS) Q/A 140-164; CX-1869 (Corning Photos Ex. D) at 2-4, 6-40; CPX-0040 (EDGE Base-8 Chassis); CPX-

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0041 (EDGE Base-12 Chassis); CPX-0042 (EDGE Base-8 Module); CPX-0043 (EDGE Base-12 Module).

Respondents make the following arguments regarding the '153 patent:

> Complainant failed to prove any combination of an EDGE chassis and modules practices claims 9, 16, 23, or 26 of the '153 Patent. RX-0008C (Lebby RWS) Q/A 380-389. The claims of the '153 Patent require, *inter alia*, a combination of a chassis and a "plurality of fiber optic modules." Complainant did not prove any instance of an EDGE Chassis loaded with EDGE modules. RX-0008C (Lebby RWS) Q/A 382-383; Ralph Tr. 212:12-15, 213:24-214:2, 214:18-215:7. Complainant also did not prove that the EDGE Chassis necessarily must be combined with a plurality of EDGE Base-12 or Base-8 Modules. RX-0008C (Lebby RWS) Q/A 384-386, 388-389; RX-1677 (EDGE Catalog); RX-1678 (EDGE8 Catalog); Ralph Tr. 215:16-216:6, 216:17-217:14, 218:2-8. Complainant's failure to prove a practicing combination of an EDGE Chassis loaded with EDGE Modules is fatal to its claim that there is a domestic industry for the '153 Patent. *See Microsoft*, 731 F.3d at 1361.
>
> Complainant also failed to establish that any EDGE Base-12 Combination and EDGE Base-8 Combination include "a front end with at least one fiber optic routing element that comprises successive material sections extending frontward, upward and rearward, respectively," as required by claims 9, 16, 23, and 26 of the '153 Patent. RX-0008C (Lebby RWS) Q/A 390-393; Lebby Tr. 908:24-909:4. The cable management rings attached to the EDGE Chassis are not the claimed fiber optic routing element because they are not flanges, do not "extend frontward" from the front of the fiber optic equipment tray, and do not comprise successive sections extending "frontward, upward and rearward." RX-0008C (Lebby RWS) Q/A 125-135; RX-0001C (Blumenthal WS) Q/A 526; RX-0006C (Min RWS) Q/A 88-93.

Resps. Br. at 261-62 (footnote omitted).

First, as shown above, respondents make the same "fully loaded" argument as for the '320 patent, which was thoroughly addressed in that section. Further, the asserted claims of the '153 patent contain no such requirement, nor any requirement of fiber optic connection equipment such as modules in the chassis. Dr. Ralph has shown the EDGE DI Chassis is configured to receive EDGE DI Modules as required by the '153 patent.

[redacted]

See CX-1869 (Corning Photos Ex. D) at 2, 8, 17, 24.[44]

Second, as shown above, respondents argue that the EDGE DI Chassis does not have "a front end with at least one fiber optic routing element that comprises successive material successions extending frontward, upward, and rearward, respectively." Dr. Ralph, however, demonstrated that the molded plastic cable management clips on the front of the chassis meet this limitation. *See* CDX-0002C (Ralph Direct) (citing CX-1869C at 6, 21); CX-0002C (Ralph WS) Q/A 147.

Respondents argue that the "cable management rings" identified by Dr. Ralph are not fiber optic routing elements because they are not "not the claimed fiber optic routing element because they are not flanges, do not 'extend frontward' from the front of the fiber optic equipment tray, and do not comprise successive sections extending 'frontward, upward and rearward.'" This argument is not persuasive, and was addressed extensively in the above infringement section, and need not be repeated here.

Accordingly, the evidence shows that the Corning domestic industry products are covered by the asserted claims 9, 16, 23, 26 of the '153 patent.

D. Validity of the '153 Patent

As noted, Corning asserts independent claim 23 and dependent claims 9, 16, and 26 of the '153 patent.

Respondents argue that the following 21 different combinations render obvious unasserted claim 1 and asserted independent claim 23 and dependent claims 9, 16, and 26 of the '153 patent:

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[44] Additionally, there was testimony regarding customers who have combined EDGE chassis with asserted EDGE modules. *See*, *e.g.*, CX-0004C (Hicks WS) Q/A 25-26.

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Claim 1:

(1) Smrha '684 (RX-0458) alone renders unasserted claim 1 obvious;

(2) Smrha '684 in combination with RX-0442 (U.S. Patent App. Publ. No. 2008/0037209 to Niazi) ("Niazi") renders unasserted claim 1 obvious;

(3) Smrha '684 in combination with RX-0449 (U.S. Patent No. 6,086,415 to Sanchez) ("Sanchez") renders unasserted claim 1 obvious;

(4) Smrha '684 in combination with Niazi and Sanchez renders unasserted claim 1 obvious;

(5) Smrha '684 in combination with RX-0450 (U.S. Patent No. 6,175,079 to Johnston) ("Johnston") render unasserted claim 1 obvious;

(6) Smrha '684 in combination with Niazi and Johnston renders unasserted claim 1 obvious;

Claim 9:

(7) asserted claim 9 is obvious over Smrha '684, Niazi, and RX-0446 (U.S. Patent No. 5,613,030 to Hoffer) ("Hoffer")

(8) asserted claim 9 is obvious over Smrha '684, Niazi, and Hoffer, in further combination with Sanchez;

(9) asserted claim 9 is obvious over Smrha '684, Niazi, and Hoffer, in further combination with Johnston;

Claim 23:

(10) asserted claim 23 is obvious over Smrha '684, Niazi, and Hoffer;

(11) asserted claim 23 is obvious over Smrha '684, Niazi, Hoffer and Sanchez;

(12) asserted claim 23 is obvious over Smrha '684, Niazi, Hoffer and Johnston;

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Claim 16:

(13) asserted claim 16 is obvious over Smrha '684, Hoffer, and RX-0457 (U.S. Patent No. 7,689,089 to Wagner) ("Wagner");

(14) asserted claim 16 is obvious over Smrha '684, Hoffer, Wagner and Niazi;

(15) asserted claim 16 is obvious over Smrha '684, Hoffer, Wagner and Sanchez;

(16) asserted claim 16 is obvious over Smrha '684, Hoffer, Wagner and Johnston;

(17) asserted claim 16 is obvious over Smrha '684, Hoffer, Wagner, Niazi and Sanchez;

(18) asserted claim 16 is obvious over Smrha '684, Hoffer, Wagner, Niazi and Johnston;

Claim 26:

(19) asserted claim 26 is obvious over Smrha '684, Niazi, Hoffer, and Wagner;

(20) asserted claim 26 is obvious over Smrha '684, Niazi, Hoffer, Wagner, and Sanchez; and

(21) asserted claim 26 is obvious over Smrha '684, Niazi, Hoffer, Wagner, and Johnston.

Resps. Br. at 200-25.

Complainant and the Staff disagree. *See* Compl. Br. at 173-86; Staff Br. at 130-46.

For the reasons discussed below, respondents have not shown by clear and convincing evidence that asserted independent claim 23 and dependent claims 9, 16, and 26 of the '153 patent are invalid.

1. Obviousness

For the reasons discussed below, respondents have not shown by clear and convincing evidence that unasserted claim 1 and asserted independent claim 23 and dependent claims 9, 16, and 26 of the '153 patent are rendered obvious by the 21

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different combinations proposed by respondents.

As an initial matter, the PTO granted the '153 patent to Corning after reviewing the *inter partes* review proceedings of the related '320 and '206 patents, as well as U.S. Patent Nos. 8,452,148 and 8,184,938. JX-0008 ('153 Prosecution History) at 1726, 8143-45, and 10142-43. The examiner granted the '153 patent over several references on which respondents now rely, including their primary reference (Smrha '684) as well as many of their secondary references. *See* JX-0008 ('153 Prosecution History) at 10162.

Respondents argue that Smrha '684 in combination with Niazi '209 and Hoffer '030 renders obvious claims 9 and 23 — alone or in further combination with Sanchez '415 or Johnston '079; that Smrha '684 in combination with Hoffer '030 and Wagner '089 renders obvious claim 16 — alone or in further combination with Niazi '209 and Sanchez '415 or Johnston '079; that Smrha '684 in combination with Niazi '209 and Hoffer '030 renders claim 23 obvious — alone or in further combination with Sanchez '415 or Johnston '079; and that Smrha '684 in combination with Niazi '209, Hoffer '030, and Wagner '089 renders obvious claim 26 — alone or in further combination with Sanchez '415 or Johnston '079.

At the hearing, Dr. Blumenthal agreed that his obviousness opinion required one of ordinary skill to seek out, to find, and combine features from this list of five or six references in order to capture all of the features of the EDGE system claimed by the '153 patent. *See* Blumenthal Tr. 777-779. Even if he were correct that a person of ordinary skill would have found all of these references and their component features, combining them to create a new device with a new architecture is not indicative of obviousness. Rather, making of such combinations to create a new device would be similar to an

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invention. *See KSR*, 550 U.S. at 418-19 ("[I]nventions in most, if not all, instances rely upon building blocks long since uncovered, and claimed discoveries almost of necessity will be combinations of what, in some sense, is already known."); *Smiths Indus. Med. Sys. v. Vital Signs, Inc.*, 183 F.3d 1347, 1356 (Fed. Cir. 1999) ("[T]here is no basis for concluding that an invention would have been obvious solely because it is a combination of elements that were known in the art at the time of the invention.").

As discussed below, respondents have not shown motivations to combine the different combinations of prior art.

a. Motivation to combine Smrha '684 with Niazi '209, Hoffer '030, Wagner '089, Sanchez '415, or Johnston '079

As discussed below, respondents have not shown that a person of ordinary skill would solve the problem of the '153 patent — density with accessibility, modularity, and scalability in a fiber optic data center environment — by combining Smrha '684 and the other references on which respondents rely.

i. Smrha '684 with Niazi '209

As shown above for the '456 patent, a person of ordinary skill would not be motivated to combine Smrha '684 with Niazi '209, which is outside the field of fiber optics and has a different and incompatible architecture. *See* CX-2060C (Prucnal RWS) Q/A 566-67.

ii. Smrha '684 with Hoffer '030

The PTO reviewed U.S. Patent No. 5,613,030 to Hoffer, CX-1752 (Hoffer '030), before issuing the '153 patent. *See* JX-0008 ('153 Prosecution History) at 3146; CX-

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2060C (Prucnal RWS) Q/A 568. Hoffer '030 discloses an enclosure that holds fiber optic "cards" in a "card-receiving region." *See* CX-2060C (Prucnal RWS) Q/A 568; CX-1752 (Hoffer '030).

Dr. Blumenthal opines that a person of ordinary skill would combine Smrha '684 with Hoffer '030 to allow greater access to modules — the adapter packs in Smrha '684 — because Hoffer '030 discloses a system that locks cards in place and allows release of those locks to permit controlled removal from the rear of a structure. *See* RX-0001C (Blumenthal WS) Q/A 556; CX-2060C (Prucnal RWS) Q/A 570. He has not shown how or why this combination would be made, and overlooks that it is contrary to the disclosures of Smrha '684. *See* CX-2060C (Prucnal RWS) Q/A 571.

First, as Dr. Prucnal explains, combining Hoffer '030 with Smrha '684 would not have a predictable result because their purposes and structures are incompatible. *See* CX-2060C (Prucnal RWS) Q/A 571, 573. Hoffer '030 discloses vertically oriented cards that slide between two sides of a bulky enclosure that looks like a box or shelf. A person of ordinary skill would not have reason to think that the sliding rail adapter pack system disclosed in Smrha '684 would be compatible with the cards-in-a-shelf system disclosed by Hoffer '030. *Id.*

Second, neither respondents nor Dr. Blumenthal explain why a person of ordinary skill would add rear removability of adapter packs to Smrha '684 to improve access to connections in adapter packs, given that Smrha '684 already discloses an open sliding system for access to connections in adapter packs that remain securely in its chassis. *See* CX-2060C (Prucnal RWS) Q/A 573.

Third, Dr. Blumenthal does not explain how a person of ordinary skill could

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incorporate the rear releasability feature allegedly disclosed by Hoffer '030 into Smrha '684. *See* CX-2060C (Prucnal RWS) Q/A 572. As shown above, Smrha '684 does not disclose removability of its adapter packs at all, much less incorporate features for rear access and removability. The design of Smrha '684 teaches away from such rear access and removability by providing access to the rear connections on the back of the adapter packs through removable panels. *See* CX-2060C (Prucnal RWS) Q/A 602; CX-0032 (Smrha '684) at 9:22-27. Smrha '684 does not contemplate removal of the adapter packs, much less from the rear.

iii. Smrha '684 with Wagner '089

The PTO also reviewed U.S. Patent No. 7,689,089 to Wagner, CX-1761 (Wagner '089), before issuing the '153 patent. *See* JX-0008 ('153 Prosecution History) at 10350; CX-2060C (Prucnal RWS) Q/A 574. Wagner '089 is owned by Panduit, but there is no evidence that Panduit used Wagner '089 to develop the Panduit accused products. *See* CX-2060C (Prucnal RWS) Q/A 574. To the contrary, as discussed above, Panduit did not consider its prior art in designing its own products, which calls into question Dr. Blumenthal's opinion that there would be motivation to use this reference in matching the EDGE features. *See* CX-2060C (Prucnal RWS) Q/A 295 ("The group agreed on developing a new 1U enclosure that supported 144 connections using cassettes with "72 LC front ports," the same as EDGE. No mention was made of attempting to modify any of Panduit's existing products to achieve this result. Mr. Kuffel testified that he did not even consider Panduit's existing products in developing a new high-density platform to match EDGE. This testimony can be found at JX-0017C (Kuffel Dep.) at 22:3-23:10.").

Wagner '089 discloses an optical cassette designed to be inserted in and engage

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with latches on a patch panel. *See* RX-0001C (Blumenthal WS) Q/A 564. Dr. Blumenthal opines that a person of ordinary skill would rebuild the Smrha '684 adapter packs with the Wagner '089 cassette release mechanisms. *Id.* He opines that such a person would have reason to not only make the adapter packs of Smrha' 684 removable, but removable from the rear of the tray, and removable using tabs actuated from the rear of the adapter packs. *Id.* Q/A 566. He states that Smrha '684 and Wagner '089 have similar module functionality, and they would therefore be combinable with a reasonable expectation of success. *Id.* Those opinions are speculative.

First, a person of ordinary skill would not think to combine a patch panel and cassette combination with the system disclosed in Smrha '684, which discloses a system of independently sliding adapter panel sections. *See* CX-2060C (Prucnal RWS) Q/A 577. Dr. Blumenthal's contrary opinion presupposes that rear access would be useful in a system like Smrha '684, but as shown above, Smrha '684 teaches away from the type of rear accessibility claimed in the '153 patent by providing its own system for access through sliding adapter packs.

Second, Dr. Blumenthal has not shown that Smrha '684 discloses side walls with which the tabs of the Wagner '089 cassettes could interact; or that the retaining and releasing features of Wagner '089 are compatible with a system, like that of Smrha '684, in which adapter packs are designed to slide on mounting guides during operation. *Id.* Wagner '089 contains no disclosures on how such walls could be incorporated into the different architecture of Smrha '684, which uses fixed adapter packs rather than removable modules. *See* RX-0001C (Blumenthal WS) Q/A 565-66.

Third, for the same reasons, there is no basis to Dr. Blumenthal's opinion that a

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person of ordinary skill would add a depressing tab similar to the one in Wagner '089 to the rear of Smrha '684's module, so as to permit rear removability. *See* CX-2060C (Prucnal RWS) Q/A 578. As noted, the modules in the two references are not remotely alike; those in Smrha '684 are not designed to be removed. *See* RX-0001C (Blumenthal WS) Q/A 565.

iv. Smrha '684 with Sanchez '415

Respondents rely on U.S. Patent No. 6,086,415 to Sanchez (RX-0449) for a disclosure of fiber optic routing elements required by the asserted claims of the '153 patent. Sanchez '415 discloses a patch panel comprising a jack holder, which has a plurality of openings for mounting connectors, a front panel, and a cable tray that extends forward from the front of the tray and can be angled up and down to provide access to front-end connections. *See* CX-2060C (Prucnal RWS) Q/A 580. As Dr. Prucnal demonstrates, Dr. Blumenthal has not shown that a person of ordinary skill would combine this reference with Smrha '684.

First, Dr. Blumenthal does not explain how the features of Sanchez '415 could be incorporated into Smrha '684. *See* CX-2060C (Prucnal RWS) Q/A 583. His opinion assumes that the tray in Smrha '684 could be bent up to create a U shape, but does not account for the fact that the Smrha '684 tray would be unsuitable for this modification because the tray does not move along with the adapter packs, which move independently of each other and the tray. *See* CX-0032 (Smrha '684) at 5:6-16 & Figs. 2-3; CX-2060C (Prucnal RWS) Q/A 586. In addition, the tray in Smrha '684 is designed to be fully closed during operation while the adapter packs are mobile; putting a fiber optic routing guide on this tray would serve no clear purpose and impair cable management. *See* CX-

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2060C (Prucnal RWS) Q/A 585-86. Also, the chassis of Smrha '684 does not have space for both sliding adapter packs and a fiber optic routing element on the tray. *Id.* Q/A 586.

Second, a person of ordinary skill would not have been motivated to combine the routing feature of Sanchez '415 with the tray of Smrha '684. Dr. Blumenthal opines that, because both references seek to provide effective cable management, a person of ordinary skill would convert the clips of Smrha '684 into an extended lip like the flange in Figure 1 of Sanchez '415. *See* RX-0001C (Blumenthal WS) Q/A 532. However, the Smrha '684 routing elements are on the adapter packs (modules), not the tray. Also, the flange in Sanchez '415 is not part of a fiber optic equipment tray and is instead part of a separate "cable tray" that is used to hold cables, but not modules or adapters. *See* CX-2060C (Prucnal RWS) Q/A 586. The Sanchez '415 tray is permanently attached to the front of the chassis and cannot move except to be angled up and down to provide access to the connections. *Id.* These features offer no useful disclosures for modifying Smrha '684, which has no cable tray and has modules installed on a separate framework.

Even assuming that both Smrha '684 and Sanchez '415 share a goal of effective cable management, that motivation is far too generic to explain why two very different systems should, or how they could, be combined. *Id*; *Cardiac Pacemakers, Inc. v. St. Jude Med., Inc.*, 381 F.3d 1371, 1377 (Fed. Cir. 2004) ("[r]ecognition of a need" does not alone provide a motivation to combine references). Dr. Blumenthal's opinion that an extended lip would provide better cable management than Smrha '684 is unsupported. *See* CX-2060C (Prucnal RWS) Q/A 586.

v. Smrha '684 with Johnston '079

Respondents rely alternatively on U.S. Patent No. 6,175,079 to Johnston (RX-

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0450, "Johnston '079") for a fiber optic routing element. Johnston '079 was before the PTO when the '153 patent was issued. *See* JX-0008 ('153 Prosecution History) at 3150; CX-2060C (Prucnal RWS) Q/A 581. It discloses a fiber optic cable management cabinet with adjustable clips mounted by frictional force in a track for managing the cable that exits the cabinet. *See* CX-2060C (Prucnal RWS) Q/A 581. As Dr. Prucnal demonstrates, Dr. Blumenthal has not shown that a person of ordinary skill would combine this reference with Smrha '684.

First, Dr. Blumenthal opines that the routing clips on the adapter packs in Smrha '684 could be replaced with the clips from Johnston '079 attached (via screw, bolt, or other "routine" means) to the drawer in Smrha '684. *See* RX-0001C (Blumenthal WS) Q/A 541. The Johnston '079 clips are not designed for such attachment and are instead held by friction within a mounting track. *See* CX-2060C (Prucnal RWS) Q/A 583. There is no such mounting track in Smrha '684, and Johnston '079 does not show how to use its mounting clips absent that track. *Id.*

Second, Dr. Blumenthal has not shown that a person of ordinary skill would be motivated to combine the routing feature of Johnston '079 with Smrha '684. Again, the clips of Johnston '079 are not part of the tray (as claim 1 requires), but are attached to a mounting track. *See* RX-0450 (Johnston '079) at 7:50-58; CX-2060C (Prucnal RWS) Q/A 588. By contrast, the clips in Smrha '684 are attached to the adapter pack, a structure that Johnston '079 does not disclose. *See* CX-2060C (Prucnal RWS) Q/A 588. Combining the two would not result in a tray with a fiber routing element. Dr. Blumenthal also concedes that the clips in Johnston '079 are larger than those in Smrha '684 and would operate differently, but does not explain how these differences would be

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overcome and what the effect would be. CX-2060C (Prucnal RWS) Q/A 589.

b. Asserted Claims

i. Unasserted Claim 1

Respondents argue that the following six different combinations render obvious unasserted claim 1:

(1) Smrha '684 (RX-0458) alone renders unasserted claim 1 obvious;

(2) Smrha '684 in combination with RX-0442 (U.S. Patent App. Publ. No. 2008/0037209 to Niazi) ("Niazi") renders unasserted claim 1 obvious;

(3) Smrha '684 in combination with RX-0449 (U.S. Patent No. 6,086,415 to Sanchez) ("Sanchez") renders unasserted claim 1 obvious;

(4) Smrha '684 in combination with Niazi and Sanchez renders unasserted claim 1 obvious;

(5) Smrha '684 in combination with RX-0450 (U.S. Patent No. 6,175,079 to Johnston) ("Johnston") render unasserted claim 1 obvious; and

(6) Smrha '684 in combination with Niazi and Johnston renders unasserted claim 1 obvious.

See Resps. Br. at 200-11.

As discussed below, respondents have not shown by clear and convincing evidence that unasserted claim 1 of the '153 patent is rendered obvious by the above combinations.

Corning is not asserting claim 1 in this investigation, but it is the independent claim from which asserted claims 9 and 16 depend.

<u>Fiber Routing Element</u>

Respondents have not shown that Smrha '684 in combination with Niazi '209 and Sanchez '415 or Johnston '079 discloses

[redacted]

> at least one fiber optic equipment tray comprising a front end with at least one fiber optic routing element that comprises successive material sections extending frontward, upward, and rearward, respectively, to permit optical fibers to be routed to either left or right portions of the at least one fiber optic equipment tray toward the first and second ends of the chassis.

First, Dr. Blumenthal has not shown that Smrha '684 discloses the claimed routing element on its tray. *See* CX-2060C (Prucnal RWS) Q/A 591. He identifies the routing element on the adapter pack, not the drawer that he identifies as the tray. In addition, Dr. Blumenthal wrongly claims — based on a speculative interpretation of a detail in a figure, rather than a disclosure in the specification — that the Smrha '684 clips disclose a hinge that allows its clip to extend rearward. *See* CX-2060C (Prucnal RWS) Q/A 591; RX-0001C (Blumenthal WS) Q/A 540.

Second, although respondents argue that Niazi '209 would teach a person of ordinary skill to multiply the trays of Smrha '684, they do not contend that Niazi '209 would teach a person of ordinary skill to move the routing elements from the Smrha '684 adapter packs to those trays. With or without Niazi '209, a person of ordinary skill would not make that modification. Moving the clips from the adapter packs to the tray would limit the independent movement of the adapter packs because the cables into those packs would be routed through clips on the separate tray that is designed to stay in place after installation. *See* CX-2060C (Prucnal RWS) Q/A 592-93. When the adapter packs slide, the connected cables would pull at the clip on the tray. This runs contrary to the central teaching of Smrha '684, entitled in part "Sliding Adapter Panel," which uses specialized framework assemblies precisely to enable the adapter packs to handle their own cable management so they can slide independently of the tray. *Id.* Although Dr. Blumenthal opines that such a modification would make "the bend . . . more gradual," RX-0001C

[redacted]

(Blumenthal WS) Q/A 527, he did not provide support for his opinion. CX-2060C (Prucnal RWS) Q/A 593.

Third, Dr. Blumenthal has not shown that Johnston '079 discloses the routing element required by claim 1. CX-2060C (Prucnal RWS) Q/A 596. As set forth above, Johnston '079 discloses independent clips held by friction in a specially designed track on the bottom of a cabinet, not a fiber optic equipment tray. *Id.; see* RX-0450 (Johnston '079) at 7:34-67; CX-2060C (Prucnal RWS) Q/A 596.

<u>Modules Installed in a Tray</u>

Respondents have not shown that Smrha '684 discloses independently movable modules configured to be received by a fiber optic equipment tray. As shown for the '456 patent, Dr. Blumenthal has not shown that the adapter packs disclosed by Smrha '684 are received by its tray. *See* CX-2060C (Prucnal RWS) Q/A 597. The "tray" in Smrha '684 sits at the bottom of the chassis and supports the first level of mounting guides, which in turn hold the first level of adapter packs and support the second level of mounting guides, which in turn hold the second level of adapter packs. *Id.* That system is independent of the tray so that the adapters can move independently from each other and from the tray. *Id.*; CX-0032 (Smrha '684) at 3:10-19 and 9:28-45.

i. Claim 9

Respondents argue that the following three different combinations render obvious asserted dependent claim 9 of the '153 patent:

(1) asserted claim 9 is obvious over Smrha '684, Niazi, and RX-0446 (U.S. Patent No. 5,613,030 to Hoffer) ("Hoffer")

(2) asserted claim 9 is obvious over Smrha '684, Niazi, and Hoffer, in further combination with Sanchez;

[redacted]

(3) asserted claim 9 is obvious over Smrha '684, Niazi, and Hoffer, in further combination with Johnston;

See Resps. Br. at 211-16.

As discussed below, respondents have not shown by clear and convincing evidence that asserted claim 9 of the '153 patent is rendered obvious by the above combinations.

Claim 9 depends from dependent claim 6. With respect to the elements of claim 6, Dr. Blumenthal has not shown that Smrha '684 in combination with Niazi '209 discloses a "plurality of fiber optic equipment trays," as shown above for the '456 patent. Dr. Blumenthal acknowledges that Smrha '684 discloses only one tray. *See* CX-2060C (Prucnal RWS) Q/A 600; RX-0001C (Blumenthal WS) Q/A 546. Niazi '209 contains no disclosures allowing additional trays to be added to Smrha '684 without a fundamental redesign. *See* CX-2060C (Prucnal RWS) Q/A 600.

Dr. Blumenthal also has not shown that Smrha '684 discloses the additional limitation of claim 9, which recites fiber optic trays configured to permit modules to be removable from a front of the plurality of fiber optic equipment trays, and releasably removable from a rear of the plurality of fiber optic equipment trays." In addition to failing to show that Smrha '684 discloses a plurality of trays that receive multiple modules, he also has not shown that Smrha '684 in combination with Hoffer '030 discloses the removability limitations of claim 9. He opines that Smrha '684 provides the front removal limitation while Hoffer '030 provides the missing rear removal limitation. RX-0001C (Blumenthal WS) Q/A 551-52. As Dr. Prucnal has demonstrated, this is not so.

[redacted]

First, with respect to front removal, Dr. Blumenthal opines that "Smrha '684 discloses access for installing each of its fiber optic modules from the front of the drawer." RX-0001C (Blumenthal WS) Q/A 551; s*ee* CX-2060C (Prucnal RWS) Q/A 602. This disclosure in Smrha '684, however, relates solely to the initial installation of the adapter packs and does not disclose their removal. *See* CX-2060C (Prucnal RWS) Q/A 602. Smrha '684 instead discloses accessibility via movement of adapter packs in the mounting guides, not by individual insertion or removal.

Dr. Blumenthal opines that front removal would have been obvious to a person of ordinary skill in the art, but gives no basis for that assertion. *See* RX-0001C (Blumenthal WS) Q/A 551. A person of ordinary skill would instead recognize that an adapter pack may not function in the same way for installation and removal, and might see an advantage in restricting removal after installation to prevent unwanted movement and fiber damage. *See* CX-2060C (Prucnal RWS) Q/A 602. Indeed, as shown above as to infringement of the '153 patent, respondent Siemon has modified its product to permit front installation but not front removal of its modules. *Id.*

Second, Dr. Blumenthal has not shown that Hoffer '030 discloses the claimed fiber optic module or the claimed fiber optic equipment tray. *See* CX-2060C (Prucnal RWS) Q/A 602. As shown above, Hoffer '030 discloses an system of "cards" and a shelf-like chassis that is incompatible with Smrha '684's sliding adapter pack system. Dr. Blumenthal suggests that the cable management tray of Hoffer '030 is the structure from which the cards are removed, but the reference shows instead that the cards are removed from a "card-receiving region," CX-1752 (Hoffer '030) at 2:48-51. *See* CX-2060C (Prucnal RWS) Q/A 602. Regardless, neither the card-receiving region nor the

[redacted]

cable management tray is a fiber optic equipment tray that supports modules, and so Hoffer '030 cannot disclose modules removable from the rear of such a tray.

Third, Dr. Blumenthal also has not shown that Hoffer '030 discloses modules releasably removable from the rear of the tray. *Id.* He provides no basis for his conclusion that a user could "remove the modules from either the front or rear of its trays," other than quoting a statement that the card can be "pulled forwardly or rearwardly." RX-0001C (Blumenthal WS) Q/A 554. Even on its face, this vague disclosure does not explain from which end of the tray (or chassis) the card is removed. *See* CX-1752 (Hoffer '030) at 5:38-53; CX-2060C (Prucnal RWS) Q/A 602.

ii. Claim 16

Respondents argue that the following six different combinations render obvious dependent claims 16 of the '153 patent:

(1) asserted claim 16 is obvious over Smrha '684, Hoffer, and RX-0457 (U.S. Patent No. 7,689,089 to Wagner) ("Wagner");

(2) asserted claim 16 is obvious over Smrha '684, Hoffer, Wagner and Niazi;

(3) asserted claim 16 is obvious over Smrha '684, Hoffer, Wagner and Sanchez;

(4) asserted claim 16 is obvious over Smrha '684, Hoffer, Wagner and Johnston;

(5) asserted claim 16 is obvious over Smrha '684, Hoffer, Wagner, Niazi and Sanchez;

(6) asserted claim 16 is obvious over Smrha '684, Hoffer, Wagner, Niazi and Johnston;

See Resps. Br. at 216-20.

As discussed below, respondents have not shown by clear and convincing evidence that asserted claim 16 of the '153 patent is rendered obvious by the above

[redacted]

combinations.

Respondents have not shown that Smrha '684, in combination with Hoffer '030 and Wagner '089, discloses fiber optic modules that comprise "a locking latch comprising a lateral protrusion configured to prevent the at least one fiber optic module from moving rearward relative to the" tray and that is "actuatable by a user from a rear of" the module to enable rear removal.

As shown above, Dr. Blumenthal does not show that Smrha '684 discloses modules that can be removed at all, much less from a fiber optic equipment tray. *See* CX-2060C (Prucnal RWS) Q/A 605. He also has not shown that Smrha '684 discloses adapter packs with the claimed locking latch to permit removal of the adapter packs from the tray, as opposed to features related to the moving and locking of the adapter pack framework assembly within the mounting guide. *Id.*

Dr. Blumenthal relies on Hoffer '030, RX-0001C (Blumenthal WS) Q/A 564, to supply rear removability. As shown above, Hoffer '030 does not disclose this element, and a person of ordinary skill would not combine the references. *See* CX-2060C (Prucnal RWS) Q/A 605.

Dr. Blumenthal further relies on Wagner '089 to supply the actuatable latch element. *See* RX-0001C (Blumenthal WS) Q/A 564. Dr. Blumenthal opines that Wagner '089 applies to modules that snap into place on a panel or are locked in an equivalent manner. *Id.* Q/A 546. Wagner '089 does not disclose this. It merely states that the disclosed cassettes are designed to be inserted into a patch panel. Further, the "guide latch tabs 64" on which Dr. Blumenthal relies are disposed on the patch panel enclosure, not the disclosed cassette, as the claims require. *See* CX-1761 (Wagner '089) at Fig. 1.

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Wagner '089 shows that latch tab 128 is on the cassette, but Dr. Blumenthal does not opines or show that latch tab 128 is a lateral protrusion, or how it could be actuated from the rear of the cassette. To the contrary, Dr. Blumenthal points to a different locking feature, the release tabs 84, to disclose this limitation. *See* RX-0001C (Blumenthal WS) Q/A 564.

In sum, respondents did not particularly point out what features of Wagner '089 he alleges a person of ordinary skill would combine with Smrha '684 and how that combination would operate. *See ActiveVideo Networks*, 694 F.3d at 1327 (holding expert's testimony insufficient where he failed to explain how a "specific combination would operate or read on the asserted claims").

iii. Claim 23

Respondents argue that the following three different combinations render obvious asserted independent claim 23 of the '153 patent:

(1) asserted claim 23 is obvious over Smrha '684, Niazi, and Hoffer;
(2) asserted claim 23 is obvious over Smrha '684, Niazi, Hoffer and Sanchez; and
(3) asserted claim 23 is obvious over Smrha '684, Niazi, Hoffer and Johnston.

See Resps. Br. at 220-23.

As discussed below, respondents have not shown by clear and convincing evidence that asserted claim 23 of the '153 patent is rendered obvious by the above combinations.

Dr. Blumenthal has not shown that Smrha '684 in combination with one or more of Niazi '209 and Hoffer '030, alone or in combination with Sanchez '415 or Johnston

[redacted]

'079, discloses two additional elements of claim 23 that were not previously discussed in view of claim 1.

First, respondents have not shown that Smrha '684 discloses a plurality of trays configured to receive multiple modules. As shown above for claim 6, Dr. Blumenthal has not shown that Smrha '684 discloses such trays or could be modified to add them. *See* CX-2060C (Prucnal RWS) Q/A 609.

Second, as shown above for claim 9, Dr. Blumenthal has not shown that Smrha '684 in combination with Hoffer '030 discloses modules "removable from a front" of the tray and "releasably removable from a rear of the" tray.

iv. Claim 26

Respondents argue that the following three different combinations render obvious dependent claim 26 of the '153 patent:

(1) asserted claim 26 is obvious over Smrha '684, Niazi, Hoffer, and Wagner;

(2) asserted claim 26 is obvious over Smrha '684, Niazi, Hoffer, Wagner, and Sanchez; and

(3) asserted claim 26 is obvious over Smrha '684, Niazi, Hoffer, Wagner, and Johnston.

See Resps. Br. at 223-25.

As discussed below, respondents have not shown by clear and convincing evidence that asserted claim 26 of the '153 patent is rendered obvious by the above combinations.

Respondents have not shown that Smrha '684, in combination with Niazi '209, Hoffer '030 and Wagner '089, discloses the additional limitation of claim 26 (a locking feature), which depends from independent claim 1 and dependent claim 25 (module

[redacted]

guides defining channels through which modules are inserted).

As to the elements of claim 25, as set forth above, Dr. Blumenthal has not shown that Smrha '684 alone or in combination with other references discloses trays that comprise module guides. *See* CX-2060C (Prucnal RWS) Q/A 613. Further, Dr. Blumenthal has not shown that Smrha '684 discloses modules that can be inserted into the plurality of module guides from the rear and guided toward the front of the chassis. *Id.*

Dr. Blumenthal concedes that Smrha '684 does not disclose modules insertable from the rear of the chassis, but opines Hoffer '030 discloses this feature. *See* RX-0001C (Blumenthal WS) Q/A 580-81. He has not shown where such disclosures can be found. *See* CX-2060C (Prucnal RWS) Q/A 614. He provides no basis for his opinion that the "card guides" are "module guides," much less the claimed module guides. *Id.* Even assuming the "card guides" could be module guides, he has not shown how they make a guide channel that is open on a rear end. *Id.* Hoffer '030 at most discloses that card guides delineate a space in between which the cards can be slid; it does not disclose module guides that permit cards to be inserted from the rear of the enclosure. *Id.* Further, Smrha '684 already discloses an installation method involving a pullout drawer and sliding adapter packs, and Dr. Blumenthal does not show how or why a person of ordinary skill would redesign the architecture of Smrha '684 to change this operation. *Id.* Q/A 613.

Respondents also have not shown that Smrha '684, in combination with Niazi '209, Hoffer '030, and Wagner '089, disclose claim 26's additional limitation of a locking latch like that of claim 16. As shown above for claim 16, Dr. Blumenthal does

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not show how Smrha '684, alone or in combination, discloses the claimed latch. *See* CX-2060C (Prucnal RWS) Q/A 612.

* * *

Accordingly, respondents have not shown by clear and convincing evidence that asserted independent claim 23 and dependent claims 9, 16, and 26 of the '153 patent are invalid.

VII. U.S. Patent No. 8,712,206

U.S. Patent No. 8,712,206, entitled "High-Density Fiber Optic Modules and Module Housings and Related Equipment," was filed on April 30, 2010 and issued on April 29, 2014. JX-0001 ('206 Patent). The '206 patent is assigned to Corning. JX-0003 ('206 Patent Assignment Record). The '206 patent states, "The technology of the disclosure relates to fiber optic modules and fiber optic modules housings provided in fiber optic equipment to support fiber optic connections." JX-0001 at 1:17-19. The '206 patent has a total of 73 claims, of which Corning asserts dependent claims 22 and 23. *See* Compl. Br. at 8.

As discussed below, the evidence shows that (1) the accused products of FS and Wirewerks infringe asserted claims 22 and 23; (2) Siemon's accused products infringe asserted claim 22; (3) Panduit's accused products do not infringe asserted claims 22 and 23; (4) complainant has satisfied the technical prong of the domestic industry requirement; and (5) the asserted claims are not invalid.

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A. Claim Construction

1. A Person of Ordinary Skill in the Art

As noted in the '320 patent section of this initial determination, the administrative law judge finds that a person of ordinary skill in the art with respect to the four asserted patents is a person who has at least a bachelor's degree in mechanical engineering, materials science, or a related field, and at least two years of experience in fiber optic equipment.

2. "front opening" ('206 Patent, Claims 22, 23)

The claim term "front opening" appears in unasserted claim 14 of the '206 patent, from which asserted claims 22 and 23 depend. Below is a chart showing the parties' proposed claim constructions.

Complainant and the Staff[45]	Respondents
"an opening located in the front side of a fiber optic module, *e.g.*, the opening depicted in Figure 13 of the '206 Patent as having dimensions H_1 and W_1"	"a single opening located in the front side of a fiber optic module"

Joint Chart at 5; Compl. Br. at 50-53; Resps. Br. at 50-53; Staff Br. at 50-54.

Corning argues:

> The concrete dispute involving the "front opening" arises because Respondents' Accused Products, and some prior art devices, have multiple cutouts or spaces for adapters. As an example, Dr. Min argues that certain Accused Products do not infringe the Asserted Claims of the '206 patent because they "include multiple distinct openings along the longitudinal axis on the front side." RX-0006C (Min RWS) Q/A 186. Indeed, later in his analysis Dr. Min suggests, even while purporting to apply Corning's construction, that the opening must be a "single, continuous" opening, *id.*

[45] As discussed in detail below, the Staff changed its position to require a single opening as proposed by respondents.

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Q/A 190, which would add two limitations that are contrary to the claim language and specification. Respondents also suggest that, even if Corning's construction is applied, the structural material ***between*** the cutouts or spaces for adapters should be excluded when measuring the width of the front opening (W_1). *See id.* Q/A 221.

The language of claim 14 does not support reading either "single" or "continuous" into "front opening." The term "opening" is preceded by "a," but the Federal Circuit has recognized a "'general rule [that] the words "a" or "an" in a patent claim carry the meaning of "one or more."'" *01 Communique Lab., Inc. v. LogMeIn, Inc.*, 687 F.3d 1292, 1297 (Fed. Cir. 2012) (quoting *TiVo, Inc. v. EchoStar Commc'ns Corp.*, 516 F.3d 1290, 1303 (Fed. Cir .2008)). To "limit 'a' or 'an' to 'one,'" the "patentee must evince a clear intent." *Id.* (quoting *Baldwin Graphic Sys., Inc. v. Siebert, Inc.*, 512 F.3d 1338, 1342 (Fed. Cir. 2008)). Nothing in the claims of the '206 patent manifests any such intent, much less a clear one.

The specification confirms that the phrase "front opening" includes devices that have more than one cutout or space for adapters. Although Figure 13 depicts an embodiment with one single, continuous space for adapters, the specification includes other embodiments, such as Figure 15, that contain multiple spaces and that include the structural material separating the adapters as part of the "front opening 126." *See* CX-2060C (Prucnal RWS) Q/A 110; CDX-0005C (Prucnal Rebuttal) at 22. It would therefore be improper to limit the claims to the embodiment in Figure 13. *See Oatey Co. v. IPS Corp.*, 514 F.3d 1271, 1276 (Fed. Cir. 2008) ("We normally do not interpret claim terms in a way that excludes embodiments disclosed in the specification.").

Compl. Br. at 51-52, *see* Compl. Reply Br. 24-25.

Respondents argue:

Respondents' construction is consistent with the plain language of the claim and with the specification while Complainant's and Staff's proposed constructions contradict both. In fact. Complainant's and Staff's proposed constructions allows for an improper outcome of counting multiple openings as one opening. *See, e.g.*, RX-0001C (Blumenthal WS) Q/A 191.

Indeed, Claim 14 of the '206 Patent requires "**a** front opening" which means a single opening, rather than multiple. *See TiVo, Inc. v. EchoStar Commc'ns Corp.*, 516 F.3d 1290, 1303 (Fed. Cir. 2008) (interpreting "an MPEG stream" to mean a single MPEG stream); *see also* Prucnal Tr. 341:19-24. The patent specifically distinguishes and separately claims multiple front opening**s**, which is shown in claim 63 and

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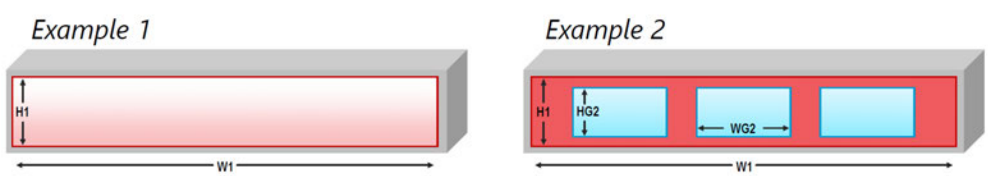
Figure 18. The specification also distinguishes between single front opening and multiple front openings embodiments. *Compare* JX-001 ('206 Patent) at 9:64-10:4 (describing Fig. 13 depicting a module with a ***single*** front opening **126**) *with id*. at 14:35-42 (describing Fig. 18 depicting a single module with ***two*** front openings **178A** and **178B**); *see also id.* at Figs. 3, 16-17 RX-0001C (Blumenthal WS) Q/A 192. Therefore, the '206 Patent distinguishes between embodiments with a single front opening and embodiments with multiple front openings. Complainant's and Staff's proposed construction which allow for multiple openings to read on a single opening are incorrect and inconsistent with the specification and differentiated claim language.

Complainant's expert, Dr. Prucnal, admits that according to Complainant's and Staff's proposed constructions, "Corning would consider the multiple cutouts or spaces as all part of the 'front opening,'" essentially changing a meaning of a singular term "a front opening" into a plural "front openings" in direct contradiction to the plain language of the claims. *See* CX-2060C (Prucnal RWS) Q/A 107. Additionally, under Complainant's and Staff's proposed constructions, Corning would consider the structural material between fiber optic components on the front of the module that supports those fiber optic components as part of the 'front opening.'" *Id*. This interpretation effectively results in counting multiple, individual openings as a single opening, as shown below:



RDX-0001.51; *see also* RX-0001C (Blumenthal WS) Q/A 191. Under Complainant's and Staff's proposed constructions, in Example 2, the three openings would be counted as one. Additionally, under that construction, the dark red material between the individual openings would be considered part of the opening, such that the entire "W_1" in Example 2 would need to be accounted for essentially rendering the singular form of a front opening used in the claim meaningless. *See Bicon, Inc. v. Straumann Co.*, 441 F.3d 945, 950-51 (Fed. Cir. 2006); *see also* RX-0001C (Blumenthal WS) Q/A 191.

Complainant's and Staff's proposed constructions contradict the plain meaning of "an opening." A POSITA would understand that Example 2 shows three front openings, and not one. *See, e.g.,* RX-0001C (Blumenthal WS) Q/A 191; Prucnal Tr. 343:21-344:14. Notably, Dr. Prucnal relies on Figure 15 to support Complainant's argument that structural material between cutouts or adapters should be included in the

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calculation of the width of a front opening. *See* CX-2060C Q/A 111-113. Yet, Figure 15 does not show structural material between the adapters disposed through a single opening 126. JX-001 ('206 Patent) at Fig. 15. Figure 14's description states that "[h]owever, in the fiber optic module 22", four (4) MPO fiber optic adapters 154 are disposed through the front opening 126 of the fiber optic module 22." JX-0001 ('206 Patent) at 12:59-61. There is no mention of structural material between the adapters in the entire description of Figure 15. *Id.* at 12:54-13:49. Dr. Prucnal has not shown that such material would have to be inherently present. *See* CX-2060C (Prucnal WS) Q/A 111-113; *see also Tronzo v. Biomet, Inc.*, 156 F.3d 1154, 1159 (Fed. Cir. 1998) ("In order for a disclosure to be inherent, . . . the missing descriptive matter must ***necessarily*** be present in the . . . application's specification such that one skilled in the art would recognize such a disclosure." (emphasis added)).

Resps. Br. at 51-53, *see* Resps. Reply Br. 14-15.

The Staff argues:

At the time that the parties' proposed claim constructions were due, the dispute between the private parties appeared to be on how to define the dimensions of the opening. The Staff's focus was therefore on emphasizing that the opening at issue was the one shown in Figure 13 and having the dimensions H_1 and W_1. Since then, it has become clear that the real dispute is whether the front opening can consist of multiple openings. On this point, the Staff agrees with Respondents – claim 14 is limited to embodiments with one, and only one, opening, as depicted in Figure 13 of the '206 patent. Although the Staff still prefers its proposed construction, to avoid any ambiguity, the Staff would not object to adopting a compromise construction of "front opening" that read "a single opening located in the front side of a fiber optic module, *e.g.*, the opening depicted in Figure 13 of the '206 Patent as having dimensions H_1 and W_1."

In this respect, the intrinsic evidence shows that Figures 13 and 18 depict different embodiments of the '206 invention, one with a single front opening and one with multiple front openings. The evidence further shows that claim 14 is directed to the embodiment shown in Figure 13. *See* RX-0001C (Blumenthal WS) Q/A 191-93. Claim 14 discloses "*a* front opening," not plural openings. JX-0001 ('206 Patent) at 20:53-54 (emphasis added). In contrast, unasserted claims 63-65 disclose plural "front openings." *Id.* at 24:15-37 ("A fiber optic module, comprising: . . . front openings having a width being at least eighty-five percent (85%) of the width of the front side of the main body;"). Where different phrases are used in separate claims, the doctrine of claim differentiation creates a rebuttable presumption that a difference in meaning and scope was

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intended. *Tandon Corp. v. International Trade Comm'n*, 831 F.2d 1017, 1023 (Fed. Cir. 1987); *see also Aspex Eyewear, Inc. v. Marchon Eyewear, Inc*., 672 F.3d 1335, 1349 (Fed. Cir. 2012) (when different words are used in separate claims, they are presumed to have different meanings); *cf. InterDigital Communications, LLC v. International Trade Comm'n*, 690 F.3d 1318, 1334 (Fed. Cir. 2012) ("Whether or not claims differ from each other, one can not interpret a claim to be broader than what is contained in the specification and claims as filed."). If both claim 14 and claim 63 were interpreted to encompass modules with multiple front openings, then one of the two claims would be superfluous. To avoid this presumptively incorrect result, claim 14 must be limited to modules with a single front opening. *See Tandon*, 831 F.2d at 1023 ("To the extent that the absence of such difference in meaning and scope would make a claim superfluous, the doctrine of claim differentiation states the presumption that the difference between claims is significant.").

Staff Br. at 52-54, *see* Staff Reply Br. 11-15.

For the reasons discussed below, the administrative law judge has determined that the claim term "front opening" should be construed to mean "a single opening located in the front side of a fiber optic module, *e.g.*, the opening depicted in Figure 13 of the '206 patent as having dimensions H_1 and W_1."

Unasserted independent claim 14 and asserted dependent claims 22 and 23 read as follows:

> **14**. A fiber optic module, comprising:
>
> a main body defining an internal chamber disposed between a front side and a rear side;
>
> a plurality of optical fibers disposed in the internal chamber;
>
> ***a front opening*** disposed along a longitudinal axis in the front side;
>
> a first plurality of fiber optic components optically connected to the plurality of optical fibers, the first plurality of fiber optic components disposed through the front opening providing a fiber optic connection density of at least one fiber optic

[redacted]

connection per 7.0 millimeters (mm) of width of the front opening; and

at least one second fiber optic component optically connected to at least one of the plurality of optical fibers to provide optical connection between the at least one second fiber optic component and at least one of the first plurality of fiber optic components.

22. The fiber optic module of claim **14**, further comprising at least one rail disposed on the main body.

23. The fiber optic module of claim **22**, further comprising at least one latch attached to the at least one rail and configured to engage the at least one rail.

JX-0001 ('206 Patent) at 20:48-65, 21:27-31 (emphasis added).

Firstly, the limitation at issue is expressed in claim 14 in terms of "a front opening." In the '206 patent, as respondents and the Staff argued, asserted claim 14 clearly claims "a front opening" as opposed to "front openings" claimed in unasserted claim 63. While "[a]s a general rule, the words 'a' or 'an' in a patent claim carry the meaning of 'one or more[,]'" an exception to this rule arises when a patentee "evince[s] a clear intent to limit 'a' or 'an' to 'one.'" *01 Communique Lab., Inc. v. LogMeIn, Inc.*, 687 F.3d 1292, 1297 (Fed. Cir. 2012). The exception to the general rule arises "where the language of the claims themselves, the specification, or the prosecution history necessitate a departure from the rule." *Id.*; *Baldwin Graphic Sys., Inc. v. Siebert, Inc.*, 512 F.3d 1338, 1342-43 (Fed. Cir. 2008). That is the case here. The explicit contrast between the language of claims 14 and 63 of the '206 patent indicates that the exception should apply.

An element by element comparison of asserted claim 14 and unasserted claim 18 is shown in the table below.

[redacted]

Claim 14	Claim 63
14. A fiber optic module, comprising: a main body defining an internal chamber disposed between a front side and a rear side;	**63**. A fiber optic module, comprising: a main body defining an internal chamber disposed between a front side and a rear side, ***wherein the front side has a width***;
a plurality of optical fibers disposed in the internal chamber;	a plurality of optical fibers disposed in the internal chamber;
a front opening **disposed along a longitudinal axis in the front side**;	***front openings having a width being at least eighty-five percent (85%) of the width of the front side of the main body***;
a first plurality of fiber optic components optically connected to the plurality of optical fibers, the first plurality of fiber optic components disposed through the front opening ***providing a fiber optic connection density of at least one fiber optic connection per 7.0 millimeters (mm) of width of the front opening***; and	a first plurality of fiber optic components optically connected to the plurality of optical fibers, the fiber optic components disposed through the front openings; and
at least one second fiber optic component optically connected to at least one of the plurality of optical fibers to provide optical connection between the at least one second fiber optic component and at least one of the first plurality of fiber optic components.	at least one second fiber optic component optically connected to at least one of the plurality of optical fibers to provide optical connection between the at least one second fiber optic component and at least one of the first plurality of fiber optic components.

JX-0001 ('206 Patent) at 20:48-65, 24:15-31 (emphasis added).

It can be seen that there are some substantive differences between claims 14 and 63 in addition to the front opening(s). The fourth element of claim 14 requires a "front opening providing a fiber optic connection density of at least one fiber optic connection per 7.0 millimeters (mm) of width of the front opening." This requirement is missing in claim 63. The third element of claim 63 requires that the front openings should have "a width being at least eighty-five percent (85%) of the width of the front side of the main

[redacted]

body" whereas claim 14 simply requires that the front opening be "disposed along a longitudinal axis in the front side."

In any event, it is clear that claim 63 is relevant to the question of whether claim 14 claims a single front opening or more than multiple front openings. Based on plain language of the claims and claim differentiation,[46] it is determined that claim 14 claims only a single front opening.

Corning argues that "[a]lthough Figure 13 depicts an embodiment with one single, continuous space for adapters, the specification includes other embodiments, such as Figure 15, that contain multiple spaces and that include the structural material separating the adapters as part of the 'front opening 126'…. It would therefore be improper to limit the claims to the embodiment in Figure 13." Compl. Br. at 52.

Concerning the embodiment shown in FIG. 15, the '206 patent discloses:

> FIG. 15 is a front perspective view of another alternate fiber optic module 22'' that can be installed in the fiber optic equipment tray 20 of FIG. 1. ***The form factor of the fiber optic module 22'' is the same as the form factor of the fiber optic module 22 illustrated in FIGS. 1-13. However, in the fiber optic module 22'', four (4) MPO fiber optic adapters 154 are disposed through the front opening 126 of the fiber***

[46] Where different phrases are used in separate claims, the doctrine of claim differentiation creates a rebuttable presumption that a difference in meaning and scope was intended. *Tandon Corp. v. International Trade Comm'n*, 831 F.2d 1017, 1023 (Fed. Cir. 1987); *see also Aspex Eyewear, Inc. v. Marchon Eyewear, Inc.*, 672 F.3d 1335, 1349 (Fed. Cir. 2012) (when different words are used in separate claims, they are presumed to have different meanings); *cf. InterDigital Communications, LLC v. International Trade Comm'n*, 690 F.3d 1318, 1334 (Fed. Cir. 2012).

[redacted]

> ***optic module 22''.*** The MPO fiber optic adapters 154 are connected to four (4) MPO fiber optic adapters 156 disposed in the rear end 98 of the main body 90 of the fiber optic module 22'. Thus, if the MPO fiber optic adapters 150 support twelve (12) fibers, the fiber optic module 22'' can support up to forty-eight (48) fiber optic connections. Thus, in this example, if up to twelve (12) fiber optic modules 22'' are provided in the fiber optic equipment trays 20 of the chassis 12, up to five hundred seventy-six (756) fiber optic connections can be supported by the chassis 12 in a 1-U space. ***Further in this example, the front opening 126 of the fiber optic module 22'' may support twenty-four (24) fiber optic connections in the width W_1 to support a fiber optic connection density of at least one fiber optic connection per 1.7 mm of width W_1 of the front opening 126***.

JX-0001 ('206 Patent) at 12:54-13:8 (emphasis added).

Thus, the specification teaches that the embodiment of the fiber optic module shown in FIG. 15 (1) has the same form factor as the module shown in FIGS. 1-13; and (2) unlike the module shown in FIGS. 1-13, in the FIG. 15 module "four (4) MPO fiber optic adapters 154 are disposed through the front opening 126"; and (3) unlike the module shown in FIGS. 1-13, the FIG. 15 module supports "a fiber optic connection density of at least one fiber optic connection per 1.7 mm of width W1 of the front opening 126."[47]

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[47] Corning did not cite FIG. 14 but it is also relevant. Concerning the embodiment shown in FIG. 14, the '206 patent discloses:

> Alternate fiber optic modules with alternative fiber optic connection densities are possible. FIG. 14 is a front perspective view of an alternate fiber optic module 22' that can be installed in the fiber optic equipment tray 20 of FIG. 1. ***The form factor of the fiber optic module 22' is the same as the form factor of the fiber optic module 22 illustrated in FIGS. 1-13. However, in the fiber optic module 22' of FIG. 14, two (2) MPO fiber optic adapters 150 are disposed through the front opening 126 of the fiber optic module 22'.*** The MPO fiber optic adapters 150 are connected to two (2) MPO fiber optic adapters 152 disposed in the rear side 98 of the main body 90 of the fiber optic module 22'. Thus, if the MPO fiber optic adapters 150 each support twelve (12) fibers, the fiber optic module 22' can support up to twenty-four (24) fiber optic

[redacted]

From the above disclosure, it is clear that multiple fiber optic components (in this case, LC adapters) may be disposed in a single front opening such as the front opening shown in FIG. 13. This is consistent with the specification's disclosure that FIGS. 10A, 10B, 11, 12, and 13 are different views of the same module embodiment. The '206 patent specification clearly states, "FIG. 13 is a front view of the fiber optic module of FIG. 11 without fiber optic components installed." JX-0001 ('206 Patent) at 3:4-5.[48] Thus, the single opening shown in FIG. 13 has dimensions H1 and W1 which is the total

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> connections. Thus, in this example, if up to twelve (12) fiber optic modules 22' are provided in the fiber optic equipment trays 20 of the chassis 12, up to two hundred eighty-eight (288) fiber optic connections can be supported by the chassis 12 in a 1-U space. ***Further in this example, the front opening 126 of the fiber optic module 22' may support twenty-four (24) fiber optic connections in the width W_1 (FIG. 13) to support a fiber optic connection density of at least one fiber optic connection per 3.4-3.5 mm of width W_1 of the front opening 126***. It should be understood that the discussion with regard to modules may also apply to a panel. For purposes of this disclosure, a panel may have one or more adapter on one side and no adapters on the opposite side.

JX-0001 ('206 Patent) at 11:53-12:12 (emphasis added).

Similar to FIG. 15, the specification teaches that the embodiment of the fiber optic module shown in FIG. 14 (1) has the same form factor as the module shown in FIGS. 1-13; and (2) unlike the module shown in FIGS. 1-13, in the FIG. 14 module "two (2) MPO fiber optic adapters 150 are disposed through the front opening 126"; and (3) unlike the module shown in FIGS. 1-13, the FIG. 14 module supports "a fiber optic connection density of at least one fiber optic connection per 3.4-3.5 mm of width W1 of the front opening 126."

[48] Additionally, the BRIEF DESCRIPTION OF THE FIGURES discloses:

> FIGS. 10A and 10B are front right and left perspective views, respectively, of an exemplary fiber optic module that can be disposed in the fiber optic equipment trays of FIG. 3;
>
> FIG. 11 is a perspective, exploded view of the fiber optic module in FIGS. 10A and 10B;
>
> FIG. 12 is a perspective top view of the fiber optic module of FIG. 11 with the cover removed and showing a fiber optic harness installed therein;...

JX-0001 ('206 Patent) at 2:60-67.

[redacted]

area in the front of the module that provides for the insertion of multiple adapters. In this example, the single front opening shown in FIG. 13 supports a plurality of fiber optic components that are shown in FIGS. 10A, 10B, 11, and 12. The main difference between the embodiments shown in FIGS. 14 and 15 and the embodiment shown in FIGS. 10A, 10B, 11, and 12 is that in the former embodiments, the spacing between the two or four MPO adapters can be easily identified whereas the spacing between the six LC adapters shown in FIGS. 10A, 10B, 11, and 12 cannot easily be seen. This is because these figures are not engineering design drawings. This does not mean that there are no spaces (or dividers) between the six LC adapters. Most design drawings are proprietary, so it is not surprising that the '206 patent specification and figures do not identify every single part that make up a module. In any event, the record evidence includes a Corning design drawing (cited by Corning's technical prong expert) that shows two dividers of 0.84 thickness disposed between three duplex LC adapters. *See* CX-0977C (Corning EDGE Base-12 Module Drawing) (SECTION E-E view); CX-0002C (Ralph WS) Q/A 101 ("This evidence shows that each Base-12 module has six duplex adapters occupying an 81.57 mm opening comprised of three 26.63m spaces for adapters and two 0.84 mm spacers.").

In view of the above analysis, the administrative law judge construes the claim term "front opening" as "a single opening located in the front side of a fiber optic module, *e.g.*, the opening depicted in Figure 13 of the '206 patent as having dimensions H_1 and W_1."

B. Infringement Analysis of the '206 Patent

As noted, Corning asserts dependent claims 22 and 23 of the '206 patent, both of

[redacted]

which depend from independent claim 14. Claims 22 and 23 are asserted against FS, Panduit, and Wirewerks. Siemon is accused of infringing claim 22 only. *See* Compl. Br. at 127-39.

For the reasons discussed below, Corning has shown by a preponderance of the evidence that (1) the accused products of FS and Wirewerks infringe asserted claims 22 and 23; and (2) Siemon's accused products infringe asserted claim 22. However, it has not been shown that Panduit's accused products infringe asserted claim 22 or 23.

1. Accused Products

The accused products consist of chassis, modules, and combinations thereof. There are three categories of accused products, Base-8, Base-12, and Base-24, which are defined by the number of fiber connections available per module. First, a Base-8 module supports eight fiber connections, and a Base-8 chassis supports eighteen Base-8 modules per 1U space. CX-0001C (Prucnal WS) Q/A 63. Second, a Base-12 module supports twelve fiber connections, and a Base-12 chassis supports twelve Base-12 modules per 1U space. *Id*. Finally, a Base-24 module supports twenty-four fiber connections, and a Base-24 chassis supports six Base-24 modules per 1U space. *Id*. In each case, there are a total of 144 connections available in a 1U space; the difference in the three categories is in the number of modules needed to fill that space.

Within each category, there are three chassis sizes: 1U, 2U, and 4U, which refer to the chassis height. *Id*. Apart from the total height, these types are materially the same for each respondent. *Id*. That is, the fiber optic connection density for a 1U chassis from a given respondent is the same as the density for a 2U or 4U chassis from that respondent. *Id*. Q/A 64. Complainant argues that therefore "for each Respondent, and within each

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fiber connectivity configuration (Base-12, Base-8, and Base-24), a 1U chassis is representative of a 2U chassis and a 4U chassis for purposes of the asserted patents." *Id.*; *see also* CX-2042 (Compl. & Siemon Stip. Re Representative Accused Prods.) (stipulating that within each of the three categories, Siemon's 1U chassis is representative of its 2U and 4U chassis for purposes of the asserted patents).

Complainant has offered a complete list of representative accused products for each respondent, along with the group of accused products represented by each such product, through the testimony of Dr. Prucnal. CX-0001C (Prucnal WS) Q/A 62; *see* CDX-0013 (Prucnal list of accused products).

Not all respondents market all types of accused products. The following describes the accused products allegedly imported and/or sold in the United States by each respondent:

Summary of Accused Products

Respondent	Brand	Chassis			Module		
		Base-8	Base-12	Base-24	Base-8	Base-12	Base-24
FS	FHX	1U	1U		X	X	
Panduit	HD FLEX	1U/2U/4U	1U/2U/4U	1U/2U/4U	X	X	X
Siemon	LightStack	1U/2U/4U	1U/2U/4U		X	X	
Wirewerks	NextSTEP					X	

See Staff Br. at 20.

[redacted]

a. Panduit

The Panduit accused products are marketed as "HD FLEX Fiber" enclosures and cassettes. The accused Panduit chassis fall into three categories (Base-8, Base-12, and Base-24), and are available in three sizes (1U, 2U, and 4U). The accused Panduit modules are available in three configurations (Base-8, Base-12, and Base-24). *See* CX-0001C (Prucnal WS) Q/A 85; CPX-0062 (Panduit Base-8 1U chassis); CPX-0063 (Panduit Base-12 1U chassis); CPX-0065 (Panduit Base-24 1U chassis); CPX-0073 (Panduit Base-8 module); CPX-0074 (Panduit Base-12 module); CPX-0075 (Panduit Base-24 module).

b. Siemon

The Siemon accused products are marketed under the name "LightStack Ultra High-Density Fiber Plug and Play system." The accused Siemon chassis fall into two categories (Base-8 and Base-12) and are available in three sizes (1U, 2U, and 4U). The accused Siemon modules are available in Base-8 and Base-12 configurations. *See* CX-0001C (Prucnal WS) Q/A 106; CPX-0076 (Siemon Base-8 1U chassis); CPX-0077 (Siemon Base-12 1U chassis); CPX-0078 (pre-Aug. 2019 version of Siemon Base-12 1U chassis); CPX-0079 (Siemon Base-8 module); CPX-0080 (Siemon Base-12 module).

c. FS

The FS accused products are marketed under the names "FHX Series" and "FHX-FCP/ FHX-C Series" and include both chassis and modules. The accused FS chassis fall into two categories (Base-8 and Base-12) and are available in just one size (1U). The accused FS modules are available in Base-8 and Base-12 configurations. *See* CX-0001C

[redacted]

(Prucnal WS) Q/A 117; CPX-0053 (FS Base-8 1U chassis); CPX-0054 (FS Base-12 1U chassis); CPX-0055 (FS Base-8 module); CPX-0056 (FS Base-12 module).

d. Wirewerks

The Wirewerks accused products consist of modules only, marketed under the name "NextSTEP." The NextSTEP modules all have LC adapters supporting twelve fiber connections on the front and a twelve-fiber MPO adapter on the rear. *See* CX-0001C (Prucnal WS) Q/A 117; CPX-0081 (Wirewerks Base-12 module).

In addition to the Wirewerks accused products, Order No. 23 provided that the parties may seek adjudication of an additional Wirewerks product identified as the "Wirewerks First Alternative Design." Order No. 23 at 5 (Oct. 14, 2020); RPX-0078C (First Alternative Design module). The First Alternative Design includes a new adapter, which is used in the same housing as the accused NextSTEP module. RX-0006C (Min RWS) Q/A 227-28. The adapter includes additional material on the front side that, according to Wirewerks, increases the "connection density" of the total product when using the method for measuring density that was used in the complaint. *Id.*; RX-1673C (Tabet WS) Q/A 41-53.

2. Direct Infringement[49]

As noted, Corning asserts dependent claims 22 and 23 of the '206 patent, both of which depend from independent claim 14. Claims 22 and 23 are asserted against FS, Panduit, and Wirewerks. Siemon is accused of infringing claim 22 only. *See* Compl. Br.

[49] Unlike the other three asserted patents, the '206 patent is directed only to modules, not also to the chassis that receive and support those modules. Thus, it is not necessary to consider whether any respondent infringes indirectly. The importation or sale of an infringing module, by itself, would be sufficient to establish direct infringement.

[redacted]

at 127-39.

a. Issues Common to Multiple Respondents

i. "front opening"

Unasserted independent claim 14 reads as follows:

> **14**. A fiber optic module, comprising:
>
> a main body defining an internal chamber disposed between a front side and a rear side;
>
> a plurality of optical fibers disposed in the internal chamber;
>
> a ***front opening*** disposed along a longitudinal axis in the front side;
>
> a first plurality of fiber optic components optically connected to the plurality of optical fibers, the first plurality of fiber optic components disposed through the front opening providing a fiber optic connection density of at least one fiber optic connection per 7.0 millimeters (mm) of width of the front opening; and
>
> at least one second fiber optic component optically connected to at least one of the plurality of optical fibers to provide optical connection between the at least one second fiber optic component and at least one of the first plurality of fiber optic components.

JX-0001 ('206 Patent) at 20:48-65 (emphasis added).

Each respondent's Base-12 and Base-8 modules satisfy independent claim 14, which claims fiber optic connection density in the front opening of the module. Under Corning's proposed construction (adopted by the administrative law judge with modification),[50] the front opening of each accused module is the total area in the front of

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[50] The administrative law judge determined that the claim term "front opening" should be construed to mean "a single opening located in the front side of a fiber optic module, *e.g.*, the opening depicted in Figure 13 of the '206 patent as having dimensions H1 and W1." *See* Section VII. A.2, *supra*.

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the module that provides for the insertion of adapters. *See* CX-0001C (Prucnal WS) Q/A 522-23; CDX-0001C (Prucnal Direct Demonstratives) at 609. Further, that space supports a plurality of fiber optic components. Panduit's Base-12 Module, for example, has six spaces for six duplex LC adapters, and each duplex LC adapter is comprised of two simplex LC adapters. *See* CX-0001C (Prucnal WS) Q/A 532; CDX-0001C (Prucnal Direct Demonstratives) at 613-14. The same is true of Panduit's Base-8 modules, which have three spaces for four duplex LC adapters. CX-0001C (Prucnal WS) Q/A 307, 533; CDX-0001C (Prucnal Direct Demonstratives) at 615. The other Accused Base-12 and Base-8 Modules have similar arrangements. *See* CX-0001C (Prucnal WS) Q/A 310-11, 314-15, 533-38; CDX-0001C (Prucnal Direct Demonstratives) at 618, 621.

Respondents argue that, based on their proposed construction of "front opening," only one component is disposed through each front opening in a module, not a "plurality of fiber optic components" as claim 14 requires. *See* Resps. Br. at 229-32. However, the '206 patent defines component to include "connector." JX-0001 ('206 Patent) at 2:6-8 ("The fiber optic components and connections can be provided by fiber optic adapters and/or fiber optic connectors as examples."); 4:51-54 (similar). Each adapter in each respondent's modules receives more than one connector that terminates an internal fiber and can connect to an external fiber in a jumper. *See* CX-2060C (Prucnal RWS) Q/A 84.

Under respondents' proposed construction, any space that houses any LC adapter is a "single opening located on the front of the module" and, thus, the "front opening." *See* Resps. Br. at 50-53. Dr. Min opines that the accused modules do not infringe under respondents' construction because they contain "multiple distinct openings" not a single opening. *See, e.g.*, RX-0006C (Min RWS) Q/A 186-89. The fact that there are multiple

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openings necessarily means there is at least one "single opening." That single opening is the "front opening" which the administrative law judge construed to mean "a single opening located in the front side of a fiber optic module, *e.g.*, the opening depicted in Figure 13 of the '206 patent as having dimensions H1 and W1." *See* Section VII. A.2, *supra*. It is undisputed that that single opening "having dimensions H1 and W1" is the total area in the front of the module that provides for the insertion of adapters. That single front opening supports a plurality of fiber optic components as shown in Figs. 11, 12, and 13 of the '206 patent. *See* Section VII. A.2, *supra* (discussing the fact that Figs. 11, 12, and 13 are different views of the same module embodiment). As noted, Panduit's Base-12 Module, for example, has six spaces (or openings) for six duplex LC adapters, and each duplex LC adapter is comprised of two simplex LC adapters. Those six spaces (or openings) are encompassed within the single "opening depicted in Figure 13 of the '206 patent as having dimensions H1 and W1." Indeed, Dr. Min explained during the hearing that he did not think it would be reasonable to treat any of the openings as the "front opening" under the Staff's or Corning's — not respondents' — proposed constructions. Min Tr. 852.

In the Staff's view, modules with plastic spacers between the adapters necessarily have more than one front opening and fall outside the scope of claim 14. *See* Staff Br. at 50-54. Dr. Min seems to support this view of Corning's and Staff's construction, opining that Figure 13 cannot represent the accused modules because Figure 13 does not show spacers installed in the modules. *See* RX-0006C (Min RWS) Q/A 192. As discussed, this cannot be the case when the '206 patent specification clearly discloses, "FIG. 13 is a front view of the fiber optic module of FIG. 11 without fiber optic components installed."

[redacted]

JX-0001 ('206 Patent) at 3:4-5.

Relying on respondents' documents, which he confirmed with his own measurements, Dr. Prucnal performed the following calculations for each accused Base-12 and Base-8 module. *See* CX-0001C (Prucnal WS) Q/A 532-40. He determined the space available on the front side for inserting adapters. *See id.* Consistent with Corning's and the Staff's proposed construction (adopted by the administrative law judge with modification), he included any space between adapters (such as that occupied by spacers) as well as any unused space on either side. *See id.* He then determined that the Base-12 modules support 12 fiber optic connections and the Base-8 modules support 8. *See id.* Dr. Prucnal then divided the available space by the number of connections to arrive at a fiber connection density, which, in each case, was greater than "at least one fiber optic connection per 7.0 millimeters (mm) of width of the front opening," and therefore satisfies this claim.

In applying respondents' proposed construction that only one, uninterrupted space should be considered, Dr. Prucnal calculated the space occupied by a single adapter, and divided that by the number of fibers that adapter supports. *See id.* Q/A 532-40. Here, too, Dr. Prucnal found that the density in each case was greater than at least one fiber connection per 7.0 mm of the width of the front opening. *See id.*

ii. Doctrine of Equivalents ("front opening")

While it is not the usual practice to discuss infringement under the doctrine of equivalents before discussing all the merits of literal infringement, this issue is common to multiple respondents, and thus it is appropriate to do so here. For the reasons set forth below, and as Dr. Prucnal has shown, the "front opening" elements of respondents'

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accused products (discussed in detail immediately above) infringe under the doctrine of equivalents because any differences between the claimed limitations and the accused devices are insubstantial. Respondents' accused modules' front spaces perform substantially the same function as the patented feature in substantially the same way to achieve substantially the same result. *See* Prucnal Tr. 414 (explaining that the "spacers are there just…as structural elements. And it would be an equivalent way to achieve the density"); CX-0001 (Prucnal WS) Q/A 541-44.

First, the front sections in respondents' accused modules perform substantially the same function as the claimed front opening. The front sections in respondents' accused modules house fiber optic adapters that achieve high-density connections, including up to 144 connections per U space, based on using simplex/duplex components. *See* CX-0001C (Prucnal WS) Q/A 541-44. As Mr. Tabet of Wirewerks explained, a module needs spaces to hold adapters; the plastic separators between the adapters support the adapters and provide no additional function; and the only reason for the spaces in the front of the module is to receive an adapter. JX-0025 (Tabet Dep. Tr.) 153-154, 156. This is the same as the function of the front opening described in the '206 patent: "[a] front opening is disposed along a longitudinal axis in the front side of the main body. A plurality of fiber optic components is disposed through the front opening." JX-0001 ('206 Patent) at 1:57-60; *id.* at 2:7-9 ("The fiber optic components and connections can be provided by fiber optic adapters and/or fiber optic connectors as examples."); *see also id.* at 4:59-60:1, 9:9-17, 9:67-68:7, 10:25-37, 11:23-41, 11:59-61, 12:58-61, 14:5-34. Dr. Min opines that Wirewerks spacers' have the same function as the channel disclosed in Figures 16-18 of the '206 patent, but that is the not the case. The channel separates two

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distinct halves of the module and receives a rail; it is not the same as plastic material separating adapters within the module body. *See* RX-0006C (Min RWS) Q/A 212.

Dr. Min opines that, because the accused modules contain spacers that he claims create separate front openings, they do "not function in substantially the same way as a single opening." *See* RX-0006C (Min RWS) Q/A 209. The only claimed function of the front opening — as Dr. Min does not dispute — is to receive fiber optic components (adapters), and Dr. Min shows no difference in terms of function between modules with spacers and those without. To the contrary, the modules shown in the '206 patent (without spacers) achieve the same result as the accused modules.

Second, the front sections in respondents' accused modules perform that function in substantially the same way as the claimed front opening. The Base-12 accused modules create spaces in the module to receive and support a total of 12 fiber optic ports (which receive 6 LC duplex connectors) on the front face of the module, so that when twelve modules are installed in the three trays of a chassis, that apparatus achieves 144 LC connections per 1U space, based on using simplex/duplex components. *See* CX-0001C (Prucnal WS) Q/A 543. This is the same configuration that the '206 patent specification describes for achieving that density. JX-0001 ('206 Patent) at 10:34-37 ("Thus, the chassis 12 is capable of supporting up to one hundred forty-four (144) fiber optic connections in a 1-U space by twelve (12) simplex or six (6) duplex fiber optic adapters being disposed in the fiber optic modules 22.").

Dr. Min opines that the spacers in the accused modules provide "structural support during molding and also allow for a more straightforward molding process," and therefore perform the claimed function in a different way. *See* RX-0006C (Min RWS)

[redacted]

Q/A 211-15. Dr. Min provides no support for this opinion. In any event, even assuming the spacers provided these or benefits, it would not change the fact that the way the modules perform the function of supporting adapters is by creating spaces for them. *See Miles Labs., Inc. v. Shandon Inc.*, 997 F.2d 870, 877 (Fed. Cir. 1993) (finding equivalence where accused product offered additional features unrelated to the result recited by the claims); *Insta-Foam Prods.*, 906 F.2d at 702.

Third, the front sections in respondents' accused modules achieve the same result as the claimed front opening. As explained, respondents' accused modules provide 144 connections per U space, using duplex LC connectors, in a configuration using three sliding trays and 4 modules per tray. *See* CX-0001C (Prucnal WS) Q/A 544.

b. Direct Infringement - Panduit

i. Unasserted Independent Claim 14

Corning has shown by a preponderance of the evidence that each Panduit Base-12 and Base-8 accused module practices each element of claims 14, 22, and 23 of the '206 patent. *See* CX-0001C (Prucnal WS) Q/A 507-14, 518, 522-24, 528, 532-33, 541-45, 549-51, 555-56.

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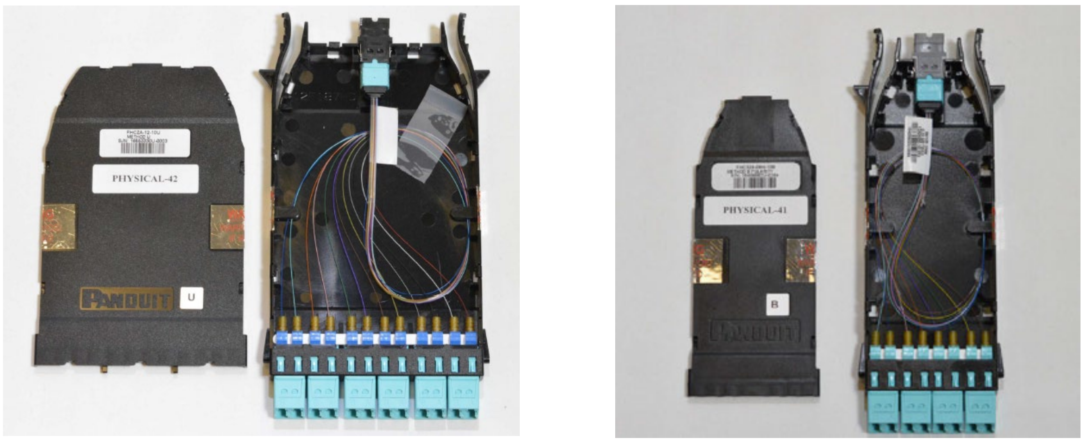
Representative modules are shown below:



Left: CX-1849 (Panduit photos) at 23 (depicting CPX-0074 (Panduit Base-12 module))
Right: CX-1849 (Panduit photos) at 45 (depicting CPX-0073 (Panduit Base-8 module))

As shown above in the common issues discussion, Dr. Prucnal has shown that Panduit's accused modules each have an infringing front opening. Respondents agree with Dr. Prucnal's calculations and concede that Panduit's Base-8 and Base-12 Modules practice this limitation under Corning's proposed construction (adopted by the administrative law judge with modification). *See* CX-0001C (Prucnal WS) Q/A 532-33. Respondents concede that all other limitations of claim 14 are met. Nonetheless, claim 14 is not asserted by Corning.

ii. Dependent Claims 22 and 23

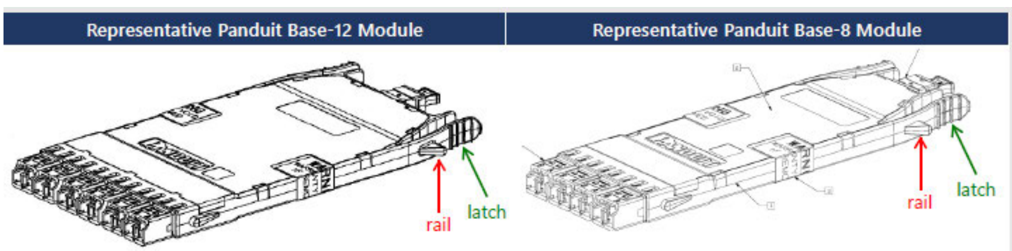
Asserted dependent claims 22 and 23 read as follows:

> **22**. The fiber optic module of claim **14**, further comprising ***at least one rail*** disposed on the main body.
>
> **23**. The fiber optic module of claim **22**, further comprising ***at least one latch attached to the at least one rail*** and configured to engage the at least one rail.

JX-0001 ('206 Patent) at 21:27-31 (emphasis added).

[redacted]

Corning argues, *inter alia*:

> Dr. Prucnal demonstrated that the Panduit accused Base-12 and Base-8 modules contain triangular protrusions on both the front and rear end of both end of the module that are used to help guide the module into a fiber optic equipment tray. *See* CX-0001C (Prucnal WS) Q/A 551; CDX-0001C (Prucnal Direct) at 629; CX-1631 (Panduit HD FLEX MPO Cassette Customer Drawing); CX-1672C (Panduit HD Flex 1-Port LC Cassette Drawing); CX-1678C (Panduit HD Flex Cassette Drawing 2); CX-0620 (Panduit HD Flex Ordering Guide-1) at 5-7; CX-1607C (Panduit HDFE 12 Fiber LC Cassette Drawing); and CX-0147 (Panduit HD Flex Cassettes Spec.). Dr. Prucnal also provided an extensive explanation as to how these rails interact with the module guides to guide the modules into the fiber optic equipment tray. *See* CX-0001C (Prucnal WS) Q/A 460. Dr. Prucnal clearly labeled the identified rails on Panduit's accused modules, as shown for example below (CDX-0001C (Prucnal Direct) at 629):
>
> 
>
>
> ….The rail on the side of each Panduit accused module extends into a protrusion at the rear of the module that forms a latch; when the module is inserted into a module guide in the tray of a corresponding chassis, the latch-protrusion snaps into an opening in the module guide, engaging the rail so that it is locked into place. A release tab that extends from the rail beyond the rear of the module is used to remove the latch-protrusion from the opening in the module, engaging the rail so that it can move within the module guide. CX-0001C (Prucnal WS) Q/A 556; CDX-0001C (Prucnal Direct) at 634; CX-0620 (Panduit HD Flex Ordering Guide-1) at 5-7; CX-1607C (Panduit HDFE 12 Fiber LC Cassette Drawing); CX-0147 (Panduit HD Flex Cassettes Spec.); and CX-1631 (Panduit HD FLEX MPO Cassette Customer Drawing); JX-0017C (Kuffel Dep. Tr.) 354:16-355:5, 433:3-12 (HD Flex modules have latches that allow movement of the module).

Compl. Br. at 133-34.

Dr. Min opined that the Panduit accused modules do not read on the limitations added by claims 22 and 23. Claim 22 requires "at least one rail disposed on the main

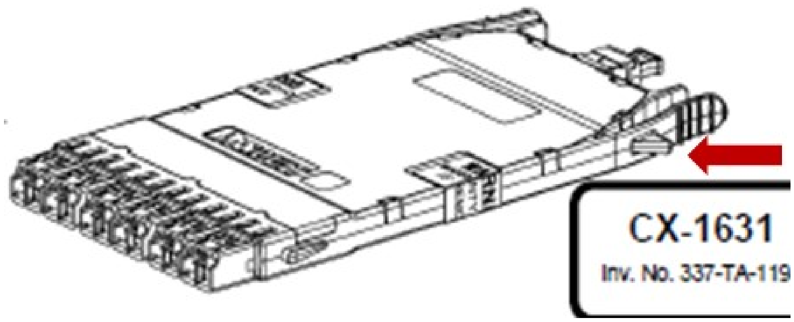
[redacted]

body." JX-0001 ('206 Patent) at 21:27-28. Claim 23 further requires "at least one latch attached to the at least one rail and configured to engage the at least one rail." *Id.* at 21:29-31. Dr. Min testified that the Panduit accused modules do not have either a "rail" or a "latch attached to the . . . rail." RX-0006C (Min RWS) Q/A 230-36, 243-46.

Dr. Prucnal testified that "a rail disposed on a module is a protrusion on the side of the module that is used for purposes of guiding the module into a device[.]" CX-0001C (Prucnal WS) Q/A 550. He further testified that the Panduit accused modules "contain[] triangular protrusions on both the front and rear end of both end[s] of the module that are used to help guide the module into a fiber optic equipment tray. *Id.* Q/A 551; *see also* CX-1631 (Panduit HD FLEX MPO Cassette customer drawing); CX-1672C (Panduit HD Flex 1-Port LC Cassette drawing).

As the Staff noted, the evidence shows that these protrusions are just that – triangular lumps or protrusions on the sides of the modules, not rails as that term is commonly understood. *See* Staff Br. at 180-81 (citing CPX-0073; CPX-0074; CX-1631 (Panduit HD FLEX MPO Cassette customer drawing); CX-1672C (Panduit HD Flex 1-Port LC Cassette drawing)). As Dr. Min testified, Dr. Prucnal failed to explain how these protrusions are used to guide the module into a device. RX-0006C (Min RWS) Q/A 236.

[redacted]



CX-1631 (HD FLEX MPO Cassette customer drawing) (depicting triangular protrusions) (arrow added by Staff)

Dr. Prucnal also testified that "[t]he rail on the side of each of these modules extends into a protrusion at the rear of the module that forms a latch[.]" CX-0001C (Prucnal WS) Q/A 551. According to Dr. Prucnal, "when the module is inserted into a module guide in the tray of a corresponding chassis, the latch-protrusion snaps into an opening in the module guide, engaging the rail so that it is locked into place." *Id*. However, the latch of claim 23 must be "attached to the at least one rail and configured to engage the at least one rail." JX-0001 ('206 Patent) at 21:29-31. Inasmuch as the Panduit accused modules do not have a rail, there can be no latch "attached to the at least one rail." *See id*.

Accordingly, although Panduit accused modules practice unasserted claim 14, they do not infringe asserted claims 22 and 23 of the '206 patent.

c. Direct Infringement - Siemon

i. Unasserted Independent Claim 14

Corning has shown by a preponderance of the evidence that each Base-12 and Base-8 Siemon accused module practices each element of claims 14 and 22 of the '206 patent. *See* CX-0001 (Prucnal WS) Q/A 507-13, 515, 519, 522-23, 525, 529, 532, 534-

[redacted]

35, 541-44, 546, 549-50, and 552.

Representative modules are shown below:

Left: CX-1853 (Siemon photos) at 14 (depicting CPX-0080 (Siemon Base-12 module))
Right: CX-1853 (Siemon photos) at 28 (depicting CPX-0079 (Siemon Base-8 module))

As in the case of Panduit, the principal issue is the dispute over the front opening. With respect to the front opening, Dr. Prucnal measured Siemon's module density the same way he measured Panduit's. *See* CX-0001C (Prucnal WS) Q/A 534-35. Respondents agree with Dr. Prucnal's calculations and concede that Siemon's Base-8 and Base-12 Modules practice this limitation under Corning's view of the proposed constructions. Respondents concede that all other limitations of claim 14 are met.

ii. Dependent Claim 22

Dr. Prucnal demonstrated that the Siemon accused Base-12 and Base-8 modules

[redacted]

have protrusions on the middle left and right sides of the module that are used to help guide the movement of the module into the tray. *See* CX-0001C (Prucnal WS) Q/A 552; CDX-0001C (Prucnal Direct Demonstratives) at 630-631.

CX-0179C (Siemon Plug and Play presentation) at 10 (excerpt) (depicting Siemon Base-12 LightStack module) (arrow added by Staff)

Dr. Prucnal also explained as to how these rails interact with the module guides to guide the modules into the fiber optic equipment tray. *See* CX-0001C (Prucnal WS) Q/A 462. Dr. Prucnal clearly labeled the identified rails on Siemon's accused modules. CDX-0001C (Prucnal Direct Demonstratives) at 630.

Dr. Min opines that Dr. Prucnal has provided no "explanation as to how" the rails that Dr. Prucnal identified" interact with a rail guide. Here again, Dr. Min overlooks the relevant part of Dr. Prucnal's testimony. Dr. Prucnal explains:

> When a Representative Siemon Base-12 Module or Siemon Base-8 Module is inserted in the front or rear of the tray of a Representative Siemon Base-12 Chassis or Siemon Base-8 Chassis, respectively, the latch on [the] left divider grabs the left rear edge of the module; the latch on the right divider grabs the front edge of the module; and the module rail protrusions slide between the surface of the tray and a plastic rail on the divider.

CX-0001C (Prucnal WS) Q/A 462. That is sufficient to explain how the rails on the module guide the module into the tray. When the module is guided into the tray, these protrusions fit under a module guide that "keep it from going . . . up and down."

[redacted]

JX-0018C (Maynard Dep. Tr.) 144. Thus, the protrusions interact with the module guides to direct module movement, as the claim requires. CX-0001C (Prucnal WS) Q/A 8, 109-10, 552.

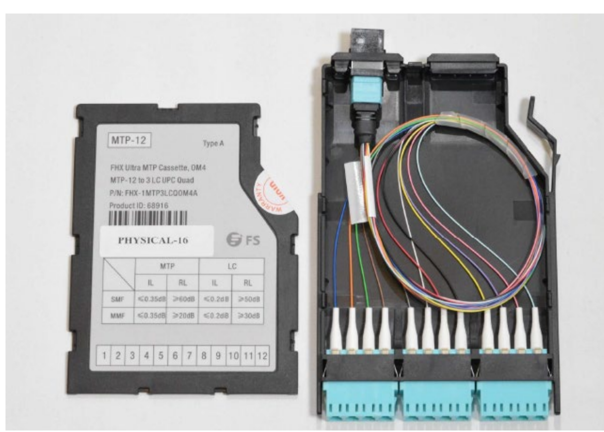
The Staff agrees that claim 22 is satisfied. *See* Staff Br. at 182-83 ("Unlike the Panduit modules, the Siemon modules have left- and right-side protrusions that are rail-shaped, and there is testimony by a Siemon engineer explaining that the protrusions, or "guides," are used to align the modules within the chassis.").

d. Direct Infringement - FS

i. Unasserted Independent Claim 14

Corning has shown by a preponderance of the evidence that each FS Base-12 and Base-8 accused module practices each element of claims 14, 22, and 23 of the '206 patent. *See* CX-0001C (Prucnal WS) Q/A 507-13, 516, 520, 522-23, 526, 530, 532, 536-37, 541-44, 547, 549-50, 553, 555, 557.

The FS accused modules are available in Base-12 and Base-8 configurations. Representative modules are shown below:



[redacted]

Left: CX-1855 (FS photos) at 20 (depicting CPX-0056 (FS Base-12 module))
Right: CX-1855 (FS photos) at 40 (depicting CPX-0055 (FS Base-8 module))

The parties agree that the FS accused modules comprise a main body defining an internal chamber, disposed between a front side and a rear side. *See* CX-0001C (Prucnal WS) Q/A 516. They also agree that there are a plurality of optical fibers disposed in the internal chamber, that there are fiber optic components optically connected to the optical fibers on the front side of the module, and that there is a second fiber optic component optically connected to at least one of the plurality of optical fibers. *See id.* Q/A 520, 530, 547.

Dr. Prucnal measured FS's module density the same way he measured Siemon's. *See* CX-0001C (Prucnal WS) Q/A 536-37. FS did not provide documents with measurements of the front opening of its accused modules, and so Dr. Prucnal took these measurements himself. He found that the FS Base-12 module had a front opening of 84.2 mm (including unused space in the opening), and a fiber optic connection density of at least one connection per 6.7 mm of a front opening of the module; and that the FS Base-8 modules had a front opening of 54.3 mm (including unused space in the opening), and the same density as the Base-12 module. *See* CX-0001C (Prucnal WS) Q/A 536-37.

[redacted]

Respondents argue that the Base-12 module density is less than required because it comes out to one fiber optic connection per 7.017 mm; but a person of ordinary skill would round that number to 7.0 mm. *See Viskase Corp. v. Am. Nat'l. Can Co.*, 261 F.3d 1316, 1320 (Fed. Cir. 2001); Prucnal Tr. 375-376. Dr. Min's extreme position on numerical precision — for example, that "84.999 million 9's" still could not be rounded up to 85, Min Tr. 849 — is thus contrary to the understanding of a person of ordinary skill and to Federal Circuit precedent.

Respondents argue that "rather than measuring the openings, Dr. Prucnal measured the space occupied by the adapters." Resps. Br. at 235. That is incorrect: Dr. Prucnal's measurements included the spacers, and therefore encompassed the entire front opening. *See* CX-0001C (Prucnal) Q/A 535-36 ("including any unused space on either side"); CDX-0001C (Prucnal Direct Demonstratives) at 617-18 (including spacers in measurements), 620-21 (showing W_1 for FS).

FS provides alternative measurements, citing Dr. Min's testimony. *See* Resps. Br. at 235. Dr. Min, however, does not describe what or how he is measuring, or provide any description or support for them. *See id.* Dr. Min's unsupported measurements are unpersuasive.

Respondents argue that the claims exclude densities even two-hundredths of a millimeter outside the 7.0 mm limitation. *See* Resps. Br. at 235. They offer no evidence that the '206 patent requires greater precision than conventional tolerances, especially where the claim recites a measurement with a single digit after the decimal point.

Respondents concede that all other limitations of claim 14 are met.

[redacted]

ii. Dependent Claims 22 and 23

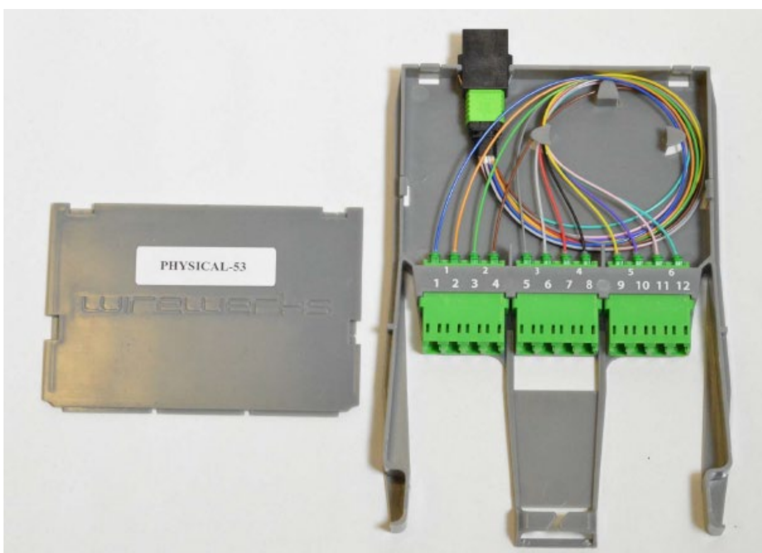
Respondents have not argued that the FS accused modules fail to satisfy the additional limitations of claims 22 and 23. Respondents concede that the FS accused modules practice these claims. *See* Resps. Br. at 237-40.

e. Direct Infringement - Wirewerks

i. Unasserted Independent Claim 14

Corning has shown by a preponderance of the evidence that each Wirewerks Base-12 accused module practices each element of claims 14, 22, and 23 of the '206 patent. *See* CX-0001 (Prucnal WS) Q/A 507-13, 517, 521-23, 527, 531, 538-40, 541-44, 54-50, 554-55, 558.

Wirewerks accused NextSTEP Base-12 module is shown below:



CX-1857 (Wirewerks photos) at 4 (depicting CPX-0081 (Wirewerks Base-12 module))

Dr. Prucnal measured Wirewerks' module density the same way he measured Siemon's. *See* CX-0001C (Prucnal WS) Q/A 538.

[redacted]

Respondents argue that, based on Figure 13, Dr. Prucnal's measurement of the front opening should have included structural material to the sides of the space designed to receive those adapters. *See* Resps. Br. at 232-34. As Dr. Prucnal explained, that structural material is not part of any opening, but falls outside the opening, and the lines drawn next to the arrows in Figure 13 do not provide a basis to conclude otherwise. Prucnal Tr. 352-353; *see In re Anderson*, 743 F.2d 1578, 1581 (Fed. Cir. 1984) (per curiam) (holding that ambiguities arising from a figure do not alter otherwise clear language in the specification).

Respondents argue that Corning "improperly measured the connection density, by measuring the adapter cutouts rather than the space occupied by the adapters." *See* Resps. Br. at 232. This is argument is based on the unsupported assumption that "W_1 is wider than the cutout to account for the space occupied by the components themselves." *Id*. at 233. The specification says the opposite — describing W_1 as the open space for receiving adapters, while additional space on the front side, such as item 96 in Figure 10A, is part of W_2. JX-0001 ('206 Patent) at 9:64-10:18. Accordingly, Dr. Prucnal measured the module housing that holds the components, not the components themselves. *See* CX-0001C (Prucnal WS) Q/A 536-40. As a result, there is no difference in density between the Wirewerks accused module and the Wirewerks First Alternative Design discussed below.

Respondents argue that Wirewerks doesn't infringe because its connection density is "7.04167 mm" rather than 7.0 mm or less. *See* Resps. Br. at 235; RX-0006C (Min RWS) Q/A 225. A person of ordinary skill would consider 7.04 mm to satisfy a claim requiring 7.0 mm — the extra decimal place is not recited in the claim, and in this case

[redacted]

would round down according to standard practice. *See Viskase Corp.*, 261 F.3d at 1320; *Noven Pharms., Inc. v. Actavis Labs. UT, Inc.*, C.A. No. 15-249-LPS, 2016 WL 3625541, at *3, 5 (D. Del. July 5, 2016) (construing the term "15 mg/cm^2" as having a "plain and ordinary meaning . . . of greater than or equal to 14.5 mg/cm^2 and less than 15.5 mg/cm^2"). Respondents offer no evidence that the '206 patent requires greater precision than conventional tolerances, especially where the claim recites a measurement with a single digit after the decimal point.

Wirewerks has asked for an additional new design to be adjudicated in this investigation, the Wirewerks First Alternative Design. *See* Order No. 23 at 5 (Oct. 14, 2020). The housing for the First Alternative Design is the same as the NextSTEP housing shown above. RX-1673C (Tabet WS) Q/A 43. The adapters, however, are modified in the manner shown below:

[redacted]

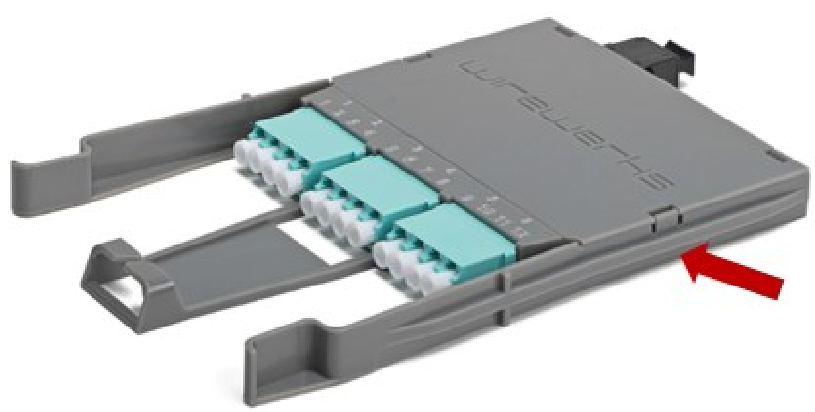
Thus, Wirewerks First Alternative Design uses the same module housing but differently shaped adapters. *See* CX-0276C (Wirewerks Custom LC Quad Adapter

[redacted]

Drawing). There is no difference between the front opening inasmuch as there is no difference between module housings. Tabet Tr. 444-445. Nor is there a difference, even if relevant, between the widths of the adapters. *Id.* As a result, the same analysis Dr. Prucnal applied to the Wirewerks accused module applies to the First Alternative.

ii. Dependent Claims 22 and 23

The accused module and the First Alternative Design satisfy the additional limitations of claims 22 and 23. Claim 22 requires “at least one rail disposed on the main body.” JX-0001 (‘206 Patent) at 21:27-28. Dr. Prucnal testified that the housing used for the two Wirewerks modules “contains rails on the left and right sides of the module.” CX-0001C (Prucnal WS) Q/A 554; *see* CX-0645 (Wirewerks NextSTEP module datasheet) at 2; CPX-0081 (Wirewerks Base-12 module). A Wirewerks engineer testified that this raised structure is a “slider,” an alignment feature used to align the module within the chassis. JX-0025C (Tabet Dep. Tr.) at 94:15-105:20.



CX-0645 (Wirewerks NextSTEP module datasheet) at 2 (arrow added by Staff)

Dr. Min opined that this rail “appears to be at least partially disposed on the arm, rather than the main body.” RX-0006C (Min RWS) Q/A 237. According to Dr. Min, this

[redacted]

is inconsistent with the language of claim 22, which requires the rail to be "disposed on the main body." *Id.*; *see* JX-0001 ('206 Patent) at 21:27-28. The bulk of the identified rail on the NextSTEP module, however, is attached to the main body of the module, with only a small portion extending to the "arm" region. CX-0645 (Wirewerks NextSTEP module datasheet) at 2; CPX-0081 (Wirewerks accused module). This is sufficient to read on the limitation of claim 22.

Claim 23 requires "at least one latch attached to the at least one rail and configured to engage the at least one rail." *Id.* at 21:29-31. Dr. Prucnal testified that "[t]he rail on the side of each of these modules extends into a protrusion at the front of the module that forms a latch[.]" *See* CX-0001C (Prucnal WS) Q/A 558. He further testified that "when the module is inserted into its corresponding chassis, the latch-protrusion snaps into an opening in the module guide, engaging the rail so that it is locked into place." *Id.*; *see* CX-1857 (Wirewerks photos) at 3; CX-0277C (Wirewerks module drawing); CPX-0081 (Wirewerks accused module); CDX-0001C (Prucnal Direct Demonstratives) at 639.

[redacted]

Dr. Min opined that the alleged latch "is located on the arm, which is not part of the main body." RX-0006C (Min RWS) Q/A 247. Claim 23, however, does not require the latch to be attached to the main body; rather, it must be attached to the rail. The asserted "latch" is attached to both the module arm and to the asserted "rail." *See* CX-1857 (Wirewerks photos) at 3; CX-0277C (Wirewerks module drawing); CPX-0081 (Wirewerks accused module).

Accordingly, the accused module and the First Alternative Design satisfy the additional limitations of claims 22 and 23.

C. Domestic Industry (Technical Prong)

Respondents do not contest that the EDGE DI Modules practice asserted 22 and 23 of the '206 patent. *See* Joint Outline at 9. The Staff argues that the EDGE modules do not satisfy the "front opening" limitation of claim 14, and thus do not practice the claim, literally or under the doctrine of equivalents. Staff Br. at 189.

For the reasons set forth below, the evidence shows that the Corning domestic

[redacted]

industry products are covered by asserted dependent claims 22 and 23 of the '206 patent.

i. Independent Claim 14 (not asserted)

The Staff argues, *inter alia*:

> In the Staff's view, however, the EDGE modules do not practice independent claim 14 because there is no "front opening disposed along a longitudinal axis in the front side" under Respondents' or the Staff's proposed constructions. For the reasons discussed in Part VIII.A.1.a above, the Staff agrees with Respondents that the "front opening" disclosed in claim 14 must be a single opening, not a series of multiple openings. The EDGE Base-12 and Base-8 modules all have multiple openings in the front side of the module, and there are physical dividers between those multiple openings. *See* CX-0002C (Ralph WS) Q/A 178, 80. The Base-12 modules have three openings containing two duplex adapters each, while the Base-8 modules have four. *Id.*; *see* CX-1869 (Corning photos) at 45, 51; CPX-0042 (EDGE Base-8 module); CPX-0043 (EDGE Base-12 module). Because they do not have a single contiguous opening, the Staff submits that the EDGE modules do not satisfy the "front opening" limitation of claim 14, and thus do not practice the claim, literally or under the doctrine of equivalents.

Staff Br. at 189.

ii. Dependent Claims 22 and 23

The Staff argues:

> With respect to the additional limitations of the dependent claims, the evidence shows that the EDGE modules have rails along the left and right sides of the main body of the module. CX-0002C (Ralph WS) Q/A 185; JX-0035C (Staber Dep. Tr.) at 134:16-135:5. "The rail on the right side of each of these modules extends into a protrusion at the rear of the module that forms a latch." CX-0002C Q/A 187. When an EDGE module is inserted into a module guide in the tray of an EDGE chassis, "the latch-protrusion snaps into an opening in the module guide, engaging the rail so that it is locked into place" *Id.*; JX-0034C (Rhoney Dep. Tr.) at 109:21-110:7. Thus, if the EDGE modules are found to practice claim 14, they will practice claims 22 and 23 as well. Nevertheless, because the EDGE modules do not practice claim 14, and therefore do not practice either claim 22 or claim 23, Corning has not satisfied the technical prong of the domestic industry requirement with regard to the '206 Patent.

[redacted]

Staff Br. at 190.

Respondents do not contest that the EDGE DI Modules practice asserted claims 22 and 23 of the '206 patent. Claims 22 and 23 depend from unasserted independent claim 14, which is directed to a fiber optic module with an internal chamber housing optical fibers connecting components on the front and rear, a front opening on the front side of the module, and a plurality of fiber optic components disposed through the front opening providing at least one connection per 7.0 mm of the front opening. JX-0001 ('206 Patent), Claim 14. Dr. Ralph demonstrated that the EDGE DI Modules satisfy each of these elements. *See* CX-0002C (Ralph WS) Q/A 167-182; CPX-0042 (EDGE Base-8 Module); CPX-0043 (EDGE Base-12 Module).

Specifically, the EDGE DI Modules have duplex adapters on the front side and an MTP adapter on the rear side; the duplex adapters provide densities of at least one connection per 7.0 mm, for both EDGE and EDGE8 modules, under Corning's and respondents' proposed constructions of "front opening." *See id.* Q/A 178-181; CX-1869 (Corning Photos Ex. D) at 46-47, 52-53. Claim 22 further recites a rail disposed on the main body of the module, and claim 23 recites a latch attached to the rail configured to engage with it: Dr. Ralph explained why the EDGE DI Modules satisfy each of these asserted claims. *See id.* Q/A 183-87.

Although respondents do not contest any of these elements, the Staff argues that the EDGE DI Modules do not practice unasserted independent claim 14 because they lack the "front opening" recited in independent claim 14. The Staff argues the modules do not practice claim 14 because they "have multiple openings in the front side of the module, and there are physical dividers between these multiple openings." *See* Staff Br.

[redacted]

at 189. As discussed above with respect to infringement in the common issues section (*see* Section VII.B.2.a.1, *supra*), however, the "front opening" in the '206 patent is the entire space into which adapters are disposed, not each individual adapter space. The presence of spacers between adapters does not change the scope of the patent. *See* CDX-0002C (Ralph Direct Demonstratives) at 129 (citing CX-1869C). As with the accused products, under the correct construction of "front opening," the EDGE DI Modules practice the asserted claims. That extensive discussion need not be repeated here.

Accordingly, the evidence shows that the Corning domestic industry products practice asserted dependent claims 22 and 23 of the '206 patent.

D. Validity of the '206 Patent

As noted, Corning asserts dependent claims 22 and 23 of the '206 patent. Respondents argue:

(1) Siemon Plug and Play Module (RX-0499 (Siemon Plug and Play Module Drawing)) anticipates the asserted claims 22 and 23;

(2) Castonguay (RX-0453 (U.S. Patent No. 7,349,616)) anticipates the unasserted claim 14;

(3) asserted claims 22 and 23 are rendered obvious by Siemon Plug and Play Module in view of Wheeler '444 (RX-0445 (U.S. Patent No. 5,497,444 to Wheeler));

(4) asserted claims 22 and 23 are rendered obvious by Siemon Plug and Play Module in view of Wagner '089 (RX-0457 (U.S. Patent No. 7,689,089));

(5) asserted claims 22 and 23 are obvious over Castonguay in view of Wagner '089;

(6) asserted claims 22 and 23 are obvious over Castonguay in view of Wheeler '444; and

(7) asserted claims 22 and 23 are obvious over Castonguay in view of Siemon Plug and Play Module.

[redacted]

See Resps. Br. at 240-54.

Complainant and the Staff disagree. *See* Compl. Br. at 186-99; Staff Br. at 190-202.

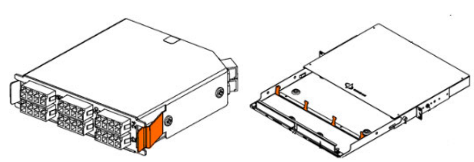
For the reasons set forth below, respondents have not shown by clear and convincing evidence that the asserted claims 22 and 23 of the '206 patent are invalid under any theory.

1. Anticipation

a. Siemon Plug & Play Module

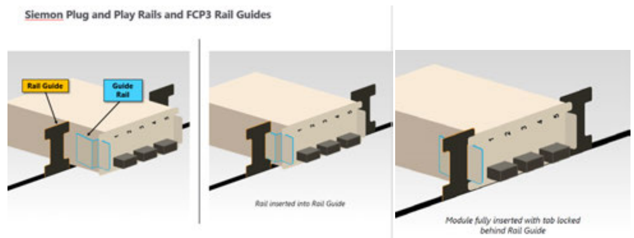
Respondents argue that Siemon Plug and Play Module (RX-0499 (Siemon Plug and Play Module Drawing)) anticipates the asserted claims 22 and 23. *See* Resps. Br. 240-44. Corning and the Staff disagree. *See* Compl. Br. at 186-90; Staff Br. at 190-93.

Respondents argue that claim 22 is anticipated, *inter alia*:

> As demonstrated below, Siemon Plug and Play renders these limitations anticipated. The Plug and Play module includes "rails", as they are claimed in the '206 Patent, along the front sides of the modules. The rails slide into guides on the chassis to assist in the insertion of the modules. In particular, the Plug and Play module discloses angled protrusions shown in orange below near the front sides of the modules. *See* annotated drawing of RX-0499 (Siemon Plug and Play Drawing). The edges of the protrusions engage with and slide along guides on the Siemon FCP3 enclosure to enable insertion of the modules into the chassis:
>
> 
>
> Annotated RX-0499 (Siemon Plug and Play Drawing) and RX-0498 (Siemon FCP3 Drawing).
>
> The corresponding guides, shown above in orange, located on the tray of the FCP3 enclosure engage with the protrusions on the modules to guide the modules into position within the enclosure, where it latches into place, as shown below in the demonstrative exhibit. *See* annotated

[redacted]

drawing of RX-0498 (Siemon FCP3 Drawing) RDX-0001.210-211 (RX-0001C (Blumenthal WS) Q/A 640); RX-1266C (Veatch WS) Q/A 41.



RDX-0012.2-5 (RX-1266C (Veatch WS) Q/A 41).

The Plug and Play discloses the "rails" as claimed in the '206 Patent along the front sides of the modules that interact and engage with the notches in an I-shaped guide structure on the FCP3 enclosure. RX-1266C (Veatch WS) Q/A 41; RX-0001C (Blumenthal WS) Q/A 640; RX-0498 (Siemon FCP3 Drawing). Complainant argued in its Pretrial Brief that "these protrusions do not perform the function of a rail as understood by a person of ordinary skill, which is to facilitate the insertion of the module into an enclosure". CPHB at 202. However, Dr. Prucnal testified that a structure is a rail if it has a corresponding rail guide. Prucnal Tr. 1009:3-1010:9. He then acknowledged the structure on the enclosure tray does in fact guide the insertion of the modules into the enclosure and admitted the notches in the rail guide on the FCP3 enclosure interact with the Plug and Play module's angled protrusions, or rails, to slide the module into position before the latch is actuated. Prucnal Tr. 1007:19-1010:9. Accordingly, by disclosing a structure on the module that is guided, this demonstrates a "rail" by Dr. Prucnal's definition. *Id.*

Resps. Br. at 242-44. Respondents also argue that claim 23 is anticipated, *inter alia*:

Claim 23, which recites a latch attached to the rail, is anticipated by the Siemon Plug and Play module. RX-0001C (Blumenthal WS) Q/A 640, 645. Complainant attempts to muddy the water by claiming in its Pretrial Brief that no latch has been identified. CPTB at 203-204. Their arguments are specious. In addition to the reasons set forth in the previous paragraph, Dr. Prucnal admitted that a latch is present on the Siemon Plug and Play module; he only claims that the latch does not anticipate claim 23 because the rail of claim 22 is not present. CX-2060C (Prucnal RWS) Q/A 636; Prucnal Tr. 1010:16-1012:7, 1015:4-1016:2.

When the rails are guided into place, the latch portion of the structure is actuated and secures the module in place, as shown for example in the demonstrative exhibit above. RDX-0001.210-211 (RX-0001C (Blumenthal WS) Q/A 640, 645); RDX-0012.2-5 (RX-1266C (Veatch WS) Q/A 41). Dr. Prucnal could not deny the latch can be

[redacted]

> actuated to allow for the module to be slid in and out of position. Prucnal Tr. 1015:4-1016:2. Accordingly, the claimed latch is anticipated by the Siemon Plug and Play module.

Resps. Br. at 244.

For the reasons discussed below, respondents have not shown by clear and convincing evidence that Siemon Plug and Play Module anticipates the asserted claims 22 and 23 of the '206 patent.

As an initial matter, the '206 patent, which claims the module density in the high-density EDGE system, has been subjected to vigorous scrutiny over several years. The examiner allowed all of the asserted claims of the '206 patent over at least Wheeler '444, which respondents nonetheless assert as prior art against asserted claim 22. *See* JX-0002 ('206 Prosecution History) at 4257. After the '206 patent issued, Panduit filed a petition requesting *inter partes* review of claims 22 and 23 (among others). *Id.* at 5138. The PTAB denied institution, finding that Panduit had not shown even "a reasonable likelihood that it [could] prevail in showing claims 14-40 . . . of the '206 patent are unpatentable." *Id.*

Unasserted independent claim 14 and asserted dependent claims 22 and 23 read as follows:

> **14**. A fiber optic module, comprising:
>
> a main body defining an internal chamber disposed between a front side and a rear side;
>
> a plurality of optical fibers disposed in the internal chamber;
>
> a ***front opening*** disposed along a longitudinal axis in the front side;
>
> a first plurality of fiber optic components optically connected to the plurality of optical fibers, the first

[redacted]

plurality of fiber optic components disposed through the front opening providing a fiber optic connection density of at least one fiber optic connection per 7.0 millimeters (mm) of width of the front opening; and

at least one second fiber optic component optically connected to at least one of the plurality of optical fibers to provide optical connection between the at least one second fiber optic component and at least one of the first plurality of fiber optic components.

22. The fiber optic module of claim **14**, further comprising at least one rail disposed on the main body.

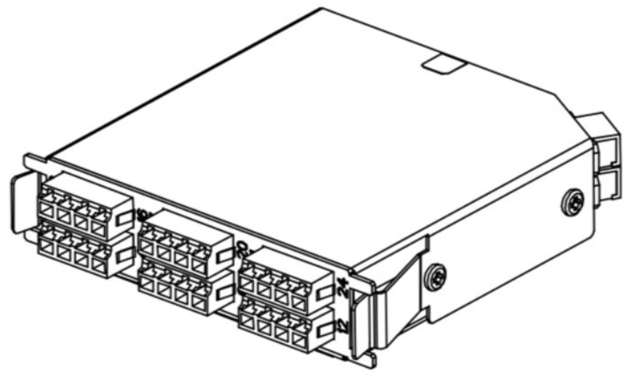
23. The fiber optic module of claim **22**, further comprising at least one latch attached to the at least one rail and configured to engage the at least one rail.

JX-0001 ('206 Patent) at 20:48-65, 21:27-31 (emphasis added).

The Siemon Plug and Play Modules ("Plug and Play"), enclosed fiber connector modules that could be installed in a rack-mountable enclosure, were offered for sale in the United States by no later than 2004. *See* RX-1266C (Veatch WS) Q/A 40; RX-0001C (Blumenthal) Q/A 618. The modules include three or six openings on the front end for installation of either one row of twelve connections or two rows totaling twenty four fiber connections. RX-0499 (Siemon Plug and Play Module drawing); Blumenthal Tr. 786 ("Looking at this module, how many front openings are there in the front side of the Siemon plug and play module? A. So in terms of actual openings, there are six openings in the front of this module."). Fiber from the front connections is routed internally within the module to a single twelve- or twenty-four port connector at the rear of the module. *See* RX-0001C (Blumenthal) Q/A 621. It is roughly rectangular in shape, with top, bottom, front, rear, and two lateral sides, but also an angled side between the rear side and one of the lateral sides. *See* CX-2060C (Prucnal RWS) Q/A 621. The rear port is

[redacted]

located on an angled edge between the rear of the module and one of its two lateral sides. RX-0499; *see id.*



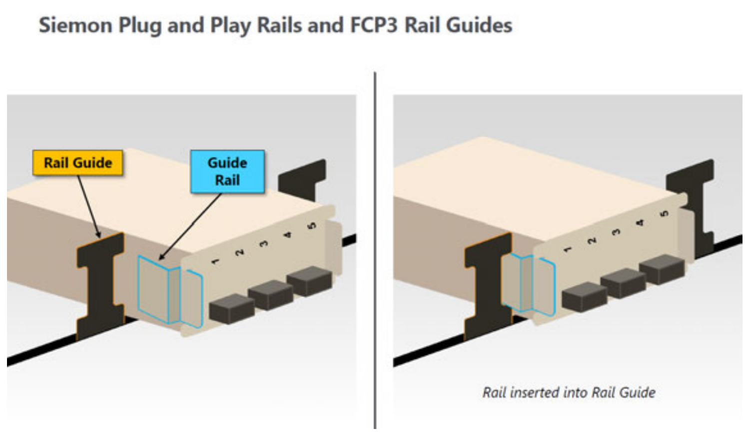
RX-0499 (Siemon Plug and Play Module drawing) 24-port version

According to Siemon's product documentation, Plug and Play fits into multiple Siemon enclosure models, although Dr. Blumenthal and Mr. Veatch testified only to its fit within the FCP3 patch panel. *Id.*; RX-0506 (Siemon Plug & Play fiber products sheet) at 1; RX-0001C (Blumenthal WS) Q/A 640; RX-1266C (Veatch WS) Q/A 41. To lock into place within these enclosures, "the front side of the Plug and Play module has flanges that extend laterally from each of that side's four corners beyond the side walls of the module." CX-2060C (Prucnal RWS) Q/A 621. Between these flanges, affixed to the side walls, Plug and Play features "integrated latches for snap-in installation and single-finger removal." RX-0506 at 1; *see* CX-2060C (Prucnal RWS) Q/A 621. The module has no other mechanisms for guiding or locking it into place. CX-2060C (Prucnal RWS) Q/A 621.

[redacted]

i. Claim 22

Claim 22 requires "at least one rail disposed on the main body." Dr. Blumenthal incorrectly opines that the latching mechanism, on the flanges, on the front corner of Plug and Play is a rail. *See* CX-2060C (Prucnal RWS) Q/A 630-31; RX-0001C (Blumenthal WS) Q/A 640-41. This feature comprises angled protrusions that are not rails. *See* CX-2060C (Prucnal RWS) Q/A 632-33.



RDX-0001C (Blumenthal Demonstratives) at 210.

These protrusions do not perform the function of a rail as understood by a person of ordinary skill, which is to facilitate the insertion of the module into an enclosure. *See* CX-2060C (Prucnal RWS) Q/A 632-33. To the contrary, the protrusions are used to secure the module to the enclosure, not to facilitate movement within it. *Id.; see also* Prucnal Tr. 1005-1008. Consistent with this, the protrusions interact with flat pieces at the front of the enclosure, not with a module guide system (as a rail would do). *See* CX-2060C (Prucnal RWS) Q/A 276. Although respondents argue that the feature outlined in blue, RDX-0001C (Blumenthal Demonstratives) at 210, "slide[s] into guides on the chassis," Dr. Blumenthal states only that "the structure of the guide on the tray of the module interacts with and guides the module's rails," RX-0001C (Blumenthal WS) Q/A

[redacted]

640.

As Dr. Prucnal explained, the I-shaped structure that respondents call a "rail guide" does not interact with the supposed module rail when the module is inserted, but instead interacts with the side of the module body. Prucnal Tr. 1006-1009 ("I think the sides of the module are actually interacting with the — with the edges of the I to guide it."). That interaction — not any interaction with the supposed module rail — facilitates the insertion of the module. *Id.*

Further, Dr. Blumenthal points to no evidence that a person of ordinary skill would identify the angled protrusions as rails. RX-0001C (Blumenthal WS) Q/A 641; CX-2060C (Prucnal RWS) Q/A 634. His expert report originally claimed that this feature was a latch. *See* CX-2060C (Prucnal RWS) Q/A 632; CDX-0005C (Prucnal Rebuttal Demonstratives) at 276. Moreover, Siemon's own documents describe this feature not as a rail, but as a latch. *See, e.g.*, CX-0029 (Siemon Plug & Play Fiber Prod. Sheet) (describing the feature as an "integrated latch[] for snap-in installation"); CX-1776 (Siemon Light Systems Catalog) (describing the feature as a latch that allows the module to "be snapped into wall or rack mount enclosures"); CX-2060C (Prucnal RWS) Q/A 635. Without a rail, Plug and Play does not anticipate either claim 22 or 23.

ii. Claim 23

Respondents have not shown that Plug and Play anticipates the additional limitation of claim 23, which depends from claim 22 and further comprises "at least one latch attached to the at least one rail and configured to engage the at least one rail." Dr. Blumenthal opines these modules disclose "latches . . . attached at one end of the" features he identified as rails, and that, "[u]pon insertion of the modules, the latches

[redacted]

deflect behind the receiving guide on the tray, holding the module in place." *See* RX-0001C (Blumenthal WS) Q/A 645; CX-2060C (Prucnal RWS) Q/A 637. This feature is not a latch disposed on a rail. As set forth above, there is no rail on which a latch can be attached or with which the latch could be engaged. *See* CX-2060C (Prucnal RWS) Q/A 636.

In addition, Dr. Blumenthal has not explained with specificity the feature he identifies as the latch, particularly given his previous opinion that what he now calls the "rail" was the "latch." Similarly, Siemon witness Mr. Veatch claims the alleged rail includes a "tab that allowed the module to be latched in place." *See* RX-1266C (Veatch WS) Q/A 41. The demonstrative image he uses does not distinguish between the "rail" and the "latch"; instead, it outlines a single feature in blue. *Id.*; RDX-0012C (Veatch Demonstratives) at 2-5. This ambiguous showing is not enough to anticipate. *See Wasica*, 853 F.3d at 1284 (ambiguous references cannot anticipate a claim).

b. Castonguay

Respondents argue that Castonguay (RX-0453 (U.S. Patent No. 7,349,616)) anticipates the unasserted claim 14. *See* Resps. Br. at 249-50.

Respondents argue, *inter alia*:

> The evidence shows that Castonguay anticipates claim 14 of the '206 Patent. *See, e.g.*, RPHB at 250-55; RX-0001C (Blumenthal WS) Q/A 648-716; RDX-0001C.220-238 (Blumenthal Demonstratives); RX-0453 (Castonguay) at 2:61-3:18, 4:34-5:55, 11:19-12:32, 13:7-14, Figures 8-11. Corning concedes claim 14 is invalid. CPHB at 200-212; see also Prucnal Tr. 1000:13-24.
>
> Castonguay discloses various embodiments of the preamble "a fiber optic module," referred to as fiber distribution terminals ("FDTs"). RX-0001C (Blumenthal WS) Q/A 653-58. Castonguay discloses limitation 14[a] "a main body defining an internal chamber disposed

[redacted]

> between a front side and a rear side." *Id.* Q/A 659-67. For example, Figures 8-11 show a module comprising a generally rectangular housing that defines an "internal chamber" as the enclosed space visible in Figures 10 and 11 and invisible in Figures 8 and 9. *Id.*
>
> Figures 8-11 and accompanying specification of Castonguay describe, and/or visibly show, a plurality of optical fibers in the internal chamber, satisfying limitation 14[b] "a plurality of optical fibers disposed in the internal chamber." RX-0001C (Blumenthal WS) Q/A 668-71. Castonguay discloses limitation 14[c] "a front opening disposed along a longitudinal axis in the front side." *Id.* at 672-79.
>
> Castonguay discloses limitation 14[d] "a first plurality of fiber optic components optically connected to the plurality of optical fibers, the first plurality of fiber optic components disposed through the front opening providing a fiber optic connection density of at least one fiber optic connection per 7.0 millimeters (mm) of width of the front opening." RX-0001C (Blumenthal WS) Q/A 680-93. In some embodiments, twelve 5 mm fiber optic connectors are oriented as two rows and six columns (or "6X2"); in some other embodiments, eight 5 mm optical connectors are oriented as one row of eight (or "8X1"). *Id.* In each of the 6X2 and 8X1 orientations, the figures and the accompanying description show the connectors optically connected to the fibers within the internal chamber. *Id*. Each of the 6X2 and 8X1 configurations show a density below 7.0 mm. *Id.*
>
> Castonguay discloses limitation 14[e] "at least one second fiber optic component optically connected to at least one of the plurality of optical fibers to provide optical connection between the at least one second fiber optic component and at least one of the first plurality of fiber optic components." RX-0001C (Blumenthal WS) Q/A 694-98. Each of Figures 8A-11C show the second fiber optic component, described as an "input opening," and the plurality of optic components are disposed through an output opening. *Id*.

Resps. Br. at 249-50.

Corning states that "Claim 14 is not asserted and Corning does not agree this is an issue that should be decided." *See* Joint Outline at 8-9. Corning also cites to pages 193-199 of its brief which discusses obviousness issues concerning Castonguay but not anticipation. *See* Compl. Br. at 193-99. Consistent with Corning's position, the Staff does not address the merits of whether Castonguay anticipates unasserted claim 14. *See*

[redacted]

Staff Br. at 200.

The administrative law judge agrees that validity of unasserted claim 14 is not at issue in this investigation.

2. Obviousness

As noted, Corning asserts dependent claims 22 and 23 of the '206 patent. Respondents argue that the following five different combinations render obvious asserted claims 22 and 23 of the '206 patent.

(1) asserted claims 22 and 23 are rendered obvious by Siemon Plug and Play Module in view of Wheeler '444 (RX-0445 (U.S. Patent No. 5,497,444 to Wheeler));

(2) asserted claims 22 and 23 are rendered obvious by Siemon Plug and Play Module in view of Wagner '089 (RX-0457 (U.S. Patent No. 7,689,089));

(3) asserted claims 22 and 23 are obvious over Castonguay in view of Wagner '089;

(4) asserted claims 22 and 23 are obvious over Castonguay in view of Wheeler '444; and

(5) asserted claims 22 and 23 are obvious over Castonguay in view of Siemon Plug and Play Module.

See Resps. Br. at 244-54.

Complainant and the Staff disagree. *See* Compl. Br. at 190-99; Staff Br. at 194-202.

For the reasons discussed below, respondents have not shown by clear and convincing evidence that the five different combinations render asserted claims 22 and 23 of the '206 patent obvious.

[redacted]

a. Siemon Plug and Play in combination with Wheeler '444 or Wagner '089

As discussed below, respondents have not shown by clear and convincing evidence that Plug and Play in view of Wheeler '444 or Wagner '089 renders claims 22 and 23 obvious.

i. Claim 22

As set forth above, Dr. Blumenthal has not shown that Plug and Play anticipates claim 22, and he offers no further evidence that a person of ordinary skill would find claim 22 obvious from Plug and Play alone. Dr. Blumenthal also has not demonstrated a motivation to combine Plug and Play with U.S. Patent No. 5,497,444 to Wheeler (CX-1751 (Wheeler '444)). *See* CX-2060C (Prucnal RWS) Q/A 640. As Dr. Prucnal explains, the structure and function of Wheeler '444 make it incompatible with Plug and Play. *See id.* Q/A 640 and 625 (explaining that Plug and Play is designed to snap securely in place without movement, and explaining that modules are designed to interact with specially designed enclosures and are likely incompatible with others).

Wheeler '444 discloses "rail[s]" attached to a "module," but only to permit movement in the vertical direction. *See* CX-1751 (Wheeler '444) at 4:39-44; CX-2060C (Prucnal RWS) Q/A 641. It discloses this vertical movement as an advantage over "forward or backward" movement to reduce fiber displacement. Prucnal Tr. 1034 (explaining that Wheeler '444 taught away from "axial movement, because of wobble [which is] a problem when you have optical fibers connecting") CX-2060C (Prucnal RWS) Q/A 641; CX-1751 (Wheeler '444) at 7:12-20. Vertical movement creates spatial inefficiency and would be a poor choice for a module designed for a high-density system.

[redacted]

CX-2060C (Prucnal RWS) Q/A 641. Wheeler '444 requires substantial space above and below for the module to move — about 1.5" in each direction. *Id.*; CX-1751 (Wheeler '444) at 7:15. Including three additional inches of space around each Plug and Play module would wipe out the density sought by the '206 patent. *See* CX-2060C (Prucnal RWS) Q/A 641.

The density achieved by the '206 patent was not a concern of Wheeler '444, which was filed in 1995 at a time when such equipment was not intended for high-density fiber optic data center environments. *Id.* Wheeler was likely meant for telecommunications services in a central office. *Id.*; CX-1751 (Wheeler '444) at 1:10-11. Thus, even if Wheeler '444 took density into account, it did so at a time when the pursuit of density in the art was far less advanced. *See* CX-2060C (Prucnal RWS) Q/A 641. It is implausible that a person of ordinary skill at the time of EDGE's invention would have relied on a mid-1990s reference such as Wheeler '444 to solve the problems that confronted Corning's inventors. *Id.*; *In re Clay*, 966 F.2d 656, 659 (Fed. Cir. 1992) (holding that prior art is analogous only if it is from the same "field of endeavor" or "reasonably pertinent" "because of the matter with which it deals, logically would have commended itself to an inventor's attention in considering his problem").

Respondents argue for the first time in their posthearing brief that "protrusion 125" in Wagner '089 discloses the claimed rail. *Compare* Resps. Br. at 247 *with* Resps. Prehearing Br. at 247-48 (identifying the "side wall" as the alleged rail; no mention of "protrusion 125"). Inasmuch as it was not timely disclosed, this contention is waived. *See* Ground Rule 7.c. Even if not waived, it is unsupported by expert testimony. Respondents mischaracterize Dr. Prucnal's testimony as supporting their new argument;

[redacted]

but Dr. Prucnal testified just the opposite, that Wagner '089 does not disclose the claimed rail. *See* CX-2060C (Prucnal RWS) Q/A 648, 663. Also, inasmuch as Wagner '089 does not disclose a rail, the alleged latch of Wagner '089 is not attached to a rail or designed to engage the rail, as claim 23 requires.

ii. Claim 23

Combining Plug and Play with Wheeler '444 does not render claim 23 obvious. *See* CX-2060C (Prucnal RWS) Q/A 640. As shown above, the structures are incompatible — Wheeler '444's lock mechanism is unsuitable for combination with the Plug and Play module because it would consume significant space on the front side of the chassis. *See* CX-2060C (Prucnal RWS) Q/A 645.

In any event, Wheeler '444 does not disclose the claimed latch. Apart from claim 15, it does not use the word latch, and it recites "latch means for securing [the module] body to [a] fixture in any one of a plurality of fixed positions along [the] line of travel" without suggesting such "latch means" are attached to the rail. *See* CX-2060C (Prucnal RWS) Q/A 642. Dr. Blumenthal opines that the "latch means" language refers to "lock mechanism 70." RX-0001C (Blumenthal WS) Q/A 705. However, "lock mechanism 70" is not attached to any rails; it is instead attached to the "top and bottom walls," while the features Dr. Blumenthal identifies as rails are attached to the "side walls." *See* CX-1751 (Wheeler '444) at 4:40-43, 4:57-62; *see* CX-2060C (Prucnal RWS) Q/A 642. Wheeler '444 contains no disclosure suggesting that one should move the disclosed lock mechanism from its top and bottom walls to its sides.

Dr. Blumenthal further opines that the "rails are illustrated in contiguous proximity to the latch" — meaning the locking mechanism — "and appear to be a

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unibody construction." RX-0001C (Blumenthal WS) Q/A 705. However, claim 23 does not read on a latch that is "in . . . proximity" to rails; it requires a latch that is "attached" to a rail and "configured to engage" that rail. *See* CX-2060C (Prucnal RWS) Q/A 644. Nor is there a basis for Dr. Blumenthal's unsupported opinion that the rails and latch "appear to be a unibody construction," which he appears to infer from the drawing of Figure 23. CX-2060C (Prucnal RWS) Q/A 644.

Combining Plug and Play with Wagner '089 would not satisfy claim 23. *See* CX-2060C (Prucnal RWS) Q/A 648-49. Respondents propose that the "side wall" in Wagner '089 is the rail of claim 22, but have provided no expert opinion or evidence why the side wall, which is part of the main body of the module, is a "rail disposed on the main body," as required by claim 22.

Further, even if the Wagner '089 latch could satisfy claim 23, a person of ordinary skill would not think that those latches (items 122 and 128), built into the angled side of its cassette, should be combined with the Plug and Play. *Id.*; CX-1761 (Wagner '089) at Fig. 19. Plug and Play is largely rectangular and has only one small angled side, which holds the rear adapter and lacks space for a latch. *See* CX-2060C (Prucnal RWS) Q/A 650. If a person of ordinary skill were seeking to combine the Plug and Play module with Wagner '089, she would need either to redesign the Plug and Play module to accommodate a latch similar to the latch of Wagner '089, or redesign the latch of Wagner '089 to accommodate the rectangular design of the Plug and Play module. *Id.* Although respondents attempt to provide an explanations for why a person of ordinary skill would be motivated to make this combination, Resps. Br. at 248, Dr. Blumenthal does not explain which of these approaches he thinks a person of ordinary skill would take, why it

[redacted]

would be obvious to do so, or how the results of doing so would be predictable. *Id.* Nor did Siemon's or Panduit's engineers actually take such an approach in the real world.

b. Castonguay '616 combined with Wheeler '444, Wagner '089, or Siemon Plug and Play

As discussed below, respondents have not shown by clear and convincing evidence that U.S. Patent. No. 7,349,616 to Castonguay, CX-1758 (Castonguay '616), in combination with Wheeler '444, Wagner '089, or Plug and Play, renders claims 22 or 23 obvious.

Castonguay '616 claims an invention in the field of "fiber optic local convergence points adapted for multiple-dwelling units," such as buildings like "apartments" and "condominiums" where different residents each need internet or cable television access. CX-1758 (Castonguay '616) at 1:9-10, 1:24-25. It discloses a device called a "fiber distribution terminal" or "FDT," which is "adapted for use in a fiber optic network of a multiple dwelling unit," and that, in its various embodiments, comprises a "housing defining a top wall, a bottom wall, and at least one sidewall extending between the top wall and bottom wall." CX-1758 (Castonguay '616) at Figs. 8A-11A, 11:19-25, 11:31-32, 12:13-18, 12:23-25, 12:57-64, 13:1-8, & cl. 33; *see* CX-2060C (Prucnal RWS) Q/A 655.

i. Motivation to Combine Castonguay '616 with Wheeler '444, Wagner '089, or Plug and Play

A person of ordinary skill would not seek to solve the problem of the '206 patent — dense fiber optic modules that fit within an enclosure that provides accessible, practicable density in a fiber optic data center environment — by combining Castonguay

[redacted]

‘616 with Wheeler ‘444, Wagner ‘089, or Plug and Play.

First, Castonguay ‘616 and the other references cited are not in the same field of art, and a person of ordinary skill would not take Castonguay ‘616 as a starting point for solving the problems solved by EDGE. *See* CX-2060C (Prucnal RWS) Q/A 659. In its claims and its specification, Castonguay defines its field as devices for “multiple dwelling units,” not for data centers. *See* CX-1758 (Castonguay ‘616) at 1:9-10 & cl.31; CX-2060C (Prucnal RWS) Q/A 659; Ralph Tr. 244 (testifying that wiring Internet or cables in an apartment building is a “distinct skill” from designing structured cabling equipment in commercial data centers).

Second, Castonguay ‘616 is designed for wall mounting. The constraints facing a person of ordinary skill in designing dwelling-unit devices to be mounted to a wall in a basement or utility room are very different from those facing one designing data-center devices to be inserted into chassis that are installed in racks that are in turn installed in long rows. *See* CX-2060C (Prucnal RWS) Q/A 659. For example, a person of ordinary skill would mount Castonguay ‘616 on the wall and attach the incoming and outgoing fiber cables to the wall to conserve space and protect fibers. *See* CX-2060C (Prucnal RWS) Q/A 659; *see also, e.g.*, CX-1758 (Castonguay ‘616) at Fig. 7. This makes sense when the device is installed in a room that has multiple purposes and contains equipment for other functions. *See* CX-2060C (Prucnal RWS) Q/A 659. This same wall-mounted layout would be grossly inefficient in a data-center environment because it would reduce the space available for fiber optic cable distribution to the two-dimensional space available on the walls rather than the three-dimensional space available by lining up racks with chassis on the data center floor. *Id.*

[redacted]

Castonguay '616 describes its wall-mounted "housing" as a "top wall," a "bottom wall," and one or more "sidewalls." *See* CX-2060C (Prucnal RWS) Q/A 660. The "top wall" faces outward from the wall; the "bottom wall" faces the wall, and the "sidewalls" — which contain adapter opening — are the much narrower sides that are perpendicular to the wall and do not face the technician. *See* CX-1758 (Castonguay '616) at Fig. 8A; CX-2060C (Prucnal RWS) Q/A 660. Although turning the adapter openings away from the user may work in a dwelling unit where the device is installed once and rarely (if ever) accessed, it is not practical in a data center where there is a need for repeated access for moves, adds, or changes. CX-2060C (Prucnal RWS) Q/A 660.

Third, Castonguay '616 relies on adapters that are not necessarily compatible with the other references (or with the '206 patent). The density achieved by the Figure 8 and Figure 9 embodiments of Castonguay '616 relies on using "5 mm fiber optic receptacles," which appear to be non-standard and therefore unsuited for data center use. *See* CX-1758 (Castonguay '616) at 12:63-64; CX-2060C (Prucnal RWS) Q/A 661. Although Castonguay also discloses standardized "MU fiber optic receptacles," respondents provide no evidence that a person of ordinary skill would have been motivated to use these adapters in a data center, where LC and MPO/MTP components prevailed. *See* CX-2060C (Prucnal RWS) Q/A 661.

ii. Claim 22

Dr. Blumenthal admits that Castonguay '616 does not disclose the rail in claim 22. *See* CX-2060C (Prucnal RWS) Q/A 662. Although Wheeler '444 discloses a rail, it is for vertical movement, which, as shown above for the Plug-and-Play combination, is fundamentally incompatible with Castonguay '616. *See* CX-2060C (Prucnal RWS) Q/A

[redacted]

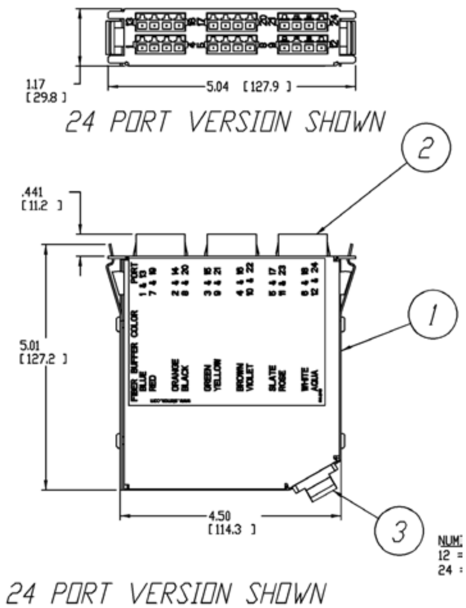
665-67.

As also shown above, Wagner '089 also does not disclose a rail. *See* CX-2060C (Prucnal RWS) Q/A 663; CX-1761 (Wagner '089) at 5:51-62 & Figs. 12-14, 19. To the extent respondents cite the "side wall" as disclosing a rail, Dr. Blumenthal's only opinion is a conclusory statement that the "side wall" shown in Figure 13 is used to guide the cassette for easy installation into the patch panel. *See* RX-0001C (Blumenthal WS) Q/A 707. He also relies on Figure 15, which does not have side wall 125 labeled, without identifying the feature himself. Dr. Blumenthal's assumptions are drawn from a side detail in one figure and unsupported by any text in the specification that describes the side wall as performing a guiding function. For example, the specification passage at 3:25-27 of Wagner '089, says nothing about installation; instead, it describes Figure 15 as illustrating "a partial top view of the pre-terminated cassette of Fig. 12 installed in the patch panel."

Dr. Blumenthal also opines that Plug and Play could be combined with Castonguay '616. However, as shown above, the feature Dr. Blumenthal identifies as a rail in Plug and Play is actually a latch, and that latch neither attaches to nor engages with a rail. *See* CX-0029 (Siemon Plug & Play Fiber Prod. Sheet); CX-2060C (Prucnal RWS) Q/A 669. In addition, a person of ordinary skill would not have been motivated to combine Castonguay '616 with Plug and Play. *See* CX-2060C (Prucnal RWS) Q/A 670. The angled protrusions disclosed by Plug and Play are unsuitable for combination with Castonguay '616 because they would consume significant space on the front end of the chassis. *Id*. The drawings in CX-0185 (Siemon LC Module Drawing) show that, unlike the rails and latches of the EDGE modules, which are disposed on the sides of those

[redacted]

modules, the angled protrusions near the front of Siemon Plug and Play require more than a half-inch of space on the front end of the chassis to accommodate them (5.04 — 4.50 = 0.54). CX-2060C (Prucnal RWS) Q/A 670.



Thus, a person of ordinary skill would not merely assume that the angled protrusions of Siemon Plug and Play could be combined with Castonguay '616 without compromising the ability to achieve density. *See* CX-2060C (Prucnal RWS) Q/A 670.

iii. Claim 23

Dr. Blumenthal admits that Castonguay '616 does not disclose the latch in claim 23. *See* CX-2060C (Prucnal RWS) Q/A 662. As shown above, although Wagner '089 discloses a latch, it is not attached to a rail and so does not disclose this limitation. *See* CX-2060C (Prucnal RWS) Q/A 664; CX-1761 (Wagner '089) at 5:51-62 & Figs. 12-14, 19. The latch disclosed by Wagner '089 (items 122 and 128) is instead built into the angled side of the Wagner '089 cassette, as shown below. CX-1761 (Wagner '089) at Fig. 19; CX-2060C (Prucnal RWS) Q/A 664.

[redacted]

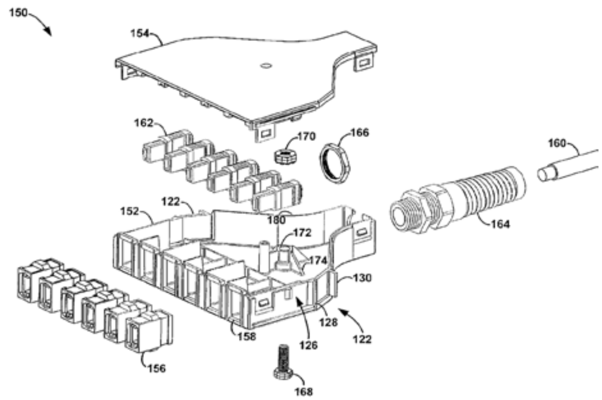


FIG. 19

The design of Wagner ‘089 is incompatible with that of Castonguay ‘616, which is rectangular and does not have angled sides. *See* CX-2060C (Prucnal RWS) Q/A 664. If a person of ordinary skill were seeking to combine Castonguay ‘616 with Wagner ‘089, they would either need to redesign Castonguay ‘616 to accommodate a latch similar to the latch of Wagner ‘089, or to redesign the latch of Wagner ‘089 to accommodate the rectangular design of Castonguay. *Id*. Dr. Blumenthal does not explain which of these approaches he thinks a person of ordinary skill would take, why it would be obvious to do so, or how the results would be predictable. *Id.*

Dr. Blumenthal also opines that Wheeler ‘444 could provide a latch, but as described above the locking mechanism disclosed by Wheeler ‘444 is not attached to a rail and also is unsuitable for combination with Castonguay ‘616. *Id*. Castonguay ‘616 involves FDTs that attach to walls, and such a device does not a locking mechanism because they do not lock into any other structure. *Id.* Further, as shown above, the vertical movement described by Wheeler ‘444 already requires three additional inches of clearance for Wheeler’s module on its top and bottom sides, and the lock mechanism (70) requires even more. *Id.*

[redacted]

Finally, Dr. Blumenthal opines that Castonguay '616 could be combined with Plug and Play. As shown above, there would be no motivation to combine these incompatible designs; nor would they satisfy the limitation because Plug & Play does not sufficiently disclose a rail and a latch. CX-0029 (Siemon Plug & Play Fiber Prod. Sheet); CX-2060C (Prucnal RWS) Q/A 669.

Accordingly, respondents have not shown by clear and convincing evidence that Plug and Play in view of Wheeler '444 or Wagner '089 renders claims 22 and 23 of the '206 patent obvious.

* * *

Further, for the reasons discussed above, respondents have not shown by clear and convincing evidence that the asserted claims 22 and 23 of the '206 patent are invalid under any theory.

VIII. Domestic Industry (Economic Prong)

A violation of section 337(a)(1)(B), (C), (D), or (E) can be found "only if an industry in the United States, with respect to the articles protected by the patent, copyright, trademark, mask work, or design concerned, exists or is in the process of being established." 19 U.S.C. § 1337(a)(2). Section 337(a) further provides:

> (3) For purposes of paragraph (2), an industry in the United States shall be considered to exist if there is in the United States, with respect to the articles protected by the patent, copyright, trademark, mask work, or design concerned—
>
> (A) significant investment in plant and equipment;
>
> (B) significant employment of labor or capital; or

[redacted]

(C) substantial investment in its exploitation, including engineering, research and development, or licensing.

19 U.S.C. § 1337(a)(3).

These statutory requirements consist of an economic prong (which requires certain activities)[51] and a technical prong (which requires that these activities relate to the intellectual property being protected). *Certain Stringed Musical Instruments and Components Thereof*, Inv. No. 337-TA-586, Comm'n Op. at 13 (May 16, 2008) ("*Stringed Musical Instruments*"). The burden is on the complainant to show by a preponderance of the evidence that the domestic industry requirement is satisfied. *Certain Multimedia Display and Navigation Devices and Systems, Components Thereof, and Products Containing Same*, Inv. No. 337-TA-694, Comm'n Op. at 5 (July 22, 2011) ("*Navigation Devices*").

With respect to the economic prong, and whether or not section 337(a)(3)(A) or (B) is satisfied, the Commission has held that "whether a complainant has established that its investment and/or employment activities are significant with respect to the articles protected by the intellectual property right concerned is not evaluated according to any

[51] The Commission practice is usually to assess the facts relating to the economic prong at the time that the complaint was filed. *See Certain Coaxial Cable Connectors and Components Thereof and Products Containing Same*, Inv. No. 337-TA-560, Comm'n Op. at 39 n.17 (Apr. 14, 2010) ("We note that only activities that occurred before the filing of a complaint with the Commission are relevant to whether a domestic industry exists or is in the process of being established under sections 337(a)(2)-(3).") (citing *Bally/Midway Mfg. Co. v. U.S. Int'l Trade Comm'n*, 714 F.2d 1117, 1121 (Fed. Cir. 1983)). In some cases, however, the Commission will consider later developments in the alleged industry, such as "when a significant and unusual development occurred after the complaint has been filed." *See Certain Video Game Systems and Controllers*, Inv. No. 337-TA-743, Comm'n Op., at 5-6 (Jan. 20, 2012) ("[I]n appropriate situations based on the specific facts and circumstances of an investigation, the Commission may consider activities and investments beyond the filing of the complaint.").

[redacted]

rigid mathematical formula." *Certain Printing and Imaging Devices and Components Thereof*, Inv. No. 337-TA-690, Comm'n Op. at 27 (Feb. 17, 2011) ("*Printing and Imaging Devices*") (citing *Certain Male Prophylactic Devices*, Inv. No. 337 TA-546, Comm'n Op. at 39 (Aug. 1, 2007)). Rather, the Commission examines "the facts in each investigation, the article of commerce, and the realities of the marketplace." *Id.* "The determination takes into account the nature of the investment and/or employment activities, 'the industry in question, and the complainant's relative size.'" *Id.* (citing *Stringed Musical Instruments* at 26).

With respect to section 337(a)(3)(C), whether an investment in domestic industry is "substantial" is a fact-dependent inquiry for which the complainant bears the burden of proof. *Stringed Musical Instruments* at 14. There is no minimum monetary expenditure that a complainant must demonstrate to qualify as a domestic industry under the "substantial investment" requirement of this section. *Id.* at 25. There is no need to define or quantify an industry in absolute mathematical terms. *Id.* at 26. Rather, "the requirement for showing the existence of a domestic industry will depend on the industry in question, and the complainant's relative size." *Id.* at 25-26.

Investments in plant and equipment, labor, and capital that are also related to research and development or licensing may be considered under subparagraph (C) as well as under subparagraphs (A) and (B). *Certain Optoelectronic Devices for Fiber Optic Communications, Components Thereof, and Products Containing the Same*, Inv. No. 337-TA-860, USITC Pub. No. 4852, Comm'n Op. at 15 (Nov. 2018); *Certain Solid State Storage Drives, Stacked Electronics Components, and Products Containing Same*, Inv. No. 337-TA-1097, Comm'n Op. at 14 (June 29, 2018) ("[T]he text of the statute, the

[redacted]

legislative history, and Commission precedent do not support narrowing subsections (A) and (B) to exclude non-manufacturing activities, such as investments in engineering and research and development. Rather, the guiding principle is whether the asserted expenditures satisfy the plain language of the statute."); *Certain Marine Sonar Imaging Devices, Including Downscan and Sidescan Devices, Products Containing the Same, and Components Thereof*, Inv. No. 337-TA-921, Comm'n Op. at 58-59, 64, 66 (Jan. 6, 2016) (reversing finding that expenses could not be counted under both subparagraphs (B) and (C); holding that the same R&D expenses "separately constitute[d]" a domestic industry under each subparagraph).

Corning argues that it satisfies the economic prong of the domestic industry requirement under subparagraphs (B) and (C). *See* Compl. Br. at 237-59. The Staff agrees and argues that Corning's "investment was shown to be significant and substantial in the context of the marketplace for fiber optic equipment," and concludes, "Corning has satisfied the economic prong of the domestic industry requirement of 19 U.S.C. § 1337(a) under either of subparagraphs (B) or (C)." Staff Br. at 203, 220, *see id.* 202-20.

Respondents disagree with Corning and the Staff, and argue, *inter alia*:

> Complainant alleges a domestic industry under subsections (B) and (C) of section 337(a)(3).[52] All of Complainant's alleged investments are the same for both subsections (B) and (C). CX-0005C (Schoettelkotte WS) Q/A 118, 120. All of Complainant's alleged investments relate to the entire EDGE and EDGE8 product lines even though Complainant's alleged DI products, the patent claims, and Notice of Investigation are limited to only chassis and modules. *Id.*; RX-0007C (Mulhern RWS) Q/A 61. Complainant ceased all R&D projects arguably related to the alleged DI products in [redacted]. Any [redacted] investments are not attributed to the DI products or exploitation of

[52] Complainant does not allege a domestic industry under subsection (A) of Section 337(a)(3).

[redacted]

> the patents.
>
> Complainant bears the burden to show that it meets the economic prong of the domestic industry requirement. *See, e.g.*, *Certain Multimedia Display and Navigation Devices and Systems, Components Thereof, and Products Containing Same*, Inv. No. 337-TA-694, Comm'n Op. at 5 (July 22, 2011). Complainant fails to meet its burden for three independent reasons.
>
> First, Complainant's claimed investments are overstated and not attributable to its alleged DI products. Rather, the investments relate to an overbroad "product line" or "system," including products unrelated to alleged DI products or the asserted patents. Second, Complainant abandoned its domestic research and development activities in its alleged DI products in [redacted], with no continuing qualifying activities at the time of filing its Complaint. Reliance on attenuated, decade-old investments is improper. Complainant's attempt to salvage or resurrect its domestic industry through its misplaced allocation methodology and *de minimis* service investments fail. Third, even crediting Complainant's overbroad *and* stale investments, Complainant's investments are not significant or substantial in any relevant context.

Resps. Br. at 262-63.

For the reasons discussed below, the record evidence supports a finding that Corning has satisfied the economic prong of the domestic industry requirement of 19 U.S.C. § 1337(a) under either of subparagraphs (B) or (C).

In summary, the evidence shows that between 2008 and 2019, Corning invested approximately [redacted] in domestic labor and capital related to the engineering, research, and development of the EDGE and EDGE8 product lines. Of that amount, [redacted] is attributable to investments in chassis and modules that practice the asserted patents. This investment is significant and substantial in the context of the marketplace for fiber optic equipment.

[redacted]

A. Employment of Labor or Capital

Corning argues that development of its EDGE and EDGE8 solutions involved "significant employment of labor and capital" in connection with research, development, engineering, maintenance, and technical support activities in the United States. *See* Compl. Br. at 237, 250-55; CX-0003C (Schoettelkotte WS) Q/A 67. As discussed below in more detail, Corning's investments are slightly smaller than alleged inasmuch as some of these investments are related to cable assemblies and other EDGE components that do not practice the asserted patents.

1. Continuity of Investment in the EDGE and EDGE8 Platforms

In an effort to address growing customer demand for greater connection densities in data centers, Corning initiated a research and development program in 2007, known as the Next Generation Data Center Program. *See* CX-0006C (Staber WS) Q/A 6; CX-0007C (Rhoney WS) Q/A 11; CX-0003C (Schoettelkotte WS) Q/A 61. Corning began marketing the resulting EDGE product line in mid-2009 and made its first EDGE product sale in August 2009. *See* CX-0006C Q/A 22; CX-0007C Q/A 14; CX-0003C Q/A 63. The first EDGE products sold were known as the "Pretium EDGE platform," and consisted of a chassis that could accommodate twelve modules per U space and removable Base-12 modules. *See* CX-0005C (Clark WS) Q/A 9; CX-0003C (Schoettelkotte WS) Q/A 63.

In later years, Corning developed a Base-8 extension to the original platform in addition to refining the Base-12 solution. *See* CX-0007 (Rhoney WS) Q/A 18-19; CX-0003C Q/A 64. Corning introduced its EDGE8 platform in 2015, consisting of removable Base-8 modules and chassis that could accommodate eighteen such modules

[redacted]

in a 1U space. *See* CX-0005C (Clark WS) Q/A 9; CX-0003C Q/A 64. Corning argues, and has provided evidence to show, that since 2015, it has continued to refine various aspects of both the EDGE and EDGE8 solutions, as well as providing ongoing maintenance and technical support services related to these products for its data center customers in the United States. *See* CX-0004C (Hicks WS) Q/A 49-50; CX-0005C (Clark WS) Q/A 49, 57; CX3C (Schoettelkotte WS) Q/A 64.

Corning's economic prong expert, Mr. Schoettelkotte, testified that Corning continues to invest heavily in phased upgrades of its flagship products like EDGE, and that it was doing so at the time the Complaint was filed on February 21, 2020. *See* CX-0003C (Schoettelkotte WS) Q/A 65. The evidence shows that EDGE-related investments in labor varied from year to year, at one point [redacted]. *See* CX-1812C (Corning EDGE Project Labor - U.S. Labor Investments). Corning argues that this is because over EDGE's lifetime, it has invested in "getting feedback from customers" and using that feedback to make "continuous improvements." CX-0005C (Clark WS) Q/A 25. Corning's Mr. Clark testified that "Corning's R&D process for projects like EDGE can be compared to a slinky that expands, contracts, and walks, corresponding to the rise in labor hours in key moments like [redacted]." *Id.*

Despite the [redacted], under Commission precedent, the entire date range for Corning's investments in its EDGE solutions should be included in the domestic industry analysis. The Commission will include past investments its analysis where a complainant has continued to make ongoing investments, such as continued sales of the domestic industry products, or warranty and technical support. *See, e.g.*, *Certain*

[redacted]

Marine Sonar Imaging Devices, Including Downscan and Sidescan Devices, Products Containing the Same, and Components Thereof, Inv. No. 337-TA-921, Comm'n Op. at 54-57 (Jan. 6. 2016) (crediting past investments in research and development for discontinued products because of ongoing investments in warranty, technical support, and software updates) (reversed on other grounds); *Certain Electronic Digital Media Devices and Components Thereof*, Inv. No. 337-TA-796, Comm'n Op. at 99-100 (Sept. 6, 2013) (crediting past investments where complainant was "further develop[ing] its existing products").

Despite the [redacted], Corning has continued to invest in its EDGE solutions and to sell its domestic industry chassis and modules, and it has no plans to discontinue its efforts. *See* Schoettelkotte Tr. 171-172; CX-1812C (Corning labor investments) (showing large investments in 2019-2020); CX-0004C (Hicks WS) Q/A 49 ([redacted]). Thus, the fact that there is a [redacted] is not a reason to find that Corning failed to satisfy the economic prong of the domestic industry requirement.

2. Allocation of Domestic Industry Investments

Corning's economic prong analysis includes investments in the entire EDGE and EDGE8 platforms, including chassis, modules, and cable assemblies. Mr. Schoettelkotte testified that Corning's EDGE and EDGE8 solutions rely on cable assemblies that are required for the EDGE chassis and modules to perform the fiber optic connection functions desired by Corning's customers. He testified that "without the EDGE and EDGE8 cable assemblies, there would be no EDGE or EDGE8 solution for Corning to

[redacted]

offer its data center customers." *See* CX-0003C (Schoettelkotte WS) Q/A 122. Accordingly, Corning included EDGE project codes relating to the research and development of EDGE cable assemblies and related components in its claimed domestic industry investments. *See*, *e.g.*, CX-0006C (Staber WS) Q/A 41 (describing project code D189, which involved "designing and developing a new cable system to work specifically and exclusively with the EDGE8 system"), 42 (describing project code D190, which involved "designing and developing new trunk cables, jumper cables, harnesses, and connectors specifically for the 8-fiber connection solution in the EDGE8 system"), 44 (describing project code D367, which involved [redacted]). Corning also included investments in certain EDGE chassis and modules that are not alleged to practice the asserted patents. *See* CX-0003C (Schoettelkotte WS) Q/A 149. Mr. Schoettelkotte testified that including all of these investments in the domestic industry analysis is appropriate because it is Corning's investments in the overall EDGE and EDGE8 solutions that have allowed for the development, commercialization, and continued exploitation of the technologies claimed by the asserted patents. *See* CX-0003C (Schoettelkotte WS) Q/A 122.

Respondents argue that EDGE cable assemblies and "non-DI" EDGE chassis and modules are not domestic industry products and that their inclusion in Corning's domestic industry analysis is inappropriate. *See* Resps. Br. at 273; RX-0007C (Mulhern RWS) Q/A 84-100. Respondents' economic prong expert, Ms. Mulhern, testified that "relevant DI investments should not be expanded in this investigation to include investments in non-patent-practicing EDGE products." *Id*. Q/A 86. In support of her

[redacted]

opinion, she noted that due to the industry-wide standardization of racks and connectors, "customers can mix and match EDGE DI Products with non-DI EDGE products and with products sold by third-parties." RX-0007C (Mulhern RWS) Q/A 86; RX-0008C (Lebby RWS) Q/A 398-402.

The evidence shows the following:

- Corning's cable assemblies can be used with third-party chassis and modules;
- Corning's cable assemblies can be used with Corning's non-DI EDGE/EDGE8 system chassis and modules;
- EDGE chassis and modules alleged to practice the asserted patents can be used with third-party cable assemblies; and
- Corning's EDGE chassis and modules are sold independently from each other and from the EDGE cable assemblies.

RX-0007C (Mulhern RWS) Q/A 86; CX-0006C (Staber WS) Q/A 13 (Corning "designed other devices that could be inserted into the fiber optic equipment trays"); CX-0007C (Rhoney WS) Q/A 25 (EDGE customers can buy cable assemblies made by other manufacturers); CX-0004C (Hicks WS) Q/A 24 (Corning sells its chassis, modules, and cable assemblies separately). Ms. Mulhern testifed that her review of this evidence "calls into question the inclusion of investments in non-patented products of the EDGE system as domestic industry investments in this investigation." RX-0007C (Mulhern RWS) Q/A 85.

As argued by respondents and the Staff, the EDGE cable assemblies and non-DI EDGE chassis and modules should not be included in the domestic industry analysis. In general, the domestic industry is defined by the patented articles. *See Certain Dynamic Sequential Gradient Compression Devices and Components Parts Thereof*, Inv. No. 337-

[redacted]

TA-335, Initial Det. at 60 (May 15, 1992) ("Congress did not intend . . . that activities of a complainant which generally relate to the subject area of the patent fall within the statutory definition of a domestic industry."). It is true that "[t]he Commission has held that in certain circumstances, the realities of the marketplace require a modification of [this] principle[.]" *Certain Video Game Systems and Wireless Controllers and Components Thereof*, Inv. No. 337-TA-770, Comm'n Op. at 66 (Oct. 28, 2013). Those circumstances, however, are not present here.

The initial determination in *Certain Sleep-Disordered Breathing Treatment Systems* is instructive. *Certain Sleep-Disordered Breathing Treatment Systems and Components Thereof*, Inv. No. 337-TA-890, Initial Det. at 139 (Sept. 16, 2014). There, the complainant advocated for a "system" approach that considered all of its CPAP treatment products to be within the scope of the domestic industry, including its CPAP masks, flow generators, and humidifiers. The respondents argued that the only articles protected by the asserted patents were the masks and humidifiers that practiced the claims. With regard to patents that disclosed mask-related inventions ("the ResMed Mask Patents"), the presiding administrative law judge found that the articles protected by the ResMed Mask Patents did not include flow generators or humidifiers.[53] The decision turned on the following three factors:

- Although customers could order masks along with flow generators

[53] On appeal, the Commission moved for a remand in light of intervening domestic industry precedent in *Lelo Inv. v. International Trade Comm'n*, 786 F.3d 879 (Fed. Cir. 2015). On remand, the presiding administrative law judge reversed his previous determination and found that a domestic industry did not exist because the claimed investments were not quantitatively "significant" under *Lelo*. *Certain Sleep-Disordered Breathing Treatment Systems and Components Thereof*, Inv. No. 337-TA-890, Final Initial Det. on Remand (Nov. 10, 2016).

[redacted]

and humidifiers, the masks were almost always purchased separately and were not packaged together with the flow generators and humidifiers.

- Unlike the H5i humidifier, which could only be used with the S9 flow generator, ResMed's masks could be used with other companies' flow generators and humidifiers because they used a standard 22mm connector and tubing, thus making the masks separate articles of commerce.

- The flow generator and humidifier were not central to enabling ResMed to exploit the patented technology of its masks.

Sleep-Disordered Breathing Treatment Systems, Inv. No. 337-TA-890, Initial Det. at 150.

The "realities of the marketplace" in the fiber optic equipment field appear to mirror those that were present with respect to sleep-disordered breathing treatment systems. First, although Corning's customers typically order cable assemblies at the same time that they order chassis and modules, and are encouraged to do so, Corning "sells these pieces individually" rather than packaging them together. *See* CX-0004C (Hicks WS) Q/A 24; Schoettelkotte Tr. 170-171 ("[T]hey're sold separately, they have separate SKUs, . . . they would be on the same bill of materials, but . . . they're not in the same package, if you will."). Second, Corning's EDGE components use standard connectors and are designed to fit in standard rack sizes. As a result, not only can customers choose to use third-party cable assemblies with their EDGE chassis and modules, but customers purchasing other companies' chassis and modules can use EDGE cable assemblies with those products. The cable assemblies are thus articles of commerce separate from the chassis and modules. *See* CX-0007C (Rhoney WS) Q/A 25 (EDGE customers can buy cable assemblies from other companies). Third, the cable assemblies are not central to enabling Corning to exploit the patented technology of its

[redacted]

chassis and modules. The asserted patents are directed to the physical characteristics of the chassis and modules, and not to their operation. Thus, a combination of chassis and modules may infringe an asserted patent even before any cable assemblies are installed. Given the similarities in this investigation to the facts in *Sleep-Disordered Breathing Treatment Systems*, the domestic industry here should be limited to investments related to chassis and modules that practice the asserted patents.

3. Calculation of EDGE Investments, 2008 - February 21, 2020

Corning documented approximately [redacted] invested in labor and capital related to the EDGE and EDGE8 product lines as a whole. *See* CX-0003C (Schoettelkotte WS) Q/A 163; CX-1809C (summary of Corning DI investments). Of that amount, approximately [redacted] is attributable to chassis and modules that practice the '320, '153, and '456 patents, approximately [redacted] of which is attributable to modules that practice the '206 patent.

a. Base Calculation

Mr. Schoettelkotte testified that to calculate the domestic labor investments recorded under Corning's EDGE project codes, he multiplied the number of U.S. labor hours reported by Corning employees for each year from 2008 through 2020 times the corresponding annual labor rate. *See* CX-0003C (Schoettelkotte WS) Q/A 81; CX-1810C (Corning U.S. labor hours); CX-1811C (Corning labor rates). These hours were worked primarily in Corning's facilities located in Keller, Texas and Hickory, North Carolina. *See* CX-0003C Q/A 68. Mr. Schoettelkotte calculated the following total annual U.S. investments in labor associated with EDGE:

[redacted]

Corning EDGE Project Labor – U.S. Labor Investments

Year	**U.S. Dollars**
2008	[redacted]
2009	
2010	
2011	
2012	
2013	
2014	
2015	
2016	
2017	
2018	
2019	
2020 (through Feb. 21, 2020)	
2008-2020 Total	
2019-2020 Total	

See CX-0003C (Schoettelkotte WS) Q/A 69-83; CX-1812C (Corning labor investments); CX-1810C (Corning EDGE Project labor – U.S. labor hours); CX-1811C (Corning Technology Division hourly labor rates).

In addition to its investment in labor, Corning has incurred capital expenses associated with EDGE. Corning's witness Mr. Clark, a senior development analyst, testified that such direct expenses includes purchases for prototype items, testing materials, consulting work, travel expenses, vendor charges, sample products, and other spending associated with a given project. *See* CX-0005C (Clark WS) Q/A 42-44; CX-0003C (Schoettelkotte WS) Q/A 88. Such expenses are tracked according to an internal order number that in many cases is assigned to a particular project code. *See* CX-0003C

[redacted]

Q/A 89. Mr. Clark testified that he collected all project direct expenses for EDGE-related project codes that were assigned an internal order number. *See* CX-0005C (Clark WS) Q/A 42-48. Inasmuch as not every EDGE project code was assigned an order number, the resulting totals are conservative figures that may underreport the total direct expenses that were incurred over the life of EDGE. *See id*. Q/A 46. All expenses were limited to those made in the United States, primarily at Corning's facilities in Keller, Texas and Hickory, North Carolina. *Id*. Q/A 44; CX-0003C (Schoettelkotte WS) Q/A 90. Corning incurred the following EDGE-related U.S. capital expenses between 2008 and February 2020:

<u>Corning EDGE Project Direct Expenses – U.S. Spend</u>

Year	U.S. Dollars
2008	[redacted]
2009	
2010	
2011	
2012	
2013	
2014	
2015	
2016	
2017	
2018	
2019	
2020 (through Feb. 21, 2020)	
2008-2020 Total	
2019-2020 Total	

[redacted]

See CX-0003C (Schoettelkotte WS) Q/A 91-92; CX-1813C (Corning EDGE Project U.S. direct expenses); CX-0711C (2008-2019 direct expenses Spreadsheet); CX-0983C ("20190101–20200221 Manhours and Expenses" Spreadsheet).

Mr. Schoettelkotte testified that in addition to the labor and capital expenses detailed above, Corning provides field engineering services to its key data center customers in the United States. *See* CX-0003C (Schoettelkotte WS) Q/A 93. These services include assistance with the installation, maintenance, and operation of Corning's EDGE products. *See* CX-0005C (Clark WS) Q/A 49. Since 2017, Corning has tracked the number of days that its engineers provide this assistance to U.S. customers. Records are not available for services performed before 2017. *Id*. Q/A 51-52; CX-0003C (Schoettelkotte WS) Q/A 94. In the normal course of business, Corning assumes an eight-hour work day and applies a daily labor rate of [redacted] per hour for all field engineering services. *See* CX-0003C Q/A 96-97; CX-0987C (FES rates). The evidence shows that on applying these figures, Corning invested the following amounts in field engineering services for U.S. EDGE customers between 2017 and February 2020:

<u>Corning EDGE Field Engineering Services Expenses</u>

Year	**U.S. Dollars**
2017	[redacted]
2018	
2019	
2020 (through Feb. 21, 2020)	
2017-2020 Total	
2019-2020 Total	

[redacted]

See CX-0003C (Schoettelkotte WS) Q/A 95-96; CX-1814C (Corning field engineering investments); *see also* CX-0707C (2017 Field Engineering FTE Tracker); CX-0708C (2018 Field Engineering FTE Tracker); CX-0710C (2019 Field Engineering FTE Tracker R1); CX-0984C ("2020 FE - FTE Tracker _gbs" Spreadsheet); CX-0987C (FES rates).

Mr. Schoettelkotte testified that in addition to the field engineering services provided by full-time Corning employees, Corning also invests in similar services provided by contractors, or "Pioneers." *See* CX-0003C (Schoettelkotte WS) Q/A 99-104; CX-0005C (Clark WS) Q/A 57-65. Corning has maintained data regarding Pioneer-related expenses since 2016. *See* CX-0003C Q/A 100. Mr. Schoettelkotte testified that he determined Corning's total investment in EDGE-related Pioneer services by multiplying the hourly rate for each Pioneer by the number of hours of technical support services that that Pioneer provided to EDGE customers in the United States. *Id.* Q/A 104; CX-0988C (Pioneer hourly rates). Corning invested the following in Pioneer services for U.S. EDGE customers between 2016 and February 2020:

Corning EDGE Field Engineering Services Expenses

Year	U.S. Dollars
2016	[redacted]
2017	
2018	
2019	
2020 (through Feb. 21, 2020)	
2016-2020 Total	
2019-2020 Total	

[redacted]

See CX-0003C (Schoettelkotte WS) Q/A 104; CX-1815C (Corning Pioneer investments); CX-0749C to CX-0752C (Corning EMP-Contractors time sheets, 2016-2019); CX-0988C (Pioneer rates); CX-0999C ("2020 Pioneers" Spreadsheet).

When the labor, direct expense, field engineering services, and Pioneer investments detailed above are added together, the result is a total investment in EDGE of [redacted] of which was incurred in the period from January 1, 2019 to February 21, 2020:

<u>Summary of Alleged Corning Domestic Industry Investments</u>

Investment Type	**2008-Feb. 21, 2020**	**2019-Feb. 21, 2020**
EDGE Project Labor	[redacted]	[redacted]
EDGE Project Direct Expenses	[redacted]	[redacted]
EDGE Field Engineering Services	[redacted]	[redacted]
EDGE Pioneer Technical Support	[redacted]	[redacted]
Total Investment in Labor and Capital	[redacted]	[redacted]

See CX-0003C (Schoettelkotte WS) Q/A 117-18; CX-1809C (summary of Corning domestic industry investments); *see also* CX-1812C through CX-1815C (detail per investment category).

b. Reallocation to Eliminate Investments in Non-DI Products

As discussed above, the [redacted] figure argued by Corning should be reduced to eliminate investments related to cable assemblies and other EDGE components that do not practice the asserted patents. Mr. Schoettelkotte testified that it is possible to do so by using a sales-based allocation method. *See* CX-0003C (Schoettelkotte WS) Q/A 150. Sales-based allocations are commonly used "to determine how much . . . investment is

[redacted]

related to the asserted patents and the DI products." *Certain Semiconductor Devices and Consumer Audiovisual Products Containing the Same*, Inv. No. 337-TA-1047, Initial Det. at 437 (May 11, 2018), *reviewed on other grounds*, Comm'n Op. (Sept. 11, 2019).

Of the three potential allocation methods that Mr. Schoettelkotte proposed, as the Staff argues, the third method is the most conservative version, and is the most appropriate here. *See* CX-0003C (Schoettelkotte WS) Q/A 149-61; Staff Br. at 214-15. That allocation eliminates investments related to EDGE cable assemblies and the small number of EDGE chassis and modules that are not alleged to practice the asserted patents. It also calculates a patent-by-patent allocation of investments to account for the fact that the '206 patent is directed to a module only, and not to a combination of chassis and modules. *Id*. Q/A 158, 161. Mr. Schoettelkotte testified to the results of this allocation:

> From 2015 through 2019, Corning's U.S. sales of EDGE and EDGE8 modules that practice the '206 Patent made up [redacted] (based on quantity) and [redacted] (based on revenue) of the total U.S. sales of EDGE and EDGE8 chassis, modules, and cable assemblies. . . . Applying these allocation figures to Corning's total domestic industry investments of [redacted] results in approximately [redacted] (based on quantity) and [redacted] (based on revenue) of investments with respect to the EDGE and EDGE8 modules that practice the '206 Patent.
>
> From 2015 through 2019, Corning's U.S. sales of EDGE and EDGE8 chassis and modules that practice the '320, '153, and '456 Patents made up [redacted] (based on quantity) and [redacted] (based on revenue) of the total U.S. sales of EDGE and EDGE8 chassis, modules, and cable assemblies. . . . Applying these allocation figures to Corning's total domestic industry investments of [redacted] results in approximately [redacted] (based on quantity) and [redacted] (based on revenue) of investments with respect to the EDGE and EDGE8 chassis and modules that practice the '320, '153, and '456 Patents.

[redacted]

Id. Q/A 160-61. He also testified that in his view, if choosing between a sales allocation based on quantity and one based on revenue, in this case "the sales unit is the better approach." Schoettelkotte Tr. 175-176.

<u>Sales-Based Allocation of Corning DI Investments Including Assemblies</u>

Product Type	Quantity	Quantity-Based Allocation		Revenue	Revenue-Based Allocation	
		% of Total	Investment		% of Total	Investment
All Chassis, Modules, & Cable Assemblies	[redacted]					
DI Chassis & Modules Only						
DI Modules Only ('206 Patent)						

CX-1819C (Sales-Based Allocation of Corning Domestic Industry Investments Including Assemblies); *see* CX-1820C (Corning U.S. Sales of EDGE & EDGE8 Chassis & Modules – Quantity); CX-1821C (Corning U.S. Sales of EDGE & EDGE8 Chassis & Modules – Revenue); CX-0973C ("Corning Module and Assembly Sales Data" Spreadsheet).

Thus, Corning's domestic investments in labor and capital, when reallocated, total approximately [redacted] for the '320, '153, and '456 patents, and approximately [redacted] for the '206 patent.

B. Investment in Engineering and Research and Development

Corning argues that its domestic industry investments also constitute a substantial investment in the exploitation of the asserted patents through engineering and research

[redacted]

and development. Mr. Schoettelkotte testified that based on the nature of the activities described above, Corning's labor and capital investments in EDGE Project Labor, EDGE Project Direct Expenses, EDGE Field Engineering Services, and EDGE Pioneer Technical Support also constitute investments in engineering, research, and development of the EDGE and EDGE8 solutions. *See* CX-0003C (Schoettelkotte WS) Q/A 120. In his opinion, the data and calculations discussed above may be considered under either subparagraph (B) or subparagraph (C) of the statute, without modification. *Id.*

The Commission has held that the same R&D expenses may "separately constitute" a domestic industry under each subparagraph of 19 U.S.C. § 1337(a)(3). *Optoelectronic Devices for Fiber Optic Communications*, Comm'n Op. at 15; *Solid State Storage Drives*, Comm'n Op. at 14; *Marine Sonar Imaging Devices*, Comm'n Op. at 58-59, 64, 66. As argued by Corning and the Staff, the administrative law judge finds that the EDGE-related expenses described above are both labor and capital investments and investments in engineering and research and development. Thus, it is equally correct to state that in the period from 2008 through February 21, 2020, Corning invested [redacted] in engineering, research and development associated with its EDGE solutions, [redacted] of which is attributable to chassis and modules practicing the asserted patents [redacted]). *See* CX-1819C (Sales-Based Allocation of Corning Domestic Industry Investments Including Assemblies).

Subparagraph (C) has an additional requirement not found in subparagraph (B) – it requires a substantial investment in the "exploitation" of the asserted patents. 19 U.S.C. § 1337(a)(3)(C). "[E]xploitation" is a "generally broad term that encompasses activities such as efforts to improve, develop, or otherwise take advantage of the asserted

[redacted]

patent." *Certain Integrated Circuit Chips and Products Containing the Same*, Inv. No. 337-TA-859, USITC Pub. No. 4849, Comm'n Op. at 39 (Nov. 2018). The evidence demonstrates a sufficient nexus between the asserted patents and Corning's claimed domestic industry investments. Each asserted patent claims technology relating to aspects of the chassis and modules that make up the base infrastructure of Corning's EDGE and EDGE8 solutions. *See* CX-0003C (Schoettelkotte WS) Q/A 122 ("More specifically, I understand that the Asserted Patents cover the EDGE and EDGE8 system of sliding trays, removable modules, and other innovative features that enable fiber optic connections to be densely packed inside an equipment rack while improving access to adapters and cables."). Investments related to the research, development, engineering, and implementation of those features of the EDGE chassis and modules are thus related to the asserted patents. *See id*. Once the expenses that Corning has claimed to be associated with the EDGE and EDGE8 solutions are reduced to eliminate investments related to non-DI components such as cable assemblies, the remaining investments share a nexus with the asserted patents, and it is appropriate to include them in the economic prong analysis under subparagraph (C).

C. Whether Corning's Investments Are "Significant" and "Substantial"

Determining whether an investment is "significant" or "substantial" under 19 U.S.C. § 1337(a)(3) is context-dependent. *Integrated Circuit Chips*, Comm'n Op. at 145. "[T]he magnitude of the investment cannot be assessed without consideration of the nature and importance of the complainant's activities to the patented products in the context of the marketplace or industry in question." *Id*. However, "qualitative factors alone are insufficient" to show that an investment is significant. *Lelo Inc. v.*

[redacted]

International Trade Comm'n, 786 F.3d 879, 885 (Fed. Cir. 2015). Section 337(a)(3) "requires a quantitative analysis to determine whether there is a 'significant' increase or attribution by virtue of the claimant's asserted commercial activity in the United States." *Id*. at 883.

For the reasons discussed below, Corning's [redacted] investment in articles practicing the asserted patents ([redacted] for the '206 patent) is both "significant" under subparagraph (B) of the statute and "substantial" under subparagraph (C). The evidence shows that Corning's domestic investment in labor associated with research and development has been both significant and substantial in overall context.

First, Corning's domestic labor hours spent on the R&D relating to the EDGE Project Codes are significant compared to the foreign labor hours spent on these projects. Commission precedent supports the use of a comparison of domestic to foreign labor expenses to show the domestic investments' significance. *See Certain Pocket Lighters*, Inv. No. 337-TA-1142, Comm'n Op. at 12-13 (July 13, 2020). To make such a comparison, Mr. Clark gathered information reflecting the global hours spent on each of the EDGE Project Codes. *See* CX-0005C (Clark WS) Q/A 38-40. He and Mr. Schoettelkotte calculated the total global hours spent on the EDGE Project Codes, which were [redacted] hours from 2008 through February 21, 2020. *See* CX-0005C (Clark WS) Q/A 41; CX-0003C (Schoettelkotte WS) Q/A 136; CX-1816C (Corning Global Labor Hours Ex. 4.1). Mr. Schoettelkotte then calculated that [redacted] of the labor hours attributed to the EDGE Project Codes were performed in the United States. *See* CX-0003C (Schoettelkotte WS) Q/A 136; CX-1817C (Corning U.S. v. Global Labor Hours Ex. 4.2).

[redacted]

Ms. Mulhern does not dispute Mr. Schoettelkotte's calculations relating to global R&D hours. Mulhern Tr. 932. Instead, she opines that "Corning conducts significant activities related to the DI products outside the U.S." such as manufacturing, and that this should undermine the conclusion that its domestic investments in research, development, and technical support are significant. RX-0007C (Mulhern RWS) Q/A 157. Corning's activities in different areas, such as manufacturing, are irrelevant to this analysis. Corning's domestic investments in research, development, and technical support of the DI products are large when viewed in the relevant context of its foreign investments in those same types of activities. *See Certain Road Milling Machines & Components Thereof*, Inv. No. 337-TA-1067, Initial Det. at 425 (Oct. 1, 2018), *aff'd*, Commission Determination to Review in Part a Final Initial Determination; Schedule for Filing Written Submissions on Remedy, the Public Interest, and Bonding (Apr. 17, 2019) (reviewed on other grounds).

Second, Corning's domestic investments are significant and substantial in the context of the cost of domestic and foreign labor. As Mr. Schoettelkotte testified, Corning's domestic labor rates, which include only salaries, wages and benefits (as opposed to a fully loaded labor rate), ranged from [redacted] per hour from 2012 to 2020. *See* CX-0003C (Schoettelkotte WS) Q/A 138; CX-1811C (Corning Labor Rates Ex. 3.3). During that same time period, the labor rates for Corning technology employees in Mexico ranged from [redacted] per hour. *See* CX-0003C (Schoettelkotte WS) Q/A 138. Thus, Corning's investment in domestic labor is even larger in context, given the relatively high cost of U.S. employee labor relative to other countries. CX-0003C (Schoettelkotte WS) Q/A 138; Schoettelkotte Tr. 169:8-21; *Certain Pocket Lighters*, Inv.

[redacted]

No. 337-TA-1142, Comm'n Op. at 12.

Third, Corning's domestic investments are significant and substantial inasmuch as they were directly responsible for the development and support of EDGE products that have been extremely successful in the market. *See, e.g.*, CX-0004C (Hicks WS) Q/A 55-57 (market share and customers); CX-0007C (Rhoney WS) Q/A 15-17 (market reaction to EDGE products); CX-0006C (Staber WS) Q/A 25-26 (customer reactions and awards). Corning's significant market share ([redacted]) and sales of the EDGE products ([redacted]) further show that Corning's domestic investments are significant because they have resulted in a product that has become a market leader. *See* CX-0003C (Schoettelkotte WS) Q/A 130, 132. Corning's ability to offer a full set of products and technical support services tied to the domestic industry products has led to greater customer satisfaction and repeat purchases in the United States. *See* CX-0004C (Hicks WS) Q/A 23-24; CX-0003C (Schoettelkotte WS) Q/A 133.

Fourth, Corning's domestic investments are significant and substantial when compared to respondents' own spending in connection with the development of the accused products. Mr. Schoettelkotte analyzed the documents respondents produced in this investigation, which showed that respondents' own total investments in developing the accused products were much smaller than Corning's investments in just the areas of U.S. based research and development labor, expenses, and technical support. *See* CX-0003C (Schoettelkotte WS) Q/A 145 (showing Leviton investments around [redacted], [redacted]

[redacted]

"[T]here is no minimum monetary expenditure that a complainant must demonstrate to qualify as a domestic industry under the 'substantial investment' requirement" of 19 U.S.C. § 1337(a)(3)(C). *Certain Stringed Musical Instruments and Components Thereof*, Inv. No. 337-TA-586, USITC Pub. 4120, Comm'n Op. at 25 (Dec. 2009). "[T]he inquiry depends on 'the facts in each investigation, the article of commerce, and the realities of the marketplace.'" *Certain Carburetors and Products Containing Such Carburetors*, Inv. No. 337-TA-1123, Comm'n Op. at 8 (Oct. 28, 2019) (quoting *Printing and Imaging Devices*, Comm'n Op. at 27).

Here, Corning has established that it invested approximately [redacted] in products that practice the asserted patents between 2008 and February 21, 2020. In the full context of this investigation, this amount is quantitatively and qualitatively significant and substantial.

Respondents argue that Corning has not shown that its investments are qualitatively or quantitatively significant or substantial, *inter alia*:

> Complainant has not met its burden to prove that its investments are qualitatively or quantitatively significant or substantial. *See Lelo*, 786 F.3d at 883. Complainant performed no assessment of the relative importance of its claimed activities in any relevant context, including the company, the marketplace, the industry, or its overall investment with respect to the DI products, and has provided insufficient information to permit a meaningful contextual analysis. *See Certain Multimedia Display and Navigation Devices and Sys. Components Thereof, and Prods Containing the Same*, Inv. No. 337-TA-694, Comm'n Op. at 15 (Jul. 22, 2011) ("type of efforts that are considered a 'substantial investment' [] will vary depending on the nature of the industry and the resources of the complainant."). The little information Complainant does provide belies a finding of significance or substantiality.
>
> The Commission has considered investments as a percentage of domestic sales as a measure of contextual significance. *Certain Carburetors and Products Containing Such Carburetors*, Inv. No. 337-

[redacted]

TA-1123, Comm'n Op. at 17 (Oct. 28, 2019) (finding "domestic investments with respect to the [a]sserted [p]atents are not significant or substantial when considered in light of the only contextual information in the record, i.e., [Complainant]'s U.S. sales and worldwide sales"); *Certain Automated Teller Machines, ATM Modules, Components Thereof and Prods. Containing Same*, Inv. No. 337-TA-972, Final ID at 190-91 (Feb. 1, 2017) (proportion of labor to revenue for domestic industry product was too low and not quantitatively significant); *cf. Certain Table Saws Incorporating Active Injury Mitigation Technology and Components Thereof*, Inv. No. 337-TA-965, Order No. 10, ID at 17 (Apr. 27, 2016) (finding quantitative significance of labor costs amounting to 11 percent to 19 percent of complainant's gross sales).

Using this approved measure, even crediting the *entirety* of Complainant's stale and overbroad claimed investments of [redacted] dollars in the *entire* EDGE product line over the *entire* claimed 12-year period, Complainant's claimed [redacted] domestic industry investment from 2008 to February 2020 comprises only [redacted] of sales for a period less than half as long. RX-0007C (Mulhern RWS) Q/A 153. The claimed [redacted] for the full *12-year period*, amounts to only [redacted] of Corning Optical Communications [redacted] in sales for the *single year* FY2019 (the year closest to filing the Complaint), [redacted] of Corning Optical Communications sales for just Enterprise Networks of [redacted] in for the *single year* FY2019, and [redacted] of Corning Optical Communication's [redacted] research and development expenses for the *single year* FY2019. *See* RX-0811 (Corning FY2019 Annual Report); RX-0808C (Corning FY2019 10-K). Focusing just on [redacted]—the year Complainant argues as its "ongoing" link or bridge between its ended domestic industry and its new projects—Complainant's claimed investments of [redacted] comprise only [redacted] of its total claimed investments and [redacted] of its sales for EDGE and EDGE8 chassis and modules for [redacted]. CX-0003C (Schoettelkotte WS) Q/A 154; CX-1812C (Labor Investments Ex. 3.4) (reflecting [redacted] investments in U.S. Labor for EDGE Projects for [redacted]); CX-1813C (Direct Expenses Ex. 3.5) (reflecting [redacted] investments in U.S. Direct Expenses for EDGE Projects for [redacted]); CX-1814C (Field Engineering Investments Ex. 3.6) (reflecting [redacted] in U.S. Labor for Field Engineering Services for EDGE customers for [redacted]); CX-1815C (Pioneer Investments Ex. 3.7) (reflecting [redacted] U.S. Labor for Pioneer Technical Support for EDGE customers for [redacted]); CX-1821C (EDGE Chassis & Modules Sales Revenue Ex. 5.4) (reflecting [redacted] total sales for EDGE chassis and modules for [redacted]).

See Resps. Br. at 286-87. Thus, citing *Carburetors*, respondents argue, "Complainant

[redacted]

performed no assessment of the relative importance of its claimed activities in any relevant context, including the company, the marketplace, the industry, or its overall investment with respect to the DI products, and has provided insufficient information to permit a meaningful contextual analysis." Yet, as discussed below, Corning has shown that in the full context of this investigation, the investment amount is quantitatively and qualitatively significant and substantial.

Respondents compare Corning's large investments in the EDGE products with other large dollar figures in a vacuum, but disregards the evidence of significance presented by Corning's witnesses.

First, respondents compare domestic industry investments in R&D and technical support for the EDGE products to Corning's sales revenue as a whole. *See* Resps. Br. at 287. This comparison is at odds with Commission precedent and is not a useful comparison. For a Fortune 500 company such as Corning, investment in any particular product line will seem small compared to total sales. *See Carburetors*, Comm'n Op. at 27-28 (citation omitted) (rejecting idea that "large multinational companies should be expected to invest larger dollar amounts in order for their investments to be deemed 'significant' or 'substantial'").

Second, respondents compare Corning's R&D and technical support investments for the EDGE products to sales of the EDGE products. *See* Resps. Br. at 287. Respondents acknowledge that the EDGE products have enjoyed significant success in the market, garnering [redacted] of dollars of revenue, but argue that more sales means less significance for the very investments made to bring those products to market. Corning argues that such an approach would reward domestic industries in

[redacted]

unsuccessful products over market leaders like EDGE that were the result of millions of dollars of U.S.-based research and development efforts. *See* Compl. Br. at 254-55.

Respondents' arguments comparing this case to *Carburetors* are unpersuasive. There, "the only contextual information in the record" was complainant's U.S. and worldwide sales of DI products as the complainant provided no additional context to perform any quantitative or qualitative and attempted to rely "solely on the absolute value" of its domestic investments. *Carburetors*, Inv. No. 337-TA-1123, Comm'n Op. at 16-17 (emphasis added). Unlike the complainant in *Carburetors*, as discussed above in detail, Corning provided four analyses of context and is not attempting to rely on the "absolute value" of its investments.

In one of those analyses, Mr. Schoettelkotte compared Corning's domestic R&D expenses for EDGE to the foreign R&D expenses, which shows that over [redacted] of the R&D labor hours took place in the United States. *See* CX-0003C (Schoettelkotte WS) Q/A 136; CX-1817C (Corning U.S. v. Global Labor Hours Ex. 4.2). In response to this data — which Ms. Mulhern does not dispute, Mulhern Tr. 932 — respondents argue that the only way to show significance is by comparing the cost of research and development to the cost of manufacturing. *See* Resps. Br. at 289. This is not persuasive, unsupported by precedent, and inconsistent with the Commission's requirement of showing the relative importance of domestic activities in context.

Third, respondents argue that Corning "performed no assessment of the relative importance of its claimed activities in any relevant context, including the company, the marketplace, the industry, or its overall investment with respect to the DI products, and has provided insufficient information to permit a meaningful contextual analysis." *See*

[redacted]

Resps. Br. at 286. As discussed above, in addition to opining on the success of the EDGE products in the data center industry, Mr. Schoettelkotte also compared the investments Corning made in the EDGE products with the investments respondents made in developing their own infringing products. *See* CX-0003C (Schoettelkotte WS) Q/A 144-46. Respondents have not shown that comparing Corning's investments to those of respondents, who are in the same industry, is "irrelevant," Resps. Br. at 290, to the contextual analysis.

Respondents also argue that Corning's showing of greater R&D expenses for domestic industry purposes is inconsistent with Corning's showing for validity purposes that respondents took time and effort to develop their products. There is no inconsistency. Corning has shown that respondents invested substantial time and effort in developing their products, even with the benefit of their use of Corning's patents and EDGE. However, Corning has also shown that it invested much more time and effort to create EDGE in the first place, which shows that its domestic R&D investments were substantial. *Compare* Resps. Br. at 290 ([redacted] hours for Leviton's Accused Product) *with* CX-0005C (Clark WS) Q/A 24 (over [redacted] hours for EDGE).

* * *

Accordingly, it is determined that Corning has satisfied the economic prong of the domestic industry requirement of 19 U.S.C. § 1337(a) under either of subparagraphs (B) or (C).

[redacted]

IX. Conclusions of Law

1. The Commission has subject matter jurisdiction, personal jurisdiction over the parties, and *in rem* jurisdiction in this investigation.

2. The accused products have been imported or sold for importation into the United States.

3. The accused products infringe the asserted claims of U.S. Patent No. 9,020,320.

4. The accused products infringe the asserted claims of U.S. Patent No. 10,444,456.

5. The accused products infringe the asserted claims of U.S. Patent No. 10,120,153.

6. With respect to U.S. Patent No. 8,712,206, (a) the accused products of FS and Wirewerks infringe asserted claims 22 and 23; (b) the accused products of Siemon infringe claim 22; and (c) the accused products of Panduit do not infringe claim 22 or claim 23.

7. The domestic industry requirement has been satisfied with respect to all asserted patents

8. It has not been shown by clear and convincing evidence that any of the asserted claims are invalid.

X. Initial Determination on Violation

Accordingly, it is the INITIAL DETERMINATION of the undersigned that a violation of section 337 (19 U.S.C. § 1337) has occurred in the importation into the

[redacted]

United States, the sale for importation, or the sale within the United States after importation, of certain high-density fiber optic equipment and components thereof that infringe the asserted claims of U.S. Patent No. 9,020,320; U.S. Patent No. 10,444,456; U.S. Patent No. 10,120,153; and U.S. Patent No. 8,712,206.

Further, this initial determination, together with the record of the hearing in this investigation consisting of (1) the transcript of the hearing, with appropriate corrections as may hereafter be ordered, and (2) the exhibits received into evidence in this investigation, is hereby certified to the Commission.

In accordance with 19 C.F.R. § 210.93(c), all material found to be confidential by the undersigned under 19 C.F.R. § 210.5 is to be given *in camera* treatment.

The Secretary shall serve a public version of this initial determination upon all parties of record and the confidential version upon counsel who are signatories to the Protective Order, as amended, issued in this investigation.

Pursuant to 19 C.F.R. § 210.42(h), this initial determination shall become the determination of the Commission unless a party files a petition for review pursuant to § 210.43(a) or the Commission, pursuant to § 210.44, orders on its own motion a review of the initial determination or certain issues herein.

XI. Recommended Determination on Remedy and Bonding

Pursuant to the notice of investigation, 85 Fed. Reg. 16653 (Mar. 24, 2020), this is the recommended determination in *Certain High-Density Fiber Optic Equipment and Components Thereof*, United States International Trade Commission Investigation No. 337-TA-1194.

[redacted]

A. Limited Exclusion Order

The Commission has broad discretion in selecting the form, scope, and extent of the remedy in a section 337 proceeding. *Viscofan, S.A. v. United States Int'l Trade Comm'n*, 787 F.2d 544, 548 (Fed. Cir. 1986). A limited exclusion order directed to respondents' infringing products is among the remedies that the Commission may impose. *See* 19 U.S.C. § 1337(d).

Corning argues, "if a general exclusion order is not issued, permanent limited exclusion orders should issue barring from entry into the United States all of Respondents' high-density fiber optic equipment and components thereof that infringe one or more claims of the Asserted Patents." Compl. Br. at 287. The Staff agrees. Staff Br. at 227 n.44. Respondents, on the other hand, argue that "any remedy should be narrowly tailored." *See* Resps. Br. at 291-92. Respondents' requests are addressed below.

As discussed below, it is the recommendation of the administrative law judge that in the event that a violation of section 337 is found, and subject to any public interest determination that the Commission may make, at least a limited exclusion order should issue.

B. Respondents' Requests

Respondents request numerous restrictions of and exceptions to any remedial orders issued in this investigation. Respondents argue that "any remedy should be narrowly tailored":

> Any issued remedy must have a "reasonable relation to the unlawful practices found to exist." *Hyundai Elecs. Indus. Co., Ltd. v. U.S. Int'l Trade Comm'n*, 899 F.2d 1204, 1209 (Fed. Cir. 1990). If a

[redacted]

> violation is found, any remedy should be restricted to imported accused products found to infringe a valid patent and should not extend to products with substantial non-infringing uses, or to domestically manufactured, non-imported products. Any remedy should include exceptions to allow for Respondents' continued service and repair of any products sold before the effective date of any remedial order and to complete any pending contracts or purchase orders. Any remedy should be delayed to permit Respondents an opportunity to develop alternative, non-infringing products. Any remedy should contain an exception for products to be sold to or used by any government agency, branch, facility, or base. Any exclusion order should contain a certification provision. Any remedy should also be appropriate in light of the public interest.
>
> For any remedial order issued against the parties for the '320, '456, or '153 Patents, the scope of the order should not encompass components imported for use with domestically-developed products. No respondent imports the accused chassis and module combinations. No respondent sells such combinations. Schoettelkotte Tr. 130:15-20.
>
> Panduit and Siemon do not import the accused chassis. Panduit's chassis are developed and manufactured in Illinois. *See, e.g.*, JX-0028C (Wagner Dep. Tr.) 42:5-43:7, 79:6-22, 81:21-82:3; JX-0029C (Wiltjer Dep. Tr.) 64:5-65-8. Siemon's LightStack enclosures are manufactured by Siemon in Connecticut. Veatch Tr. 468:10-24; RX-1266C (Veatch WS) Q/A 17. Accordingly, modules imported for use with domestically-developed chassis should be excluded from any remedial order.
>
> Leviton does not import the accused cassettes or enclosures. RX-0005C (Kim WS) Q/A 34-35. Leviton previously imported [redacted] of the accused enclosures, but no longer imports those materials. *Id.* Q/A 37; RX-0005.1C (Kim WS) Q/A 37. No remedy should apply to Leviton's domestically-made products or to products not imported.

Resps. Br. at 291-92.

Corning argues each request should be denied. *See* Compl. Reply Br. at 76-80. The Staff argues that each request should be denied, except for the service and repair, as well as the certification provision. *See* Staff Reply Br. at 42-44.

As an initial matter, the Commission, not a party found to infringe a valid patent, has broad discretion in selecting the form, scope, and extent of the remedy in a section

[redacted]

337 proceeding. Any summary request for exceptions without legal and/or factual support is without any merit and need not be considered. That is the case here. Further, these exceptions would improperly narrow the remedies and enable respondents to circumvent an exclusion order.

As shown below, for the reasons argued by Corning and the Staff (for the most part), the administrative law judge cannot recommend any of these requests except for service and repair, and the certification provision. *See* Compl. Reply Br. at 76-80; Staff Reply Br. at 42-44.

(1) Restriction of any remedy to "imported accused products found to infringe a valid patent"

"The Commission's long-standing practice is to direct its remedial orders to all products covered by the patent claims as to which a violation has been found, rather than limiting its orders only to those specific models selected for the infringement analysis." *Certain Optical Disk Controller Chips & Chipsets & Prods. Containing Same, Including DVD Players & PC Optical Storage Devices*, Inv. No. 337-TA-506, Comm'n Op. at 56 (Sept. 28, 2005). This practice ensures fulfillment of the central remedial policy of the statute: "ensur[ing] complete relief to the domestic industry." *Certain Road Milling Machines & Components Thereof*, Inv. No. 337-TA-1067, Comm'n Op. at 6 (Aug. 7, 2019) (internal citation and quotation marks omitted). Moreover, an "exclusion order covering only specific models of an accused device could easily be circumvented, thereby denying complete relief." *Id.*

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(2) Exception for products that have "substantial non-infringing uses" or are "domestically manufactured[and] non-imported"

Respondents argue that any products that have "substantial non-infringing uses" should be excepted from the remedial orders, including from cease and desist orders. While the existence of substantial noninfringing uses can preclude a finding of contributory infringement, they do not preclude a finding of direct or induced infringement. If infringement of any kind is found, a remedy should issue unless the asserted patent claims are shown to be invalid or the Commission finds that a remedy would violate one or more of the statutory public interest factors.

Respondents argue that "the scope of the order should not encompass components imported for use with domestically-developed products." This argument is inconsistent with the holdings in *Suprema* and *Blood Cholesterol Testing Strips*. A remedial order may apply to components that do not infringe at the time of importation, but infringe when combined with other components post-importation. *See Suprema*, 796 F.3d at 1348-52; *Blood Cholesterol Testing Strips*, Comm'n Op. at 32-33.

(3) Exceptions for service and repair

Corning argues, "Respondents' request for an exception to any exclusion order for "service and repair" must be denied. Although a service and repair exception can be appropriate in investigations where Respondents provide sufficient evidence that these activities are important, Respondents have provided no such evidence here." Compl. Reply Br. at 78. The Staff argues that "to the extent that any third party customers need specific parts for servicing existing products, the Staff would not oppose an exception to any remedial order for service and repair of products sold before the order issued."

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Here, respondents simply argue, "Any remedy should include exceptions to allow for Respondents' continued service and repair of any products sold before the effective date of any remedial order and to complete any pending contracts or purchase orders." Resps. Br. at 291. Respondents say nothing more, and they do not cite to any evidence. *See* Resps. Br. at 291-92.[54]

Nonetheless, while respondents have not come forward with evidentiary support, the administrative law judge recommends the exception for service and repair inasmuch as that is the Commission practice, and the purpose of the remedy is not to cause disruption to end users.

(4) Exceptions to complete "pending contracts" or "purchase orders";

Respondents have not provided sufficient evidence of either pending contracts or purchase orders in existence, nor have they provided any reason why such contracts being fulfilled would be justified. *See Road Milling Machines*, Inv. No. 337-TA-1067, Comm'n Op. at 14-15 (rejecting exception for shipments "scheduled for delivery" because it "would potentially circumvent the exclusion order," particularly where respondent failed to identify what the shipments entailed or how many shipments the exception would permit).

(5) Delay to permit respondents to develop non-infringing products

Respondents offered no evidence or basis to justify a delay or transition period of any kind. *Certain Mobile Devices, Associated Software, & Components Thereof*, Inv.

[54] In the Joint Outline, respondents also cite pages 295-300 (of their brief) concerning "the scope, duration, and exceptions." However, in those pages, there is no discussion of "the scope, duration, and exceptions." *See* Resps. Br. at 295-300; *see* also Resps. Reply Br. at 78, 79-80 (no discussion of "the scope, duration, and exceptions).

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No. 337-TA-744, Comm'n Op. at 22-23 (June 5, 2012) (rejecting respondent's argument for a "transition period" delaying enforcement of a limited exclusion order because "neither [respondent] nor any third party provided any factual basis to justify implementation of a transition period in this investigation"). They give no reason why the Commission should allow respondents to continue their infringing activities while attempting to design around complainant's patents. *See* Resps. Br. at 291-92.

(6) Exceptions for sales to government agencies

Respondents do not qualify for an exemption for "products to be sold to or used by any government agency, branch, facility, or base." Such exemptions are governed by 19 U.S.C. § 1337(l), which respondents do not cite or discuss. That statute specifically exempts only the United States government, not state or local governments or their affiliates. *See id.* Respondents offer no evidence that they sell the accused products to the federal government. *Certain Intraoral Scanners & Related Hardware & Software*, Inv. No. 337-TA-1090, Initial Det. at 151 (Apr. 26, 2019).

(7) Certification provision

The Staff does not oppose the inclusion of a certification provision. *See* Staff Reply Br. at 43 n.19. As noted by the Staff, certification provisions are standard in all Commission exclusion orders.

(8) Any remedy should be appropriate in light of the public interest

Consideration of the public interest factors has not been delegated to the administrative law judge in this investigation.

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C. General Exclusion Order

If a violation is found, Corning has requested a general exclusion order pursuant to 19 U.S.C. § 1337(d)(2), excluding from entry into the United States all products and components thereof that infringe one or more asserted claims of the patents at issue. *See* Compl. Br. at 259-86, 299-300. Corning argues, "A general exclusion order ('GEO') should issue prohibiting the unlicensed entry of all high-density fiber optic equipment and components thereof that infringe the Asserted Claims. Both potential bases for a GEO under 19 U.S.C. § 1337(d)(2) are present: (A) a general exclusion from entry of articles is necessary to prevent circumvention of limited exclusion orders; and (B) there is a pattern of violation, and it is difficult to identify the source of infringing products." Compl. Br. at 259. The Staff argues, "The evidence has established that a general exclusion order is warranted in this investigation under subparagraph (B) of 19 U.S.C. § 1337(d)(2)." Staff Br. at 222.

Under 19 U.S.C. § 1337(g)(2), "a general exclusion from entry of articles, regardless of the source or importer of the articles, may be issued if --- (A) no person appears to contest an investigation concerning a violation of the provisions of this section, (B) such a violation is established by substantial, reliable, and probative evidence, and (C) the requirements of subsection (d)(2) are met." 19 U.S.C. § 1337(g)(2).

Section 337(d)(2) states in relevant part:

(d) Exclusion of articles from entry . . .

> (2) The authority of the Commission to order an exclusion from entry of articles shall be limited to persons determined by the

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> Commission to be violating this section unless the Commission determines that –
>
> (A) a general exclusion from entry of articles is necessary to prevent circumvention of an exclusion order limited to products of named persons; or
>
> (B) there is a pattern of violation of this section and it is difficult to identify the source of infringing products.

19 U.S.C. § 1337(d)(2).

Thus, a GEO is warranted when “a general exclusion from entry of articles is necessary to prevent circumvention of an exclusion order limited to products of named persons” or “there is a pattern of violation of this section and it is difficult to identify the source of infringing products.” 19 U.S.C. § 1337(d)(2)(A); 19 U.S.C. § 1337(d)(2)(B). Satisfaction of either criterion is sufficient for imposition of a GEO. *Certain Cigarettes and Packaging Thereof*, Inv. No. 337-TA-643, Comm’n Op. at 24 (Oct. 1, 2009). The Commission “now focus[es] principally on the statutory language itself” when determining whether a GEO is warranted. *Certain Ground Fault Circuit Interrupters and Products Containing Same*, Inv. No. 337-TA-615, Comm’n Op. at 25 (Mar. 27, 2009). “In determining whether either criterion is satisfied the Commission may look not only to the activities of active respondents, but also to those of non-respondents as well as respondents who have defaulted or been terminated from an investigation.” *Certain Personal Transporters, Components Thereof, and Manuals Therefor*, Inv. No. 337-TA-935, USITC Pub. No. 4906, Comm’n Op. at 6 (June 2019).

For the reasons discussed below, the evidence establishes that a general exclusion order is warranted in this investigation under subparagraph (B) of 19 U.S.C. § 1337(d)(2).

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1. Preventing Circumvention of a Limited Exclusion Order

The evidence does not demonstrate that conditions in the market for fiber optic equipment provide incentives for the named respondents to attempt to circumvent a limited exclusion order. Corning argues that high demand for infringing products, the availability of high profit margins, and low barriers to entering the market would encourage respondents, particularly the defaulting respondents, to attempt to circumvent any limited exclusion order imposed in this investigation. *See* Compl. Br. at 260-63; *see* CX-0003C (Schoettelkotte WS) Q/A 166-77 (analyzing respondents' profitability). There is evidence, however, suggesting that attempts at circumvention would be unlikely to succeed.

The market in which the named respondents operate is a tight-knit market with sophisticated customers who have established relationships with known suppliers. *See* RX-0007C (Mulhern RWS) Q/A 179 ("[E]nd-users of the fiber optic products at issue are sophisticated and demanding."); *accord* Schoettelkotte Tr. 177. Just four "Hyper4" data center customers (Microsoft, Google, Amazon, and Facebook) account for nearly 50 percent of the entire data center market. *Id*. Q/A 201. Customers "typically look for a complete integrated solution platform that meets the density requirements across the entire application including not only enclosures and cassettes but also horizontal and vertical cable management, cable pathways, and labeling. These customers also demand a high level of technical support in consultative pre- and post-sales support." CX-0003C (Schoettelkotte WS) Q/A 115; CX-1726C (Panduit 2014 Business Plan) at 9. Thus, even if complainant is correct that profits are high and production costs are low in the fiber

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optic equipment industry, CX-0004C (Hicks WS) Q/A 65, the evidence of customer demand for stable, established relationships with suppliers suggests that barriers to entry are actually quite high. *See* Schoettelkotte Tr. 177.

Customer expectations also provide a significant disincentive for the named respondents to attempt to circumvent a limited exclusion order by importing products under other, less-established brand names or distribution channels. The evidence shows that some respondents have long-standing positions in the fiber optics communications market.[55] Siemon, for example, was founded in 1903 and began manufacturing and selling telecommunications equipment in 1906. *See* RX-1266C (Veatch WS) Q/A 4. There is insufficient evidence to suggest that such respondents would be willing to risk their relationships with current customers for the sake of circumventing a limited exclusion order.

Accordingly, Corning has not met its burden of establishing that a general exclusion order is necessary to prevent circumvention of a limited exclusion order. *See* 19 U.S.C. § 1337(d)(2)(A).

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[55] An exception is FS.com, which has a history of corporate name changes. The manufacturer of FS products, FS.com Ltd., was "formerly known as Fiberstore Co. Ltd." and appears to still be using that old name on its invoices. CX-1970 (FS June 5, 2020 Resps. to Interrogs.) at 7; CX-0412 (FS.com invoices) at 5. For U.S. distribution, Wei Xiang, the majority owner of the FS.com corporate family, created Fiberstore Inc. in Washington and FS.com in Delaware. JX-0030C (Xiang Dep. Tr.) at 29-30; *see id*. at 20-22, 30 (for a time, both entities fulfilled U.S. orders placed on the FS.com website operated by a third, Chinese entity). A customer making a purchase on the FS.com website could not tell which entity was completing the transaction. *Id*. at 30-31; JX-0031C (Zhang Dep.) at 74-75. Fiberstore Inc. has since ceased operations and FS.com has taken over its inventory and customer relationships. JX-0030C at 30:6-11; JX-0031C at 19-21.

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2. Pattern of Violation and Difficulty in Identifying the Source of Infringing Products

While a general exclusion order would not be warranted under subparagraph (A) of 19 U.S.C. § 1337(d)(2), complainant has established the need for a general exclusion order under subparagraph (B).

First, a pattern of violation of the asserted patents exists. Of the thirteen original respondents in this investigation, four have been shown to infringe (FS, Leviton, Panduit, and Siemon).

Five more respondents have been found in default:

- Order No. 7 (Initial Determination Finding Respondent Huber+Suhner AG in Default) (June 9, 2020), Order No. 8 (Initial Determination Finding Respondent Huber+Suhner Inc. in Default) (June 9, 2020), *aff'd*, Commission Determination Not to Review Initial Determinations Finding Two Respondents in Default (June 22, 2020).
- Order No. 13 (Initial Determination Finding Respondents Anfkom, Tarluz, and Wulei Bonelinks in Default) (Aug. 21, 2020), *aff'd*, Commission Determination Not to Review an Initial Determination Finding Three Respondents in Default (Sept. 15, 2020).

The evidence shows that it is more likely than not that these defaulting respondents' products infringe. *See* CX-0597 (Huber+Suhner chassis webpage); CX-0598 (Huber+Suhner module webpage); CX-0638 (TARLUZ product catalog); CX-0639 (TARLUZ chassis webpage); CX-0582 (Anfkom chassis webpage); CX-0583 (Anfkom module webpage); CX-0649 (Alibaba.com Wulei Bonelinks Webpage-1); CX-0651 (Wulei Bonelinks sample product photos) (all showing products with strong similarities to the products disclosed in the asserted patents); *see also* Complaint, ¶¶ 91-119, 149-75, 286-302, 338-60 (describing alleged infringement by defaulting respondents). The

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evidence concerning these nine respondents is sufficient to establish a pattern of violation.

Second, Corning argues, and has shown, that there are many non-respondent entities in the market for fiber optic equipment, any of whom could be the source of infringing products. Corning's Mr. Hicks identified 31 non-respondent entities that sell or offer to sell products that he alleges are copies of EDGE likely to infringe the asserted patents.[56] *See* Compl. Br. at 275-76 citing (CX-0004C (Hicks WS) Q/A 72-74, CDX-0004.1 (Hicks Direct Demonstratives) at 18-49). Mr. Hicks testified that the products sold by these companies are all "strikingly similar to EDGE." CX-0004C (Hicks WS) Q/A 70; Hicks Tr. 100-102. For example, regarding the products one of the companies identified, Shenzhen DYS Fiberoptic Tech Company, Ltd., Mr. Hicks testified:

> [Y]ou'll see, again, in quotes on the slide, which are quotations taken from the literature from Shenzhen DYS Fiber, which is actually advertised on Alibaba.com, talks about the density of the 144 fiber per 1U, the sliding tray designs, and the 19-inch fitting in a 19-inch installation. That – that in and of itself is not necessarily related to EDGE, because most data center hardware can fit in a 19-

[56] The entities identified are (1) Amphenol Network Solutions; (2) APS Cables & Connectors OY; (3) CABLExpress (part of CXtec Inc.); (4) Conexus Technologies, Inc.; (5) Fiber Connections, Inc.; (6) Fibernet Ltd. (Israel); (7) Fibernet (Italy); (8) FiberOptic Distribution LLC; (9) Hefei Xingcheng Comms. Co., Ltd.; (10) Hubbell Inc./Hubbell Premise Wiring; (11) Hubei Chenyu Photoelectric Tech. Co., Ltd.; (12) Hunan Twilight Optic Co., Ltd.; (13) HYC Co., Ltd.; (14) JFOPT Co., Ltd./Shenzhen Jiafu Optical Comm. Co., Ltd.; (15) Kocent Optec, Ltd.; (16) Molex Inc.; (17) Nexans; (18) Ningbo Geteknet Telecom Equipment Co., Ltd.; (19) Ningbo Jingkon Fiber Comm. Apparatus Co., Ltd.; (20) Rosenberger-OSI GmbH & Co. OHG; (21) Shenzhen Damu Tech Co., Ltd.; (22) Shenzhen DYS Fiber Optic Tech Co., Ltd.; (23) Shenzhen Fenglin Optical Comm. Co., Ltd.; (24) Shenzhen Fibercan Optical Co., Ltd.; (25) Shenzhen IH Optics Co., Ltd.; (26) Shenzhen Junjin Tech. Co., Ltd.; (27) Shenzhen Spring Optical Comm. Tech. Co., Ltd.; (28) Shenzhen Unifiber Tech. Co., Ltd.; (29) Shenzhen UT-King Tech. Co., Ltd.; (30) SHKE Comm. Tech. Co., Ltd.; and (31) Wuhan Wolon Comm. Tech. Co., Ltd. CX-0004C (Hicks WS) Q/A 72-74.

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> inch rack. But there's also, in the foreground, modules that very closely resemble the footprint and look of EDGE, even in terms of the latching mechanisms at the back of the – of the module. The two little tabs that you squeeze, that's actually an invention from a coworker of mine, who's a close friend.
>
> Q. Now, did you obtain the images that are shown in CDX-0004C? Excuse me, in CDX-0004?
>
> A. Yes. Our team did a great deal of due diligence to identify companies, in addition to the Respondents that are – have products that appear to be mere copies of the – of EDGE solution.

Hicks Tr. 101-102.

Finally, there is evidence that it is difficult to identify the sources of potentially infringing products. Mr. Hicks testified that "[t]hese companies pop up quickly and we are unable to determine who they sell to or if they have significant market share. It's also hard for Corning to buy products from these companies." *Id*. Q/A 75. He further testified that "it's often hard to tell which company actually makes any given product." *Id*. Some entities, such as defaulting respondents TARLUZ and Wulei Bonelinks, sell potentially infringing products without branding or identification. *See id*. Q/A 77; CX-0640 (TARLUZ product photos); CX-0651 (Wulei Bonelinks product photos). Such original equipment manufacturers ("OEMs") may easily produce EDGE copies and then sell them to anyone under any brand. *See* CX-0004C (Hicks WS) Q/A 79. Mr. Hicks testified:

> There are so many different entities that have been copying Corning's products. Several companies are original equipment manufacturers ("OEMs") that manufacture copied products but under a different company's label. Other times, products are unlabeled, mislabeled, or falsely associated with a different brand. For example, at pages 5-17 of CDX-0004C (Hicks Direct), you can see that certain copied products look

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> identical to each other even though they came from different manufacturers. Page 7 shows five different companies that produce identical modules, and page 11 shows four different companies that produce identical chassis. It's hard (and often impossible) to know whether these companies independently manufactured these products with the same design or bought them from a third party or each other. Finally, once the product arrives in the United States, there are many different domestic distributors. That makes it hard to recognize and keep track of all the copiers.

Id. Q/A 77.

Corning argues that although it would not be practical to name every entity found to be selling products similar to EDGE products as a respondent, there is evidence that any one of them, if named in an investigation, would be found to infringe the asserted patents. *See* Compl. Br. at 277. Corning has shown that a number of non-respondents' products closely resemble respondents' accused products. For example:

- Shenzhen Unifiber, Shenzhen DYS, SHKE, and Ningbo Jingkon sell fiber optic modules that appear identical to respondent FS's modules. *Compare* CX-1412 (Unifiber Tech.); CX-1075 (Shenzhen DYS); CX-1440 (SHKE); CX-1326 (Ningbo Jingkon) *with* CX-0263 (FS module inventory) at 5.

- SHKE also sells fiber optic equipment that appears identical to one of defaulting respondent Anfkom's systems. *Compare* CX-1439 (SHKE 8); CX-1440 (SHKE 9) *with* CX-0582 (Anfkom chassis webpage); CX-0583 (Anfkom module webpage).

- Ningbo Geteknet sells products that appear identical to systems sold by defaulting respondents Anfkom and Wulei Bonelinks. *Compare* CX-1171 (Ningbo Geteknet) *with* CX-0649 (Alibaba.com Wulei Bonelinks webpage); CX-0582 (Anfkom chassis webpage).

- Shenzhen Spring Optical, Hefei Xingcheng, Ningbo Geteknet, and Shenzhen UT-King sell chassis that appear identical to those sold by defaulting respondents TARLUZ and Wulei Bonelinks. *Compare* CX-1395 (Spring Optical); CX-1206 (Hefei); CX-1422 (UT-King Tech.); CX-1169 (Ningbo Geteknet) *with* CX-0640 (TARLUZ product photos); CX-0651 (Wulei Bonelinks product photos).

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See also Hicks Tr. 100-101 ("[Y]ou'll see that [the product sold by JFOPT Co., Ltd. is] a 1U rack mount patch panel that houses three independent sliding trays, just like EDGE, with a density of 144 fibers, just like EDGE. Each independent tray has sliding rail to pull smoothly, just like EDGE. And it – each tray is able to hold four cassettes, just like EDGE. And so it has the same features, the same look, format, as well as matching some of the Chinese Respondents' product."); *see* CDX-0004.1 (Hicks Direct Demonstratives) at 32.

* * *

"In general, in determining whether to issue a GEO, the Commission balances the complainant's interest in obtaining complete protection from all potential foreign infringers against the inherent potential of a GEO to disrupt legitimate trade." *Certain Erasable Programmable Read-Only Memories*, Inv. No. 337-TA-276, USITC Pub. No. 2196, Comm'n Op. at 125 (May 1989), *aff'd sub. nom*. *Hyundai Elec. Indus. v. International Trade Comm'n*, 899 F.2d 1204 (Fed. Cir. 1990). In this investigation, complainant and the named respondents account for the majority of the fiber optic equipment market, both globally and in the United States. *See* RX-0007C (Mulhern) Q/A 33, 196-205; RX-0731C through RX-0733C (market shares by segment); RDX-0007C (Mulhern demonstratives) at 20 (Corning and respondents account for 57 percent of North American market and 81 percent of sales to the "Hyper4" data center users).

A limited exclusion order directed to the named respondents would provide Corning with most of the relief to which it is entitled, and would avoid the disruption of legitimate trade that a general exclusion order can create. As discussed above, however,

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the portion of the market not occupied by the named respondents, appears to be full of rapidly appearing and disappearing manufacturers and distributors that make and sell products with strong similarities to both Corning's EDGE products and the infringing products of the named respondents. *See* CX-0004C (Hicks WS) Q/A 75. As the Staff argued, this is exactly the sort of situation that general exclusion orders are designed to address.

* * *

Accordingly, Corning has met its burden of establishing that a pattern of violation exists with respect to the asserted patents and that it is difficult to identify the source of infringing products. *See* 19 U.S.C. § 1337(d)(2)(B).

D. Cease and Desist Order

Corning requests the administrative law judge to recommend the entry of cease and desist orders directed to the respondents discussed below. *See* Compl. Br. at 287-94.

Section 337 provides that in addition to, or in lieu of, the issuance of an exclusion order, the Commission may issue a cease and desist order as a remedy for a violation of section 337. 19 U.S.C. § 1337(f)(1). The Commission "generally issues a cease and desist order only when a respondent maintains a commercially significant inventory of infringing products in the United States." *Certain Ground Fault Circuit Interrupters and Products Containing Same*, Inv. No. 337-TA-615, Comm'n Op. at 24 (Mar. 26, 2009); *Certain Video Game Systems, Accessories, and Components Thereof*, Inv. No. 337-TA-473, Comm'n Op. at 2 (Dec. 24, 2002).

[redacted]

1. Participating Respondents

With respect to the participating respondents, Corning argues, "The Commission should issue cease and desist orders to Respondents FS.com, Leviton, and Panduit because each maintains commercially significant inventory of the Accused Products in the U.S. and has significant domestic operations relating to the Accused Products." Compl. Br. at 287.

The Staff agrees. *See* Staff Br. at 228-32.

Respondents argue:

> Complainant and Mr. Schoettelkotte's analysis regarding amounts in inventory is flawed and overstated. First, Mr. Schoettelkotte's opinion regarding aggregate "months of inventory" fails to account for the nature of sales in the data center marketplace and the data produced by Respondents. RX-0007C (Mulhern RWS) Q/A 225–231. Indeed, sales in the data center market are not uniform or steady, since orders from clients tend to be large and sporadic. *Id.*; *see also* JX-0028C (Wagner Dep. Tr.) 102:2–13.
>
> Second, each of the Asserted Patents, except for the '206 Patent, require a combination of chassis and modules that are used together in a particular combination in order to allegedly infringe. *See* RX-0008C (Lebby RWS) Q/A 194, 252, 290. Certain Respondents do not import either the accused chassis or the accused modules, and none import the accused system or combinations. RX-0007C (Mulhern RWS) Q/A 233-237; RX-0005C (Kim WS) Q/A 34–35; JX-0013C (Byquist Dep. Tr.) 113-114; CX-1982C (Leviton Responses to Requests for Admission); CX-1988C (Leviton Responses to Interrogatories); JX-0028C (Wagner Dep. Tr.) 43, 79, 81-82; RX-1266C (Veatch WS) Q/A 18-19. All of the accused products have substantial non-infringing uses. *See* §§ VI.A, VII.A, and VIII.A, *supra*. Staff agrees. SPHB at 78. Mr. Schoettelkotte admitted he did not assess inventories of the accused combinations. Schoettelkotte Tr. 130:6-20. Complainant cannot, on the basis of importation of non-infringing components with substantial non-infringing uses, enjoin entirely domestic products and aspects of Respondents' high-density fiber optic business.
>
> Third, only imported inventory—not inventory of products manufactured in the United States—is relevant to the CDO analysis.

[redacted]

Complainant has not addressed this point at all. Schoettelkotte Tr. 129:11-21 (taking no opinion on importation of inventory). Any remedy provided must have a "reasonable relation to the unlawful practices found to exist." *Hyundai Elecs. Indus. Co., Ltd. v. U.S. Int'l Trade Comm'n*, 899 F.2d 1204, 1209 (Fed. Cir. 1990); *see also* 19 U.S.C. § 1337(d). By statute, a CDO is only available "[i]n addition to, or in lieu of, taking action under subsection (d) or (e)." 19 U.S.C. § 1337(f)(1). In other words, if action cannot be taken in this investigation pursuant to subsection (d) or (e), then no CDO can issue because it would not be "[i]n addition to" or "in lieu of" the remedies in subsection (d) or (e). Any CDO against Respondents' domestic products and activities would effectively amount to a conventional patent injunction under 35 U.S.C. § 283, which the Commission is not empowered to or constitutionally authorized to grant as a non-Article III administrative body. CDOs do not give the Commission jurisdiction to issue injunctions on entirely domestic activity, divorced from importation. Doing so turns Section 337 on its head. Any CDO as to Respondents' domestic manufacture and sale exceeds the Commission's statutory authority. 19 U.S.C. § 1337; *see also Kisor v. Wilkie*, 139 S. Ct. 2400 (2019); *Chevron, U.S.A., Inc. v. Nat. Res. Def. Council, Inc.*, 467 U.S. 837 (1984). Any CDO should be limited to imported, infringing products.

Finally, Complainant ignores evidence of no inventory for many products. RX-0007C (Mulhern RWS) Q/A 238-241; RX-0750C (Mulhern Exhibit 26); RX-0752C (Mulhern Exhibit 28); RX-0753C (Exhibit 29 to Mulhern Expert Report). There are no inventories of accused Leviton modules, FS chassis, certain FS modules, and 160 models of Panduit modules. RX-0007C (Mulhern RWS) Q/A 238-241; Schoettelkotte Tr. 129:23-130:5 (confirming no opinion of significant inventory of Leviton modules). Because certain products are not imported, there are also no relevant inventories of imported accused Leviton chassis or Panduit chassis. *Id.*

As Leviton does not import any products—and no longer imports any components or materials—there will be no inventory of any imported infringing products at the time any remedy issues. RX-0005.1C (Kim WS) Q/A 37. No CDO should issue as to any product for which there is zero inventory, or as to any product manufactured in the United States. Even (improperly) using [redacted] for Leviton, this is [redacted]. *See* CX-1820C (U.S. Sales of EDGE Chassis Ex. 5.3) (reflecting [redacted]. That number is not commercially significant by any measure.

Resps. Br. at 292-95.

[redacted]

Both Mr. Schoettelkotte and Mr. Hicks testified that due to the direct, head-to-head competitive relationship between the parties, Corning has lost sales of the EDGE DI Products to respondents FS, Leviton, and Panduit. *See* CX-0003C (Schoettelkotte WS) Q/A 180; CX-0004C (Hicks WS) Q/A 63-65. Respondents' documents and testimony show that respondents view Corning as the market benchmark both from a technical and pricing standpoint. *See* CX-0003C (Schoettelkotte WS) Q/A 180. Thus, as Mr. Schoettelkotte testified, respondents' domestic inventory, combined with their domestic operations, is commercially significant due to the potential to take sales from Corning. *See* CX-0003C (Schoettelkotte WS) Q/A 180-81.

To assess respondents' inventory, Mr. Schoettelkotte analyzed the available data to determine the average sales of accused products per month for each respondent, separated by accused chassis and accused modules. *See* CX-0003C (Schoettelkotte WS) Q/A 195-97 (FS); 204 (Leviton); 212-13 (Panduit). He used this information to calculate the number of months of inventory held by FS, Leviton, and Panduit, which he found commercially significant. *Id*. He also found these respondents' business operations in the U.S. relating to the accused products commercially significant. *Id.* Q/A 192, 198 (FS); 200-01, 205 (Leviton); 207-08, 214 (Panduit). Mr. Schoettelkotte's analysis of significant business operations is supported by Mr. Polidan's (of former respondent AFL) testimony that Panduit, Leviton, and Siemon have broad distribution networks throughout the country. *See* Polidan Tr. 194-195.

Ms. Mulhern critiques Mr. Schoettelkotte's analysis, but does not dispute that any of these respondents has commercially significant inventory or significant domestic operations relating to the accused products. *See* Mulhern Tr. 944-945. Instead, Ms.

[redacted]

Mulhern opines that, inasmuch as sales in this market are "lumpy," an average-months-of-inventory analysis is inappropriate. *See* RX-0007C (Mulhern RWS) Q/A 226-30. Ms. Mulhern has not opined on a more reliable approach. Ms. Mulhern also opines that some models of some respondents' accused products have no domestic inventory. *Id.* Q/A 230. However, a cease and desist order does not require a product-by-product calculation where, as here, there are hundreds of accused products, and it would be unworkable for the Commission and Customs to differentiate among them.

a. FS

FS's accused products compete with the EDGE DI Products. *See* CX-0003C (Schoettelkotte WS) Q/A 191; CX-0004C (Hicks WS) Q/A 58. FS has significant domestic operations that include a 44,000 square foot warehouse in Delaware with almost 2,000 different parts that provides prompt delivery of products to domestic customers. *See* CX-0003C (Schoettelkotte WS) Q/A 192, 37-38. FS's sales and inventory data relating to the accused products indicate that its domestic inventory is sufficient to satisfy approximately 15-19 months of sales of chassis and modules. *See* CX-0003C (Schoettelkotte WS) Q/A 197; CX-1838C (FS Inventory Amended Ex. 7.2). This inventory is commercially significant, and coupled with FS's significant domestic business operations, supports issuance of a cease and desist order against FS. *See* CX-0003C (Schoettelkotte WS) Q/A 198.

FS argues it stopped selling its accused products when it received Corning's complaint, and that it had no inventory of accused chassis in May 2020. *See* RX-0007C (Mulhern RWS) Q/A 204, 234. As Mr. Schoettelkotte testified, this is inconsistent with FS data showing that it had an inventory of nearly 800 chassis worth over $100,000 just

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days before the complaint was filed. Mr. Schoettelkotte therefore considered the data from just before the complaint in his analysis of months of chassis sales for FS. CX-0003C (Schoettelkotte WS) Q/A 195. Also, the testimony of FS's witnesses about the date that it stopped selling products was subject to impeachment at the hearing, where Mr. Zhang first testified that information about the accused products was "removed from [the FS] web site . . . close in time to when FS.com, Inc. received the complaint." However, when confronted with a July download of a web page, he stated that he did not know whether the page was still on the website. *See* Zhang Tr. 583-584.

b. Leviton

Leviton's accused products compete with Corning's DI Products. *See* CX-0003C (Schoettelkotte WS) Q/A 200; CX-0004C (Hicks WS) Q/A 58. Leviton has significant business operations in the United States, including two manufacturing facilities and two distribution centers that maintain inventory of accused products, as well as a wide network of domestic distributors. *See* CX-0003C (Schoettelkotte WS) Q/A 201, 41. Leviton's sales and inventory data relating to the accused products indicate that its current domestic inventory is sufficient to satisfy approximately one month of sales of chassis. *See* CX-0003C (Schoettelkotte WS) Q/A 204; CX-1827C (Leviton Inventory Ex. 7.3). This inventory is commercially significant, and coupled with Leviton's significant domestic business operations, supports a cease and desist order against Leviton. *See* CX-0003C (Schoettelkotte WS) Q/A 205.

c. Panduit

Panduit's accused products compete with Corning's DI Products. *See* CX-0003C

[redacted]

(Schoettelkotte WS) Q/A 207; CX-0004C (Hicks WS) Q/A 58. Panduit has significant business operations in the United States, including a large warehouse in Illinois that maintains an inventory of thousands of accused products and a network of distributors that maintains an unspecified inventory of accused products and accounts for close to 99% of Panduit's sales. *See* CX-0003C (Schoettelkotte WS) Q/A 208-09, 45. [redacted]. *Id.* Q/A 213; CX-1828C (Panduit Inventory Amended Ex. 7.4). [redacted] *See* CX-0003C (Schoettelkotte WS) Q/A 212. This inventory is commercially significant, and coupled with Panduit's significant domestic operations, supports a cease and desist order against Panduit. *Id.* Q/A 214.

2. Defaulting Respondents

Section 337(g)(l) authorizes the Commission to issue cease and desist orders against defaulted respondents. 19 U.S.C. § 1337(g)(l); *see Certain Hand Dryers and Housing for Hand Dryers*, Inv. No. 337-TA-1015, Comm'n Op. at 9-10 (Oct. 30, 2017) ("*Hand Dryers*"). This provision provides:

> If—
>
> (A) a complaint is filed against a person under this section;
>
> (B) the complaint and a notice of investigation are served on the person;
>
> (C) the person fails to respond to the complaint and notice or otherwise fails to appear to answer the complaint and notice;
>
> (D) the person fails to show good cause why the person should not be found in default; and

[redacted]

> (E) the complainant seeks relief limited solely to that person;
>
> the Commission shall presume the facts alleged in the complaint to be true and shall, upon request, issue an exclusion from entry or a cease and desist order, or both, limited to that person unless, after considering the effect of such exclusion or order upon the public health and welfare, competitive conditions in the United States economy, the production of like or directly competitive articles in the United States, and United States consumers, the Commission finds that such exclusion or order should not be issued.

19 U.S.C. § 1337(g)(1).

As discussed above, the Commission has personal jurisdiction over all the respondents in this investigation. Nevertheless, "[i]n determining whether the issuance of a CDO against a defaulted respondent is appropriate, the Commission considers whether the defaulted respondent maintains commercially significant inventories in the United States or has significant domestic operations that could undercut the remedy provided by an exclusion order." *See Hand Dryers*, Inv. No. 337-TA-1015, Comm'n Op. at 10; *Certain Electric Skin Care Devices, Brushes and Chargers Therefore, and Kits Containing the Same*, Inv. No. 337-TA-959, Comm'n Op. at 21-31 (Feb. 13, 2017) ("*Skin Care Devices*") (discussion of statutory provision and Commission precedent). The Commission's practice recognizes that inasmuch as a defaulted respondent has chosen not to participate in the investigation, complainants are not able to obtain detailed information in discovery to support a request for a cease and desist order. *See Hand Dryers*, Inv. No. 337-TA-1015, Comm'n Op. at 10.

As to domestic respondents found in default under section 337(g)(1), the Commission has consistently inferred the presence of commercially significant inventories in the United States and granted complainant's request for relief in the form of a cease and desist order. *See Hand Dryers*, Inv. No. 337-TA-1015, Comm'n Op. at 24

[redacted]

(citing *Certain Agricultural Tractors, Lawn Tractors, Riding Lawnmowers, and Components Thereof*, Inv. No. 337-TA-486, Comm'n Op. at l7-18 (July 14, 2003)); *Certain Mobile Device Holders and Components Thereof*, Inv. No. 337-TA-1028, Comm'n Op. at 24 (Mar. 22, 2018).

As to defaulting respondents, Corning argues, *inter alia*:

> Cease-and-desist orders are further warranted against defaulting respondents Huber + Suhner, Inc., Huber+Suhner AG, TARLUZ, Anfkom, and Wulei Bonelinks. When a respondent defaults, "the Commission shall presume the facts alleged in the complaint to be true and shall, upon request, issue an exclusion from entry or a cease and desist order, or both, limited to that person." 19 U.S.C. § 1337(g)(l); *see Certain Electric Skin Care Devices, Brushes and Chargers Therefor*, Inv. No. 337-TA-959, Comm'n Op. at 28 (Feb. 13, 2017).

Compl. Br. at 291.

The Staff agrees. *See* Staff Br. at 231-32.

a. Domestic Defaulting Respondent

Huber + Suhner, Inc. is a Delaware corporation with a principal place of business in Delaware. *See* Complaint, ¶ 19. Huber + Suhner, Inc. filed a notice of default on April 29, 2020 (EDIS Doc. ID No. 709180), the administrative law judge issued an ID finding Huber + Suhner, Inc. in default (Order No. 8 (June 9, 2020)), and the Commission did not review the ID (Comm'n Notice, June 22, 2020). The complaint and its exhibits show sufficient U.S. activities for a cease and desist order. Specifically, complaint Exhibits 94 (H+S Chassis Webpage) and 95 (H+S Module Webpage) are images of H+S's U.S. website, showing that it advertises the accused products and provides a customer service email and phone number for Huber + Suhner, Inc. in the United States. Complaint Exhibit 96 (H+S Sales Contact Webpage) is another image of

[redacted]

H+S's U.S. website, showing that it gives a physical address in Charlotte, NC, as well as an email, phone number, and website for Huber + Suhner, Inc. customer service. Complaint Exhibit 93 (H+S Press Release) is a press release discussing H+S displaying the accused products at a trade show in the United States. Complaint Physical Exhibit 19 (IANOS High-Density Connectivity System Video) is a video advertising the features of the Accused H+S Products.

b. Foreign Defaulting Respondents

For foreign companies that default, "the Commission has examined allegations in the complaint that foreign defaulting respondents maintain commercially significant U.S. inventories and/or are engaging in significant commercial business operations in the United States supported by available circumstantial evidence of online offers for sale, sales, and distribution of infringing products (as well as corresponding supporting documents relating to those sales) by foreign defaulting respondents demonstrating such significant domestic presence." *Certain Electric Skin Care Devices*, Inv. No. 337-TA-959, Comm'n Op. at 30 (*citing Certain Digital Photo Frames & Image Display Devices & Components Thereof*, Inv. No. 337-TA-807, Comm'n Op. at 10-11 (March 27, 2013)).

As set forth below, the complaint and its exhibits show that each defaulting respondent has domestic activities that support a cease and desist order.

Huber + Suhner AG

Huber+Suhner AG is a Swiss corporation with a principal place of business in Switzerland. *See* Complaint, ¶ 18. Huber+Suhner AG filed a notice of default on April 29, 2020 (EDIS Doc. ID No. 709180), the administrative law judge issued an ID finding Huber + Suhner, Inc. in default (Order No. 7 (June 9, 2020)), and the Commission did not

[redacted]

review the ID (Comm'n Notice, June 22, 2020). The complaint and its exhibits show sufficient U.S. activities for a cease and desist order. Specifically, complaint Exhibits 91 (H+S U.S. Trademark Application) and 92 (H+S Trademark Status) show that Huber+Suhner AG applied for a trademark in the United States for the name of the accused products, "IANOS," in 2015 and that the trademark remains active today. Complaint Exhibit 93 (H+S Press Release) is a press release discussing H+S displaying the accused products at a trade show in the United States. Complaint Exhibit 97 (H+S Catalog Excerpt) is a publicly available H+S product catalog advertising the features of the Accused H+S Products.

TARLUZ

TARLUZ is a Chinese company with its principal place of business in China. *See* Complaint, ¶ 23. TARLUZ failed to respond to the complaint or to discovery, and the administrative law judge issued an ID finding it in default on August 21, 2020 (Order No. 13), which was not reviewed by the Commission (Comm'n Notice, Sept. 15, 2020). The complaint and its exhibits show sufficient U.S. activities for a cease and desist order. Specifically, complaint Exhibit 139 (CX-0637 (TARLUZ Invoices and Shipping Info)) shows a sale and importation of the Accused TARLUZ Products in the United States, including showing unit prices that are multiple orders of magnitude lower than the DI products. Complaint Exhibits 140 (CX-0638 (TARLUZ Prod. Catalog)) and 141 (TARLUZ Chassis Webpage) show a publicly available price list and advertisements for the accused products from TARLUZ's U.S. website.

Anfkom

Anfkom is a Chinese company with a principal place of business in China. *See*

[redacted]

Complaint, ¶ 24. Anfkom failed to respond to the complaint or discovery, and the administrative law judge issued an ID finding it in default on August 21, 2020 (Order No. 13), which was not reviewed by the Commission (Comm'n Notice, Sept. 15, 2020). The complaint and its exhibits show sufficient U.S. activities for a cease and desist order. Specifically, complaint Exhibit 74 (CX-0581 (Anfkom Invoice)) shows a sale and importation of the Accused Anfkom Products in the United States, including showing unit prices that are multiple orders of magnitude lower than the DI products. Complaint Exhibits 75 (CX-0582, Anfkom Chassis Webpage) and 76 (CX-0583 (Anfkom Module Webpage)) show publicly available advertisements for the accused products from Anfkom's U.S. website, including links for "Live Chat" and "Send Inquiry."

Wulei Bonelinks

Wulei Bonelinks is a Chinese company with a principal place of business in China. *See* Complaint, ¶ 28. Wulei Bonelinks failed to respond to the complaint or discovery, and the administrative law judge issued an ID finding it in default on August 21, 2020 (Order No. 13), which was not reviewed by the Commission (Comm'n Notice, Sept. 15, 2020). The complaint and its exhibits show sufficient U.S. activities for a cease and desist order. Specifically, complaint Exhibit 154 (Wulei Bonelinks Invoice and Shipment Info) shows a sale and importation of the Accused Wulei Bonelinks Products in the United States, including showing unit prices that are multiple orders of magnitude lower than the DI products. Complaint Exhibits 155 (CX-0649 (Alibaba.com Wulei Bonelinks Webpage-1)) and 156 (Alibaba.com Wulei Bonelinks Webpage-2) show advertisements for the accused products on Alibaba.com, accessed in the United States, indicating that the products could "Ship to United States" in 3-4 days to 7 days, and with

[redacted]

prices as low as $13.50, compared to several hundred dollars for the DI products.

* * *

Accordingly, should a violation be found, the administrative law judge recommends that the Commission issue a cease and desist order as to the respondents discussed above.

E. Bond

Pursuant to section 337(j)(3), the administrative law judge and the Commission must determine the amount of bond to be required of a respondent, during the 60-day Presidential review period following the issuance of permanent relief, in the event that the Commission determines to issue a remedy. The purpose of the bond is to protect the complainant from any injury. 19 U.S.C. § 1337(j)(3); 19 C.F.R. §§ 210.42(a)(1)(ii), 210.50(a)(3).

When reliable price information is available, the Commission has often set bond by eliminating the differential between the domestic product and the imported, infringing product. *Certain Microsphere Adhesives, Processes for Making Same, and Products Containing Same, Including Self-Stick Repositionable Notes*, Inv. No. 337-TA-366, Comm'n Op. at 24 (1995). In other cases, the Commission has turned to alternative approaches, especially when the level of a reasonable royalty rate could be ascertained. *Certain Integrated Circuit Telecommunication Chips and Products Containing Same, Including Dialing Apparatus*, Inv. No. 337-TA-337, Comm'n Op. at 41 (1995). A 100 percent bond has been required when no effective alternative existed. *Certain Flash Memory Circuits and Products Containing Same*, Inv. No. 337-TA-382, USITC Pub. No.

[redacted]

3046, Comm'n Op. at 26-27 (July 1997) (a 100% bond imposed when price comparison was not practical because the parties sold products at different levels of commerce, and the proposed royalty rate appeared to be *de minimis* and without adequate support in the record).

Corning argues, *inter alia*:

> As Mr. Schoettelkotte testified, for each of the participating Respondents, a bond based on the price differential is appropriate and is necessary to protect Corning from injury during Presidential Review. CX-0003C (Schoettelkotte WS) Q/A 219. Because here are no established royalty rates for the Asserted Patents, a bond based on a reasonable royalty would not be appropriate. CX-0004.1C (Hicks WS Errata) Q/A 83-84;[57] RX-0007C (Mulhern RWS) Q/A 267.
>
> Mr. Schoettelkotte and Mr. Hicks testified that Respondents' Accused Products directly compete with the EDGE DI Products in the U.S., and that Corning has both lost sales to Respondents and had to lower prices of the EDGE DI products to compete. CX-0003C (Schoettelkotte WS) Q/A 217, 219; CX-0004C (Hicks WS) Q/A 63-65. Mr. Schoettelkotte further explained that Respondents advertise and sell their products at a price that is intended to undercut the pricing of the DI Products. CX-0003C (Schoettelkotte WS) Q/A 217. Mr. Schoettelkotte accordingly determined the appropriate bond by calculating the price differential between each Respondent's accused chassis and modules and the EDGE DI chassis and modules, as set forth in CX-1840C (Summary of Price Differential Amended Ex. 8.1).
>
> Ms. Mulhern argues that differences in product characteristics, pricing by distribution channel, and differing sales volumes makes the use of price differential impractical. RX-0007C (Mulhern RWS) Q/A 265. But Ms. Mulhern does not dispute that Respondents' prices are significantly lower than Corning's, or that Corning has lowered prices and lost sales due to this competition. Nor does Ms. Mulhern offer any alternative bond calculations. Thus, while Corning maintains that Mr. Schoettelkotte's price differential analysis is appropriate, the alternative

[57] Corning recently entered into licenses with former Respondent AFL and with CommScope. However, these licenses do not inform the bond analysis because they do not contain the type of "royalty" the Commission considers relevant. Instead, the licenses are complex business arrangements in which both parties obtain value from various interrelated provisions.

[redacted]

> should be a bond of 100%, given the need to protect Corning from further harm due to Respondents' pricing, the lack of an appropriate standard royalty rate, and Respondents' failure to offer an alternative. *See Certain Flash Memory Circuits*, Inv. No. 337-TA-382, Comm'n Op. at 26-27.

Compl. Br. at 295-96.

Respondents' entire argument on the appropriate bond rate is as follows:

> Complainant fails to show any amount is needed to offset any purported injury. Schoettelkotte Tr. 133:6-12. Complainant's price differential analysis is flawed. RX-0007C (Mulhern RWS) Q/A 246-256. Complainant failed to provide information regarding its licenses to Respondents' competitors. Complainant has not met its burden of showing that a bond is warranted, thus no bond should be imposed. *See Magnetic Tape Cartridges*, Inv. No. 337-TA-1058, Comm'n Op. at 73-74 (imposing no bond upon failure to show bond is warranted).

Resps. Br. at 300.

The Staff argues, *inter alia*:

> In the Staff's view, a bond rate of zero percent of entered value is not "sufficient to protect the complainant from any injury." *See* 19 C.F.R. § 210.50(a)(3). At the same time, Complainant's proposed matrix of multiple bond rates per Respondent may be administratively unworkable in this particular investigation, given the number of products and Respondents involved. The Staff does not object to the particular bond rates suggested by Complainant, but suggests that if the proposed matrix is found to be unmanageable, then a single bond rate of 100 percent would be appropriate. In investigations where available pricing information is inadequate, the Commission may set the bond at 100 percent of entered value. *See, e.g.*, *Certain Flash Memory Circuits and Products Containing Same*, Inv. No. 337-TA-382, USITC Pub. No. 3046, Comm'n. Op. at 26-27 (July 1997); *Certain Neodymium-Iron-Boron Magnets, Magnet Alloys*, Inv. No. 337-TA-372, USITC Pub. 2964, Comm'n Op. at 15 (May 1996). Accordingly, the Presidential review period bond should either be set according to Complainants' matrix or, if this is found to be unworkable, in the amount of 100 percent of entered value.

Staff Br. at 234.

Corning and the Staff persuasively argued that a bond is required in this instance to protect Corning from injury during the Presidential review period.

[redacted]

Corning provides a thorough analysis for the five participating respondents and the defaulting respondents. *See* Compl. Br. at 296-99. Corning argues that the Commission should set two separate bond rates for each respondent, one for chassis and one for modules, based on a comparison of that respondent's weighted average sales prices to those of complainant. Mr. Schoettelkotte testified that using this approach, he calculated the following bond rates:

<u>Complainant's Suggested Bond Rates</u>

Respondent	Chassis Rate	Module Rate
FS	262.5%	239.9%
Leviton	72.5%	N/A
Panduit	43.9%	20.7%
Siemon	N/A	82.4%
Wirewerks	N/A	4.4%
All Other Imports	100%	100%

See id.; Staff Br. at 233 citing (CX-0003C (Schoettelkotte WS) Q/A 221, 228-53; CX-1840C (summary of price differentials)).

In investigations where, as here, "there is no reliable pricing information because the respondents have defaulted and failed to participate in discovery," the Commission typically sets the bond at 100% of the value of the infringing products. *Certain Ink Cartridges & Components Thereof*, Inv. No. 337-TA-946, Comm'n Op. at 18 (June 29, 2016); *Certain Pocket Lighters*, Inv. No. 337-TA-1142, Comm'n Op. at 23-24.

Accordingly, the administrative law judge recommends the bond rates calculated by Corning's expert.

[redacted]

XII. Order

To expedite service of the public version of this document, the parties shall file a joint proposed public version, on the date and in the manner required by Order No. 30.

DPShaw

David P. Shaw
Administrative Law Judge

Issued: March 23, 2021

CERTAIN HIGH-DENSITY FIBER OPTIC EQUIPMENT AND COMPONENTS THEREOF **Inv. No. 337-TA-1194**

PUBLIC CERTIFICATE OF SERVICE

I, Lisa R. Barton, hereby certify that the attached **INITIAL DETERMINATION** has been served via EDIS upon the Commission Investigative Attorney, **Lisa J. Murray, Esq.**, and the following parties as indicated, on **April 20, 2021.**

Lisa R. Barton, Secretary
U.S. International Trade Commission
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U 2053569

THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office

February 18, 2020

THIS IS TO CERTIFY THAT ANNEXED HERETO IS A TRUE COPY FROM THE RECORDS OF THIS OFFICE OF:

U.S. PATENT: *9,020,320*
ISSUE DATE: *April 28, 2015*

By Authority of the
Under Secretary of Commerce for Intellectual Property
and Director of the United States Patent and Trademark Office

SYLVIA HOLLEY
Certifying Officer

US009020320B2

(12) **United States Patent**
Cooke et al.

(10) **Patent No.: US 9,020,320 B2**
(45) **Date of Patent: Apr. 28, 2015**

(54) **HIGH DENSITY AND BANDWIDTH FIBER OPTIC APPARATUSES AND RELATED EQUIPMENT AND METHODS**

(71) Applicants: **Terry L. Cooke**, Hickory, NC (US); **David L. Dean, Jr.**, Hickory, NC (US); **Harley J. Staber**, Coppell, TX (US); **Kevin L. Strause**, Keller, TX (US); **Alan W. Ugolini**, Hickory, NC (US)

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **13/746,938**

(22) Filed: **Jan. 22, 2013**

(65) **Prior Publication Data**

US 2013/0148935 A1 Jun. 13, 2013

Related U.S. Application Data

(63) Continuation of application No. 12/819,081, filed on Jun. 18, 2010, now abandoned, which is a continuation-in-part of application No. 12/323,415, filed on Nov. 25, 2008, now Pat. No. 8,452,148.

(60) Provisional application No. 61/218,880, filed on Jun. 19, 2009, provisional application No. 61/190,538, filed on Aug. 29, 2008, provisional application No. 61/197,068, filed on Oct. 23, 2008.

(51) **Int. Cl.**
G02B 6/00 (2006.01)
G02B 6/46 (2006.01)
G02B 6/44 (2006.01)

(52) **U.S. Cl.**
CPC ***G02B 6/46*** (2013.01); ***G02B 6/4452*** (2013.01); ***G02B 6/4453*** (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

620,013	A	2/1899	Barnes
2,528,910	A	11/1950	Poe
2,614,685	A	10/1952	Miller
3,081,717	A	3/1963	Yurevich
3,175,873	A	3/1965	Blomquist et al.
3,212,192	A	10/1965	Bachmann et al.
3,433,886	A	3/1969	Myers
3,494,306	A	2/1970	Aguilar
3,545,712	A	12/1970	Ellis
3,568,263	A	3/1971	Meehan
3,646,244	A	2/1972	Cole
3,664,514	A	5/1972	Drake
3,683,238	A	8/1972	Olds et al.
3,701,835	A	10/1972	Eisele et al.
3,880,396	A	4/1975	Freiberger et al.
3,906,592	A	9/1975	Sakasegawa et al.
3,991,960	A	11/1976	Tanaka
4,047,797	A	9/1977	Arnold et al.
4,059,872	A	11/1977	Delesandri
4,119,285	A	10/1978	Bisping et al.
4,148,454	A	4/1979	Carlson et al.
4,239,316	A	12/1980	Spaulding
4,244,638	A	1/1981	Little et al.
4,285,486	A	8/1981	Von Osten et al.
4,303,296	A	12/1981	Spaulding
4,354,731	A	10/1982	Mouissie
4,457,482	A	7/1984	Kitagawa
4,525,012	A	6/1985	Dunner
4,540,222	A	9/1985	Burrell
4,561,615	A	12/1985	Medlin, Jr.
4,564,163	A	1/1986	Barnett
4,597,173	A	7/1986	Chino et al.
4,611,875	A	9/1986	Clarke et al.
4,635,886	A	1/1987	Santucci et al.
4,645,292	A	2/1987	Sammueller
4,657,340	A	4/1987	Tanaka et al.
4,681,288	A	7/1987	Nakamura
4,702,551	A	10/1987	Coulombe
4,711,518	A	12/1987	Shank et al.
4,736,100	A	4/1988	Vastagh

(Continued)

FOREIGN PATENT DOCUMENTS

AU	2010270959	A1	2/2012
CA	2029592	A1	5/1992

(Continued)

OTHER PUBLICATIONS

International Search Report for PCT/US2009/066779 mailed Aug. 27, 2010, 3 pages.

(Continued)

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(57) **ABSTRACT**

High-connection density and bandwidth fiber optic apparatuses and related equipment and methods are disclosed. In certain embodiments, fiber optic apparatuses are provided and comprise a chassis defining one or more U space fiber optic equipment units. At least one of the one or more U space fiber optic equipment units may be configured to support particular fiber optic connection densities and bandwidths in a given 1-U space. The fiber optic connection densities and bandwidths may be supported by one or more fiber optic components, including but not limited to fiber optic adapters and fiber optic connectors, including but not limited to simplex, duplex, and other multi-fiber fiber optic components. The fiber optic components may also be disposed in fiber optic modules, fiber optic patch panels, or other types of fiber optic equipment.

28 Claims, 25 Drawing Sheets

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,744,629 A 5/1988 Bertoglio et al.
4,747,020 A 5/1988 Brickley et al.
4,752,110 A 6/1988 Blanchet et al.
4,753,510 A 6/1988 Sezerman
4,787,706 A 11/1988 Cannon, Jr. et al.
4,792,203 A 12/1988 Nelson et al.
4,798,432 A 1/1989 Becker et al.
4,805,979 A 2/1989 Bossard et al.
4,808,774 A 2/1989 Crane
4,824,193 A 4/1989 Maeda et al.
4,824,196 A 4/1989 Bylander
4,826,277 A 5/1989 Weber et al.
4,838,643 A 6/1989 Hodges et al.
4,840,449 A 6/1989 Ghandeharizadeh
4,865,280 A 9/1989 Wollar
4,898,448 A 2/1990 Cooper
4,900,123 A 2/1990 Barlow
4,911,662 A 3/1990 Debortoli et al.
4,948,220 A 8/1990 Violo et al.
4,949,376 A 8/1990 Nieves et al.
4,971,421 A 11/1990 Ori
4,986,625 A 1/1991 Yamada et al.
4,988,831 A 1/1991 Wilson et al.
4,991,928 A 2/1991 Zimmer
4,995,688 A 2/1991 Anton et al.
5,001,602 A 3/1991 Suffi et al.
5,005,941 A 4/1991 Barlow et al.
5,017,211 A 5/1991 Wenger et al.
5,023,646 A 6/1991 Ishida et al.
5,024,498 A 6/1991 Becker et al.
5,028,114 A 7/1991 Krausse et al.
5,037,175 A 8/1991 Weber
5,048,918 A 9/1991 Daems et al.
5,060,897 A 10/1991 Thalenfeld
5,066,149 A 11/1991 Wheeler et al.
5,067,784 A 11/1991 Debortoli et al.
5,071,211 A 12/1991 Debortoli et al.
5,071,220 A 12/1991 Ruello et al.
5,073,042 A 12/1991 Mulholland et al.
5,074,635 A 12/1991 Justice et al.
5,076,688 A 12/1991 Bowen et al.
5,080,459 A 1/1992 Wettengel et al.
5,100,221 A 3/1992 Carney et al.
5,104,336 A 4/1992 Hatanaka et al.
5,125,060 A 6/1992 Edmundson
5,127,082 A 6/1992 Below et al.
5,127,851 A 7/1992 Hilbert et al.
5,129,030 A 7/1992 Petrunia
5,129,607 A 7/1992 Satoh
5,133,039 A 7/1992 Dixit
5,138,678 A 8/1992 Briggs et al.
5,138,688 A 8/1992 Debortoli
5,142,598 A 8/1992 Tabone
5,142,607 A 8/1992 Petrotta et al.
5,150,277 A 9/1992 Bainbridge et al.
D330,368 S 10/1992 Bourgeois et al.
5,152,760 A 10/1992 Latina
5,153,910 A 10/1992 Mickelson et al.
5,157,749 A 10/1992 Briggs et al.
5,167,001 A 11/1992 Debortoli et al.
5,170,452 A 12/1992 Ott
5,189,723 A 2/1993 Johnson et al.
5,199,099 A 3/1993 Dalgoutte
5,204,929 A 4/1993 Machall et al.
5,209,572 A 5/1993 Jordan
5,214,735 A 5/1993 Henneberger et al.
5,224,186 A 6/1993 Kishimoto et al.
5,230,492 A 7/1993 Zwart et al.
5,231,687 A 7/1993 Handley
5,231,688 A 7/1993 Zimmer
5,233,674 A 8/1993 Vladic
5,239,609 A 8/1993 Auteri
5,243,679 A 9/1993 Sharrow et al.
5,253,320 A 10/1993 Takahashi et al.
5,260,957 A 11/1993 Hakimi et al.
5,261,633 A 11/1993 Mastro
5,265,187 A 11/1993 Morin et al.
5,274,729 A 12/1993 King et al.
5,274,731 A 12/1993 White
5,278,933 A 1/1994 Hunsinger et al.
5,280,138 A 1/1994 Preston et al.
5,285,515 A 2/1994 Milanowski et al.
5,291,570 A 3/1994 Filgas et al.
5,315,679 A 5/1994 Baldwin et al.
5,317,663 A 5/1994 Beard et al.
5,323,478 A 6/1994 Milanowski et al.
5,323,480 A 6/1994 Mullaney et al.
5,329,520 A 7/1994 Richardson
5,333,193 A 7/1994 Cote et al.
5,333,221 A 7/1994 Briggs et al.
5,333,222 A 7/1994 Belenkiy et al.
5,337,400 A 8/1994 Morin et al.
5,339,379 A 8/1994 Kutsch et al.
5,347,603 A 9/1994 Belenkiy et al.
5,353,367 A 10/1994 Czosnowski et al.
5,359,688 A 10/1994 Underwood
5,363,466 A 11/1994 Milanowski et al.
5,363,467 A 11/1994 Keith
5,366,388 A 11/1994 Freeman et al.
5,367,598 A 11/1994 Devenish, III et al.
5,373,421 A 12/1994 Detsikas et al.
5,383,051 A 1/1995 Delrosso et al.
5,390,272 A 2/1995 Repta et al.
5,398,295 A 3/1995 Chang et al.
5,398,820 A 3/1995 Kiss
5,399,814 A 3/1995 Staber et al.
5,401,193 A 3/1995 Lo Cicero et al.
5,402,515 A 3/1995 Vidacovich et al.
5,408,557 A 4/1995 Hsu
RE34,955 E 5/1995 Anton et al.
5,412,751 A 5/1995 Siemon et al.
5,416,837 A 5/1995 Cote et al.
5,418,874 A 5/1995 Carlisle et al.
5,420,956 A 5/1995 Grugel et al.
5,420,958 A 5/1995 Henson et al.
5,421,532 A 6/1995 Richter
5,438,641 A 8/1995 Malacarne
5,442,725 A 8/1995 Peng
5,442,726 A 8/1995 Howard et al.
5,443,232 A 8/1995 Kesinger et al.
5,444,804 A 8/1995 Yui et al.
5,448,015 A 9/1995 Jamet et al.
5,450,518 A 9/1995 Burek et al.
5,458,019 A 10/1995 Trevino
5,471,555 A 11/1995 Braga et al.
5,479,505 A 12/1995 Butler et al.
5,481,634 A 1/1996 Anderson et al.
5,481,939 A 1/1996 Bernardini
5,490,229 A 2/1996 Ghandeharizadeh et al.
5,495,549 A 2/1996 Schneider et al.
5,497,416 A 3/1996 Butler, III et al.
5,497,444 A 3/1996 Wheeler
5,511,144 A 4/1996 Hawkins et al.
5,511,798 A 4/1996 Kawamoto et al.
5,519,804 A 5/1996 Burek et al.
5,530,786 A 6/1996 Radliff et al.
5,535,970 A 7/1996 Gobbi
5,538,213 A 7/1996 Brown
5,542,015 A 7/1996 Hultermans
5,546,495 A 8/1996 Bruckner et al.
5,548,641 A 8/1996 Butler et al.
5,553,183 A 9/1996 Bechamps
5,553,186 A 9/1996 Allen
5,563,971 A 10/1996 Abendschein
5,572,617 A 11/1996 Bernhardt et al.
5,575,680 A 11/1996 Suffi
5,577,151 A 11/1996 Hoffer
5,590,234 A 12/1996 Pulido
5,595,507 A 1/1997 Braun et al.
5,596,670 A 1/1997 Debortoli et al.
5,600,020 A 2/1997 Wehle et al.
5,602,954 A 2/1997 Nolf et al.
5,608,606 A 3/1997 Blaney
5,613,030 A 3/1997 Hoffer et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,617,501	A	4/1997	Miller et al.
5,638,474	A	6/1997	Lampert et al.
5,640,476	A	6/1997	Womack et al.
5,640,482	A	6/1997	Barry et al.
5,647,043	A	7/1997	Anderson et al.
5,647,045	A	7/1997	Robinson et al.
5,650,334	A	7/1997	Zuk et al.
5,668,910	A	9/1997	Arnett
5,668,911	A	9/1997	Debortoli
5,671,273	A	9/1997	Lanquist
5,689,605	A	11/1997	Cobb et al.
5,689,607	A	11/1997	Vincent et al.
5,692,079	A	11/1997	Iso
5,694,511	A	12/1997	Pimpinella et al.
5,701,380	A	12/1997	Larson et al.
5,704,573	A	1/1998	de Beers et al.
5,708,742	A	1/1998	Beun et al.
5,708,751	A	1/1998	Mattei
5,710,851	A	1/1998	Walter et al.
5,717,810	A	2/1998	Wheeler
5,734,776	A	3/1998	Puetz
5,740,300	A	4/1998	Hodge
5,742,982	A	4/1998	Dodd et al.
5,751,874	A	5/1998	Chudoba et al.
5,751,882	A	5/1998	Daems et al.
5,754,724	A	5/1998	Peterson et al.
5,758,003	A	5/1998	Wheeler et al.
5,758,004	A	5/1998	Alarcon et al.
5,761,026	A	6/1998	Robinson et al.
5,765,698	A	6/1998	Bullivant
5,769,908	A	6/1998	Koppelman
5,774,612	A	6/1998	Belenkiy et al.
5,778,122	A	7/1998	Giebel et al.
5,778,130	A	7/1998	Walters et al.
5,781,686	A	7/1998	Robinson et al.
5,788,087	A	8/1998	Orlando
5,790,741	A	8/1998	Vincent et al.
5,793,920	A	8/1998	Wilkins et al.
5,793,921	A	8/1998	Wilkins et al.
5,796,908	A	8/1998	Vicory
5,806,687	A	9/1998	Ballesteros et al.
5,823,646	A	10/1998	Arizpe et al.
5,825,955	A	10/1998	Ernst et al.
5,825,961	A	10/1998	Wilkins et al.
5,828,807	A	10/1998	Tucker et al.
5,832,162	A	11/1998	Sarbell
5,835,657	A	11/1998	Suarez et al.
5,835,658	A	11/1998	Smith
5,862,290	A	1/1999	Burek et al.
5,870,519	A	2/1999	Jenkins et al.
5,874,733	A	2/1999	Silver et al.
5,877,565	A	3/1999	Hollenbach et al.
5,880,864	A	3/1999	Williams et al.
5,881,200	A	3/1999	Burt
5,883,995	A	3/1999	Lu
5,884,003	A	3/1999	Cloud et al.
5,887,095	A	3/1999	Nagase et al.
5,887,106	A	3/1999	Cheeseman et al.
5,892,877	A	4/1999	Meyerhoefer
5,894,540	A	4/1999	Drewing
5,901,220	A	5/1999	Garver et al.
5,903,693	A	5/1999	Brown
5,906,342	A	5/1999	Kraus
5,909,298	A	6/1999	Shimada et al.
5,913,006	A	6/1999	Summach
5,914,976	A	6/1999	Jayaraman et al.
5,915,055	A	6/1999	Bennett et al.
5,923,804	A	7/1999	Rosson
5,930,425	A	7/1999	Abel et al.
5,933,557	A	8/1999	Ott
5,940,563	A	8/1999	Kobayashi et al.
5,943,460	A	8/1999	Mead et al.
5,945,633	A	8/1999	Ott et al.
5,946,440	A	8/1999	Puetz
5,949,946	A	9/1999	Debortoli et al.
5,953,962	A	9/1999	Hewson
5,956,439	A	9/1999	Pimpinella
5,956,444	A	9/1999	Duda et al.
5,956,449	A	9/1999	Otani et al.
5,966,492	A	10/1999	Bechamps et al.
5,969,294	A	10/1999	Eberle et al.
5,975,769	A	11/1999	Larson et al.
5,978,540	A	11/1999	Bechamps et al.
5,980,303	A	11/1999	Lee et al.
5,987,203	A	11/1999	Abel et al.
5,993,071	A	11/1999	Hultermans
5,995,700	A	11/1999	Burek et al.
5,999,393	A	12/1999	Brower
6,001,831	A	12/1999	Papenfuhs et al.
6,009,224	A	12/1999	Allen
6,009,225	A	12/1999	Ray et al.
6,011,831	A	1/2000	Nieves et al.
6,027,252	A	2/2000	Erdman et al.
6,027,352	A	2/2000	Byrne
6,041,042	A	3/2000	Bussiere
6,044,193	A	3/2000	Szentesi et al.
6,049,963	A	4/2000	Boe
6,058,235	A	5/2000	Hiramatsu et al.
6,061,492	A	5/2000	Strause et al.
6,078,661	A	6/2000	Arnett et al.
6,079,881	A	6/2000	Roth
6,088,497	A	7/2000	Phillips et al.
6,118,075	A	9/2000	Baker et al.
6,127,627	A	10/2000	Daoud
6,130,983	A	10/2000	Cheng
6,134,370	A	10/2000	Childers et al.
6,141,222	A	10/2000	Toor et al.
6,149,313	A	11/2000	Giebel et al.
6,149,315	A	11/2000	Stephenson
6,151,432	A	11/2000	Nakajima et al.
6,160,946	A	12/2000	Thompson et al.
6,170,784	B1	1/2001	MacDonald et al.
6,172,782	B1	1/2001	Kobayashi
6,175,079	B1	1/2001	Johnston et al.
6,181,861	B1	1/2001	Wenski et al.
6,188,687	B1	2/2001	Mussman et al.
6,188,825	B1	2/2001	Bandy et al.
6,192,180	B1	2/2001	Kim et al.
6,200,170	B1	3/2001	Amberg et al.
6,201,919	B1	3/2001	Puetz et al.
6,201,920	B1	3/2001	Noble et al.
6,208,796	B1	3/2001	Williams Vigliaturo
6,212,324	B1	4/2001	Lin et al.
6,215,938	B1	4/2001	Reitmeier et al.
6,216,987	B1	4/2001	Fukuo
6,227,717	B1	5/2001	Ott et al.
6,229,948	B1	5/2001	Blee et al.
6,234,683	B1	5/2001	Waldron et al.
6,234,685	B1	5/2001	Carlisle et al.
6,236,795	B1	5/2001	Rodgers
6,240,229	B1	5/2001	Roth
6,243,522	B1	6/2001	Allan et al.
6,245,998	B1	6/2001	Curry et al.
6,247,851	B1	6/2001	Ichihara
6,250,816	B1	6/2001	Johnston et al.
6,259,850	B1	7/2001	Crosby, Jr. et al.
6,263,141	B1	7/2001	Smith
6,265,680	B1	7/2001	Robertson
6,269,212	B1	7/2001	Schiattone
6,273,532	B1	8/2001	Chen et al.
6,275,641	B1	8/2001	Daoud
6,278,829	B1	8/2001	BuAbbud et al.
6,278,831	B1	8/2001	Henderson et al.
D448,005	S	9/2001	Klein, Jr. et al.
6,289,618	B1	9/2001	Kump et al.
6,292,614	B1	9/2001	Smith et al.
6,301,424	B1	10/2001	Hwang
6,305,848	B1	10/2001	Gregory
6,307,997	B1	10/2001	Walters et al.
6,318,824	B1	11/2001	LaGrotta et al.
6,321,017	B1	11/2001	Janus et al.
6,322,279	B1	11/2001	Yamamoto et al.
6,324,575	B1	11/2001	Jain et al.
6,325,549	B1	12/2001	Shevchuk

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,327,059	B1	12/2001	Bhalla et al.
RE37,489	E	1/2002	Anton et al.
6,343,313	B1	1/2002	Salesky et al.
6,344,615	B1	2/2002	Nolf et al.
6,347,888	B1	2/2002	Puetz
6,353,696	B1	3/2002	Gordon et al.
6,353,697	B1	3/2002	Daoud
6,357,712	B1	3/2002	Lu
6,359,228	B1	3/2002	Strause et al.
6,363,198	B1	3/2002	Braga et al.
6,363,200	B1	3/2002	Thompson et al.
6,370,309	B1	4/2002	Daoud
6,371,419	B1	4/2002	Ohnuki
6,375,129	B2	4/2002	Koziol
6,377,218	B1	4/2002	Nelson et al.
6,379,052	B1	4/2002	de Jong et al.
6,381,642	B1	4/2002	O'Donnell et al.
6,385,374	B2	5/2002	Kropp
6,385,381	B1	5/2002	Janus et al.
6,389,214	B1	5/2002	Smith et al.
6,397,166	B1	5/2002	Leung et al.
6,398,149	B1	6/2002	Hines et al.
6,406,314	B1	6/2002	Byrne
6,410,850	B1	6/2002	Abel et al.
6,411,767	B1	6/2002	Burrous et al.
6,412,986	B1	7/2002	Ngo et al.
6,418,262	B1	7/2002	Puetz et al.
6,419,519	B1	7/2002	Young
6,424,781	B1	7/2002	Puetz et al.
6,425,694	B1	7/2002	Szilagyi et al.
6,427,045	B1	7/2002	Matthes et al.
6,431,762	B1	8/2002	Taira et al.
6,434,313	B1	8/2002	Clapp, Jr. et al.
6,438,310	B1	8/2002	Lance et al.
6,452,925	B1	9/2002	Sistanizadeh et al.
6,456,773	B1	9/2002	Keys
6,464,402	B1	10/2002	Andrews et al.
6,466,724	B1	10/2002	Glover et al.
6,469,905	B1	10/2002	Hwang
D466,087	S	11/2002	Cuny et al.
6,478,472	B1	11/2002	Anderson et al.
6,480,487	B1	11/2002	Wegleitner et al.
6,480,660	B1	11/2002	Reitmeier et al.
6,483,977	B2	11/2002	Battey et al.
6,484,958	B1	11/2002	Xue et al.
6,494,550	B1	12/2002	Chen et al.
6,496,640	B1	12/2002	Harvey et al.
6,504,988	B1	1/2003	Trebesch et al.
6,507,980	B2	1/2003	Bremicker
6,510,274	B1	1/2003	Wu et al.
6,532,332	B2	3/2003	Solheid et al.
6,533,472	B1	3/2003	Dinh et al.
6,535,397	B2	3/2003	Clark et al.
6,535,682	B1	3/2003	Puetz et al.
6,539,147	B1	3/2003	Mahony
6,539,160	B2	3/2003	Battey et al.
6,542,688	B1	4/2003	Battey et al.
6,544,075	B1	4/2003	Liao
6,550,977	B2	4/2003	Hizuka
6,554,485	B1	4/2003	Beatty et al.
6,560,334	B1	5/2003	Mullaney et al.
6,567,601	B2	5/2003	Daoud et al.
6,568,542	B1	5/2003	Chen
6,571,048	B1	5/2003	Bechamps et al.
6,577,595	B1	6/2003	Counterman
6,577,801	B2	6/2003	Broderick et al.
6,579,014	B2	6/2003	Melton et al.
6,584,267	B1	6/2003	Caveney et al.
6,585,423	B1	7/2003	Vergeest
6,587,630	B2	7/2003	Spence et al.
6,588,938	B1	7/2003	Lampert et al.
6,591,051	B2	7/2003	Solheid et al.
6,591,053	B2	7/2003	Fritz
6,592,266	B1	7/2003	Hankins et al.
6,597,670	B1	7/2003	Tweedy et al.
6,600,106	B2	7/2003	Standish et al.
6,600,866	B2	7/2003	Gatica et al.
6,601,997	B2	8/2003	Ngo
6,612,515	B1	9/2003	Tinucci et al.
6,612,874	B1	9/2003	Stout et al.
6,614,978	B1	9/2003	Caveney
6,614,980	B1	9/2003	Mahony
6,621,975	B2	9/2003	Laporte et al.
6,622,873	B2	9/2003	Hegrenes et al.
6,624,389	B1	9/2003	Cox
6,625,374	B2	9/2003	Holman et al.
6,625,375	B1	9/2003	Mahony
6,631,237	B2	10/2003	Knudsen et al.
6,640,042	B2	10/2003	Araki et al.
RE38,311	E	11/2003	Wheeler
6,644,863	B1	11/2003	Azami et al.
6,647,197	B1	11/2003	Marrs et al.
6,648,520	B2	11/2003	McDonald et al.
6,654,536	B2	11/2003	Battey et al.
6,668,127	B1	12/2003	Mahony
6,669,149	B2	12/2003	Akizuki
6,677,520	B1	1/2004	Kim et al.
6,679,604	B1	1/2004	Bove et al.
6,684,005	B1	1/2004	Egnell et al.
6,687,450	B1	2/2004	Kempeneers et al.
6,693,552	B1	2/2004	Herzig et al.
6,695,620	B1	2/2004	Huang
6,701,056	B2	3/2004	Burek et al.
6,710,366	B1	3/2004	Lee et al.
6,715,619	B2	4/2004	Kim et al.
6,719,149	B2	4/2004	Tomino
6,721,482	B1	4/2004	Glynn
6,741,784	B1	5/2004	Guan
6,741,785	B2	5/2004	Barthel et al.
6,746,037	B1	6/2004	Kaplenski et al.
6,748,154	B2	6/2004	Patel et al.
6,748,155	B2	6/2004	Kim et al.
6,758,600	B2	7/2004	Del Grosso et al.
6,768,860	B2	7/2004	Liberty
6,771,861	B2	8/2004	Wagner et al.
6,773,297	B2	8/2004	Komiya
6,778,525	B1	8/2004	Baum et al.
6,778,752	B2	8/2004	Laporte et al.
6,786,647	B1	9/2004	Hinds et al.
6,786,743	B2	9/2004	Huang
6,786,896	B1	9/2004	Madhani et al.
6,788,871	B2	9/2004	Taylor
6,792,190	B2	9/2004	Xin et al.
6,798,751	B1	9/2004	Voit et al.
6,804,447	B2	10/2004	Smith et al.
6,810,194	B2	10/2004	Griffiths et al.
6,813,412	B2	11/2004	Lin
6,816,660	B2	11/2004	Nashimoto
6,818,834	B1	11/2004	Lin
6,819,856	B2	11/2004	Dagley et al.
6,819,857	B2	11/2004	Douglas et al.
6,822,874	B1	11/2004	Marler
6,826,174	B1	11/2004	Erekson et al.
6,826,346	B2	11/2004	Sloan et al.
6,826,631	B2	11/2004	Webb
6,830,489	B2	12/2004	Aoyama
6,839,428	B2	1/2005	Brower et al.
6,839,438	B1	1/2005	Riegelsberger et al.
6,840,815	B2	1/2005	Musolf et al.
6,845,207	B2	1/2005	Schray
6,847,614	B2	1/2005	Banker et al.
6,848,862	B1	2/2005	Schlig
6,850,685	B2	2/2005	Tinucci et al.
6,853,637	B1	2/2005	Norrell et al.
6,854,894	B1	2/2005	Yunker et al.
6,856,334	B1	2/2005	Fukui
6,856,505	B1	2/2005	Venegas et al.
6,863,444	B2	3/2005	Anderson et al.
6,865,331	B2	3/2005	Mertesdorf
6,865,334	B2	3/2005	Cooke et al.
6,866,541	B2	3/2005	Barker et al.
6,868,216	B1	3/2005	Gehrke
6,869,227	B2	3/2005	Del Grosso et al.
6,870,734	B2	3/2005	Mertesdorf et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,870,997	B2	3/2005	Cooke
6,879,545	B2	4/2005	Cooke et al.
6,915,058	B2	7/2005	Pons
6,920,273	B2	7/2005	Knudsen
6,920,274	B2	7/2005	Rapp et al.
6,923,406	B2	8/2005	Akizuki
6,925,241	B2	8/2005	Bohle et al.
6,934,451	B2	8/2005	Cooke
6,934,456	B2	8/2005	Ferris et al.
6,935,598	B2	8/2005	Sono et al.
6,937,807	B2	8/2005	Franklin et al.
6,944,383	B1	9/2005	Herzog et al.
6,944,389	B2	9/2005	Giraud et al.
6,945,701	B2	9/2005	Trezza et al.
6,952,530	B2	10/2005	Helvajian et al.
6,963,690	B1	11/2005	Kassal et al.
6,968,107	B2	11/2005	Belardi et al.
6,968,111	B2	11/2005	Trebesch et al.
6,985,665	B2	1/2006	Baechtle
6,993,237	B2	1/2006	Cooke et al.
7,000,784	B2	2/2006	Canty et al.
7,005,582	B2	2/2006	Muller et al.
7,006,748	B2	2/2006	Dagley et al.
7,007,296	B2	2/2006	Rakib
7,025,275	B2	4/2006	Huang et al.
7,027,695	B2	4/2006	Cooke et al.
7,027,706	B2	4/2006	Diaz et al.
7,031,588	B2	4/2006	Cowley et al.
7,035,510	B2	4/2006	Zimmel et al.
7,038,137	B2	5/2006	Grubish et al.
7,048,447	B1	5/2006	Patel et al.
7,054,513	B2	5/2006	Herz et al.
7,066,748	B2	6/2006	Bricaud et al.
7,068,907	B2	6/2006	Schray
7,070,459	B2	7/2006	Denovich et al.
7,077,710	B2	7/2006	Haggay et al.
7,079,744	B2	7/2006	Douglas et al.
7,090,406	B2	8/2006	Melton et al.
7,090,407	B2	8/2006	Melton et al.
7,094,095	B1	8/2006	Caveney
7,097,047	B2	8/2006	Lee et al.
7,101,093	B2	9/2006	Hsiao et al.
7,102,884	B2	9/2006	Mertesdorf et al.
7,103,255	B2	9/2006	Reagan et al
7,110,654	B2	9/2006	Dillat
7,111,990	B2	9/2006	Melton et al.
7,113,679	B2	9/2006	Melton et al.
7,113,686	B2	9/2006	Bellekens et al.
7,113,687	B2	9/2006	Womack et al
7,116,491	B1	10/2006	Willey et al.
7,116,883	B2	10/2006	Kline et al.
7,118,281	B2	10/2006	Chiu et al.
7,118,405	B2	10/2006	Peng
7,120,347	B2	10/2006	Blackwell, Jr. et al.
7,120,348	B2	10/2006	Trebesch et al.
7,120,349	B2	10/2006	Elliott
7,127,143	B2	10/2006	Elkins, II et al.
7,128,471	B2	10/2006	Wilson
7,136,555	B2	11/2006	Theuerkorn et al.
7,139,462	B1	11/2006	Richtman
7,140,903	B2	11/2006	Pulizzi et al.
7,147,383	B2	12/2006	Sullivan
7,170,466	B2	1/2007	Janoschka
7,171,099	B2	1/2007	Barnes et al.
7,171,121	B1	1/2007	Skarica et al.
7,181,142	B1	2/2007	Xu et al.
7,186,134	B2	3/2007	Togami et al.
7,193,783	B2	3/2007	Willey et al.
7,194,181	B2	3/2007	Holmberg et al.
7,195,521	B2	3/2007	Musolf et al.
7,200,314	B2	4/2007	Womack et al.
7,200,316	B2	4/2007	Giraud et al.
7,201,595	B1	4/2007	Morello
7,217,040	B2	5/2007	Crews et al.
7,218,526	B2	5/2007	Mayer
7,220,065	B2	5/2007	Han et al.
7,221,832	B2	5/2007	Tinucci
7,228,036	B2	6/2007	Elkins, II et al.
7,228,047	B1	6/2007	Szilagyi et al.
7,231,125	B2	6/2007	Douglas et al.
7,234,878	B2	6/2007	Yamauchi et al.
7,236,677	B2	6/2007	Escoto et al.
7,239,789	B2	7/2007	Grubish et al.
7,245,809	B1	7/2007	Gniadek et al.
7,259,325	B2	8/2007	Pincu et al.
7,266,283	B2	9/2007	Kline et al.
7,270,485	B1	9/2007	Robinson et al.
7,272,291	B2	9/2007	Bayazit et al.
7,274,852	B1	9/2007	Smrha et al.
7,284,785	B2	10/2007	Gotou et al.
7,287,913	B2	10/2007	Keenum et al.
7,289,731	B2	10/2007	Thinguldstad
7,292,769	B2	11/2007	Watanabe et al.
7,298,950	B2	11/2007	Frohlich
7,300,216	B2	11/2007	Morse et al.
7,300,308	B2	11/2007	Laursen et al.
7,302,149	B2	11/2007	Swam et al.
7,302,153	B2	11/2007	Thom
7,302,154	B2	11/2007	Trebesch et al.
7,308,184	B2	12/2007	Barnes et al.
7,310,471	B2	12/2007	Bayazit et al.
7,310,472	B2	12/2007	Haberman
7,315,681	B2	1/2008	Kewitsch
7,325,975	B2	2/2008	Yamada et al.
7,330,624	B2	2/2008	Isenhour et al.
7,330,625	B2	2/2008	Barth
7,330,626	B2	2/2008	Kowalczyk et al.
7,330,629	B2	2/2008	Cooke et al.
7,331,718	B2	2/2008	Yazaki et al.
7,340,145	B2	3/2008	Allen
7,349,615	B2	3/2008	Frazier et al.
7,352,946	B2	4/2008	Heller et al.
7,352,947	B2	4/2008	Phung et al.
7,373,071	B2	5/2008	Douglas et al.
7,376,321	B2	5/2008	Bolster et al.
7,376,323	B2	5/2008	Zimmel
7,391,952	B1	6/2008	Ugolini et al.
7,397,996	B2	7/2008	Herzog et al.
7,400,813	B2	7/2008	Zimmel
7,404,736	B2	7/2008	Herbst et al.
7,409,137	B2	8/2008	Barnes
7,414,198	B2	8/2008	Stansbie et al.
7,417,188	B2	8/2008	McNutt et al.
7,418,182	B2	8/2008	Krampotich
7,418,184	B1	8/2008	Gonzales et al.
7,421,182	B2	9/2008	Bayazit et al.
7,428,363	B2	9/2008	Leon et al.
7,435,090	B1	10/2008	Schriefer et al.
7,437,049	B2	10/2008	Krampotich
7,439,453	B2	10/2008	Murano et al.
7,454,113	B2	11/2008	Barnes
7,460,757	B2	12/2008	Hoehne et al.
7,460,758	B2	12/2008	Xin
7,461,981	B2	12/2008	Yow, Jr. et al.
7,462,779	B2	12/2008	Caveney et al.
7,463,810	B2	12/2008	Bayazit et al.
7,463,811	B2	12/2008	Trebesch et al.
7,469,090	B2	12/2008	Ferris et al.
7,471,867	B2	12/2008	Vogel et al.
7,474,828	B2	1/2009	Leon et al.
7,477,824	B2	1/2009	Reagan et al.
7,477,826	B2	1/2009	Mullaney et al.
7,480,438	B2	1/2009	Douglas et al.
7,488,205	B2	2/2009	Spisany et al.
7,493,002	B2	2/2009	Coburn et al.
7,496,269	B1	2/2009	Lee
7,499,622	B2	3/2009	Castonguay et al.
7,499,623	B2	3/2009	Barnes et al.
7,507,111	B2	3/2009	Togami et al.
7,509,015	B2	3/2009	Murano
7,509,016	B2	3/2009	Smith et al.
7,510,421	B2	3/2009	Fransen et al.
7,522,804	B2	4/2009	Araki et al.
7,523,898	B1	4/2009	Barry et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,526,171	B2	4/2009	Caveney et al.
7,526,172	B2	4/2009	Gniadek et al.
7,526,174	B2	4/2009	Leon et al.
7,529,458	B2	5/2009	Spisany et al.
7,534,958	B2	5/2009	McNutt et al.
7,536,075	B2	5/2009	Zimmel
7,540,666	B2	6/2009	Luther et al.
7,542,645	B1	6/2009	Hua et al.
7,544,085	B2	6/2009	Baldwin et al.
7,552,899	B2	6/2009	Chen et al.
7,555,193	B2	6/2009	Rapp et al.
7,558,458	B2	7/2009	Gronvall et al.
7,565,051	B2	7/2009	Vongseng
7,567,744	B2	7/2009	Krampotich et al.
7,570,860	B2	8/2009	Smrha et al.
7,570,861	B2	8/2009	Smrha et al.
7,577,331	B2	8/2009	Laurisch et al.
7,596,293	B2	9/2009	Isenhour et al.
7,603,020	B1	10/2009	Wakileh et al.
7,607,938	B2	10/2009	Clark et al.
7,609,967	B2	10/2009	Hochbaum et al.
7,613,377	B2	11/2009	Gonzales et al.
7,614,903	B1	11/2009	Huang
7,620,272	B2	11/2009	Hino et al.
7,620,287	B2	11/2009	Appenzeller et al.
7,641,398	B2	1/2010	O'Riorden et al.
7,668,430	B2	2/2010	McClellan et al.
7,668,433	B2	2/2010	Bayazit et al.
7,672,561	B1	3/2010	Keith et al.
7,676,135	B2	3/2010	Chen
7,689,079	B2	3/2010	Burnham et al.
7,694,926	B2	4/2010	Allen et al.
7,697,811	B2	4/2010	Murano et al.
7,706,294	B2	4/2010	Natarajan et al.
7,715,125	B2	5/2010	Willey
7,715,683	B2	5/2010	Kowalczyk et al.
7,734,138	B2	6/2010	Bloodworth et al.
7,740,409	B2	6/2010	Bolton et al.
7,743,495	B2	6/2010	Mori et al
7,751,674	B2	7/2010	Hill
7,751,675	B2	7/2010	Holmberg et al.
7,756,371	B1	7/2010	Burnham et al.
7,756,382	B2	7/2010	Saravanos et al.
7,760,984	B2	7/2010	Solheid et al.
7,764,858	B2	7/2010	Bayazit et al.
7,764,859	B2	7/2010	Krampotich et al.
7,769,266	B2	8/2010	Morris
7,805,044	B2	9/2010	Reagan et al.
7,809,232	B2	10/2010	Reagan et al.
7,809,235	B2	10/2010	Reagan et al.
7,811,136	B1	10/2010	Hsieh et al.
7,822,310	B2	10/2010	Castonguay et al.
7,837,495	B2	11/2010	Baldwin et al.
7,850,372	B2	12/2010	Nishimura et al.
7,853,112	B2	12/2010	Zimmel et al.
7,856,166	B2	12/2010	Biribuze et al.
7,862,369	B2	1/2011	Gimenes et al.
7,869,685	B2	1/2011	Hendrickson et al.
7,876,580	B2	1/2011	Mayer
7,899,298	B2	3/2011	Cox et al.
7,914,332	B2	3/2011	Song et al.
7,942,589	B2	5/2011	Yazaki et al.
7,945,135	B2	5/2011	Cooke et al.
7,945,136	B2	5/2011	Cooke et al.
7,945,138	B2	5/2011	Hill et al.
7,970,250	B2	6/2011	Morris
7,991,252	B2	8/2011	Cheng et al.
8,009,959	B2	8/2011	Barnes et al.
8,014,171	B2	9/2011	Kelly et al.
8,014,646	B2	9/2011	Keith et al.
8,020,813	B1	9/2011	Clark et al.
8,059,932	B2	11/2011	Hill et al.
8,093,499	B2	1/2012	Hoffer et al.
8,107,785	B2	1/2012	Berglund et al.
8,131,126	B2	3/2012	Kowalczyk et al.
8,184,938	B2	5/2012	Cooke et al.
8,206,043	B2	6/2012	Thirugnanam et al.
8,206,058	B2	6/2012	Vrondran et al.
8,220,881	B2	7/2012	Keith
8,226,305	B2	7/2012	Thirugnanam et al.
8,249,410	B2	8/2012	Andrus et al.
8,251,591	B2	8/2012	Barnes et al.
8,270,798	B2	9/2012	Dagley et al.
8,280,216	B2	10/2012	Cooke et al.
8,285,104	B2	10/2012	Davis et al.
8,301,004	B2	10/2012	Cooke et al.
8,331,752	B2	12/2012	Biribuze et al.
8,353,494	B2	1/2013	Peng et al.
8,369,679	B2	2/2013	Wakileh et al.
8,391,666	B2	3/2013	Hetzer et al.
8,472,773	B2	6/2013	de Jong
8,491,331	B2	7/2013	Follingstad
8,528,872	B2	9/2013	Mattlin et al.
8,537,477	B2	9/2013	Shioda
8,538,226	B2	9/2013	Makrides-Saravanos et al.
8,559,783	B2	10/2013	Campos et al.
2001/0010741	A1	8/2001	Hizuka
2001/0029125	A1	10/2001	Morita et al.
2002/0010818	A1	1/2002	Wei et al.
2002/0012353	A1	1/2002	Gerszberg et al.
2002/0014571	A1	2/2002	Thompson
2002/0034290	A1	3/2002	Pershan
2002/0037139	A1	3/2002	Asao et al.
2002/0064364	A1	5/2002	Battey et al.
2002/0131730	A1	9/2002	Keeble et al.
2002/0136519	A1	9/2002	Tinucci et al.
2002/0141724	A1	10/2002	Ogawa et al.
2002/0150372	A1	10/2002	Schray
2002/0172467	A1	11/2002	Anderson et al.
2002/0180163	A1	12/2002	Muller et al.
2002/0181918	A1	12/2002	Spence et al.
2002/0181922	A1	12/2002	Xin et al.
2002/0191939	A1	12/2002	Daoud et al.
2002/0194596	A1	12/2002	Srivastava
2003/0002802	A1	1/2003	Trezza et al.
2003/0007743	A1	1/2003	Asada
2003/0007767	A1	1/2003	Douglas et al.
2003/0011855	A1	1/2003	Fujiwara
2003/0021539	A1	1/2003	Kwon et al.
2003/0036748	A1	2/2003	Cooper et al.
2003/0051026	A1	3/2003	Carter et al.
2003/0066998	A1	4/2003	Lee
2003/0086675	A1	5/2003	Wu et al.
2003/0095753	A1	5/2003	Wada et al.
2003/0147604	A1	8/2003	Tapia et al.
2003/0156552	A1	8/2003	Banker et al.
2003/0174996	A1	9/2003	Henschel et al.
2003/0180004	A1	9/2003	Cox et al.
2003/0180012	A1	9/2003	Deane et al.
2003/0183413	A1	10/2003	Kato
2003/0199201	A1	10/2003	Mullaney et al.
2003/0210882	A1	11/2003	Barthel et al.
2003/0223723	A1	12/2003	Massey et al.
2003/0223725	A1	12/2003	Laporte et al.
2003/0235387	A1	12/2003	Dufour
2004/0001717	A1	1/2004	Bennett et al.
2004/0013389	A1	1/2004	Taylor
2004/0013390	A1	1/2004	Kim et al.
2004/0022494	A1	2/2004	Liddle et al.
2004/0024934	A1	2/2004	Webb
2004/0067036	A1	4/2004	Clark et al.
2004/0074852	A1	4/2004	Knudsen et al.
2004/0086238	A1	5/2004	Finona et al.
2004/0086252	A1	5/2004	Smith et al.
2004/0120679	A1	6/2004	Vincent et al.
2004/0147159	A1	7/2004	Urban et al.
2004/0151465	A1	8/2004	Krampotich et al.
2004/0175090	A1	9/2004	Vastmans et al.
2004/0192115	A1	9/2004	Bugg
2004/0196841	A1	10/2004	Tudor et al.
2004/0208459	A1	10/2004	Mizue et al.
2004/0228598	A1	11/2004	Allen et al.
2004/0240827	A1	12/2004	Daoud et al.
2004/0240882	A1	12/2004	Lipski et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2004/0264873 A1 12/2004 Smith et al.
2005/0002633 A1 1/2005 Solheid et al.
2005/0008131 A1 1/2005 Cook
2005/0026497 A1 2/2005 Holliday
2005/0036749 A1 2/2005 Vogel et al.
2005/0067358 A1 3/2005 Lee et al.
2005/0069248 A1 3/2005 Jasti et al.
2005/0074990 A1 4/2005 Shearman et al.
2005/0076149 A1 4/2005 McKown et al.
2005/0083959 A1 4/2005 Binder
2005/0107086 A1 5/2005 Tell et al.
2005/0111809 A1 5/2005 Giraud et al.
2005/0123261 A1 6/2005 Bellekens et al.
2005/0129379 A1 6/2005 Reagan et al.
2005/0178573 A1 8/2005 James
2005/0201073 A1 9/2005 Pincu et al.
2005/0232566 A1 10/2005 Rapp et al.
2005/0233647 A1 10/2005 Denovich et al.
2005/0254757 A1 11/2005 Ferretti et al.
2005/0281526 A1 12/2005 Vongseng et al.
2005/0281527 A1 12/2005 Wilson et al.
2005/0285493 A1 12/2005 Hu et al.
2006/0007562 A1 1/2006 Willey et al.
2006/0018448 A1 1/2006 Stevens et al.
2006/0018622 A1 1/2006 Caveney
2006/0034048 A1 2/2006 Xu
2006/0039290 A1 2/2006 Roden et al.
2006/0044774 A1 3/2006 Vasavda et al.
2006/0045458 A1 3/2006 Sasaki et al.
2006/0072606 A1 4/2006 Posthuma
2006/0077968 A1 4/2006 Pitsoulakis et al.
2006/0093303 A1 5/2006 Reagan et al.
2006/0103270 A1 5/2006 Bergesch et al.
2006/0127026 A1 6/2006 Beck
2006/0133736 A1 6/2006 Sullivan
2006/0133759 A1 6/2006 Mullaney et al.
2006/0147172 A1 7/2006 Luther et al.
2006/0153517 A1 7/2006 Reagan et al.
2006/0160377 A1 7/2006 Huang
2006/0165365 A1 7/2006 Feustel et al.
2006/0165366 A1 7/2006 Feustel et al.
2006/0191700 A1 8/2006 Herzog et al.
2006/0193590 A1 8/2006 Puetz et al.
2006/0193591 A1 8/2006 Rapp et al.
2006/0198098 A1 9/2006 Clark et al.
2006/0204179 A1 9/2006 Patel et al.
2006/0215980 A1 9/2006 Bayazit et al.
2006/0225912 A1 10/2006 Clark et al.
2006/0228087 A1 10/2006 Bayazit et al.
2006/0269194 A1 11/2006 Luther et al.
2006/0269206 A1 11/2006 Zimmel
2006/0269208 A1 11/2006 Allen et al.
2006/0275008 A1 12/2006 Xin
2006/0275009 A1 12/2006 Ellison et al.
2006/0285812 A1 12/2006 Ferris et al.
2007/0003204 A1 1/2007 Makrides-Saravanos et al.
2007/0025070 A1 2/2007 Jiang et al.
2007/0031099 A1 2/2007 Herzog et al.
2007/0033629 A1 2/2007 McGranahan et al.
2007/0047894 A1 3/2007 Holmberg et al.
2007/0058641 A1 3/2007 Cicchetti et al.
2007/0086723 A1 4/2007 Sasaki et al.
2007/0104447 A1 5/2007 Allen
2007/0110373 A1 5/2007 Dudek et al.
2007/0131628 A1 6/2007 Mimlitch, III et al.
2007/0183732 A1 8/2007 Wittmeier et al.
2007/0189692 A1 8/2007 Zimmel et al.
2007/0196071 A1 8/2007 Laursen et al
2007/0221793 A1 9/2007 Kusuda et al.
2007/0237484 A1 10/2007 Reagan et al.
2007/0257159 A1 11/2007 Nelson et al.
2007/0266192 A1 11/2007 Campini et al.
2007/0274718 A1 11/2007 Bridges et al.
2008/0011514 A1 1/2008 Zheng et al.
2008/0025683 A1 1/2008 Murano
2008/0031585 A1 2/2008 Solheid et al.
2008/0063350 A1 3/2008 Trebesch et al.
2008/0068788 A1 3/2008 Ozawa et al.
2008/0069511 A1 3/2008 Blackwell, Jr. et al.
2008/0069512 A1 3/2008 Barnes et al.
2008/0078899 A1 4/2008 Chen et al.
2008/0080826 A1 4/2008 Leon et al.
2008/0080827 A1 4/2008 Leon et al.
2008/0080828 A1 4/2008 Leon et al.
2008/0085094 A1 4/2008 Krampotich
2008/0089656 A1 4/2008 Wagner et al.
2008/0095502 A1 4/2008 McColloch
2008/0095541 A1 4/2008 Dallesasse
2008/0100440 A1 5/2008 Downie et al.
2008/0106871 A1 5/2008 James
2008/0112681 A1 5/2008 Battey et al.
2008/0118207 A1 5/2008 Yamamoto et al.
2008/0121423 A1 5/2008 Vogel et al.
2008/0124039 A1 5/2008 Gniadek et al.
2008/0131068 A1 6/2008 Mertesdorf et al.
2008/0145013 A1 6/2008 Escoto et al.
2008/0152294 A1 6/2008 Hirano et al.
2008/0166094 A1 7/2008 Bookbinder et al.
2008/0166131 A1 7/2008 Hudgins et al.
2008/0175541 A1 7/2008 Lu et al.
2008/0175550 A1 7/2008 Coburn et al.
2008/0175551 A1 7/2008 Smrha et al.
2008/0175552 A1 7/2008 Smrha et al.
2008/0193091 A1 8/2008 Herbst
2008/0205823 A1 8/2008 Luther et al.
2008/0205843 A1 8/2008 Castonguay et al.
2008/0205844 A1 8/2008 Castonguay et al.
2008/0212928 A1 9/2008 Kowalczyk et al.
2008/0219632 A1 9/2008 Smith et al.
2008/0219634 A1 9/2008 Rapp et al.
2008/0236858 A1 10/2008 Quijano
2008/0247723 A1 10/2008 Herzog et al.
2008/0267573 A1 10/2008 Douglas et al.
2008/0285934 A1 11/2008 Standish et al.
2008/0292261 A1 11/2008 Kowalczyk et al.
2008/0296060 A1 12/2008 Hawley et al.
2008/0298763 A1 12/2008 Appenzeller et al.
2008/0304803 A1 12/2008 Krampotich et al.
2008/0310810 A1 12/2008 Gallagher
2009/0010607 A1 1/2009 Elisson et al.
2009/0016685 A1 1/2009 Hudgins et al.
2009/0022470 A1 1/2009 Krampotich
2009/0038845 A1 2/2009 Fransen et al.
2009/0060439 A1 3/2009 Cox et al.
2009/0060440 A1 3/2009 Wright et al.
2009/0067800 A1 3/2009 Vazquez et al.
2009/0074371 A1 3/2009 Bayazit et al.
2009/0080849 A1 3/2009 Hankins et al.
2009/0097813 A1 4/2009 Hill
2009/0110347 A1 4/2009 Jacobsson
2009/0121092 A1 5/2009 Keith
2009/0136194 A1 5/2009 Barnes
2009/0136195 A1 5/2009 Smrha et al.
2009/0136196 A1 5/2009 Trebesch et al.
2009/0146342 A1 6/2009 Haney et al.
2009/0148117 A1 6/2009 Laurisch
2009/0166404 A1 7/2009 German et al.
2009/0169163 A1 7/2009 Abbott, III et al.
2009/0175588 A1 7/2009 Brandt et al.
2009/0180749 A1 7/2009 Douglas et al.
2009/0184221 A1 7/2009 Sculler
2009/0185782 A1 7/2009 Parikh et al.
2009/0191891 A1 7/2009 Ma et al.
2009/0194647 A1 8/2009 Keith
2009/0196563 A1 8/2009 Mullsteff et al.
2009/0202214 A1 8/2009 Holmberg et al.
2009/0207577 A1 8/2009 Fransen et al.
2009/0208178 A1 8/2009 Kowalczyk et al.
2009/0208210 A1 8/2009 Trojer et al.
2009/0212679 A1 8/2009 Frousiakis et al.
2009/0214171 A1 8/2009 Coburn et al.
2009/0220200 A1 9/2009 Sheau Tung Wong et al.
2009/0220204 A1 9/2009 Ruiz
2009/0226142 A1 9/2009 Barnes et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2009/0238531	A1	9/2009	Holmberg et al.
2009/0245743	A1	10/2009	Cote et al.
2009/0252472	A1	10/2009	Solheid et al.
2009/0257726	A1	10/2009	Redmann et al.
2009/0257727	A1	10/2009	Laurisch et al.
2009/0257754	A1	10/2009	Theodoras, II et al.
2009/0263096	A1	10/2009	Solheid et al.
2009/0263122	A1	10/2009	Helkey et al.
2009/0267865	A1	10/2009	Miller et al.
2009/0269016	A1	10/2009	Korampally et al.
2009/0269018	A1	10/2009	Frohlich et al.
2009/0269019	A1	10/2009	Andrus et al.
2009/0274429	A1	11/2009	Krampotich et al.
2009/0274430	A1	11/2009	Krampotich et al.
2009/0274432	A1	11/2009	Iwaya
2009/0290842	A1	11/2009	Bran de Leon et al.
2009/0290843	A1	11/2009	Reagan et al.
2009/0297111	A1	12/2009	Reagan et al.
2009/0304342	A1	12/2009	Adomeit et al.
2009/0324189	A1	12/2009	Hill et al.
2010/0003000	A1	1/2010	Rapp et al.
2010/0012671	A1	1/2010	Vrondran et al.
2010/0027953	A1	2/2010	Russell
2010/0054681	A1	3/2010	Biribuze et al.
2010/0054682	A1	3/2010	Cooke et al.
2010/0054683	A1	3/2010	Cooke et al.
2010/0054684	A1	3/2010	Cooke et al.
2010/0054685	A1	3/2010	Cooke et al.
2010/0054686	A1	3/2010	Cooke et al.
2010/0054687	A1	3/2010	Ye et al.
2010/0061691	A1	3/2010	Murano et al.
2010/0061693	A1	3/2010	Bran de Leon et al.
2010/0074587	A1	3/2010	Loeffelholz et al.
2010/0080517	A1	4/2010	Cline et al.
2010/0086267	A1	4/2010	Cooke et al.
2010/0086274	A1	4/2010	Keith
2010/0111483	A1	5/2010	Reinhardt et al.
2010/0119201	A1	5/2010	Smrha et al.
2010/0129035	A1	5/2010	Teo
2010/0142544	A1	6/2010	Chapel et al.
2010/0142910	A1	6/2010	Hill et al.
2010/0150518	A1	6/2010	Leon et al.
2010/0158467	A1	6/2010	Hou et al.
2010/0166377	A1	7/2010	Nair et al.
2010/0178022	A1	7/2010	Schroeder et al.
2010/0202740	A1	8/2010	Barlowe et al.
2010/0202745	A1	8/2010	Sokolowski et al.
2010/0202748	A1	8/2010	Pierce et al.
2010/0220967	A1	9/2010	Cooke et al.
2010/0220968	A1	9/2010	Dagley et al.
2010/0247051	A1	9/2010	Kowalczyk et al.
2010/0266245	A1	10/2010	Sabo
2010/0278499	A1	11/2010	Mures et al.
2010/0296790	A1	11/2010	Cooke et al.
2010/0296791	A1	11/2010	Makrides-Saravanos et al.
2010/0310225	A1	12/2010	Anderson et al.
2010/0310226	A1	12/2010	Wakileh et al.
2010/0316334	A1	12/2010	Kewitsch
2010/0322554	A1	12/2010	Barnes et al.
2010/0322579	A1	12/2010	Cooke et al.
2010/0322580	A1	12/2010	Beamon et al.
2010/0322581	A1	12/2010	Cooke et al.
2010/0322582	A1	12/2010	Cooke et al.
2010/0322583	A1	12/2010	Cooke et al.
2010/0329624	A1	12/2010	Zhou et al.
2011/0008004	A1	1/2011	Liao et al.
2011/0069931	A1	3/2011	Cote et al.
2011/0073730	A1	3/2011	Kitchen
2011/0085774	A1	4/2011	Murphy et al.
2011/0085776	A1	4/2011	Biribuze et al.
2011/0097053	A1	4/2011	Smith et al.
2011/0097977	A1	4/2011	Bubnick et al.
2011/0129185	A1	6/2011	Lewallen et al.
2011/0129186	A1	6/2011	Lewallen et al.
2011/0186532	A1	8/2011	Wu
2011/0192631	A1	8/2011	Burek et al.
2011/0211799	A1	9/2011	Conner et al.
2011/0217014	A1	9/2011	Dominique
2011/0217016	A1	9/2011	Mullsteff
2011/0222821	A1	9/2011	Pitwon et al.
2011/0249950	A1	10/2011	Chapa Ramirez et al.
2011/0268404	A1	11/2011	Cote et al.
2011/0268405	A1	11/2011	Cote et al.
2011/0268407	A1	11/2011	Cowen et al.
2011/0268408	A1	11/2011	Giraud et al.
2011/0268413	A1	11/2011	Cote et al.
2011/0280537	A1	11/2011	Cowen et al.
2012/0025683	A1	2/2012	Mattlin et al.
2012/0051707	A1	3/2012	Barnes et al.
2012/0057838	A1	3/2012	Hill et al.
2012/0106899	A1	5/2012	Choi
2012/0183263	A1	7/2012	Wu
2012/0183289	A1	7/2012	Lou et al.
2012/0219263	A1	8/2012	Beamon et al.
2012/0288244	A1	11/2012	Wu et al.
2012/0288248	A1	11/2012	Chapa Ramirez et al.
2012/0301083	A1	11/2012	Carter et al.
2013/0004136	A1	1/2013	Brower et al.
2013/0058616	A1	3/2013	Cote et al.
2013/0077927	A1	3/2013	O'Connor
2013/0214108	A1	8/2013	Irudayaraj et al.
2013/0266282	A1	10/2013	Cote et al.
2013/0308916	A1*	11/2013	Buff et al. 385/135
2014/0003782	A1	1/2014	Blackwell, Jr. et al.
2014/0010510	A1*	1/2014	Blackard 385/135
2014/0112628	A1	4/2014	Keenum et al.

FOREIGN PATENT DOCUMENTS

CA	2186314	A1	4/1997
CA	2765835	A1	1/2011
CH	688705	A5	1/1998
CN	102460258	A	5/2012
DE	8711970	U1	10/1987
DE	3726718	A1	2/1989
DE	3726719	A1	2/1989
DE	4030301	A1	3/1992
DE	4231181	C1	8/1993
DE	20115940	U1	1/2002
DE	10338848	A1	3/2005
DE	202005009932	U1	11/2005
DE	202007000556	U1	10/2007
DE	102007024476	A1	11/2008
DE	202010009385	U1	9/2010
EP	29512	A1	6/1981
EP	0105597	A2	4/1984
EP	0250900	A2	1/1988
EP	0408266	A2	1/1991
EP	0474091	A1	8/1991
EP	0468671	A1	1/1992
EP	0490698	A1	6/1992
EP	0529830	A1	3/1993
EP	0544004	A1	6/1993
EP	0547778	A1	6/1993
EP	0581527	A1	2/1994
EP	0620462	A1	10/1994
EP	0693699	A1	1/1996
EP	0720322	A2	7/1996
EP	0776557	B1	6/1997
EP	0940700	A2	9/1999
EP	0949522	A2	10/1999
EP	1041417	A2	10/2000
EP	1056177	A1	11/2000
EP	1065542	A1	1/2001
EP	1162485	A2	12/2001
EP	1203974	A2	5/2002
EP	1289319	A2	3/2003
EP	1310816	A2	5/2003
EP	1316829	A2	6/2003
EP	1367308	A1	12/2003
EP	1621907	A1	2/2006
EP	1777563	A1	4/2007
EP	2060942	A2	5/2009
EP	2159613	A2	3/2010

(56) **References Cited**

FOREIGN PATENT DOCUMENTS

FR	1586331	A	2/1970
FR	2123728	AS	9/1972
FR	2378378	A1	8/1978
GB	2241591	A	9/1991
GB	2277812	A	11/1994
GB	2367379	A	4/2002
GB	2377839	A	1/2003
JP	3060994	A	3/1991
JP	3172806	A	7/1991
JP	3281378	A	12/1991
JP	5045541	A	2/1993
JP	6018749	A	1/1994
JP	06018749	A	1/1994
JP	7308011	A	11/1995
JP	7318761	A	12/1995
JP	8007308	A	1/1996
JP	8248235	A	9/1996
JP	8248237	A	9/1996
JP	3487946	A	10/1996
JP	8254620	A	10/1996
JP	3279474	A	10/1997
JP	9258033	A	10/1997
JP	9258055	A	10/1997
JP	2771870	B2	7/1998
JP	3448448	A	8/1998
JP	10227919	A	8/1998
JP	3478944	A	12/1998
JP	10332945	A	12/1998
JP	10339817	A	12/1998
JP	11023858	A	1/1999
JP	2000098138	A	4/2000
JP	2000098139	A	4/2000
JP	2000241631	A	9/2000
JP	2001004849	A	1/2001
JP	3160322	B2	4/2001
JP	2001133636	A	5/2001
JP	3173962	B2	6/2001
JP	3176906	B2	6/2001
JP	2001154030	A	6/2001
JP	2001159714	A	6/2001
JP	2002022974	A	1/2002
JP	2002077236	A	3/2002
JP	2002116337	A	4/2002
JP	2002169035	A	6/2002
JP	3312893	B2	8/2002
JP	200133636	A	8/2002
JP	2002305389	A	10/2002
JP	3344701	B2	11/2002
JP	2003029054	A	1/2003
JP	3403573	B2	5/2003
JP	2003169026	A	6/2003
JP	2003215353	A	7/2003
JP	2003344701	A	12/2003
JP	3516765	B2	4/2004
JP	2004144808	A	5/2004
JP	2004514931	A	5/2004
JP	3542939	B2	7/2004
JP	2004246147	A	9/2004
JP	2004361652	A	12/2004
JP	2004361893	A	12/2004
JP	3107704	U	2/2005
JP	2005055748	A	3/2005
JP	2005062569	A	3/2005
JP	2005084241	A	3/2005
JP	2005148327	A	6/2005
JP	2005257937	A	9/2005
JP	3763645		4/2006
JP	3763645	B2	4/2006
JP	3778021	B2	5/2006
JP	2006126513	A	5/2006
JP	2006126516	A	5/2006
JP	3794540	B2	7/2006
JP	2006227041	A1	8/2006
JP	3833638	B2	10/2006
JP	2006292924	A	10/2006
JP	3841344	B2	11/2006
JP	3847533	B2	11/2006
JP	200747336	A	2/2007
JP	3896035	B2	3/2007
JP	2007067458	A1	3/2007
JP	3934052	B2	6/2007
JP	3964191	B2	8/2007
JP	3989853	B2	10/2007
JP	4026244	B2	12/2007
JP	4029494	B2	1/2008
JP	4065223	B2	3/2008
JP	4093475	B2	6/2008
JP	4105696	B2	6/2008
JP	4112437	B2	7/2008
JP	4118862	B2	7/2008
JP	2008176118	A1	7/2008
JP	2008180817	A1	8/2008
JP	4184329	B2	11/2008
JP	2008271017	A	11/2008
JP	2008542822	T	11/2008
JP	2009503582	T	1/2009
JP	2009229506	A	10/2009
JP	2012065019	A	3/2012
KR	20110037404	A	4/2011
WO	9105281	A1	4/1991
WO	9326070	A1	12/1993
WO	9520175	A1	7/1995
WO	9636896	A1	11/1996
WO	9638752	A1	12/1996
WO	9712268	A1	4/1997
WO	9722025	A1	6/1997
WO	9736197	A1	10/1997
WO	9744605	A1	11/1997
WO	9825416	A1	6/1998
WO	9927404	A1	6/1999
WO	0005611	A2	2/2000
WO	0127660	A2	4/2001
WO	0130007	A2	4/2001
WO	0180596	A1	10/2001
WO	0242818	A1	5/2002
WO	03009527	A2	1/2003
WO	03014943	A2	2/2003
WO	2004052066	A1	6/2004
WO	2005020400	A1	3/2005
WO	2006076062	A	7/2006
WO	2006108024	A1	10/2006
WO	2007050515	A1	5/2007
WO	2007079074	A2	7/2007
WO	2007089682	A2	8/2007
WO	2007149215	A2	12/2007
WO	2008027201	A2	3/2008
WO	2008063054	A2	5/2008
WO	2008113054	A2	9/2008
WO	2008157248	A1	12/2008
WO	2009026688	A1	3/2009
WO	2009029485	A1	3/2009
WO	2009030360	A1	3/2009
WO	2009120280	A2	10/2009
WO	2010024847	A2	3/2010
WO	2010080745	A1	7/2010
WO	2011005461	A1	1/2011
WO	2011011510	A2	1/2011

OTHER PUBLICATIONS

"MPO Fiber Optic Rack Panels now available from L-com Connectivity Products," article dated Jun. 4, 2007, 16 pages, http://www.l-com.com/content/Article.aspx?Type=P&ID=438.

"19" Rack Panel with 16 MPO Fiber Optic Couplers—1U high," product page, accessed Oct. 23, 2012, 2 pages, http://www.l-com.com/item.aspx?id=9767#.UlbgG8XXay5.

"Drawing for L-com 1U Panel with 16 MTP couplers," May 15, 2007, 1 page, http://www.l-com.com/multimedia/eng_drawings/PR17516MTP.pdf.

"RapidNet Fibre MTP VHD Cassette," Brochure, Date Unknown, 1 page, http://www.hellermanntyton.se/documents/5000/576_fiber_1U.pdf.

(56) **References Cited**

OTHER PUBLICATIONS

"MPO for Gigabit Ethernet/FAS-NET MTP Solution," Brochure, Date Unknown, 11 pages, http://www.infinique.com/upload/13182286190.pdf.
"Hubbell OptiChannel High Density 144 Port 1U Fiber Enclosure," Brochure, Date Unknown, 2 pages, http://www.hubbell-premise.com/literature/PLDF010.pdf.
Non-final Office Action for U.S. Appl. No. 12/819,034 mailed May 11, 2012, 7 pages.
Non-final Office Action for U.S. Appl. No. 12/819,081 mailed Aug. 21, 2012, 12 pages.
Notice of Allowance of for U.S. Appl. No. 12/819,034 mailed Sep. 11, 2012, 7 pages.
Notice of Allowance for U.S. Appl. No. 12/417,325 mailed Aug. 22, 2012, 7 pages.
Notice of Panel Decision for Pre-Appeal Brief for U.S. Appl. No. 12/417,325 mailed Aug. 8, 2012, 2 pages.
Advisory Action for U.S. Appl. No. 12/417,325 mailed Jun. 29, 2012, 3 pages.
Advisory Action for U.S. Appl. No. 12/417,325 mailed Jun. 12, 2012, 3 pages.
Final Office Action for U.S. Appl. No. 12/417,325 mailed Apr. 16, 2012, 6 pages.
Final Office Action for U.S. Appl. No. 12/417,325 mailed Feb. 7, 2012, 7 pages.
Non-final Office Action for U.S. Appl. No. 12/417,325 mailed Jun. 15, 2011, 6 pages.
Notice of Allowance for U.S. Appl. No. 12/487,929 mailed Sep. 12, 2012, 4 pages.
Notice of Allowance for U.S. Appl. No. 12/487,929 mailed Jun. 13, 2012, 8 pages.
Advisory Action for U.S. Appl. No. 12/487,929 mailed Apr. 17, 2012, 3 pages.
Final Office Action for U.S. Appl. No. 12/487,929 mailed Feb. 14, 2012, 6 pages.
Final Office Action for U.S. Appl. No. 12/487,929 mailed Dec. 5, 2011, 7 pages.
Non-final Office Action for U.S. Appl. No. 12/487,929 mailed May 23, 2011, 7 pages.
Notice of Allowance for U.S. Appl. No. 12/415,253 mailed Mar. 11, 2011, 7 pages.
Non-final Office Action for U.S. Appl. No. 12/415,253 mailed Jul. 12, 2010, 11 pages.
Final Office Action for U.S. Appl. No. 12/415,253 mailed Apr. 16, 2010, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/415,253 mailed Sep. 30, 2009, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/641,617 mailed Oct. 5, 2012, 21 pages.
Final Office Action for U.S. Appl. No. 12/630,938 mailed Jun. 1, 2012, 18 pages.
Non-final Office Action for U.S. Appl. No. 12/630,938 mailed Dec. 19, 2011, 15 pages.
Non-final Office Action for U.S. Appl. No. 12/751,884 mailed Jul. 2, 2012, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/871,052 mailed Aug. 13, 2012, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/576,806 mailed Dec. 13, 2011, 6 pages.
Notice of Allowance for U.S. Appl. No. 12/576,806 mailed Apr. 18, 2012, 5 pages.
International Search Report for PCT/US2013/041268 mailed Aug. 20, 2013, 5 pages.
Notice of Allowance for U.S. Appl. No. 13/292,130 mailed Feb. 14, 2014, 7 pages.
Final Office Action for U.S. Appl. No. 12/707,889 mailed Feb. 11, 2014, 17 pages.
Non-final Office Action for U.S. Appl. No. 12/940,699 mailed Feb. 3, 2014, 10 pages.
Notice of Allowance for U.S. Appl. No. 12/952,960 mailed Feb. 13, 2014, 7 pages.
Notice of Allowance and Applicant-Initiated Interview Summary for U.S. Appl. No. 12/771,473 mailed Feb. 27, 2014, 8 pages.
Non-final Office Action for U.S. Appl. No. 13/081,856 mailed Nov. 26, 2013, 11 pages.
Non-final Office Action for U.S. Appl. No. 13/688,675 mailed Jan 31, 2014, 13 pages.
Non-final Office Action for U.S. Appl. No. 13/663,975 mailed Jan. 31, 2014, 18 pages.
Non-final Office Action for U.S. Appl. No. 12/394,114 mailed Mar. 21, 2014, 9 pages.
Final Office Action for U.S. Appl. No. 12/940,585 mailed Mar. 18, 2014, 15 pages.
Non-final Office Action for U.S. Appl. No. 12/953,101 mailed Apr. 3, 2014, 9 pages.
Advisory Action for U.S. Appl. No. 12/956,446 mailed Mar. 20, 2014, 3 pages.
Final Office Action for U.S. Appl. No. 13/603,894 mailed Mar. 20, 2014, 15 pages.
Advisory Action for U.S. Appl. No. 12/953,039 mailed Mar. 6, 2014, 3 pages.
International Search Report for PCT/US2012/023622 mailed Mar. 9, 2012, 4 pages.
International Search Report for PCT/US2012/023635 mailed Sep. 14, 2012, 3 pages.
International Search Report for PCT/US2012/023626 mailed May 22, 2012, 4 pages.
Notice of Allowance for U.S. Appl. No. 13/951,916 mailed Dec. 16, 2013, 12 pages.
International Preliminary Report on Patentability for PCT/US2012/052958 mailed Mar. 13, 2014, 14 pages.
Non-final Office Action for U.S. Appl. No. 12/947,883 mailed Sep. 6, 2013, 9 pages.
Final Office Action for U.S. Appl. No. 12/947,883 mailed Mar. 31, 2014, 13 pages.
Annex to Form PCT/ISA/2006, Communication Relating to the Results of the Partial International Search, for PCT/US2009/004549 mailed Feb. 10, 2010, 2 pages.
Annex to Form PCT/ISA/206, Communication Relating to the Results of the Partial International Search, for PCT/US2009/004548 mailed Jan. 19, 2010, 2 pages.
Corning Cable Systems, "Corning Cable Systems Products for BellSouth High Density Shelves," Jun. 2000, 2 pages.
Corning Cable Systems, "Corning Cable Systems Quick Reference Guide for Verizon FTTP FDH Products," Jun. 2005, 4 pages.
Conner, M. "Passive Optical Design for RFOG and Beyond," Braodband Properties, Apr. 2009, pp. 78-81.
Corning Evolant, "Eclipse Hardware Family," Nov. 2009, 1 page.
Corning Evolant, "Enhanced Management Frame," Dec. 2009, 1 page.
Corning Evolant, "Enhanced Management Frame (EMF)," Specification Sheet, Nov. 2009, 24 pages.
Corning Cable Systems, "Evolant Solutions for Evolving Networks: Fiber Optic Hardware," Oct. 2002, 2 pages.
Corning Cable Systems, "Fiber Optic Hardware with Factory-Installed Pigtails: Features and Benefits," Nov. 2010, 12 pages.
Corning Cable Systems, "FiberManager System 1- and 3-Position Compact Shelves," Jan. 2003, 4 pages.
Corning Cable Systems, "FiberManager System Frame and Components," Jan. 2003, 12 pages.
Corning Cable Systems, "High Density Frame," Jul. 2001, 2 pages.
Corning Cable Systems, "High Density Frame (HDF) Connector-Splice Shelves and Housings," May 2003, 4 pages.
International Search Report for PCT/US10/35529 mailed Jul. 23, 2010, 2 pages.
International Search Report for PCT/US10/35563 mailed Jul. 23, 2012, 1 page.
International Search Report for PCT/US2008/002514 mailed Aug. 8, 2008, 2 pages.
International Search Report for PCT/US2008/010317 mailed Mar. 4, 2008, 2 pages.
International Search Report for PCT/US2009/001692 mailed Nov. 24, 2009, 5 pages.

(56) **References Cited**

OTHER PUBLICATIONS

International Search Report for PCT/US2010/024888 mailed Jun. 23, 2010, 5 pages.
International Search Report for PCT/US2010/027402 mailed Jun. 16, 2010, 2 pages.
Corning Cable Systems, "MTX Frames and Accessories," Feb. 2006, 4 pages.
Panduit, "Lock-in LC Duplex Clip," Accessed Mar. 22, 2012, 1 page.
International Search Report for PCT/US06/49351 mailed Apr. 25, 2008, 1 page.
International Search Report for PCT/US09/57069 mailed Mar. 24, 2010, 2 pages.
International Search Report for PCT/US20091057244 mailed Nov. 9, 2009 3 pages.
International Search Report for PCTUS2009004548 mailed Mar. 19, 2010, 5 pages.
International Search Report for PCTUS2009004549 mailed Apr. 20, 2010, 6 pages.
Siecor, "Single Shelf HDF with Slack Storage and Heat Shield (HH1-CSH-1238-1V-BS)," Jan. 1998, 12 pages.
Corning Cable Systems, "Mass Termination Xchange (MTX) Frame System Equipment Office Planning and Application Guide," SRP003-664, Issue 1, Mar. 2005, 57 pages.
Corning Cable Systems, "Mass Termination Xchange (MTX) Equipment Patch Cord Interbay Vertical Channel," SRP003-684, Issue 1, Mar. 2005, 8 pages.
Corning Cable Systems, "High Density Frame (HDF) Installation," SRP003-355, Issue 4, Sep. 2002, 18 pages.
Written Opinion for PCT/US2010/023901 mailed Aug. 25, 2011, 8 pages.
Advisory Action for U.S. Appl. No. 12/221,117 mailed Aug. 24, 2011, 3 pages.
Examiner's Answer to Appeal Brief for U.S. Appl. No. 12/221,117 mailed Mar. 29, 2012, 16 pages.
Final Office Action for U.S. Appl. No. 12/221,117 mailed Feb. 19, 2010, 7 pages.
Final Office Action for U.S. Appl. No. 12/221,117 mailed Jun. 10, 2011, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/221,117 mailed Jul. 14, 2010, 7 pages.
Non-final Office Action for U.S. Appl. No. 12/221,117 mailed Jun. 9, 2009, 5 pages.
Non-final Office Action for U.S. Appl. No. 12/221,117 mailed Dec. 21, 2010, 7 pages.
Advisory Action for U.S. Appl. No. 12/394,483 mailed Feb. 16, 2012, 3 pages.
Final Office Action for U.S. Appl. No. 12/394,483 mailed Dec. 6, 2011, 14 pages.
Non-final Office Action for U.S. Appl. No. 12/394,483 mailed Jun. 17, 2011, 11 pages.
Advisory Action for U.S. Appl. No. 12/950.234 mailed Dec. 21, 2011, 3 pages.
Non-final Office Action for U.S. Appl. No. 12/950,234 mailed Jun. 17, 2011, 7 pages.
Non-final Office Action for U.S. Appl. No. 12/950,234 mailed Mar. 12, 2012, 10 pages.
Final Office Action for U.S. Appl. No. 12/950,234 mailed Oct. 14, 2011, 10 pages.
Advisory Action mailed May 12, 2011, for U.S. Appl. No. 12/323,423, 3 pages.
Final Rejection mailed Mar. 3, 2011, for U.S. Appl. No. 12/323,423, 17 pages.
Non-Final Rejection mailed Aug. 5, 2011, for U.S. Appl. No. 12/323,423, 13 pages.
Non-Final Rejection mailed Sep. 7, 2010, for U.S. Appl. No. 12/323,423, 18 pages.
Notice of Allowance for U.S. Appl. No. 12/323,423 mailed Jan. 24, 2012, 8 pages.
Examiner's Answer mailed Mar. 4, 2011, for U.S. Appl. No. 12/323,415, 11 pages.
Final Rejection mailed Jun. 25, 2010, for U.S. Appl. No. 12/323,415, 10 pages.
Non-Final Rejection mailed Aug. 5, 2011, for U.S. Appl. No 12/323,415, 41 pages.
Non-final Office Action for U.S. Appl. No. 12/323,415 mailed Apr. 23, 2012, 11 pages.
Non-Final Rejection mailed Dec. 10, 2009, for U.S. Appl. No. 12/323,415, 7 pages.
Examiner's Answer to Appeal Brief for U.S. Appl. No 11/320,062 mailed Dec. 8, 2011, 8 pages.
Final Office Action for U.S. Appl. No. 11/320,062 mailed Mar. 8, 2011, 8 pages.
Non-final Office Action for U.S. Appl. No. 11/320,062 mailed Jan 15, 2010, 11 pages.
Non-final Office Action for U.S. Appl. No. 12/320.062 mailed Sep 30, 2010, 7 pages.
Final Office Action for U.S. Appl. No. 11/439,086 mailed Feb. 4, 2010, 14 pages.
Non-final Office Action for U.S. Appl. No. 11/439,086 mailed May 3, 2010, 11 pages.
Non-final Office Action for U.S. Appl. No. 11/439,086 mailed Sep. 21, 2009, 10 pages.
Final Office Action for U.S. Appl. No. 12/079,481 mailed Mar. 18, 2010, 10 pages.
Non-final Office Action for U.S. Appl. No. 12/079,481 mailed Dec. 26, 2008, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/079,481 mailed Sep. 16, 2009, 10 pages.
Notice of Allowance for U.S. Appl. No. 12/079,481 mailed Jun. 3, 2010, 6 pages.
Notice of Allowance for U.S. Appl. No. 12/079,481 mailed Oct. 4, 2010, 4 pages.
Notice of Allowance for U.S. Appl. No. 12/415,454 mailed Jun. 19, 2012, 5 pages.
Non-final Office Action for U.S. Appl. No. 12/323,373 mailed May 3, 2012, 7 pages.
Non-final Office Action for U.S. Appl. No. 11/809,474 mailed Apr. 8, 2008, 13 pages.
Non-final Office Action for U.S. Appl. No. 11/809,474 mailed Nov 13, 2008, 10 pages.
Notice of Allowance for U.S. Appl. No. 11/809,474 mailed Jul. 6, 2009, 6 pages.
Final Office Action for U.S. Appl. No. 11/320,031 mailed Mar. 8, 2011, 8 pages.
Non-final Office Action for U.S. Appl. No. 11/320,031 mailed Jan. 5, 2010, 16 pages.
Non-final Office Action for U.S. Appl. No. 11/320,031 mailed Sep. 30, 2010, 7 pages.
Notice of Allowance for U.S. Appl. No. 11/320.031 mailed Nov. 15, 2011, 7 pages.
Non-final Office Action for U.S. Appl. No. 12/157,622 mailed Mar. 31, 2009, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/157,622 mailed Oct. 15, 2009, 9 pages.
Notice of Allowance for U.S. Appl. No. 12/157,622 mailed Apr. 22, 2010, 4 pages.
Non-final Office Action for U.S. Appl. No. 12/323,395 mailed Dec. 8, 2011, 7 pages.
Non-final Office Action for U.S. Appl. No. 12/415,454 mailed Mar. 2, 2012, 5 pages.
Non-final Office Action for U.S. Appl. No. 12/415,454 mailed Sep. 6, 2011, 7 pages.
Notice of Allowance for U.S. Appl. No. 12/415,454 mailed Jan. 13, 2012, 5 pages.
Non-final Office Action for U.S. Appl. No. 12/576,769 mailed Feb. 2, 2012, 23 pages.
International Search Report and Written Opinion for PCT/US2011/035683 mailed Sep. 8, 2011, 15 pages.
International Search Report and Written Opinion for PCT/US2010/039218 mailed Oct. 27, 2010, 13 pages.
International Search Report and Written Opinion for PCT/US2011/035684 mailed Jul. 1, 2011, 11 pages.

(56) **References Cited**

OTHER PUBLICATIONS

International Search Report and Written Opinion for PCT/US11/61754 mailed Mar. 26, 2012, 9 pages.
First Office Action for Chinese patent application 201080032453.2 issued Mar. 26, 2013, 6 pages.
Chinese Search Report for Chinese patent application 201080032453.2 mailed May 15, 2013, 2 pages.
First Office Action for Chinese patent application 201080031621.6 mailed Sep. 26, 2013, 9 pages.
Chinese Search Report for Chinese patent application 201080031621.6 mailed Sep. 13, 2013, 2 pages.
Ramdas, "Modern File Systems and Storage," Proceedings of the 2nd International SANE Conference, May 22-25, 2000, MECC, Maastricht, The Netherlands, Copyright Rodney R. Ramdas. 10 pages.
Author Unknown, "144 Fiber Patch Panel 1U," Technical Data. ADTEK Group Limited, 2009, 2 pages.
Non-final Office Action for U.S. Appl. No. 13/603,894 mailed Oct. 3, 2013, 9 pages.
Advisory Action for U.S. Appl. No. 12/394,114 mailed Jan. 2, 2014, 3 pages.
Notice of Allowance for U.S. Appl. No. 12/871,052 mailed Dec. 24, 2013, 9 pages.
Final Office Action for U.S. Appl. No. 12/953,039 mailed Dec. 27, 2013, 10 pages.
Advisory Action for U.S. Appl. No. 12/952.960 mailed Jan. 8, 2014, 3 pages.
Advisory Action for U.S. Appl. No. 12/952.912 mailed Nov. 26, 2013. 3 pages.
Examiner's Answer to the Appeal Brief for U.S. Appl. No. 12/953,118 mailed Dec. 3. 2013, 6 pages.
Non-final Office Action for U.S. Appl. No. 13/597.549 mailed Jan. 14, 2014, 9 pages.
Final Office Action for U.S. Appl. No. 12/732,487 mailed Dec. 6, 2013, 24 pages.
Final Office Action for U.S. Appl. No. 12/956.446 mailed Dec. 23, 2013. 12 pages.
Non-final Office Action for U.S. Appl. No. 12/953,536 mailed Dec. 17, 2013, 21 pages.
Non-final Office Action for U.S. Appl. No. 12/819,065 mailed Dec. 3, 2013, 8 pages.
International Search Report and Written Opinion for PCT/US2011/062353 mailed Apr. 10, 2012. 15 pages.
International Search Report for PCT/US2011/030446 mailed Jul. 14, 2011, 2 pages.
International Search Report for PCT/US2011/030448 mailed Jul. 20, 2011, 2 pages.
International Search Report for PCT/US2011/030466 mailed Aug. 5, 2011, 2 pages.
International Search Report for PCT/US2012/052958 mailed Mar. 1, 2013, 7 pages.
International Search Report for PCT/US2013/041266 mailed Aug. 20, 2013, 4 pages.
Non-final Office Action for U.S. Appl. No. 13/621,958 mailed Feb. 13, 2014, 10 pages.
Non-final Office Action for U.S. Appl. No. 13/649,417 mailed Feb. 13, 2014. 10 pages.
Non-final Office Action for U.S. Appl. No. 13/663,949 mailed Feb. 3, 2014. 19 pages.
Non-final Office Action for U.S. Appl. No. 12/953,003 mailed Apr. 14, 2014, 13 pages.
Non-final Office Action for U.S. Appl. No. 12/953,039 mailed Apr. 15, 2014, 8 pages.
Final Office Action for U.S. Appl. No. 12/946,139 mailed Apr. 22, 2014, 18 pages.
Final Office Action for U.S. Appl. No. 13/597,549 mailed Apr. 24, 2014, 10 pages.
Final Office Action for U.S. Appl. No. 13/901,074 mailed May 9, 2014, 7 pages.
Final Office Action for U.S. Appl. No. 12/394,114 mailed Oct. 25, 2012, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/915,682 mailed Oct. 24, 2012, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/818,986 mailed Feb. 3, 2012, 12 pages.
Final Office Action for U.S. Appl. No. 12/818.986 mailed Oct. 18, 2012, 13 pages.
Non-final Office Action for U.S. Appl. No. 12/952,960 mailed Oct. 4, 2012, 11 pages.
Non-final Office Action for U.S. Appl. No. 12/953,134 mailed Sep. 25, 2012, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/953,039 mailed Jan. 11, 2013, 6 pages.
Non-final Office Action for U.S. Appl. No. 12/952,912 mailed Dec. 28, 2012, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/953,118 mailed Jan. 7, 2013. 9 pages.
Non-final Office Action for U.S. Appl. No. 12/953,536 mailed Jan. 2, 2013, 20 pages.
Non-final Office Action for U.S. Appl. No. 12/707,889 mailed Jan. 2, 2013, 7 pages.
European Search Report for patent application 10790017.7 mailed Nov. 8, 2012, 7 pages.
Examination Report for European patent application 09789090.9-2216 mailed Aug. 29, 2011, 4 pages.
Examination Report for European patent application 09789090.9-2216 mailed Mar. 30, 2012, 6 pages.
Written Opinion of the International Searching Authority for International patent application PCT/US2009004548, mailed Apr. 5, 2011, 6 pages.
European Search Report for European patent application 09789090.9-2217 mailed Jan. 24, 2013, 5 pages.
Non-final Office Action for U.S. Appl. No. 12/946,139 mailed Jul. 26, 2012, 12 pages.
Final Office Action for U.S. Appl. No. 12/946,139 mailed Feb. 15, 2013, 17 pages.
Non-final Office Action for U.S. Appl. No. 12/751,884 mailed Feb. 15, 2013, 5 pages.
Non-final Office Action for U.S. Appl. No. 12/394,114 mailed Feb. 27, 2013, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/819,065 mailed Mar. 4, 2013, 7 pages.
Final Office Action for U.S. Appl. No. 12/952,960 mailed Mar. 7, 2013, 13 pages.
Notice of Allowance for U.S. Appl. No. 12/732,487 mailed Mar. 19, 2013, 11 pages.
Non-final Office Action for U.S. Appl. No. 12/953,134 mailed Mar. 21, 2013, 9 pages.
Final Office Action for U.S. Appl. No. 12/641,617 mailed May 10, 2013, 21 pages.
Notice of Allowance for U.S. Appl. No. 13/090,621 mailed Apr. 22, 2013, 8 pages.
Final Office Action for U.S. Appl. No. 12/953,039 mailed May 1, 2013, 8 pages.
Final Office Action for U.S. Appl. No. 12/953,118 mailed May 3, 2013, 11 pages.
Final Office Action for U.S. Appl. No. 12/915.682 mailed Apr. 18, 2013, 9 pages.
Advisory Action for U.S. Appl. No. 12/952,960 mailed May 15, 2013, 2 pages.
Non-final Office Action for U.S. Appl. No. 12/952,960 mailed Jun. 20, 2013, 13 pages.
Non-final Office Action for U.S. Appl. No. 12/953,536 mailed Jun. 6, 2013. 21 pages.
Non-final Office Action for U.S. Appl. No. 11/820,300 mailed Apr. 25, 2012, 10 pages.
Final Office Action for U.S. Appl. No. 12/871,052 mailed Jul. 1, 2013, 12 pages.
Non-final Office Action for U.S. Appl. No. 12/940,699 mailed Jun. 26, 2013, 9 pages.
Notice of Allowance for U.S. Appl. No. 13/090,621 mailed Jun. 25, 2013, 8 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Non-final Office Action for U.S. Appl. No. 12/956,475 mailed Oct. 4, 2012, 7 pages.
Non-final Office Action for U.S. Appl. No. 13/302,067 mailed Jun. 7, 2013, 13 pages.
Final Office Action for U.S. Appl. No. 12/771,473 mailed Jul. 19, 2013, 7 pages.
Notice of Allowance for U.S. Appl. No. 12/751,884 mailed Jul. 17, 2013, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/940,585 mailed Aug. 16, 2013, 14 pages.
Final Office Action for U.S. Appl. No. 12/953,134 mailed Aug. 23, 2013, 11 pages.
Ex parte Quayle Action for U.S. Appl. No. 12/953,164 mailed Aug. 16, 2013, 5 pages.
Non-final Office Action for U.S. Appl. No. 12/732,487 mailed Jul. 17, 2013, 22 pages.
Non-final Office Action and Interview Summary for U.S. Appl. No. 12/707,889 mailed Aug. 8, 2013, 15 pages.
Advisory Action for U.S. Appl. No. 12/953,039 mailed Jul. 12, 2013, 3 pages.
Advisory Action for U.S. Appl. No. 12/953,118 mailed Jul. 12, 2013, 3 pages.
Advisory Action for U.S. Appl. No. 12/641,617 mailed Jul. 29, 2013, 3 pages.
Final Office Action for U.S. Appl. No. 12/952,912 mailed Aug. 30, 2013, 15 pages.
Advisory Action for U.S. Appl. No. 12/771,473 mailed Oct. 2, 2013, 3 pages.
Notice of Allowance for U.S. Appl. No. 121641,617 mailed Sep. 4, 2013, 9 pages.
Notice of Allowance for U.S. Appl. No. 12/871,052 mailed Sep. 18, 2013, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/953,039 mailed Sep. 12, 2013, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/946,139 mailed Oct. 2, 2013, 18 pages.
Final Office Action for U.S. Appl. No. 12/394,114 mailed Oct. 4, 2013, 10 pages.
Non-final Office Action for U.S. Appl. No. 12/818,986 mailed Oct. 4, 2013, 19 pages.
Advisory Action for U.S. Appl. No. 12/953,134 mailed Nov. 4, 2013, 3 pages.
Final Office Action for U.S. Appl. No. 12/952,960 mailed Oct. 29, 2013, 8 pages.
Notice of Allowance for U.S. Appl. No. 13/292,130 mailed Oct. 18, 2013, 9 pages.
Non-final Office Action for U.S. Appl. No. 13/901,074 mailed Oct. 9, 2013, 6 pages.
Non-final Office Action for U.S. Appl. No. 12/956,446 mailed Sep. 6, 2013, 10 pages.
International Search Report for PCT/US2010/023901 mailed Jun. 11, 2010, 3 pages.
Notice of Allowance for U.S. Appl. No. 12/576,769 mailed May 31, 2012, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/946,217 mailed Jul. 26, 2012, 25 pages.
Final Office Action for U.S. Appl. No. 12/946,217 mailed Mar. 18, 2013, 48 pages.
Non-final Office Action for U.S. Appl. No. 12/946,217 mailed Oct. 3, 2013, 47 pages.
Final Office Action for U.S. Appl. No. 12/946,217 mailed Apr. 25, 2014, 40 pages.
Non-final Office Action for U.S. Appl. No. 13/833,876 mailed Apr. 24, 2014, 7 pages.
Notice of Allowance for U.S. Appl. No. 12/953,536 mailed May 20, 2014, 9 pages.
Advisory Action for U.S. Appl. No. 12/707,889 mailed Jun. 11, 2014, 4 pages.
Advisory Action for U.S. Appl. No. 12/940,585 mailed Jun. 17, 2014, 3 pages.
Advisory Action for U.S. Appl. No. 12/947,883 mailed Jun. 19, 2014, 3 pages.
Non-final Office Action for U.S. Appl. No. 12/732,487 mailed Jun. 20, 2014, 24 pages.
Non-final Office Action for U.S. Appl. No. 13/621,958 mailed Jun. 20, 2014, 13 pages.
Final Office Action for U.S. Appl. No. 13/649,417 mailed Jun. 25, 2014, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/952,960 mailed Jun. 26, 2014, 13 pages.
Non-final Office Action for U.S. Appl. No. 12/751,895 mailed May 20, 2014, 9 pages.
Notice of Allowance for U.S. Appl. No. 13/533,093 mailed Jul. 8, 2014, 9 pages.
Notice of Allowance for U.S. Appl. No. 13/597,549 mailed Jul. 8, 2014, 8 pages.
Notice of Allowance for U.S. Appl. No. 13/455,646 mailed Jun. 2, 2014, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/819,065 mailed Jul. 18, 2014, 10 pages.
Final Office Action for U.S. Appl. No. 12/818,986 mailed Jul. 18, 2014, 27 pages.
Final Office Action for U.S. Appl. No. 13/081,856 mailed Jul. 2, 2014, 8 pages.
Notice of Allowance for U.S. Appl. No. 12/221,117 mailed Jul. 16, 2014, 7 pages.
Decision on Appeal for U.S. Appl. No. 12/221,117 mailed Jul. 1, 2014, 7 pages.
Final Office Action for U.S. Appl. No. 12/953,039 mailed Jul. 25, 2014, 10 pages.
Advisory Action for U.S. Appl. No. 12/953,039 mailed Oct. 3, 2014, 3 pages.
Notice of Allowance for U.S. Appl. No. 12/953,536 mailed Aug. 28, 2014, 9 pages.
Final Office Action for U.S. Appl. No. 13/901,074 mailed Sep. 5, 2014, 7 pages.
Final Office Action for U.S. Appl. No. 13/663,975 mailed Aug. 14, 2014, 42 pages.
Corrected Notice of Allowance for U.S. Appl. No. 13/533,093 mailed Sep. 2, 2014, 7 pages.
Notice of Allowance for U.S. Appl. No. 13/649,417 mailed Sep. 8, 2014, 7 pages.
Examiner's Answer to the Appeal for U.S. Appl. No. 12/952,912 mailed Sep. 11, 2014, 15 pages.
Advisory Action and Examiner-Initiated Interview Summary for U.S. Appl. No. 13/081,856 mailed Sep. 16, 2014, 4 pages.
Notice of Allowance for U.S. Appl. No. 13/455,646 mailed Sep. 26, 2014, 9 pages.
Non-Final Office Action for U.S. Appl. No. 13/663,949 mailed Sep. 25, 2014, 21 pages.
Non-Final Office Action for U.S. Appl. No. 13/688,675 mailed Sep. 30, 2014, 9 pages.
Notice of Allowance for U.S. Appl. No. 13/597,549 mailed Oct. 3, 2014, 8 pages.
Decision on Appeal for U.S. Appl. No. 11/320,062 mailed Aug. 14, 2014, 8 pages.
Final Office Action for U.S. Appl. No. 12/953,101 mailed Oct. 20, 2014, 14 pages.
Notice of Allowance for U.S. Appl. No. 13/533,093 mailed Oct. 17, 2014, 9 pages.
Notice of Allowance for U.S. Appl. No. 12/732,487 mailed Oct. 7, 2014, 8 pages.
Non-Final Office Action for U.S. Appl. No. 13/567,288 mailed Oct. 8, 2014, 7 pages.
Advisory Action for U.S. Appl. No. 12/818,986 mailed Oct. 15, 2014, 5 pages.
Examiner's Answer to the Appeal Brief for U.S. Appl. No. 12/953,134 mailed Aug. 1, 2014, 7 pages.
Non-final Office Action for U.S. Appl. No. 12/956,446 mailed Dec. 5, 2014, 12 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Advisory Action for U.S. Appl. No. 13/663,975 mailed Dec. 24, 2014, 7 pages.
Final Office Action for U.S. Appl. No. 12/394,114 mailed Oct. 31, 2014, 10 pages.
Non-final Office Action for U.S. Appl. No. 12/940,699 mailed Oct. 28, 2014, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/953,039 mailed Nov. 12, 2014, 8 pages.
Notice of Allowance for U.S. Appl. No. 12/952,960 mailed Nov. 10, 2014, 7 pages.
Notice of Allowance for U.S. Appl. No. 13/081,856 mailed Oct. 29, 2014, 10 pages.
Notice of Allowance for U.S. Appl. No. 13/833,876 mailed Nov. 7, 2014, 7 pages.
Advisory Action for U.S. Appl. No. 13/901,074 mailed Nov. 24, 2014, 3 pages.
Notice of Allowance for U.S. Appl. No. 12/751,895 mailed Nov. 19, 2014, 8 pages.

* cited by examiner

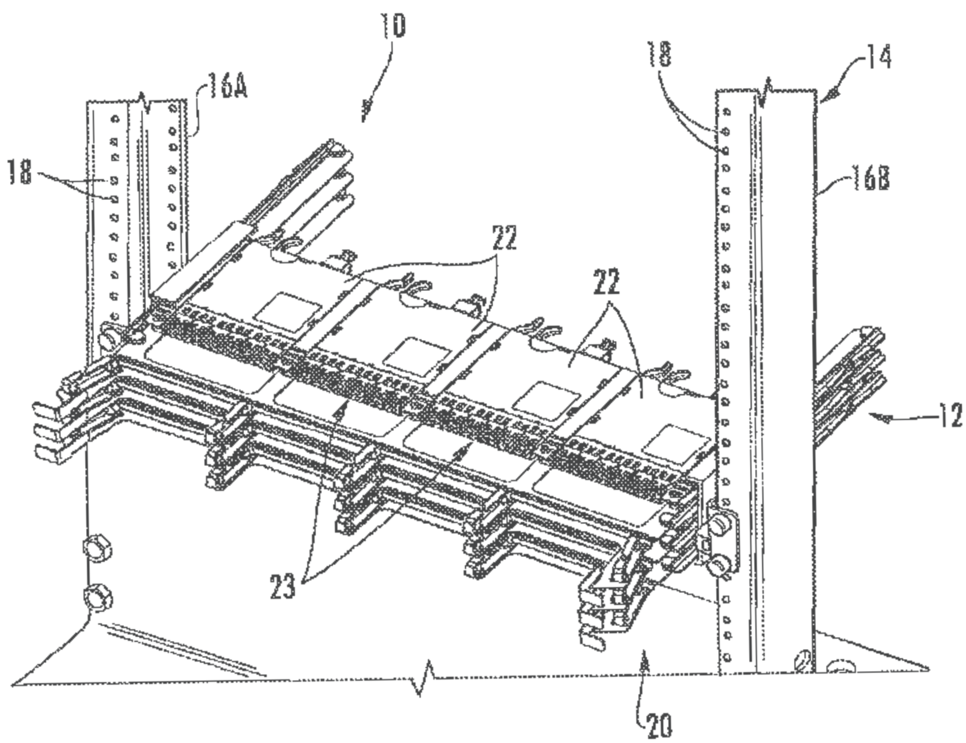

FIG. 1

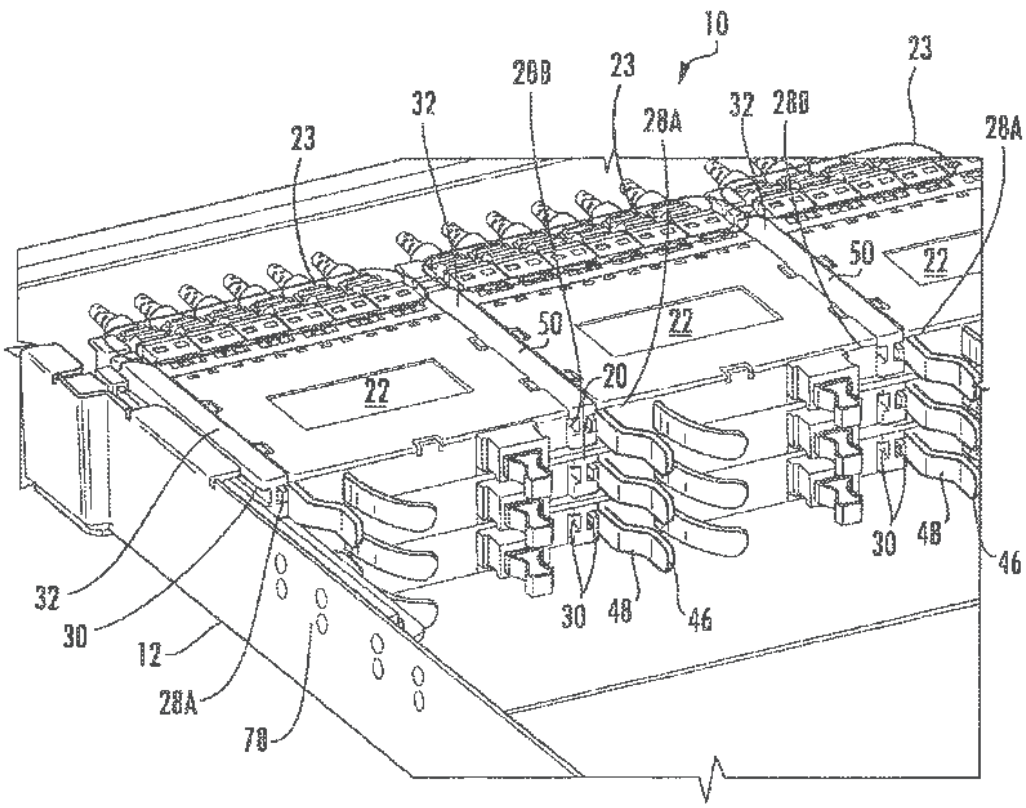
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FIG. 2

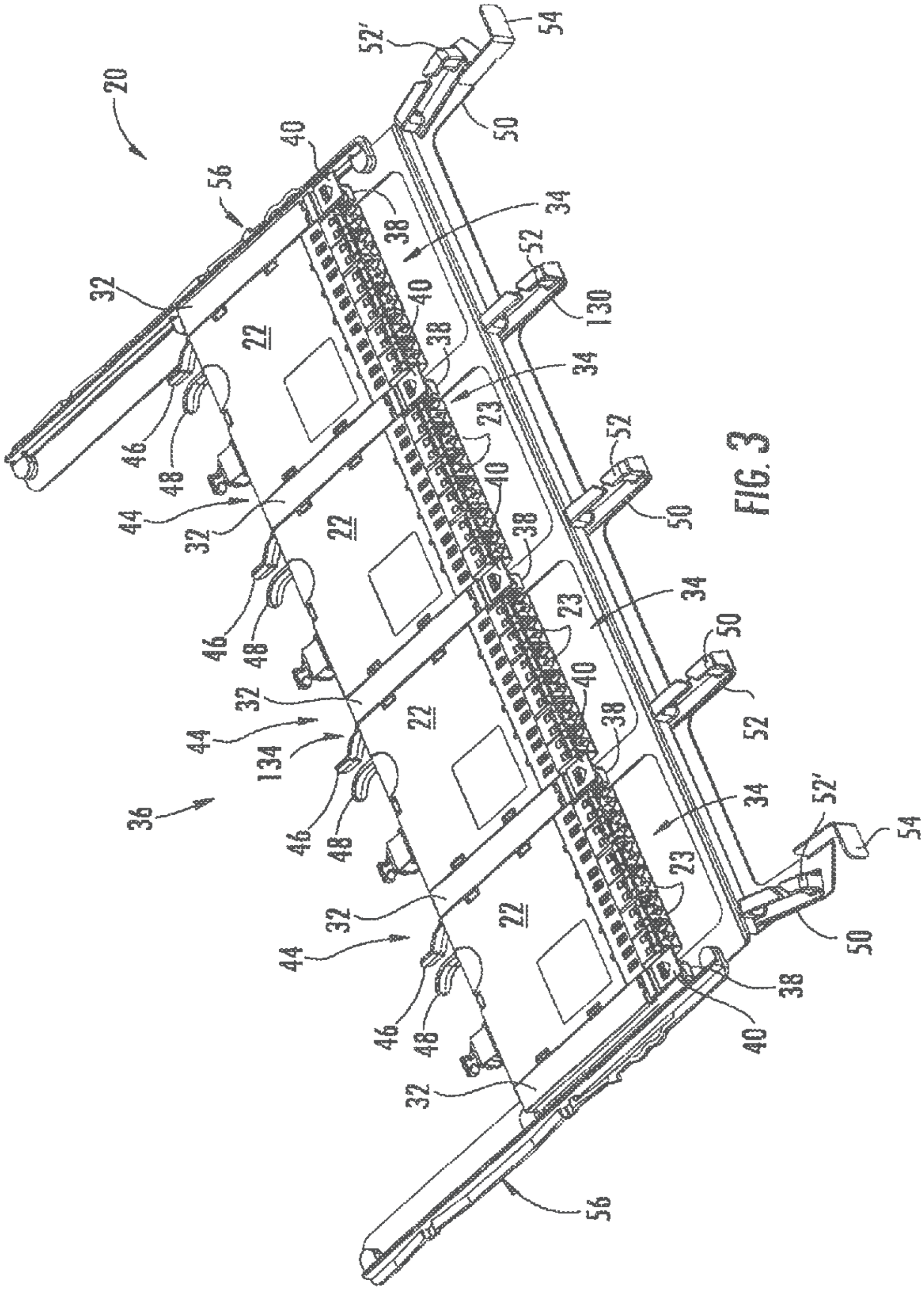
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FIG. 3

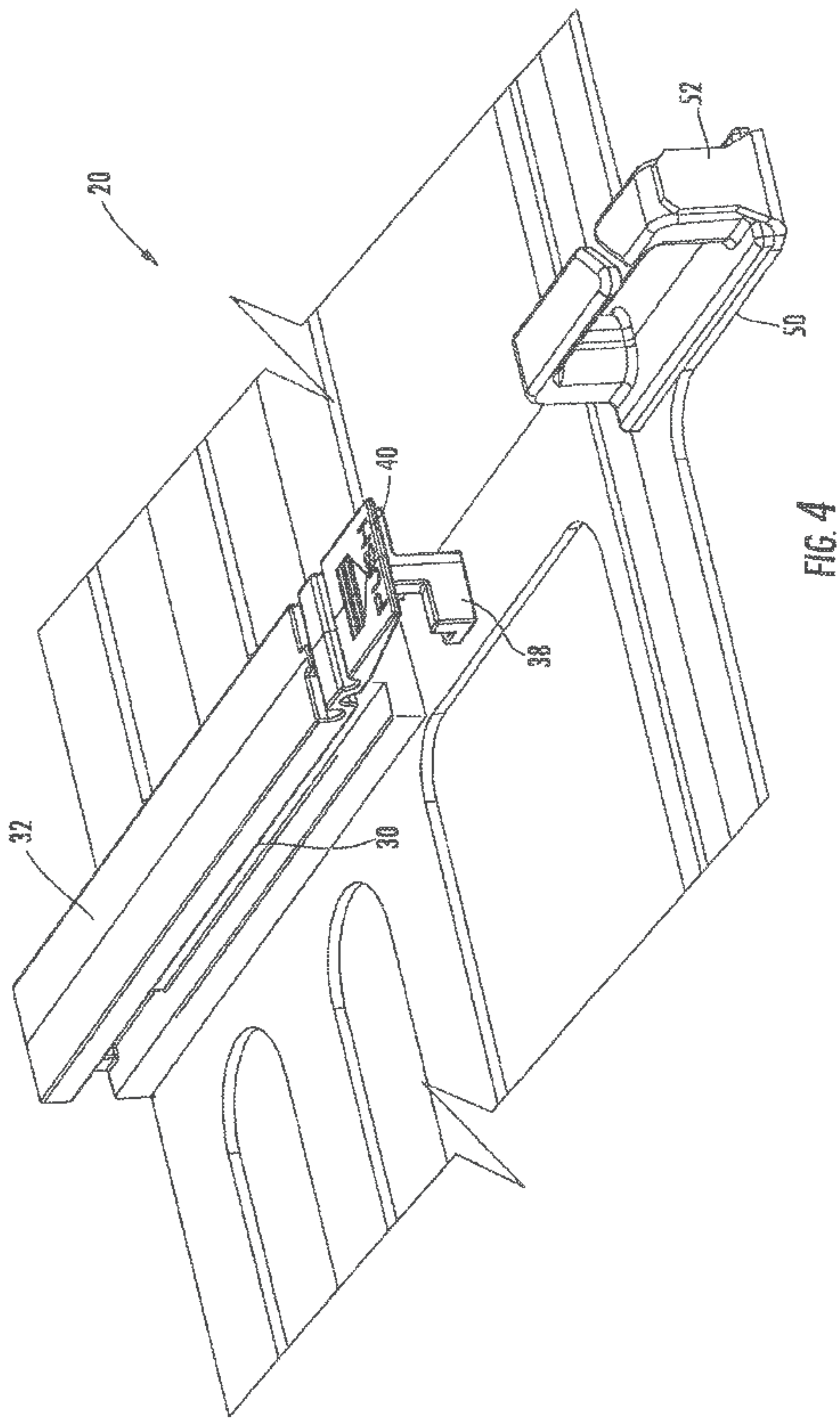
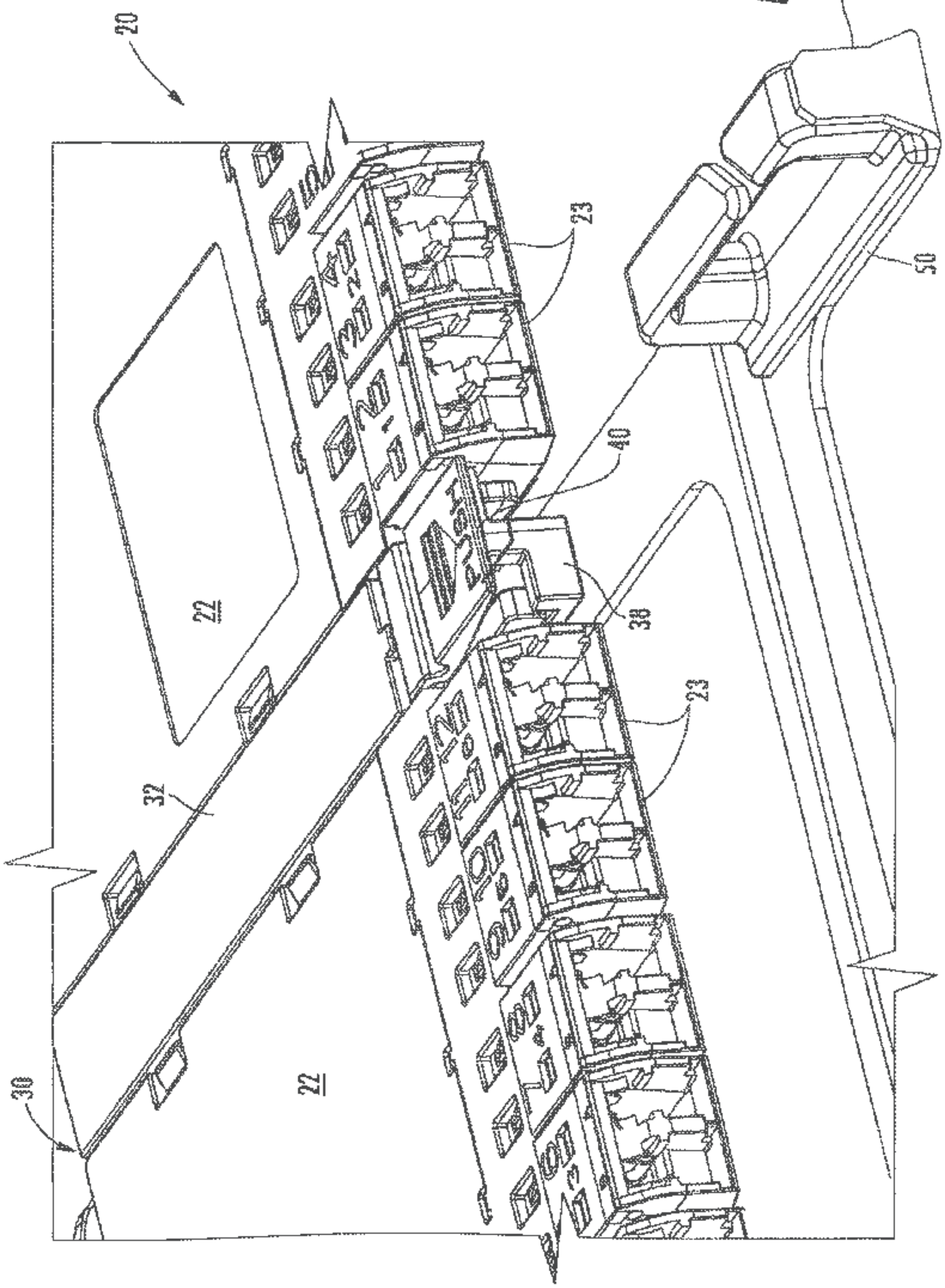
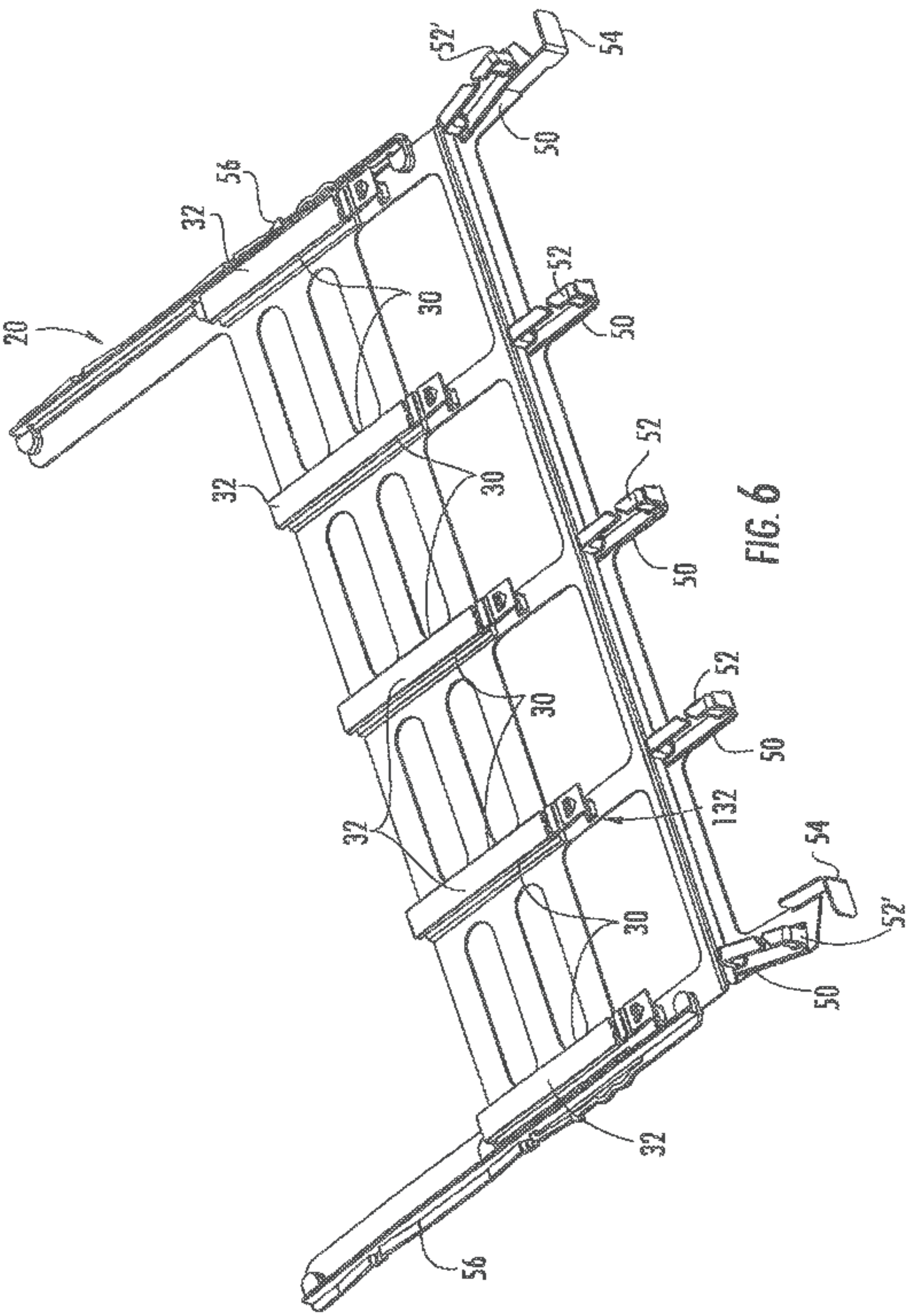


FIG. 4

FIG. 5





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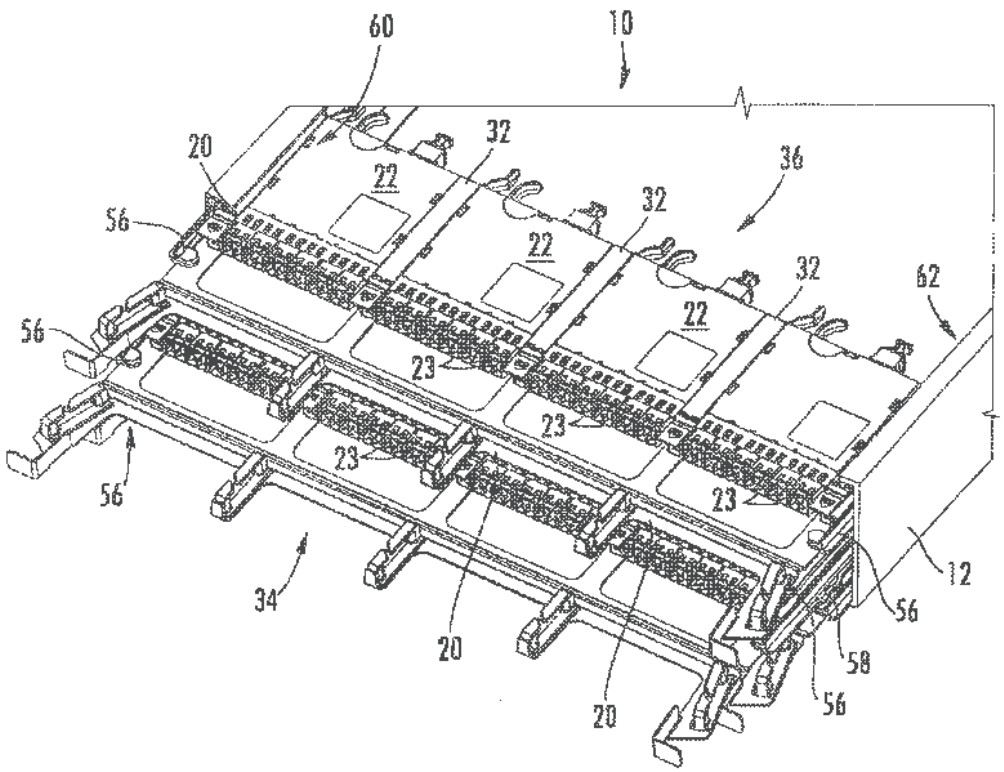
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FIG. 7

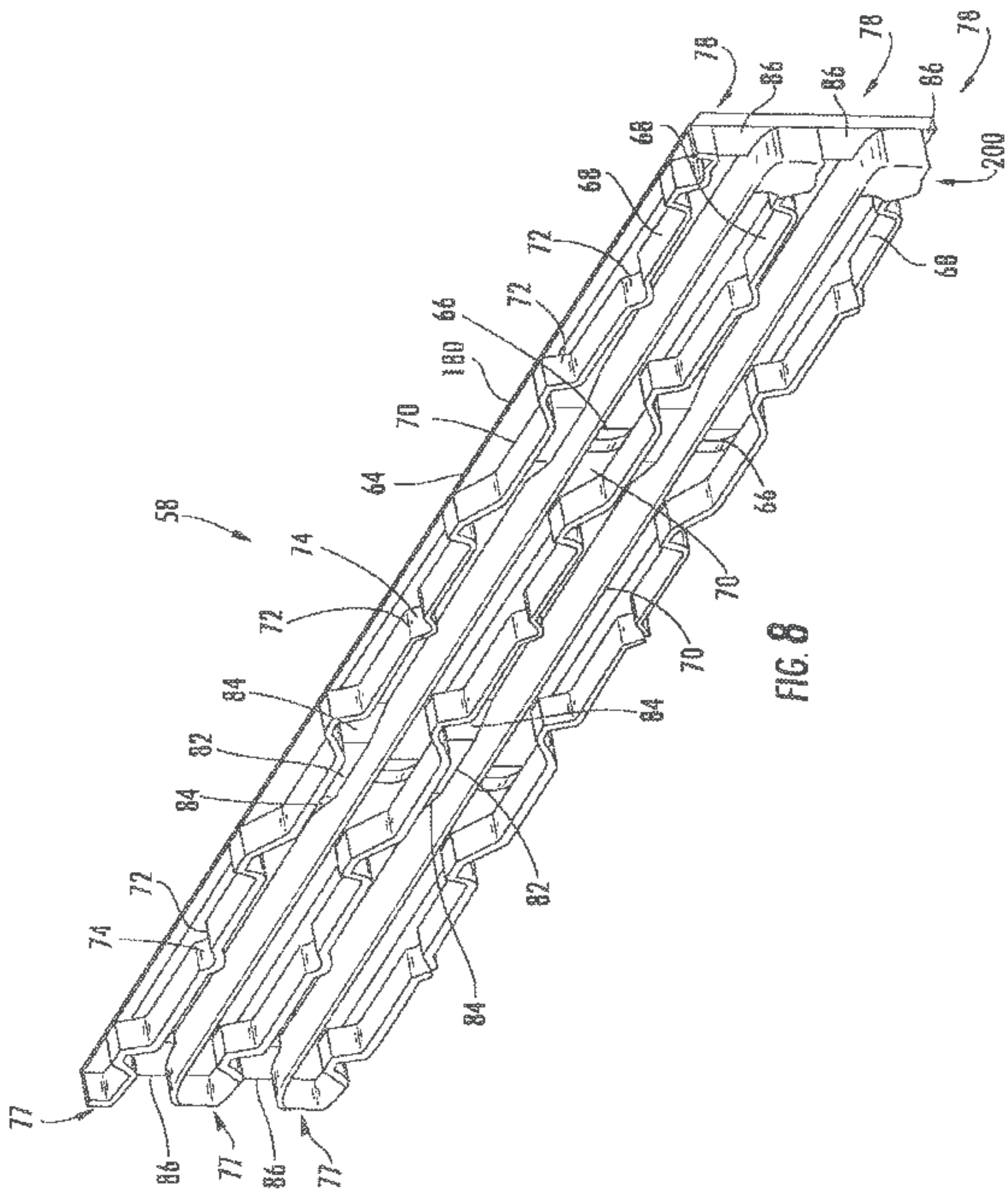
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FIG. 8

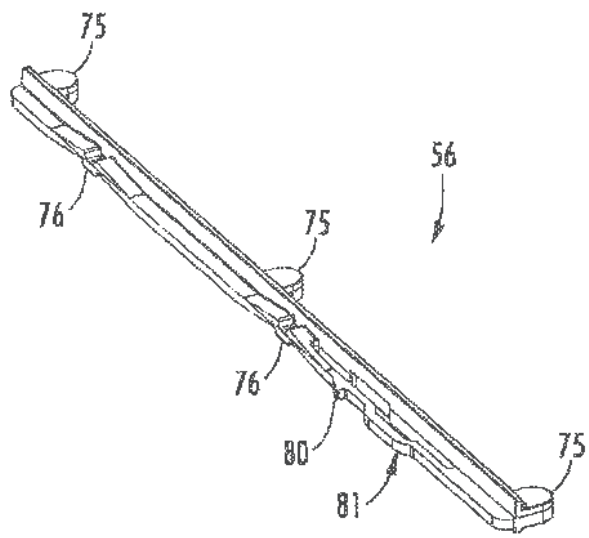


FIG. 9A

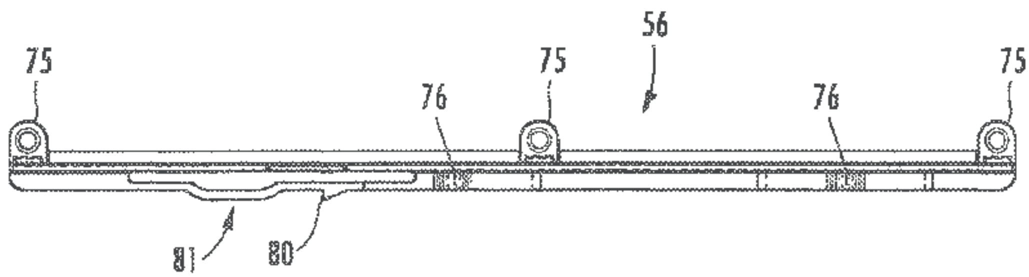


FIG. 9B

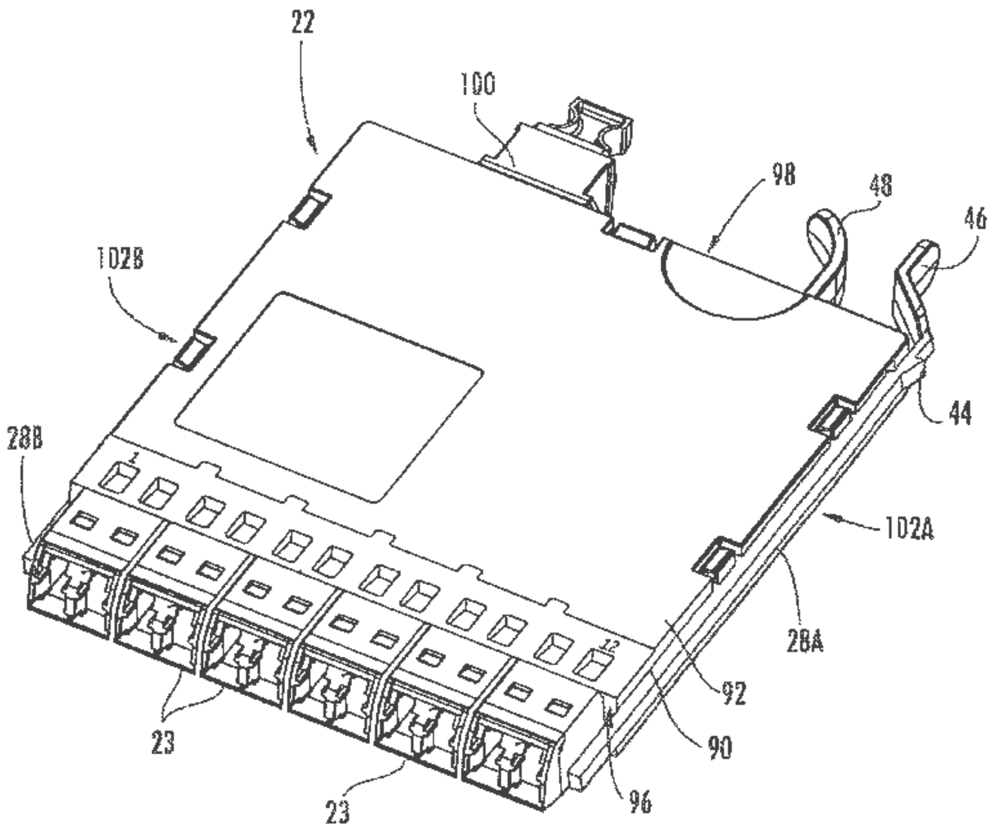


FIG. 10A

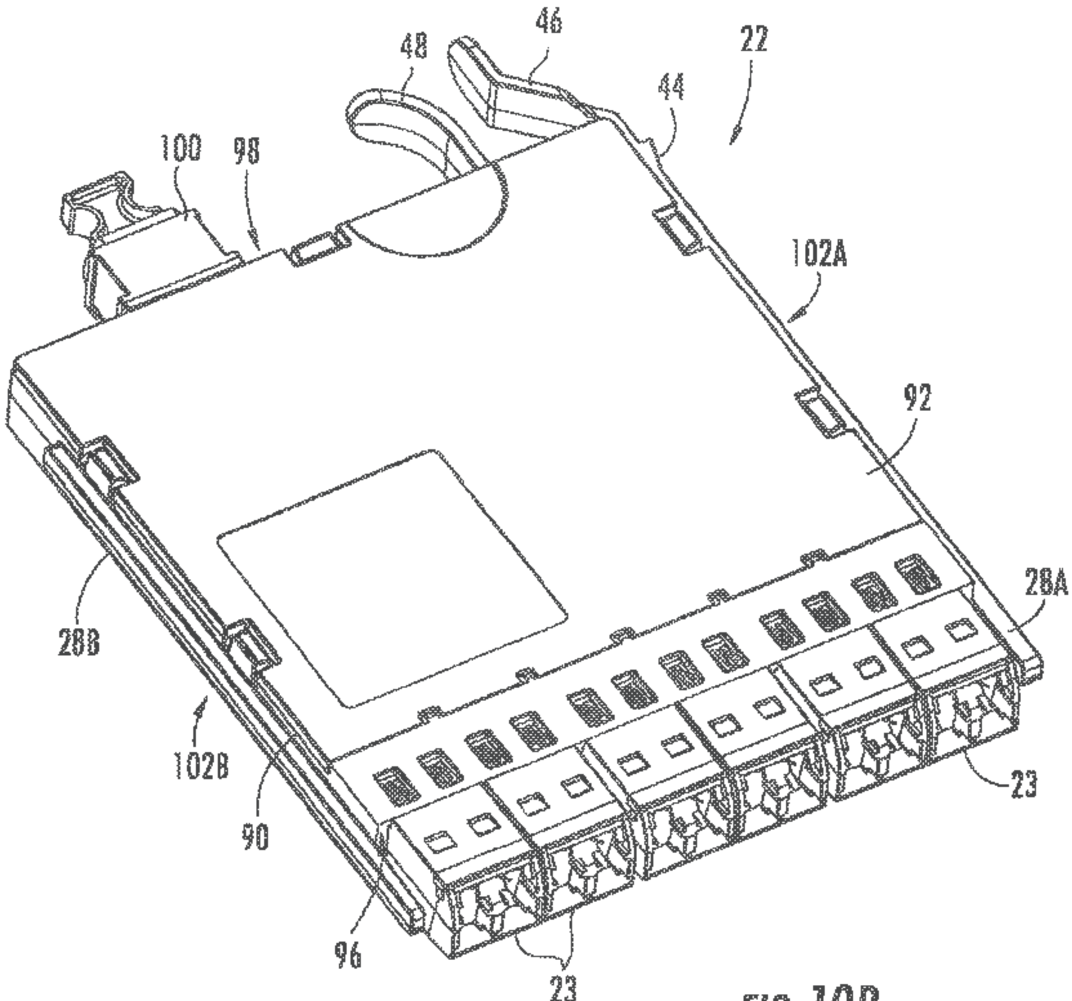


FIG. 10B

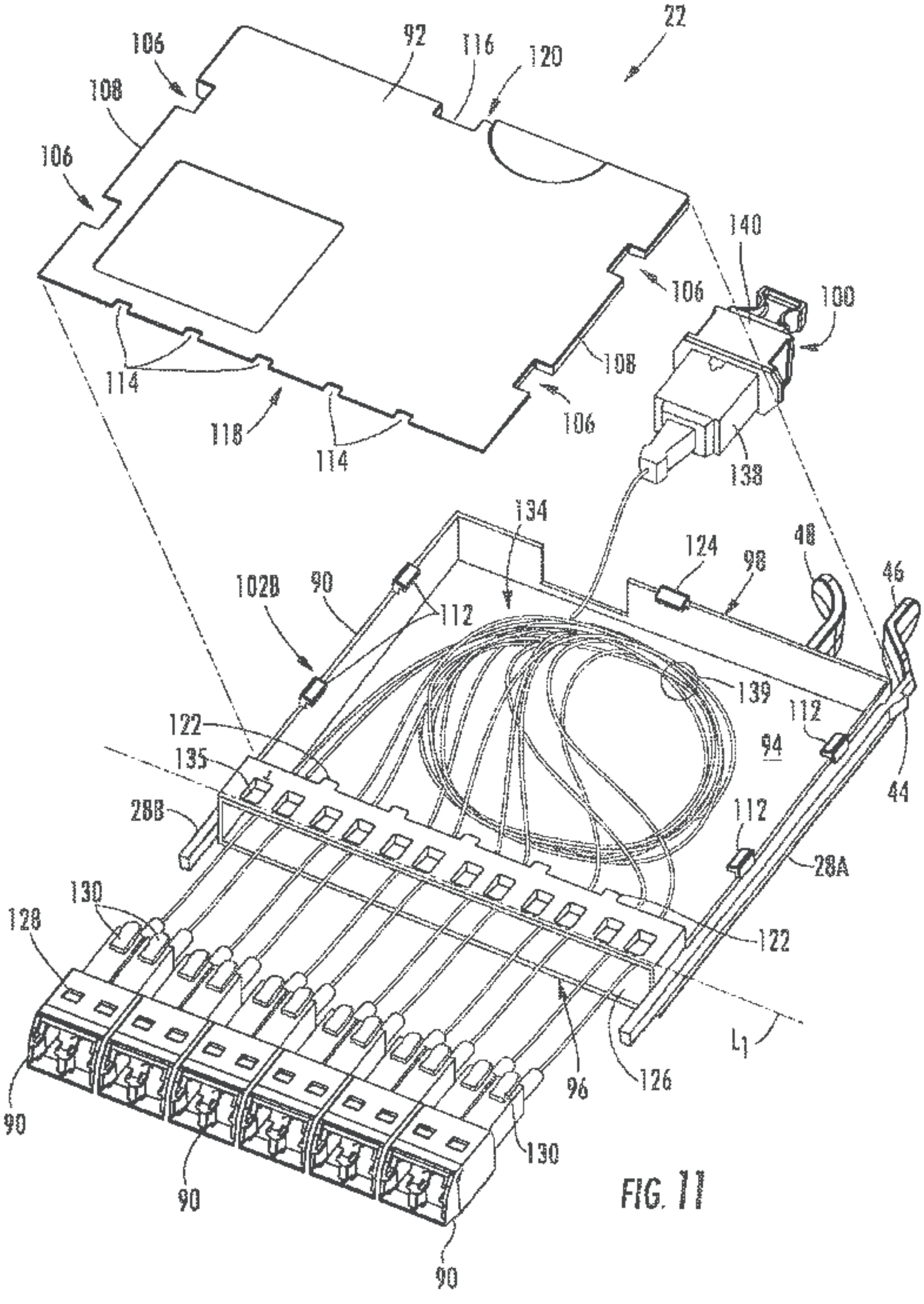

22
106
92
116
120
108
106
140
106
100
114
108
118
106
114
138
134
124
48
102B
90
98
46
112
139
122
112
135
94
28B
44
112
28A
130
128
122
L1
96
126
90
130
90
90

FIG. 11

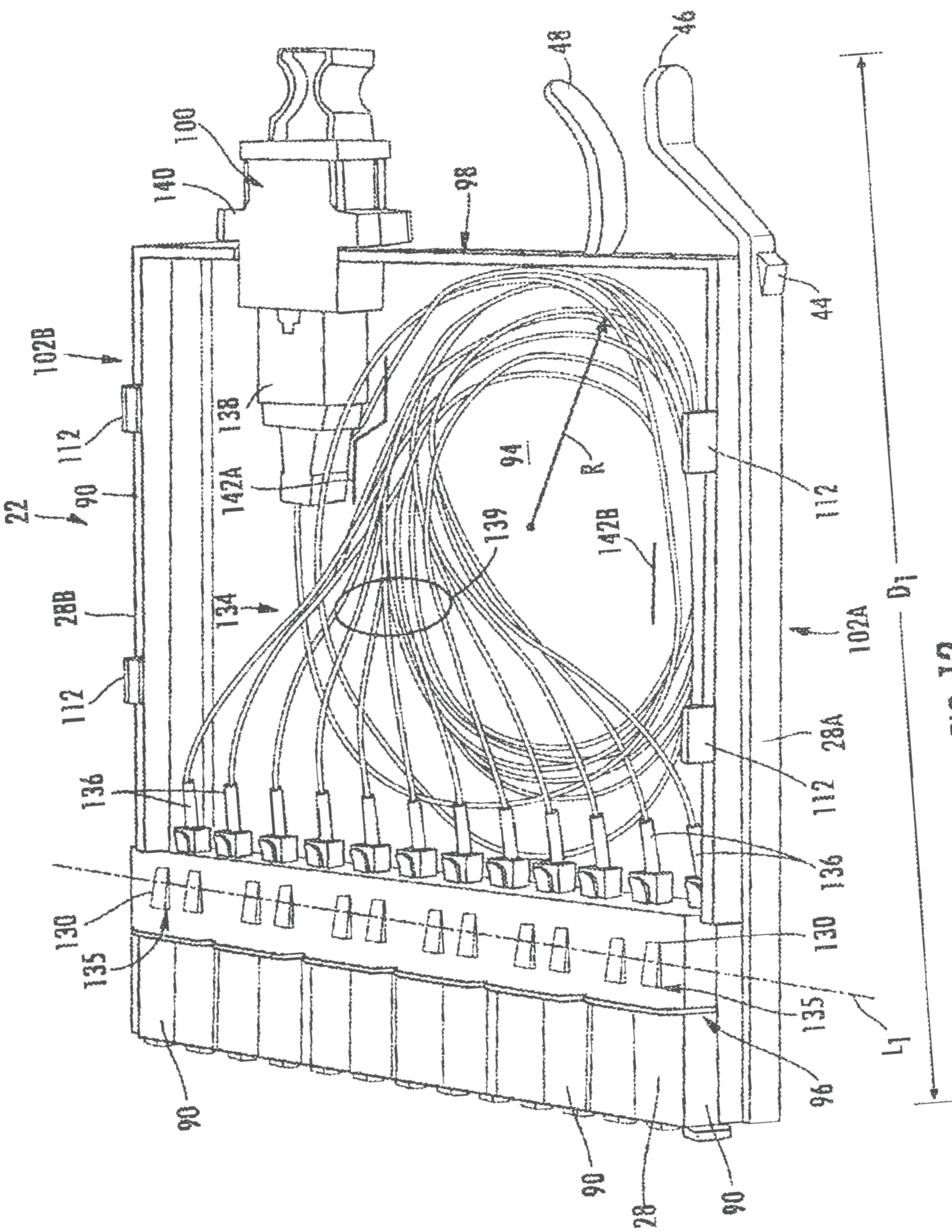

100
140
98
48
46
44
102B
112
138
142A
94
R
22
90
139
142B
28B
134
102A
D1
28A
136
130
135
L1
96
128

FIG. 12

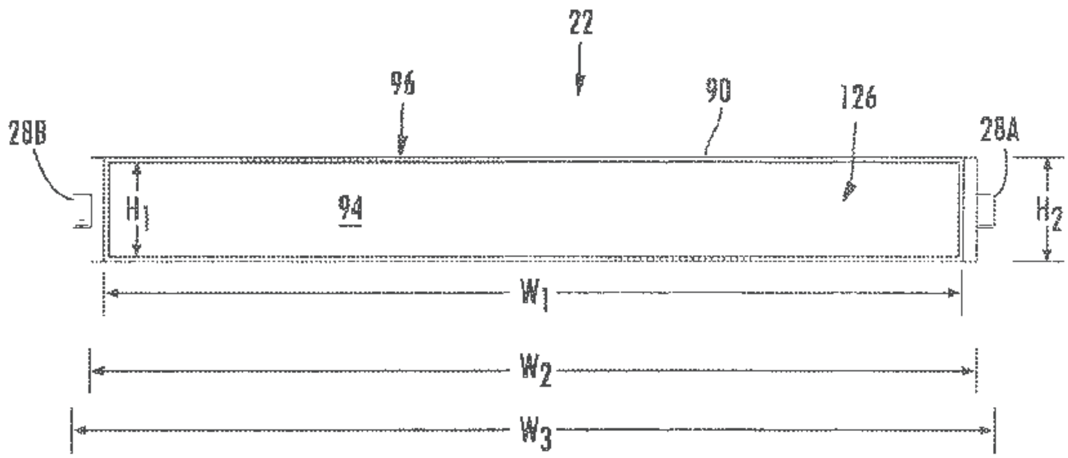


FIG. 13

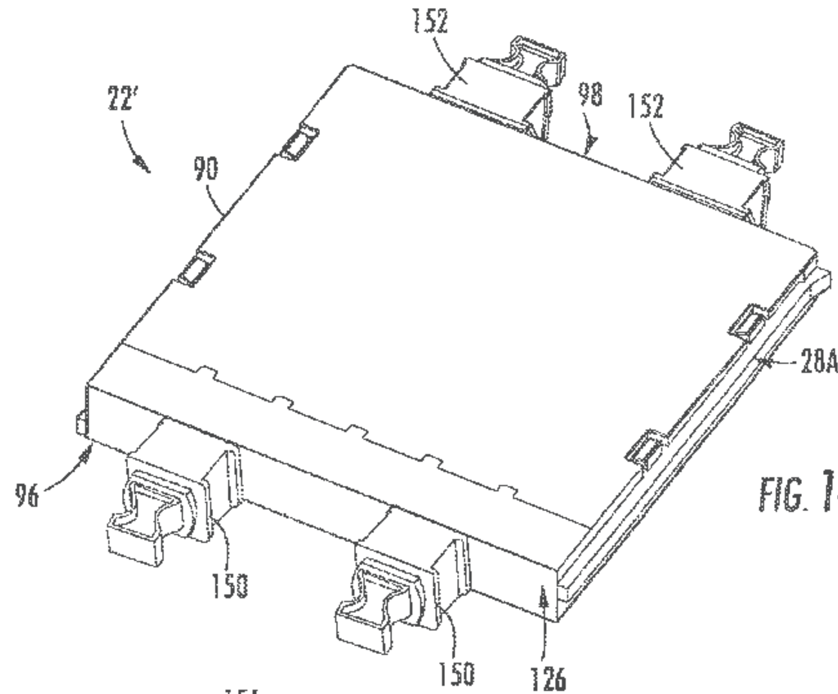

152
22'
98
152
90
28A
96
150
150
126

FIG. 14

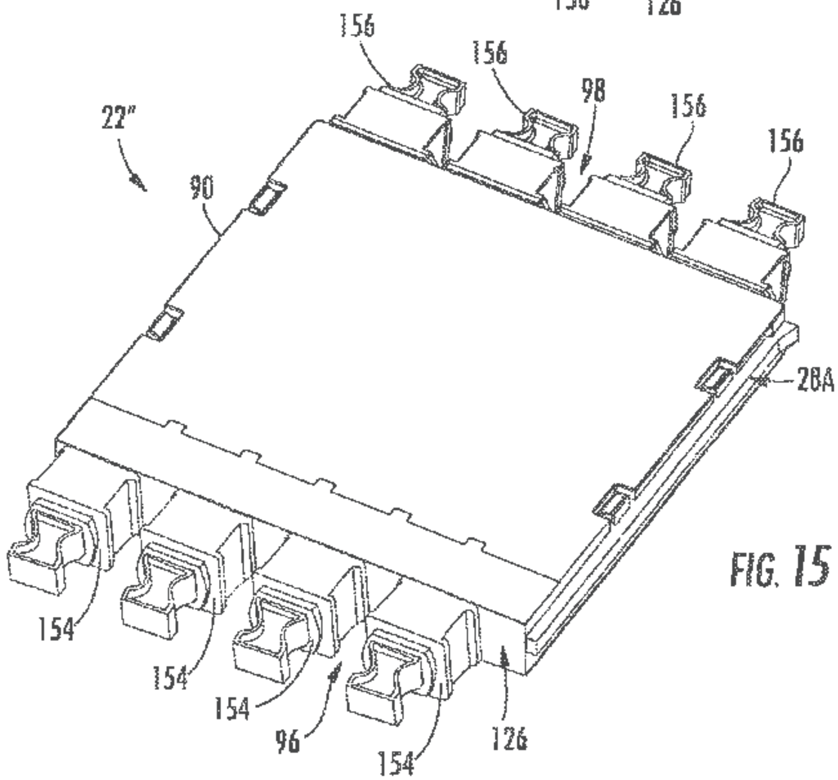

156
156
98
156
156
22"
90
28A
154
154
154
96
154
126

FIG. 15

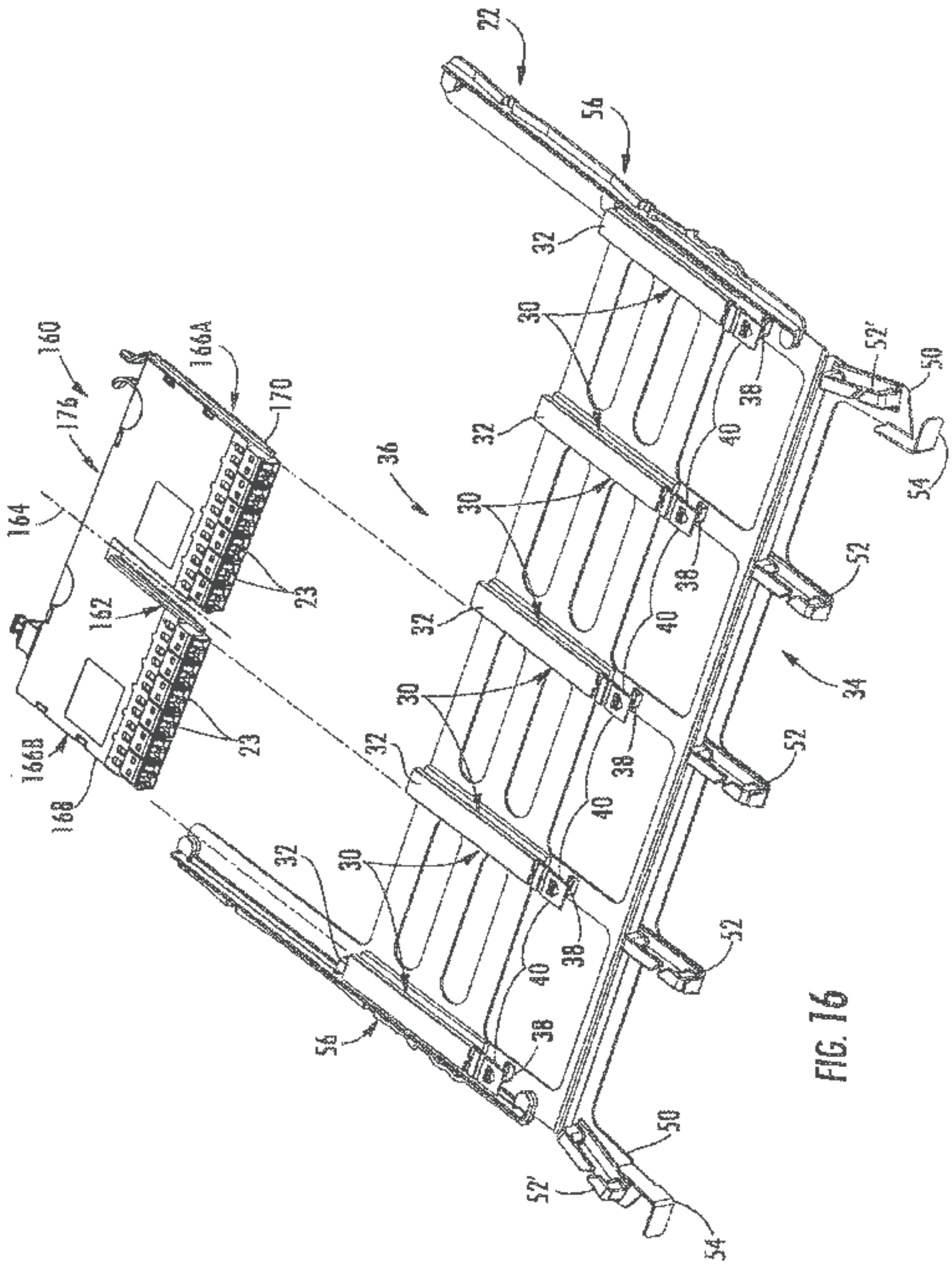

22
56
32
30
52'
50
38
40
54
36
52
34
160
166A
176
170
164
162
23
166B
168

FIG. 16

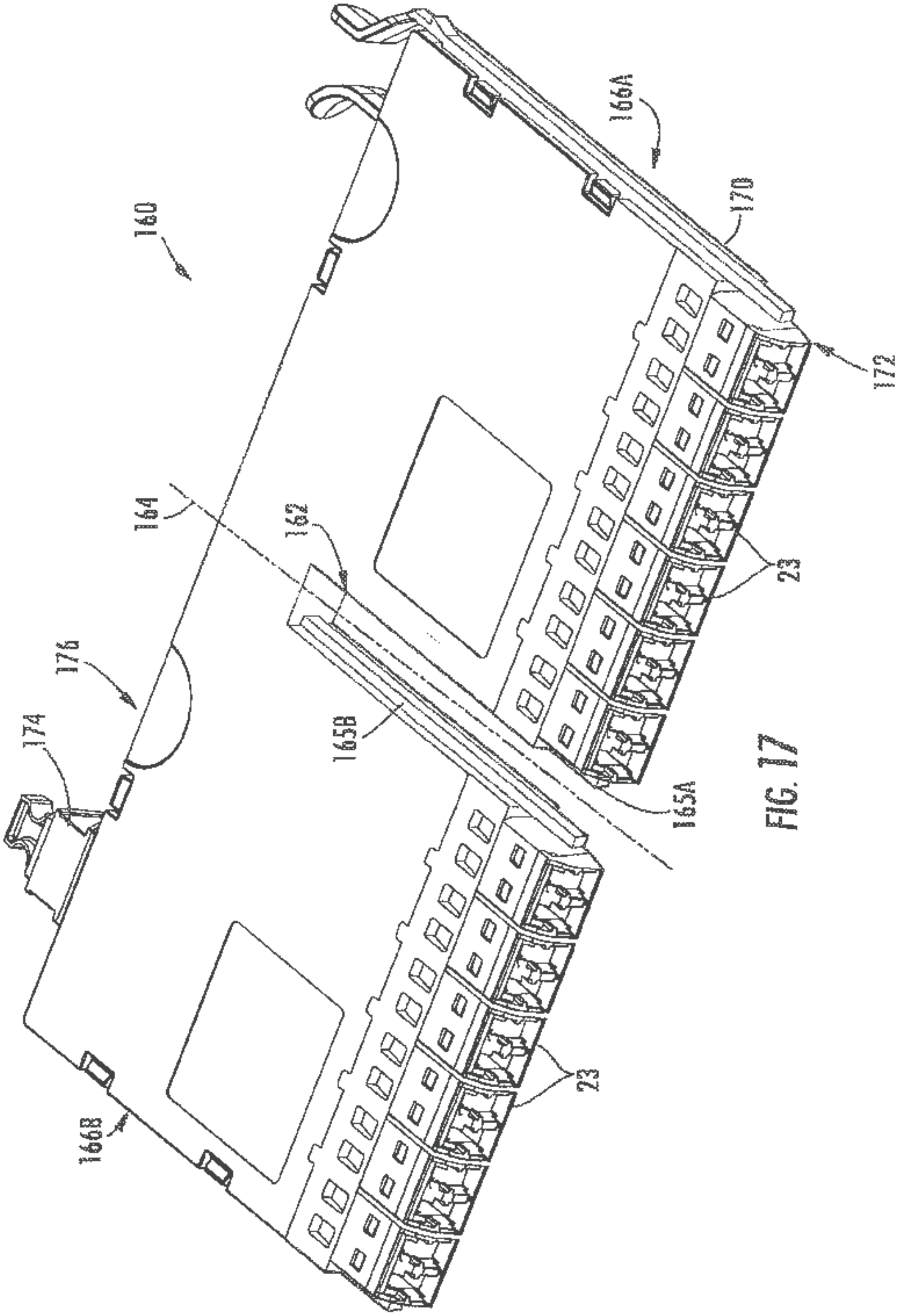
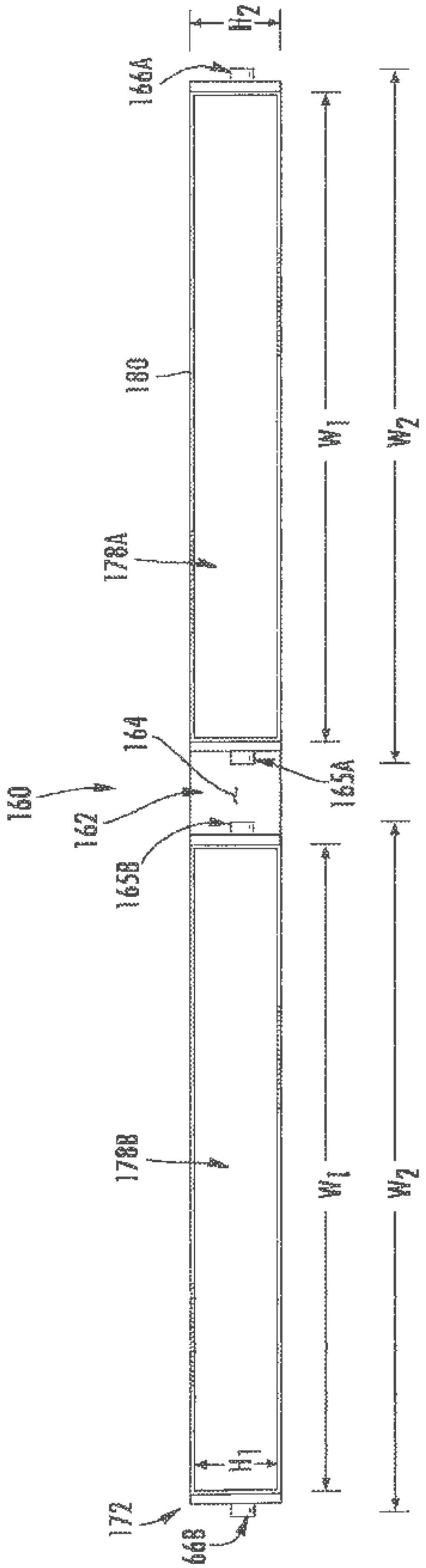
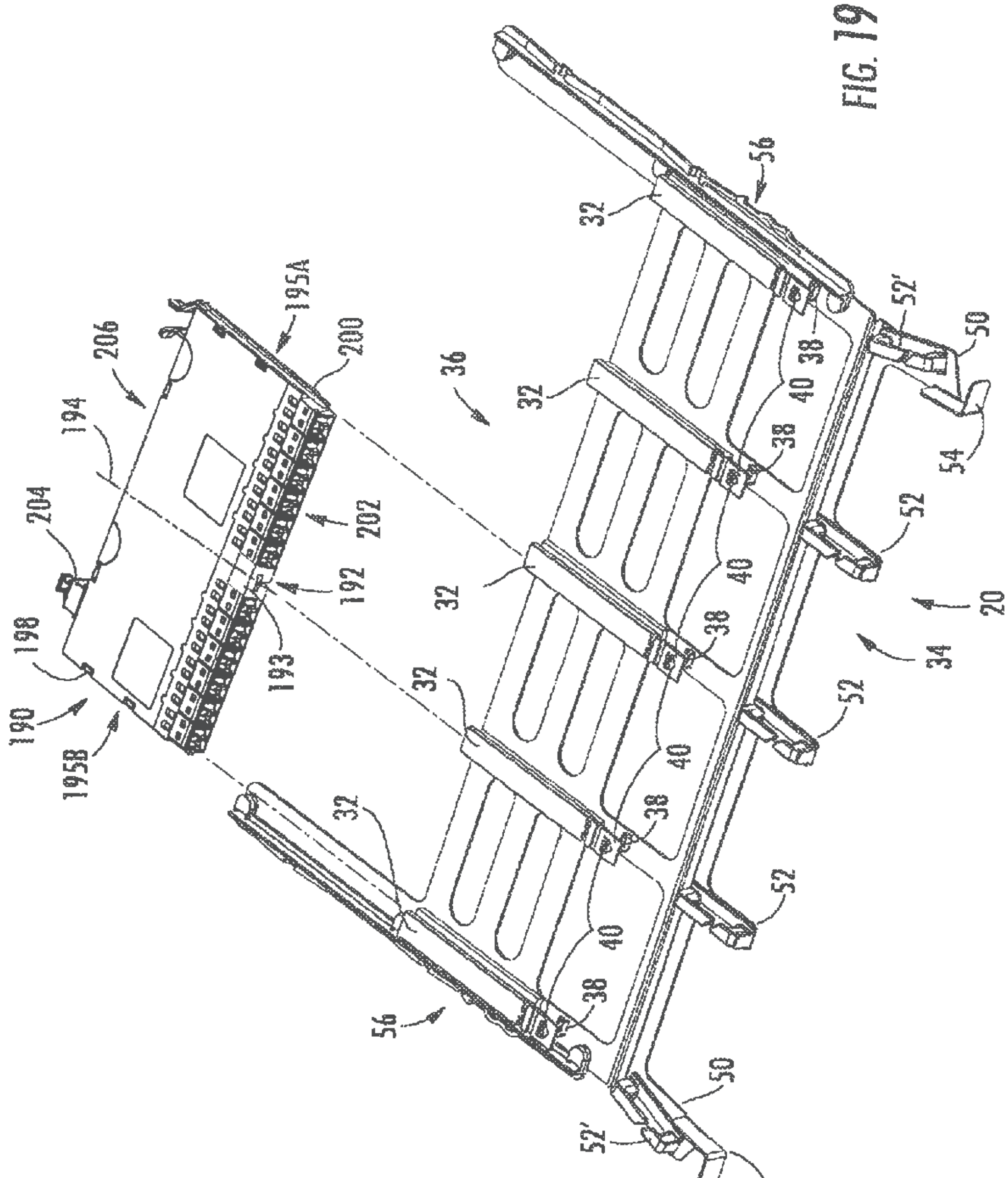


FIG. 17



H_2
166A
180
W_1
W_2
178A
164
165A
160
162
165B
178B
W_1
W_2
H_1
172
166B

FIG. 18



190
195B
198
204
194
206
195A
200
202
192
193
36
32
32
32
32
32
56
56
52'
52'
50
50
54
54
38
38
38
38
38
40
40
40
40
40
52
52
52
34
20

FIG. 19

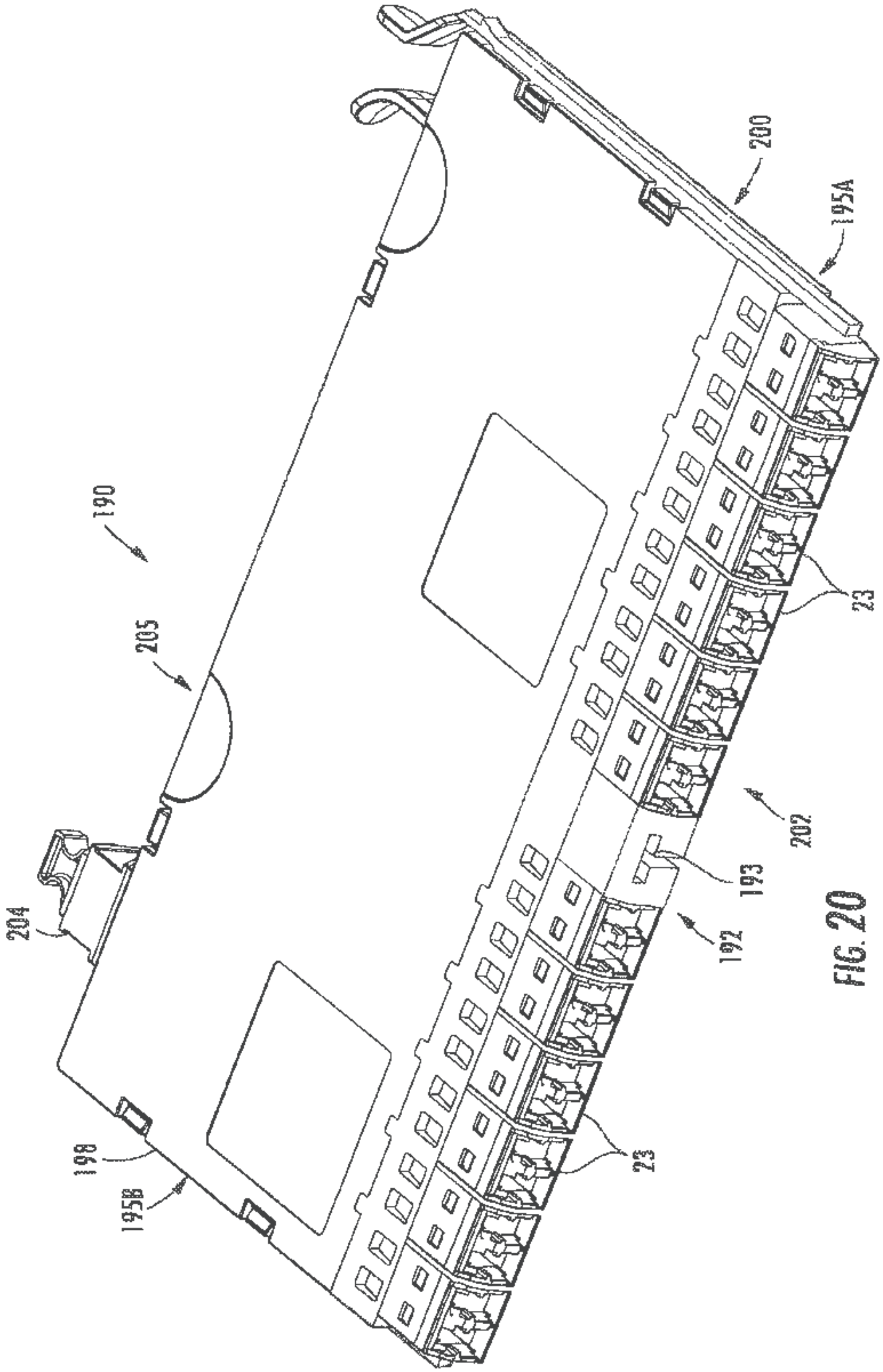


FIG. 20

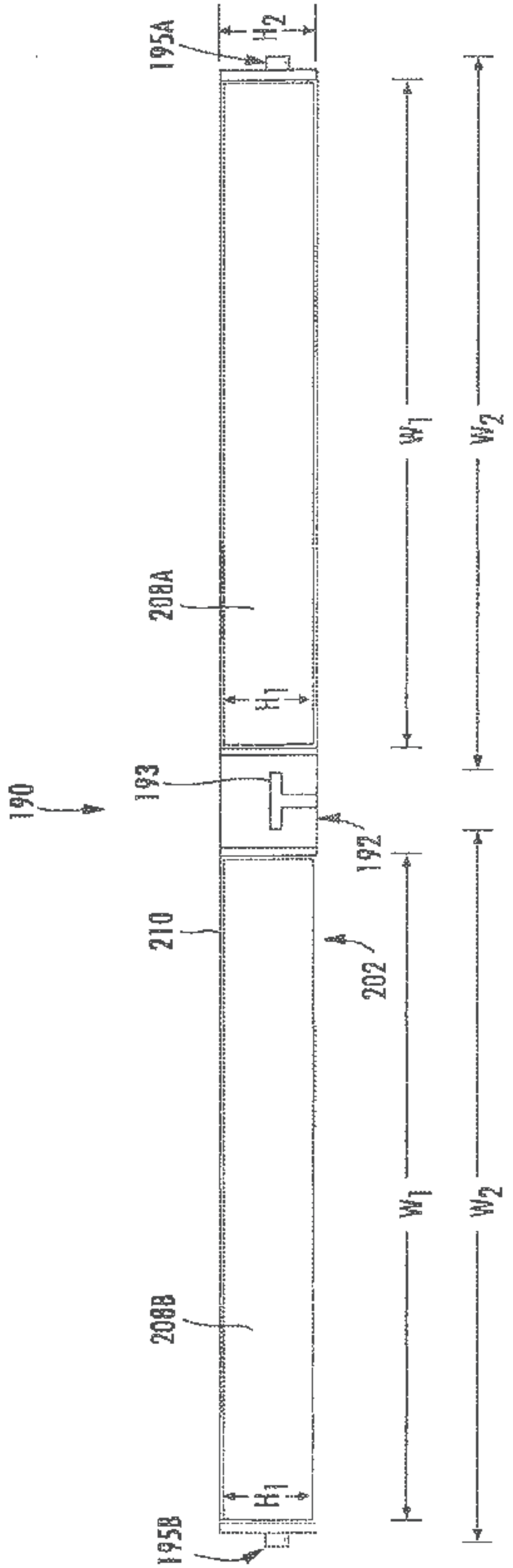


FIG. 27

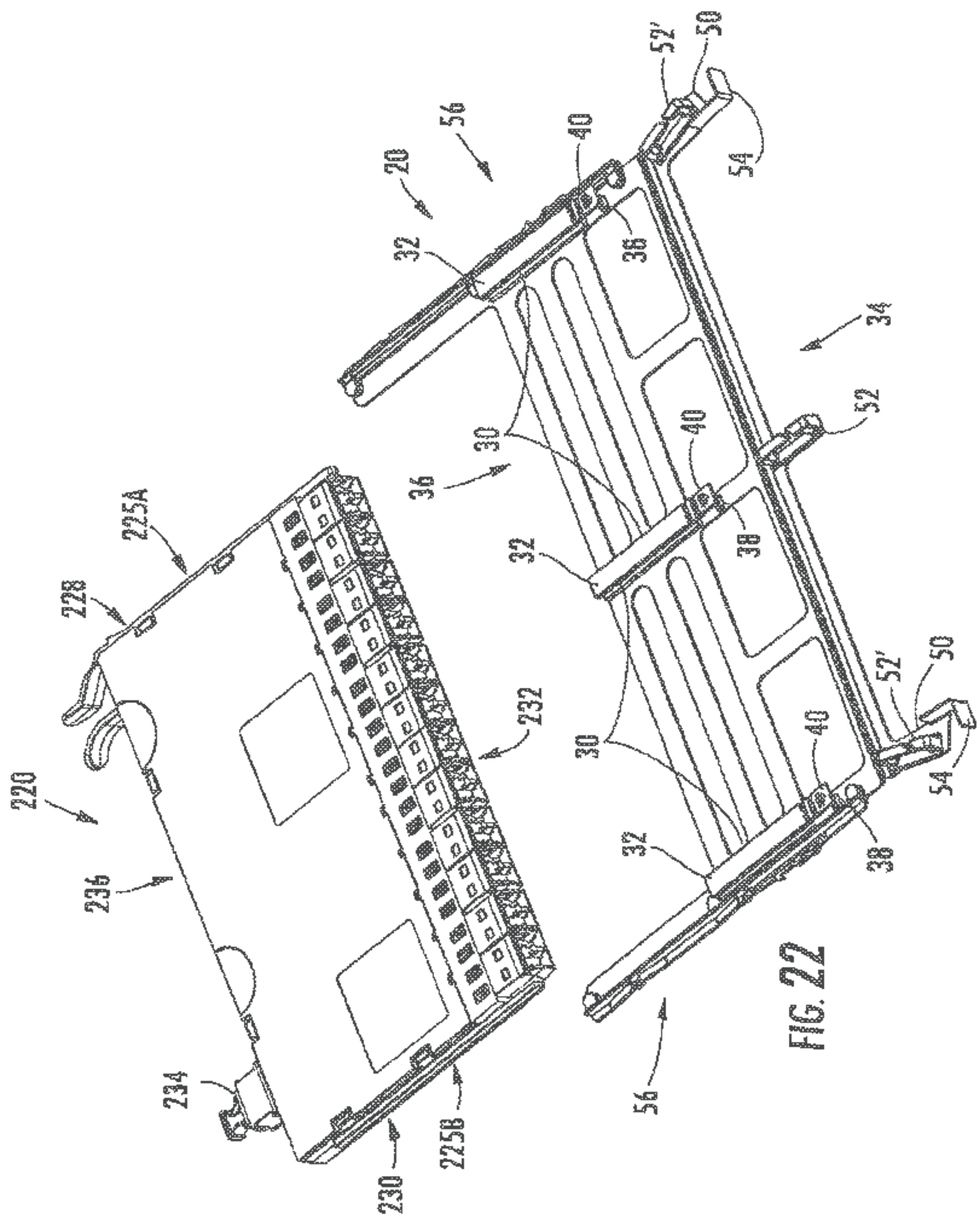

20
56
32
40
36
52'
50
54
34
52
30
38
225A
228
232
220
236
234
225B
230

FIG. 22

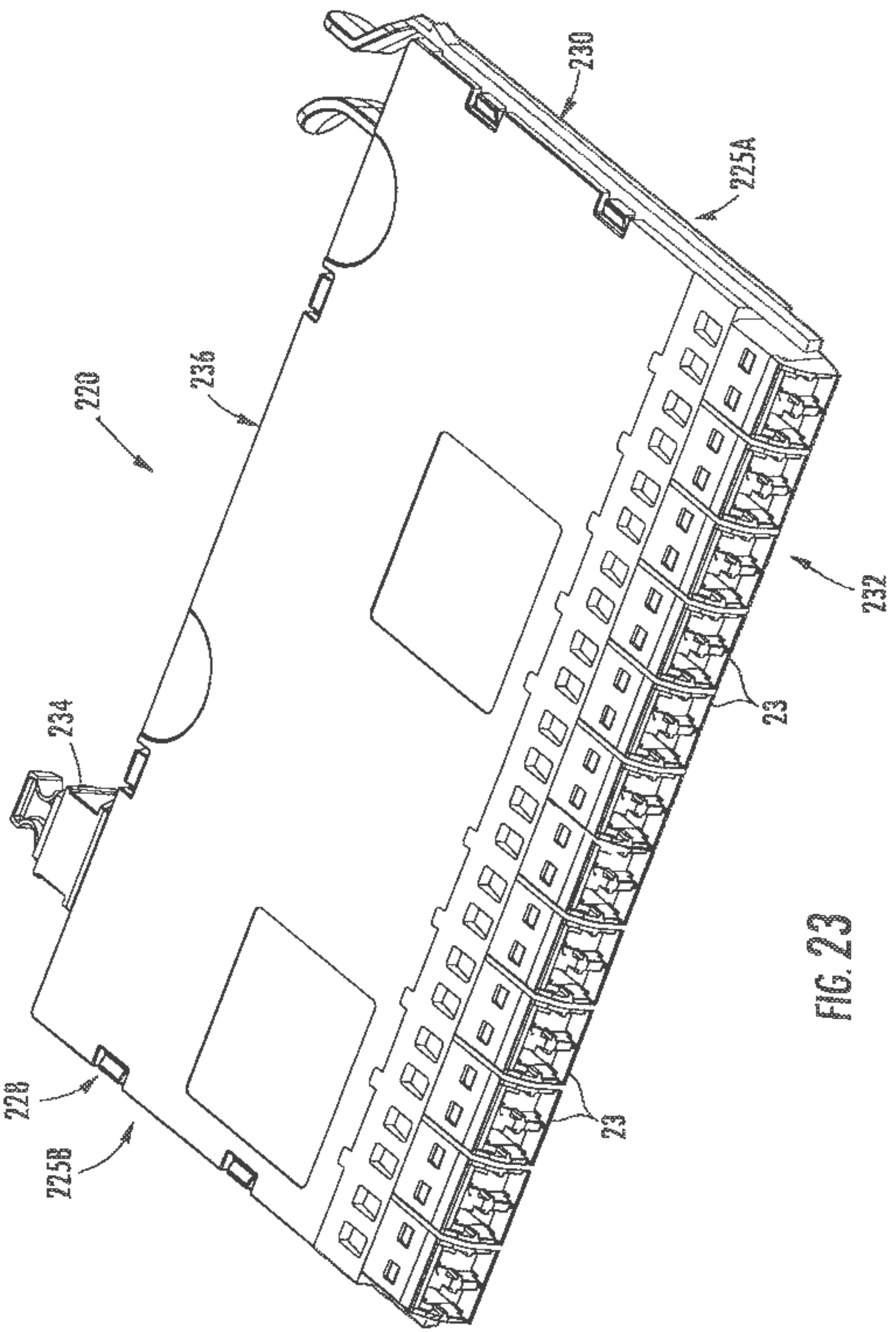


FIG. 23

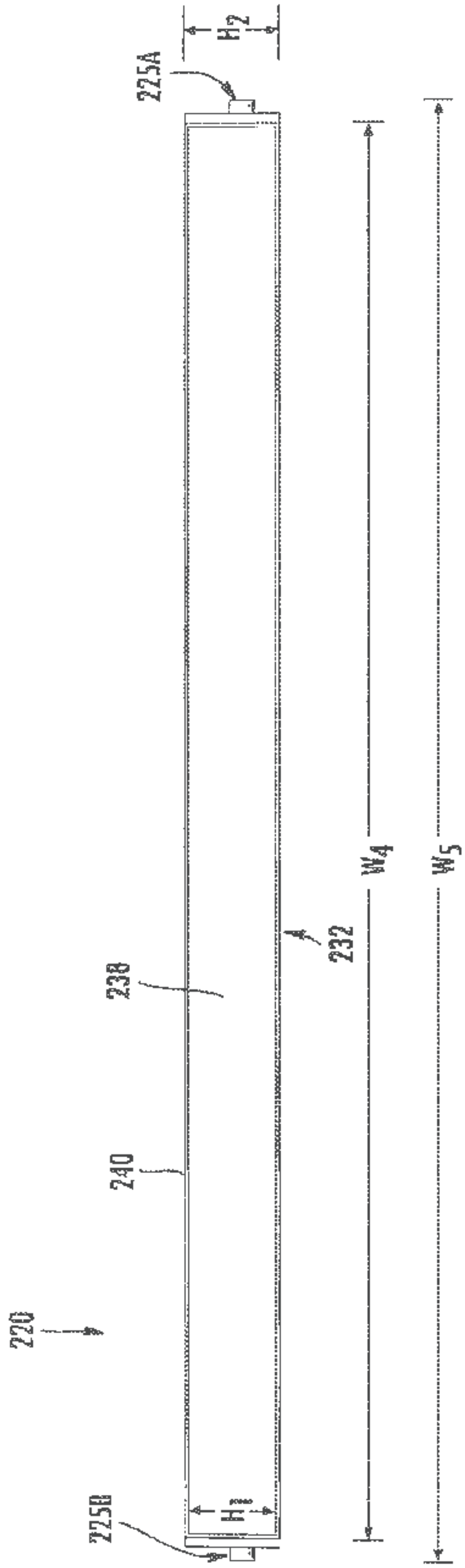


FIG. 24

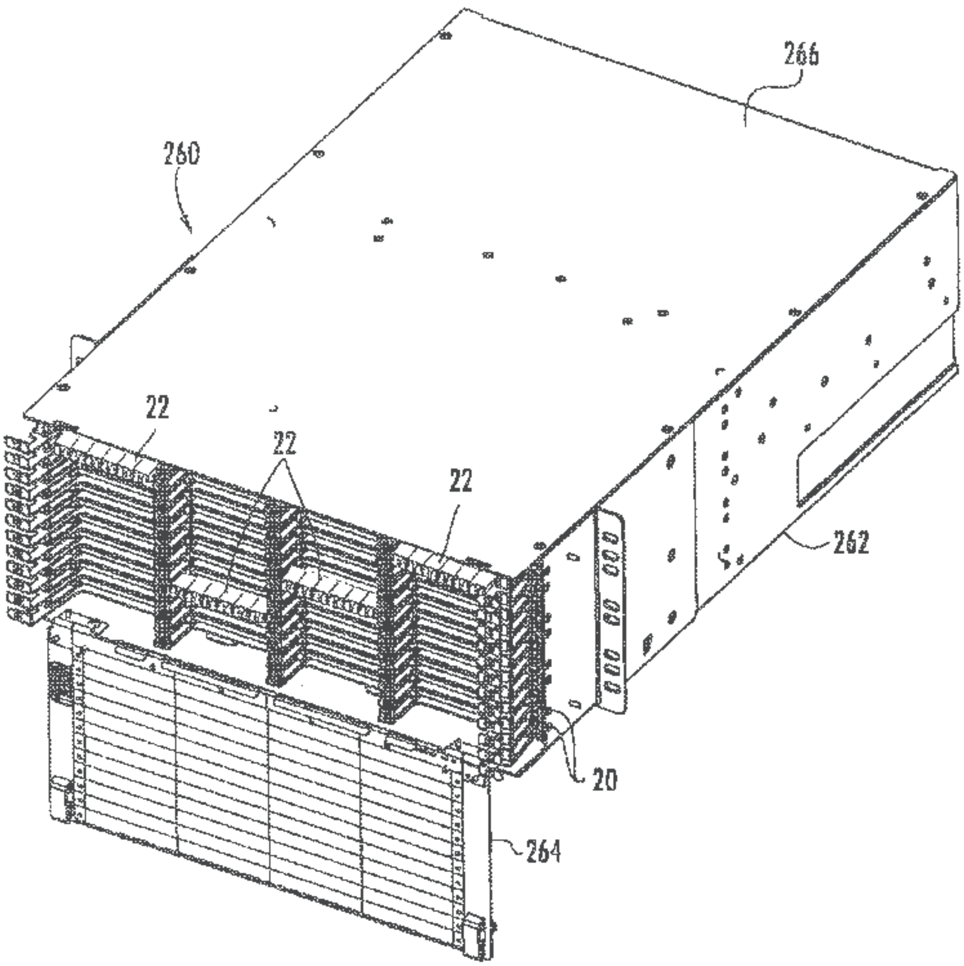


FIG. 25

HIGH DENSITY AND BANDWIDTH FIBER OPTIC APPARATUSES AND RELATED EQUIPMENT AND METHODS

PRIORITY APPLICATION

The present application is a continuation application of, and claims priority to, U.S. patent application Ser. No. 12/819,081 filed on Jun. 18, 2010 and entitled "High Density and Bandwidth Fiber Optic Apparatuses and Related Equipment and Methods," which claims priority to U.S. Provisional Patent Application Ser. No. 61/218,880 filed on Jun. 19, 2009 and entitled "High Density and Bandwidth Fiber Optic Apparatuses and Related Equipment and Methods," which are both incorporated herein in their entireties.

The present application is also a continuation-in-part application of, and claims priority to, U.S. patent application Ser. No. 12/323,415 filed on Nov. 25, 2008 and entitled "Independently Translatable Modules and Fiber Optic Equipment Trays in Fiber Optic Equipment," which claims priority to U.S. Provisional Patent Application Ser. No. 61/197,068 filed on Oct. 23, 2008 and entitled "High Density Data Hardware, Assemblies, and Components" and U.S. Provisional Patent Application Ser. No. 61/190,538 filed on Aug. 29, 2008 and entitled "High Density Data Center Hardware, Assemblies and Components" all of which are incorporated herein in their entireties.

BACKGROUND

1. Field of the Disclosure

The technology of the disclosure relates to fiber optic connection density and bandwidth provided in fiber optic apparatuses and equipment.

2. Technical Background

Benefits of optical fiber include extremely wide bandwidth and low noise operation. Because of these advantages, optical fiber is increasingly being used for a variety of applications, including but not limited to broadband voice, video, and data transmission. Fiber optic networks employing optical fiber are being developed and used to deliver voice, video, and data transmissions to subscribers over both private and public networks. These fiber optic networks often include separated connection points linking optical fibers to provide "live fiber" from one connection point to another connection point. In this regard, fiber optic equipment is located in data distribution centers or central offices to support interconnections. For example, the fiber optic equipment can support interconnections between servers, storage area networks (SANs), and other equipment at data centers. Interconnections may be supported by fiber optic patch panels or modules.

The fiber optic equipment is customized based on the application and connection bandwidth needs. The fiber optic equipment is typically included in housings that are mounted in equipment racks to optimize use of space. The data rates that can be provided by equipment in a data center are governed by the connection bandwidth supported by the fiber optic equipment. The bandwidth is governed by the number of optical fiber ports included in the fiber optic equipment and the data rate capabilities of a transceiver connected to the optical fiber ports. When additional bandwidth is needed or desired, additional fiber optic equipment can be employed or scaled in the data center to increase optical fiber port count. However, increasing the number of optical fiber ports can require more equipment rack space in a data center. Providing additional space for fiber optic equipment increases costs. A need exists to provide fiber optic equipment that provides a foundation in data centers for migration to high density patch fields and ports and greater connection bandwidth capacity to provide a migration path to higher data rates while minimizing the space needed for such fiber optic equipment.

SUMMARY OF THE DETAILED DESCRIPTION

Embodiments disclosed in the detailed description include high-density and connection bandwidth fiber optic apparatuses and related equipment and methods. In certain embodiments, fiber optic apparatuses comprising a chassis are provided. the chassis may be configured to support a fiber optic connection density of at least ninety-eight (98), at least one hundred twenty (120) per U space, or at least one hundred forty-four (144) fiber optic connections per U space based on using at least one simplex or duplex fiber optic component. In other disclosed embodiments, the chassis may be configured to support a fiber optic connection density of at least four hundred thirty-four (434) or at least five hundred seventy-six (576) fiber optic connections per U space based on using at least one twelve (12) fiber, fiber optic component. In other disclosed embodiments, the at least one of the chassis may be configured to support a fiber optic connection density of at least eight hundred sixty-six (866) per U space or at least one thousand one hundred fifty-two (1152) fiber optic connections per U space based on using at least one twenty-four (24) fiber, fiber optic component. Methods of providing and supporting the aforementioned fiber optic connections densities are also provided.

In other embodiments, fiber optic apparatuses comprising a chassis may be configured to support a full-duplex connection bandwidth of at least nine hundred sixty-two (962) Gigabits per second per U space, at least one thousand two hundred (1200) Gigabits per second, or at least one thousand four hundred forty (1440) Gigabits per second per U space based on using at least one simplex or duplex fiber optic component. In other disclosed embodiments, the chassis may be configured to support a full-duplex connection bandwidth of at least four thousand three hundred twenty-two (4322) Gigabits per second per U space, at least four thousand eight hundred (4800) Gigabits per second, or at least five thousand seven hundred sixty (5760) Gigabits per second per U space based on using at least one twelve (12) fiber, fiber optic component. In another disclosed embodiment, the chassis may be configured to support a full-duplex connection bandwidth of at least eight thousand six hundred forty-two (8642) Gigabits per second per U space. Methods of providing and supporting the aforementioned fiber optic connection bandwidths are also provided.

Additional features and advantages will be set forth in the detailed description which follows, and in part will be readily apparent to those skilled in the art from that description or recognized by practicing the invention as described herein, including the detailed description that follows, the claims, as well as the appended drawings.

It is to be understood that both the foregoing general description and the following detailed description present embodiments, and are intended to provide an overview or framework for understanding the nature and character of the disclosure. The accompanying drawings are included to provide a further understanding, and are incorporated into and constitute a part of this specification. The drawings illustrate various embodiments, and together with the description serve to explain the principles and operation of the concepts disclosed.

BRIEF DESCRIPTION OF THE FIGURES

FIG. 1 is a front perspective view of an exemplary fiber optic equipment rack with an installed exemplary 1-U size chassis supporting high-density fiber optic modules to provide a given fiber optic connection density and bandwidth capability, according to one embodiment;

FIG. 2 is a rear perspective close-up view of the chassis of FIG. 1 with fiber optic modules installed in fiber optic equipment trays installed in the fiber optic equipment;

FIG. 3 is a front perspective view of one fiber optic equipment tray with installed fiber optic modules configured to be installed in the chassis of FIG. 1;

FIG. 4 is a close-up view of the fiber optic equipment tray of FIG. 3 without fiber optic modules installed;

FIG. 5 is a close-up view of the fiber optic equipment tray of FIG. 3 with fiber optic modules installed;

FIG. 6 is a front perspective view of the fiber optic equipment tray of FIG. 3 without fiber optic modules installed;

FIG. 7 is a front perspective view of fiber optic equipment trays supporting fiber optic modules with one fiber optic equipment tray extended out from the chassis of FIG. 1;

FIG. 8 is a left perspective view of an exemplary tray guide disposed in the chassis of FIG. 1 configured to receive fiber optic equipment trays of FIG. 6 capable of supporting one or more fiber optic modules;

FIGS. 9A and 9B are perspective and top views, respectively, of an exemplary tray rail disposed on each side of the fiber optic equipment tray of FIG. 3 and configured to be received in the chassis of FIG. 1 by the tray guide of FIG. 8;

FIGS. 10A and 10B are front right and left perspective views, respectively, of an exemplary fiber optic module that can be disposed in the fiber optic equipment trays of FIG. 3;

FIG. 11 is a perspective, exploded view of the fiber optic module in FIGS. 10A and 10B;

FIG. 12 is a perspective top view of the fiber optic module of FIG. 11 with the cover removed and showing a fiber optic harness installed therein;

FIG. 13 is a front view of the fiber optic module of FIG. 11 without fiber optic components installed;

FIG. 14 is a front right perspective view of another alternate fiber optic module that supports twelve (12) fiber MPO fiber optic components and which can be installed in the fiber optic equipment tray of FIG. 3;

FIG. 15 is front right perspective view of another alternate fiber optic module that supports twenty-four (24) fiber MPO fiber optic components and which can be installed in the fiber optic equipment tray of FIG. 3;

FIG. 16 is a front perspective view of an alternate fiber optic module being installed in the fiber optic equipment tray of FIG. 3;

FIG. 17 is front right perspective view of the fiber optic module of FIG. 16;

FIG. 18 is a front view of the fiber optic module of FIGS. 16 and 17;

FIG. 19 is a front perspective view of another alternate fiber optic module being installed in the fiber optic equipment tray of FIG. 3;

FIG. 20 is front right perspective view of the fiber optic module of FIG. 19;

FIG. 21 is a front view of the fiber optic module of FIGS. 19 and 20;

FIG. 22 is a front perspective view of another alternate fiber optic module being installed in an alternate fiber optic equipment tray that can be installed in the chassis of FIG. 1;

FIG. 23 is front right perspective view of the fiber optic module of FIG. 22;

FIG. 24 is a front view of the fiber optic module of FIGS. 22 and 23; and

FIG. 25 is a front perspective view of alternate exemplary 4-U size fiber optic chassis that can support the fiber optic equipment trays and fiber optic modules according to the fiber optic equipment tray and fiber optic modules disclosed.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Reference will now be made in detail to certain embodiments, examples of which are illustrated in the accompanying drawings, in which some, but not all features are shown. Indeed, embodiments disclosed herein may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will satisfy applicable legal requirements. Whenever possible, like reference numbers will be used to refer to like components or parts.

Embodiments disclosed in the detailed description include high-density fiber optic modules and fiber optic module housings and related equipment. In certain embodiments, the width and/or height of the front opening of fiber optic modules and/or fiber optic module housings can be provided according to a designed relationship to the width and/or height, respectively, of a front side of the main body of the fiber optic modules and fiber optic module housings to support fiber optic components or connections. In this manner, fiber optic components can be installed in a given percentage or area of the front side of the fiber optic module to provide a high density of fiber optic connections for a given fiber optic component type(s). In another embodiment, the front openings of the fiber optic modules and/or fiber optic module housings can be provided to support a designed connection density of fiber optic components or connections for a given width and/or height of the front opening of the fiber optic module and/or fiber optic module housing. Embodiments disclosed in the detailed description also include high connection density and bandwidth fiber optic apparatuses and related equipment. In certain embodiments, fiber optic apparatuses are provided and comprise a chassis defining one or more U space fiber optic equipment units, wherein at least one of the one or more U space fiber optic equipment units is configured to support a given fiber optic connection density or bandwidth in a 1-U space, and for a given fiber optic component type(s).

In this regard, FIG. 1 illustrates exemplary 1-U size fiber optic equipment 10 from a front perspective view. The fiber optic equipment 10 supports high-density fiber optic modules that support a high fiber optic connection density and bandwidth in a 1-U space, as will be described in greater detail below. The fiber optic equipment 10 may be provided at a data distribution center or central office to support cable-to-cable fiber optic connections and to manage a plurality of fiber optic cable connections. As will be described in greater detail below, the fiber optic equipment 10 has one or more fiber optic equipment trays that each support one or more fiber optic modules. However, the fiber optic equipment 10 could also be adapted to support one or more fiber optic patch panels or other fiber optic equipment that supports fiber optic components and connectivity.

The fiber optic equipment 10 includes a fiber optic equipment chassis 12 ("chassis 12"). The chassis 12 is shown as being installed in a fiber optic equipment rack 14. The fiber optic equipment rack 14 contains two vertical rails 16A, 16B that extend vertically and include a series of apertures 18 for facilitating attachment of the chassis 12 inside the fiber optic equipment rack 14. The chassis 12 is attached and supported by the fiber optic equipment rack 14 in the form of shelves that are stacked on top of each other within the vertical rails 16A, 16B. As illustrated, the chassis 12 is attached to the vertical rails **16**A, **16**B. The fiber optic equipment rack **14** may support 1-U-sized shelves, with "U" equal to a standard 1.75 inches in height and nineteen (19) inches in width. In certain applications, the width of "U" may be twenty-three (23) inches. Also, the term fiber optic equipment rack **14** should be understood to include structures that are cabinets as well. In this embodiment, the chassis **12** is 1-U in size; however, the chassis **12** could be provided in a size greater than 1-U as well.

As will be discussed in greater detail later below, the fiber optic equipment **10** includes a plurality of extendable fiber optic equipment trays **20** that each carries one or more fiber optic modules **22**. The chassis **12** and fiber optic equipment trays **20** support fiber optic modules **22** that support high-density fiber optic modules and a fiber optic connection density and bandwidth connections in a given space, including in a 1-U space. FIG. **1** shows exemplary fiber optic components **23** disposed in the fiber optic modules **22** that support fiber optic connections. For example, the fiber optic components **23** may be fiber optic adapters or fiber optic connectors. As will also be discussed in greater detail later below, the fiber optic modules **22** in this embodiment can be provided such that the fiber optic components **23** can be disposed through at least eighty-five percent (85%) of the width of the front side or face of the fiber optic module **22**, as an example. This fiber optic module **22** configuration may provide a front opening of approximately 90 millimeters (mm) or less wherein fiber optic components can be disposed through the front opening and at a fiber optic connection density of at least one fiber optic connection per 7.0 mm of width of the front opening of the fiber optic modules **22** for simplex or duplex fiber optic components **23**. In this example, six (6) duplex or twelve (12) simplex fiber optic components may be installed in each fiber optic module **22**. The fiber optic equipment trays **20** in this embodiment support up to four (4) of the fiber optic modules **22** in approximately the width of a 1-U space, and three (3) fiber optic equipment trays **20** in the height of a 1-U space for a total of twelve (12) fiber optic modules **22** in a 1-U space. Thus, for example, if six (6) duplex fiber optic components were disposed in each of the twelve (12) fiber optic modules **22** installed in fiber optic equipment trays **20** of the chassis **12** as illustrated in FIG. **1**, a total of one hundred forty-four (144) fiber optic connections, or seventy-two (72) duplex channels (i.e., transmit and receive channels), would be supported by the chassis **12** in a 1-U space. If five (5) duplex fiber optic adapters are disposed in each of the twelve (12) fiber optic modules **22** installed in fiber optic equipment trays **20** of the chassis **12**, a total of one hundred twenty (120) fiber optic connections, or sixty (60) duplex channels, would be supported by the chassis **12** in a 1-U space. The chassis **12** also supports at least ninety-eight (98) fiber optic components in a 1-U space wherein at least one of the fiber optic components is a simplex or duplex fiber optic component.

If multi-fiber fiber optic components were installed in the fiber optic modules **22**, such as MPO components for example, higher fiber optic connection density and bandwidths would be possible over other chassis **12** that use similar fiber optic components. For example, if up to four (4) twelve (12) fiber MPO fiber optic components were disposed in each fiber optic module **22**, and twelve (12) of the fiber optic modules **22** were disposed in the chassis **12** in a 1-U space, the chassis **12** would support up to five hundred seventy-six (576) fiber optic connections in a 1-U space. If up to four (4) twenty-four (24) fiber MPO fiber optic components were disposed in each fiber optic module **22**, and twelve (12) of the fiber optic modules **22** were disposed in the chassis **12**, up to one thousand one hundred fifty-two (1152) fiber optic connections in a 1-U space.

FIG. 2 is a rear perspective close-up view of the chassis **12** of FIG. **1** with fiber optic modules **22** loaded with fiber optic components **23** and installed in fiber optic equipment trays **20** installed in the chassis **12**. Module rails **28**A, **28**B are disposed on each side of each fiber optic module **22**. The module rails **28**A, **28**B are configured to be inserted within tray channels **30** of module rail guides **32** disposed in the fiber optic equipment tray **20**, as illustrated in more detail in FIGS. **3-5**. Note that any number of module rail guides **32** can be provided. The fiber optic module **22** can be installed from both a front end **34** and a rear end **36** of the fiber optic equipment tray **20** in this embodiment. If it is desired to install the fiber optic module **22** in the fiber optic equipment tray **20** from the rear end **36**, a front end **33** of the fiber optic module **22** can be inserted from the rear end **36** of the fiber optic equipment tray **20**. More specifically, the front end **33** of the fiber optic module **22** is inserted into the tray channels **30** of the module rail guides **32**. The fiber optic module **22** can then be pushed forward within the tray channels **30** until the fiber optic module **22** reaches the front end **34** of the module rail guides **32**. The fiber optic modules **22** can be moved towards the front end **34** until the fiber optic modules **22** reach a stop or locking feature disposed in the front end **34** as will described later in this application. FIG. **6** also illustrates the fiber optic equipment tray **20** without installed fiber optic modules **22** to illustrate the tray channels **30** and other features of the fiber optic equipment tray **20**.

The fiber optic module **22** can be locked into place in the fiber optic equipment tray **20** by pushing the fiber optic module **22** forward to the front end **33** of the fiber optic equipment tray **20**. A locking feature in the form of a front stop **38** is disposed in the module rail guides **32**, as illustrated in FIG. **3** and in more detail in the close-up view in FIG. **4**. The front stop **38** prevents the fiber optic module **22** from extending beyond the front end **34**, as illustrated in the close-up view of the fiber optic equipment tray **20** with installed fiber optic modules **22** in FIG. **5**. When it is desired to remove a fiber optic module **22** from the fiber optic equipment tray **20**, a front module tab **40** also disposed in the module rail guides **32** and coupled to the front stop **38** can be pushed downward to engage the front stop **38**. As a result, the front stop **38** will move outward away from the fiber optic module **22** such that the fiber optic module **22** is not obstructed from being pulled forward. The fiber optic module **22**, and in particular its module rails **28**A, **28**B (FIG. **2**), can be pulled forward along the module rail guides **32** to remove the fiber optic module **22** from the fiber optic equipment tray **20**.

The fiber optic module **22** can also be removed from the rear end **36** of the fiber optic equipment tray **20**. To remove the fiber optic module **22** from the rear end **36** of the fiber optic equipment tray **20**, a latch **44** is disengaged by pushing a lever **46** (see FIGS. **2** and **3**; see also, FIGS. **10**A and **10**B) inward towards the fiber optic module **22** to release the latch **44** from the module rail guide **32**. To facilitate pushing the lever **46** inward towards the fiber optic module **22**, a finger hook **48** is provided adjacent to the lever **46** so the lever **46** can easily be squeezed into the finger hook **48** by a thumb and index finger.

With continuing reference to FIG. **3-6**, the fiber optic equipment tray **20** may also contain extension members **50**. Routing guides **52** may be conveniently disposed on the extension members **50** to provide routing for optical fibers or fiber optic cables connected to fiber optic components **23** disposed in the fiber optic modules **22** (FIG. **3**). The routing guides **52'** on the ends of the fiber optic equipment tray **20** may be angled with respect to the module rail guides **32** to route optical fibers or fiber optic cables at an angle to the sides of the fiber optic equipment tray **20**. Pull tabs **54** may also be connected to the extension members 50 to provide a means to allow the fiber optic equipment tray 20 to easily be pulled out from and pushed into the chassis 12.

As illustrated in FIGS. 3 and 6, the fiber optic equipment tray 20 also contains tray rails 56. The tray rails 56 are configured to be received in tray guides 58 disposed in the chassis 12 to retain and allow the fiber optic equipment trays 20 to move in and out of the chassis 12, as illustrated in FIG. 7. More detail regarding the tray rails 56 and their coupling to the tray guides 58 in the chassis 12 is discussed below with regard to FIGS. 8 and 9A-9B. The fiber optic equipment trays 20 can be moved in and out of the chassis 12 by their tray rails 56 moving within the tray guides 58. In this manner, the fiber optic equipment trays 20 can be independently movable about the tray guides 58 in the chassis 12. FIG. 7 illustrates a front perspective view of one fiber optic equipment tray 20 pulled out from the chassis 12 among three (3) fiber optic equipment trays 20 disposed within the tray guides 58 of the chassis 12. The tray guides 58 may be disposed on both a left side end 60 and a right side end 62 of the fiber optic equipment tray 20. The tray guides 58 are installed opposite and facing each other in the chassis 12 to provide complementary tray guides 58 for the tray rails 56 of the fiber optic equipment trays 20 received therein. If it is desired to access a particular fiber optic equipment tray 20 and/or a particular fiber optic module 22 in a fiber optic equipment tray 20, the pull tab 54 of the desired fiber optic equipment tray 20 can be pulled forward to cause the fiber optic equipment tray 20 to extend forward out from the chassis 12, as illustrated in FIG. 7. The fiber optic module 22 can be removed from the fiber optic equipment tray 20 as previously discussed. When access is completed, the fiber optic equipment tray 20 can be pushed back into the chassis 12 wherein the tray rails 56 move within the tray guides 58 disposed in the chassis 12.

FIG. 8 is a left perspective view of an exemplary tray guide 58 disposed in the chassis 12 of FIG. 1. As discussed above, the tray guides 58 are configured to receive fiber optic equipment trays 20 supporting one or more fiber optic modules 22 in the chassis 12. The tray guides 58 allow the fiber optic equipment trays 20 to be pulled out from the chassis 12, as illustrated in FIG. 7. The tray guide 58 in this embodiment is comprised of a guide panel 64. The guide panel 64 may be constructed out of any material desired, including but not limited to a polymer or metal. The guide panel 64 contains a series of apertures 66 to facilitate attachment of the guide panel 64 to the chassis 12, as illustrated in FIG. 8. Guide members 68 are disposed in the guide panel 64 and configured to receive the tray rail 56 of the fiber optic equipment tray 20. Three (3) guide members 68 are disposed in the guide panel 64 in the embodiment of FIG. 8 to be capable of receiving up to three (3) tray rails 56 of three (3) fiber optic equipment trays 20 in a 1-U space. However, any number of guide members 68 desired may be provided in the tray guide 58 to cover sizes less than or greater than a 1-U space. In this embodiment, the guide members 68 each include guide channels 70 configured to receive and allow tray rails 56 to move along the guide channels 70 for translation of the fiber optic equipment trays 20 about the chassis 12.

Leaf springs 72 are disposed in each of the guide members 68 of the tray guide 58 and are each configured to provide stopping positions for the tray rails 56 during movement of the fiber optic equipment tray 20 in the guide members 68. The leaf springs 72 each contain detents 74 that are configured to receive protrusions 76 (FIG. 9A-9D) disposed in the tray rails 56 to provide stopping or resting positions. The tray rails 56 contain mounting platforms 75 that are used to attach the tray rails 56 to the fiber optic equipment trays 20. It may

be desirable to provide stopping positions in the tray guide 56 to allow the fiber optic equipment trays 20 to have stopping positions when moved in and out of the chassis 12. Two (2) protrusions 76 in the tray rail 56 are disposed in two (2) detents 74 in the tray guide 58 at any given time. When the fiber optic equipment tray 20 is fully retracted into the chassis 12 in a first stopping position, the two (2) protrusions 76 of the tray rail 56 are disposed in the one detent 74 adjacent a rear end 77 of the guide channel 70 and the middle detent 74 disposed between the rear end 77 and a front end 78 of the guide channel 70. When the fiber optic equipment tray 20 is pulled out from the chassis 12, the two (2) protrusions 76 of the tray rail 56 are disposed in the one detent 74 adjacent the front end 78 of the guide channel 70 and the middle detent 74 disposed between the rear end 77 and the front end 78 of the guide channel 70.

As the tray rail 56 is pulled within the guide channel 70, a protrusion 80 disposed in the tray rail 56 and illustrated in FIGS. 9A and 9B is biased to pass over transition members 82 disposed between the leaf springs 72, as illustrated in FIG. 8. The protrusion 80 is provided in a leaf spring 81 disposed in the tray rail 56, as illustrated in FIGS. 9A and 9B. The transition members 82 have inclined surfaces 84 that allow the protrusion 80 to pass over the transition members 82 as the fiber optic equipment tray 20 is being translated with the guide channel 70. As the protrusion 80 contains the transition members 82, the force imparted onto the protrusion 80 causes the leaf spring 81 to bend inward to allow the protrusion 80 to pass over the transition member 82. To prevent the tray rail 56 and thus the fiber optic equipment tray 20 from being extended beyond the front end 78 and rear end 77 of the guide channel 70, stopping members 86 are disposed at the front end 78 and rear end 77 of the guide channel 70. The stopping members 86 do not have an inclined surface; thus the protrusion 80 in the tray rail 56 abuts against the stopping member 86 and is prevented from extending over the stopping member 86 and outside of the front end 78 of the guide channel 70.

Against the background of the above disclosed embodiment of a 1-U chassis 12 and fiber optic equipment trays 20 and fiber optic modules 22 that can installed therein, the form factor of the fiber optic module 22 will now be described. The form factor of the fiber optic module 22 allows a high density of fiber optic components 23 to be disposed within a certain percentage area of the front of the fiber optic module 22 thus supporting a particular fiber optic connection density and bandwidth for a given type of fiber optic component 23. When this fiber optic module 22 form factor is combined with the ability to support up to twelve (12) fiber optic modules 22 in a 1-U space, as described by the exemplary chassis 12 example above, a higher fiber optic connection density and bandwidth is supported and possible.

In this regard, FIGS. 10A and 10B are right and left perspective views of the exemplary fiber optic module 22. As discussed above, the fiber optic module 22 can be installed in the fiber optic equipment trays 20 to provide fiber optic connections in the chassis 12. The fiber optic module 22 is comprised of a main body 90 receiving a cover 92. An internal chamber 94 (FIG. 11) disposed inside the main body 90 and the cover 92 and is configured to receive or retain optical fibers or a fiber optic cable harness, as will be described in more detail below. The main body 90 is disposed between a front side 96 and a rear side 98 of the main body 90. Fiber optic components 23 can be disposed through the front side 96 of the main body 90 and configured to receive fiber optic connectors connected to fiber optic cables (not shown). In this example, the fiber optic components 23 are duplex LC fiber optic adapters that are configured to receive and support connections with duplex LC fiber optic connectors. However, any fiber optic connection type desired can be provided in the fiber optic module 22. The fiber optic components 23 are connected to a fiber optic component 100 disposed through the rear side 98 of the main body 90. In this manner, a connection to the fiber optic component 23 creates a fiber optic connection to the fiber optic component 100. In this example, the fiber optic component 100 is a multi-fiber MPO fiber optic adapter equipped to establish connections to multiple optical fibers (e.g., either twelve (12) or twenty-four (24) optical fibers). The fiber optic module 22 may also manage polarity between the fiber optic components 23, 100.

The module rails 28A, 28B are disposed on each side 102A, 102B of the fiber optic module 22. As previously discussed, the module rails 28A, 28B are configured to be inserted within the module rail guides 32 in the fiber optic equipment tray 20, as illustrated in FIG. 3. In this manner, when it is desired to install a fiber optic module 22 in the fiber optic equipment tray 20, the front side 96 of the fiber optic module 22 can be inserted from either the front end 33 or the rear end 36 of the fiber optic equipment tray 20, as previously discussed.

FIG. 11 illustrates the fiber optic module 22 in an exploded view with the cover 92 of the fiber optic module 22 removed to illustrate the internal chamber 94 and other internal components of the fiber optic module 22. FIG. 12 illustrates the fiber optic module 22 assembled, but without the cover 92 installed on the main body 90. The cover 92 includes notches 106 disposed in sides 108, 110 that are configured to interlock with protrusions 112 disposed on the sides 102A, 102B of the main body 90 of the fiber optic modules 22 when the cover 92 is attached to the main body 90 to secure the cover 92 to the main body 90. The cover 92 also contains notches 114, 116 disposed on a front side 118 and rear side 120, respectively, of the cover 92. The notches 114, 116 are configured to interlock with protrusions 122, 124 disposed in the front side 96 and the rear end 98, respectively, of the main body 90 when the cover 92 is attached to the main body 90 to also secure the cover 92 to the main body 90. FIG. 12 does not show protrusions 122, 124.

With continuing reference to FIG. 11, the fiber optic components 23 are disposed through a front opening 126 disposed along a longitudinal axis L_1 in the front side 96 of the main body 90. In this embodiment, the fiber optic components 23 are duplex LC adapters 128, which support single or duplex fiber connections and connectors. The duplex LC adapters 128 in this embodiment contain protrusions 130 that are configured to engage with orifices 135 disposed on the main body 90 to secure the duplex LC adapters 128 in the main body 90 in this embodiment. A cable harness 134 is disposed in the internal chamber 94 with fiber optic connectors 136, 138 disposed on each end of optical fibers 139 connected to the duplex LC adapters 128 and the fiber optic component 100 disposed in the rear side 98 of the main body 90. The fiber optic component 100 in this embodiment is a twelve (12) fiber MPO fiber optic adapter 140 in this embodiment. Two vertical members 142A, 142B are disposed in the internal chamber 94 of the main body 90, as illustrated in FIG. 12, to retain the looping of the optical fibers 139 of the cable harness 134. The vertical members 142A, 142B and the distance therebetween are designed to provide a bend radius R in the optical fibers 139 no greater than forty (40) mm and preferably twenty-five (25) mm or less in this embodiment.

FIG. 13 illustrates a front view of the fiber optic module 22 without loaded fiber optic components 23 in the front side 96 to further illustrate the form factor of the fiber optic module 22. As previously discussed, the front opening 126 is disposed through the front side 96 of the main body 90 to receive the fiber optic components 23. The greater the width W_1 of the front opening 126, the greater the number of fiber optic components 23 that may be disposed in the fiber optic module 22. Greater numbers of fiber optic components 23 equates to more fiber optic connections, which supports higher fiber optic connectivity and bandwidth. However, the larger the width W_1 of the front opening 126, the greater the area required to be provided in the chassis 12 for the fiber optic module 22. Thus, in this embodiment, the width W_1 of the front opening 126 is design to be at least eighty-five percent (85%) of the width W_2 of the front side 96 of the main body 90 of the fiber optic module 22. The greater the percentage of the width W_1 to width W_2, the larger the area provided in the front opening 126 to receive fiber optic components 23 without increasing width W_2. Width W_3, the overall width of the fiber optic module 22, may be 86.6 mm or 3.5 inches in this embodiment. The overall depth D_1 of the fiber optic module 22 is 113.9 mm or 4.5 inches in this embodiment (FIG. 12). As previously discussed, the fiber optic module 22 is designed such that four (4) fiber optic modules 22 can be disposed in a 1-U width space in the fiber optic equipment tray 20 in the chassis 12. The width of the chassis 12 is designed to accommodate a 1-U space width in this embodiment.

With three (3) fiber optic equipment trays 20 disposed in the 1-U height of the chassis 12, a total of twelve (12) fiber optic modules 22 can be supported in a given 1-U space. Supporting up to twelve (12) fiber optic connections per fiber optic module 22 as illustrated in the chassis 12 in FIG. 1 equates to the chassis 12 supporting up to one hundred forty-four (144) fiber optic connections, or seventy-two (72) duplex channels, in a 1-U space in the chassis 12 (i.e., twelve (12) fiber optic connections X twelve (12) fiber optic modules 22 in a 1-U space). Thus, the chassis 12 is capable of supporting up to one hundred forty-four (144) fiber optic connections in a 1-U space by twelve (12) simplex or six (6) duplex fiber optic adapters being disposed in the fiber optic modules 22. Supporting up to ten (10) fiber optic connections per fiber optic module 22 equates to the chassis 12 supporting one hundred twenty (120) fiber optic connections, or sixty (60) duplex channels, in a 1-U space in the chassis 12 (i.e., ten (10) fiber optic connections X twelve (12) fiber optic modules 22 in a 1-U space). Thus, the chassis 12 is also capable of supporting up to one hundred twenty (120) fiber optic connections in a 1-U space by ten (10) simplex or five (5) duplex fiber optic adapters being disposed in the fiber optic modules 22.

This embodiment of the chassis 12 and fiber optic module 22 disclosed herein can support a fiber optic connection density within a 1-U space wherein the area occupied by the fiber optic component 23 in twelve (12) fiber optic modules 22 in a 1-U space represents at least fifty percent (50%) of the total fiber optic equipment rack 14 area in a 1-U space (see FIG. 1). In the case of twelve (12) fiber optic modules 22 provided in a 1-U space in the chassis 12, the 1-U space is comprised of the fiber optic components 23 occupying at least seventy-five percent (75%) of the area of the front side 96 of the fiber optic module 22.

Two (2) duplexed optical fibers to provide one (1) transmission/reception pair can allow for a data rate of ten (10) Gigabits per second in half-duplex mode or twenty (20) Gigabits per second in full-duplex mode. Thus, with the above-described embodiment, providing at least seventy-two (72) duplex transmission and reception pairs in a 1-U space employing at least one duplex or simplex fiber optic component can support a data rate of at least seven hundred twenty (720) Gigabits per second in half-duplex mode in a 1-U space or at least one thousand four hundred forty (1440) Gigabits per second in a 1-U space in full-duplex mode if employing a ten (10) Gigabit transceiver. This configuration can also support at least six hundred (600) Gigabits per second in half-duplex mode in a 1-U space and at least one thousand two hundred (1200) Gigabits per second in full-duplex mode in a 1-U space, respectively, if employing a one hundred (100) Gigabit transceiver. This configuration can also support at least four hundred eighty (480) Gigabits per second in half-duplex mode in a 1-U space and nine hundred sixty (960) Gigabits per second in full duplex mode in a 1-U space, respectively, if employing a forty (40) Gigabit transceiver. At least sixty (60) duplex transmission and reception pairs in a 1-U space can allow for a data rate of at least six hundred (600) Gigabits per second in a 1-U space in half-duplex mode or at least one thousand two hundred (1200) Gigabits per second in a 1-U space in full-duplex mode when employing a ten (10) Gigabit transceiver. At least forty nine (49) duplex transmission and reception pairs in a 1-U space can allow for a data rate of at least four hundred eighty-one (481) Gigabits per second in half-duplex mode or at least nine hundred sixty-two (962) Gigabits per second in a 1-U space in full-duplex mode when employing a ten (10) Gigabit transceiver.

The width W_1 of front opening **126** could be designed to be greater than eighty-five percent (85%) of the width W_2 of the front side **96** of the main body **90** of the fiber optic module **22**. For example, the width W_1 could be designed to be between ninety percent (90%) and ninety-nine percent (99%) of the width W_2. As an example, the width W_1 could be less than ninety (90) mm. As another example, the width W_1 could be less than eighty-five (85) mm or less than eighty (80) mm. For example, the width W_1 may be eighty-three (83) mm and width W_2 may be eighty-five (85) mm, for a ratio of width W_1 to width W_2 of 97.6%. In this example, the front opening **126** may support twelve (12) fiber optic connections in the width W_1 to support a fiber optic connection density of at least one fiber optic connection per 7.0 mm of width W_1 of the front opening **126**. Further, the front opening **126** of the fiber optic module **22** may support twelve (12) fiber optic connections in the width W_1 to support a fiber optic connection density of at least one fiber optic connection per 6.9 mm of width W_1 of the front opening **126**.

Further as illustrated in FIG. **13**, height H_1 of front opening **126** could be designed to be at least ninety percent (90%) of height H_2 of the front side **96** of the main body **90** of the fiber optic module **22**. In this manner, the front opening **126** has sufficient height to receive the fiber optic components **23**, and such that three (3) fiber optic modules **22** can be disposed in a 1-U space height. As an example, height H_1 could be twelve (12) mm or less or ten (10) mm or less. As an example, height H_1 could be ten (10) mm and height H_2 could be eleven (11) mm (or 7/16 inches), for a ratio of height H_1 to width H_2 of 90.9%.

Alternate fiber optic modules with alternative fiber optic connection densities are possible. FIG. **14** is a front perspective view of an alternate fiber optic module **22'** that can be installed in the fiber optic equipment tray **20** of FIG. **1**. The form factor of the fiber optic module **22'** is the same as the form factor of the fiber optic module **22** illustrated in FIGS. **1-13**. However, in the fiber optic module **22'** of FIG. **14**, two (2) MPO fiber optic adapters **150** are disposed through the front opening **126** of the fiber optic module **22'**. The MPO fiber optic adapters **150** are connected to two (2) MPO fiber optic adapters **152** disposed in the rear side **98** of the main body **90** of the fiber optic module **22'**. Thus, if the MPO fiber optic adapters **150** each support twelve (12) fibers, the fiber optic module **22'** can support up to twenty-four (24) fiber optic connections. Thus, in this example, if up to twelve (12) fiber optic modules **22'** are provided in the fiber optic equipment trays **20** of the chassis **12**, up to two hundred eighty-eight (288) fiber optic connections can be supported by the chassis **12** in a 1-U space. Further in this example, the front opening **126** of the fiber optic module **22'** may support twenty-four (24) fiber optic connections in the width W_1 (FIG. **13**) to support a fiber optic connection density of at least one fiber optic connection per 3.4-3.5 mm of width W_1 of the front opening **126**. It should be understood that the discussion with regard to modules may also apply to a panel. For purposes of this disclosure, a panel may have one or more adapter on one side and no adapters on the opposite side.

Thus, with the above-described embodiment, providing at least two-hundred eighty-eight (288) duplex transmission and reception pairs in a 1-U space employing at least one twelve (12) fiber MPO fiber optic components can support a data rate of at least two thousand eight hundred eighty (2880) Gigabits per second in half-duplex mode in a 1-U space or at least five thousand seven hundred sixty (5760) Gigabits per second in a 1-U space in full-duplex mode if employing a ten (10) Gigabit transceiver. This configuration can also support at least four thousand eight hundred (4800) Gigabits per second in half-duplex mode in a 1-U space and nine thousand six hundred (9600) Gigabits per second in full-duplex mode in a 1-U space, respectively, if employing a one hundred (100) Gigabit transceiver. This configuration can also support at least one thousand nine hundred twenty (1920) Gigabits per second in half-duplex mode in a 1-U space and three thousand eight hundred forty (3840) Gigabits per second in full-duplex mode in a 1-U space, respectively, if employing a forty (40) Gigabit transceiver. This configuration also supports a data rate of at least four thousand three hundred twenty-two (4322) Gigabits per second in full-duplex mode in a 1-U space when employing a ten (10) Gigabit transceiver employing at least one twelve (12) fiber MPO fiber optic component, or two thousand one hundred sixty-one (2161) Gigabits per second in full-duplex mode in a 1-U space when employing a ten (10) Gigabit transceiver employing at least one twenty-four (24) fiber MPO fiber optic component.

If the MPO fiber optic adapters **150** in the fiber optic module **22'** support twenty-four (24) fibers, the fiber optic module **22'** can support up to forty-eight (48) fiber optic connections. Thus, in this example, if up to twelve (12) fiber optic modules **22'** are provided in the fiber optic equipment trays **20** of the chassis **12**, up to five hundred seventy-six (576) fiber optic connections can be supported by the chassis **12** in a 1-U space if the fiber optic modules **22'** are disposed in the fiber optic equipment trays **20**. Further, in this example, the front opening **126** of the fiber optic module **22'** may support up to forty-eight (48) fiber optic connections in the width W_1 to support a fiber optic connection density of at least one fiber optic connection per 1.7 mm of width W_1 of the front opening **126**.

FIG. **15** is a front perspective view of another alternate fiber optic module **22"** that can be installed in the fiber optic equipment tray **20** of FIG. **1**. The form factor of the fiber optic module **22"** is the same as the form factor of the fiber optic module **22** illustrated in FIGS. **1-13**. However, in the fiber optic module **22"**, four (4) MPO fiber optic adapters **154** are disposed through the front opening **126** of the fiber optic module **22"**. The MPO fiber optic adapters **154** are connected to four (4) MPO fiber optic adapters **156** disposed in the rear end **98** of the main body **90** of the fiber optic module **22'**. Thus, if the MPO fiber optic adapters **150** support twelve (12) fibers, the fiber optic module **22"** can support up to forty-eight (48) fiber optic connections. Thus, in this example, if up to twelve (12) fiber optic modules **22"** are provided in the fiber optic equipment trays 20 of the chassis 12, up to five hundred seventy-six (756) fiber optic connections can be supported by the chassis 12 in a 1-U space. Further in this example, the front opening 126 of the fiber optic module 22" may support twenty-four (24) fiber optic connections in the width W_1 to support a fiber optic connection density of at least one fiber optic connection per 1.7 mm of width W_1 of the front opening 126.

If the four (4) MPO fiber optic adapters 154 disposed in the fiber optic module 22" support twenty-four (24) fibers, the fiber optic module 22" can support up to ninety-six (96) fiber optic connections. Thus, in this example, if up to twelve (12) fiber optic modules 22" are provided in the fiber optic equipment trays 20 of the chassis 12, up to one thousand one hundred fifty-two (1152) fiber optic connections can be supported by the chassis 12 in a 1-U space. Further, in this example, the front opening 126 of the fiber optic module 22" may support up to ninety-six (96) fiber optic connections in the width W_1 to support a fiber optic connection density of at least one fiber optic connection per 0.85 mm of width W_1 of the front opening 126.

Further, with the above-described embodiment, providing at least five hundred seventy-six (576) duplex transmission and reception pairs in a 1-U space employing at least one twenty-four (24) fiber MPO fiber optic component can support a data rate of at least five thousand seven hundred sixty (5760) Gigabits per second in half-duplex mode in a 1-U space or at least eleven thousand five hundred twenty (11520) Gigabits per second in a 1-U space in full-duplex mode if employing a ten (10) Gigabit transceiver. This configuration can also support at least four thousand eight hundred (4800) Gigabits per second in half-duplex mode in a 1-U space and at least nine thousand six hundred (9600) Gigabits per second in full-duplex mode in a 1-U space, respectively, if employing a one hundred (100) Gigabit transceiver. This configuration can also support at least three thousand eight hundred forty (3840) Gigabits per second in half-duplex mode in a 1-U space and at least seven thousand six hundred eighty (7680) Gigabits per second in full-duplex mode in a 1-U space, respectively, if employing a forty (40) Gigabit transceiver. This configuration also supports a data rate of at least eight thousand six hundred forty two (8642) Gigabits per second in full-duplex mode in a 1-U space when employing a ten (10) Gigabit transceiver employing at least one twenty-four (24) fiber MPO fiber optic component, or four thousand three hundred twenty one (4321) Gigabits per second in full-duplex mode in a 1-U space when employing a ten (10) Gigabit transceiver employing at least one twenty-four (24) fiber MPO fiber optic component.

FIG. 16 illustrates an alternate fiber optic module 160 that may be provided in the fiber optic equipment trays 20 to support fiber optic connections and connection densities and bandwidths. FIG. 17 is a right front perspective view of the fiber optic module 160 of FIG. 16. In this embodiment, the fiber optic module 160 is designed to fit across two sets of module rail guides 32. A channel 162 is disposed through a center axis 164 of the fiber optic module 160 to receive a module rail guide 32 in the fiber optic equipment tray 20. Module rails 165A, 165B, similar to the module rails 28A, 28B of the fiber optic module 22 of FIGS. 1-13, are disposed on the inside the channel 162 of the fiber optic module 160 and configured to engage with tray channels 30 in the fiber optic equipment tray 20. Module rails 166A, 166B, similar to the module rails 28A, 28B of the fiber optic module 22 of FIGS. 1-13, are disposed on each side 168, 170 of the fiber optic module 160 that are configured to engage with tray channels 30 in the fiber optic equipment tray 20. The module rails 166A, 166B are configured to engage with tray channels 30 in a module rail guide 32 disposed between module rail guides 32 engaged with the module rail guides 32 disposed on the sides 168, 170 of the fiber optic module 160.

Up to twenty-four (24) fiber optic components 23 can be disposed in a front side 172 of the fiber optic module 160. In this embodiment, the fiber optic components 23 are comprised of up to twelve (12) duplex LC fiber optic adapters, which are connected to one twenty-four (24) fiber MPO fiber optic connector 174 disposed in a rear end 176 of the fiber optic module 160. Thus, with three (3) fiber optic equipment trays 20 disposed in the height of the chassis 12, a total of six (6) fiber optic modules 160 can be supported in a given 1-U space. Supporting up to twenty-four (24) fiber optic connections per fiber optic module 160 equates to the chassis 12 supporting up to one hundred forty-four (144) fiber optic connections, or seventy-two (72) duplex channels, in a 1-U space in the chassis 12 (i.e., twenty-four (24) fiber optic connections X six (6) fiber optic modules 160 in a 1-U space). Thus, the chassis 12 is capable of supporting up to one hundred forty-four (144) fiber optic connections in a 1-U space by twenty-four (24) simplex or twelve (12) duplex fiber optic adapters being disposed in the fiber optic modules 160. Supporting up to twenty (20) fiber optic connections per fiber optic module 160 equates to the chassis 12 supporting one hundred twenty (120) fiber optic connections, or sixty (60) duplex channels, in a 1-U space in the chassis 12 (i.e., twenty (20) fiber optic connections X six (6) fiber optic modules 160 in a 1-U space). Thus, the chassis 12 is also capable of supporting up to one hundred twenty (120) fiber optic connections in a 1-U space by twenty (20) simplex or ten (10) duplex fiber optic adapters being disposed in the fiber optic modules 160.

FIG. 18 illustrates a front view of the fiber optic module 160 of FIGS. 16-17 without loaded fiber optic components 23 in the front side 172 to further illustrate the form factor of the fiber optic module 160 in this embodiment. Front openings 178A, 178B disposed on each side of the channel 162 are disposed through the front side 172 of a main body 180 of the fiber optic module 160 to receive the fiber optic components 23. The widths W_1 and W_2 and the heights H_1 and H_2 are the same as in the fiber optic module 22 illustrated in FIG. 13. Thus, in this embodiment, the widths W_1 of front openings 178A, 178B are designed to be at least eighty-five percent (85%) of the width W_2 of the front side 172 of the main body 180 of the fiber optic module 160. The greater the percentage of the width W_1 to width W_2, the larger the area provided in the front openings 178A, 178B to receive fiber optic components 23 without increasing width W_2.

The width W_1 of the front openings 178A, 178B could each be designed to be greater than eighty-five percent (85%) of the width W_2 of the front side 172 of the main body 180 of the fiber optic module 160. For example, the width W_1 could be designed to be between ninety percent (90%) and ninety-nine percent (99%) of the width W_2. As an example, the width W_1 could be less than ninety (90) mm. As another example, the width W_1 could be less than eighty-five (85) mm or less than eighty (80) mm. For example, width W_1 may be eighty-three (83) mm and width W_2 may be eighty-five (85) mm, for a ratio of width W_1 to width W_2 of 97.6%. In this example, the front openings 178A, 178B may support twelve (12) fiber optic connections in the widths W_1 to support a fiber optic connection density of at least one fiber optic connection per 7.0 mm of width W_1 of the front openings 178A, 178B. Further, each of the front openings 178A, 178B may support twelve (12) fiber optic connections in the widths W_1 to support a fiber optic connection density of at least one fiber optic connection per 6.9 mm of width W_1 of the front openings 178A, 178B.

Further as illustrated in FIG. 18, the height H_1 of front openings 178A, 178B could be designed to be at least ninety percent (90%) of the height H_2 of the front side 172 of the main body 180 of the fiber optic module 160. In this manner, the front openings 178A, 178B have sufficient height to receive the fiber optic components 23, while three (3) fiber optic modules 160 can be disposed in the height of a 1-U space. As an example, the height H_1 could be twelve (12) mm or less or ten (10) mm or less. As an example, the height H_1 could be ten (10) mm and height H_2 could be eleven (11) mm, for a ratio of height H_1 to height H_2 of 90.9%.

FIG. 19 illustrates another alternate fiber optic module 190 that may be provided in the fiber optic equipment trays 20 to support fiber optic connections and connection densities and bandwidths. FIG. 20 is a right front perspective view of the fiber optic module 190 of FIG. 19. In this embodiment, the fiber optic module 190 is designed to fit across two sets of module rail guides 32. A longitudinal receiver 192 is disposed through a center axis 194 and is configured to receive a module rail guide 32 in the fiber optic equipment tray 20 through an opening 193 in the receiver 192. Module rails 195A, 195B, similar to the module rails 28A, 28B of the fiber optic module 22 of FIGS. 1-13, are disposed on each side 198, 200 of the fiber optic module 190 that are configured to engage with tray channels 30 in the fiber optic equipment tray 20.

Up to twenty-four (24) fiber optic components 23 can be disposed in a front side 202 of the fiber optic module 190. In this embodiment, the fiber optic components 23 are comprised of up to twelve (12) duplex LC fiber optic adapters, which are connected to one twenty-four (24) fiber MPO fiber optic connector 204 disposed in a rear end 206 of the fiber optic module 190. Thus, with three (3) fiber optic equipment trays 20 disposed in the height of the chassis 12, a total of six (6) fiber optic modules 190 can be supported in a given 1-U space. Supporting up to twenty-four (24) fiber optic connections per fiber optic module 190 equates to the chassis 12 supporting up to one hundred forty-four (144) fiber optic connections, or seventy-two (72) duplex channels, in a 1-U space in the chassis 12 (i.e., twenty-four (24) fiber optic connections X six (6) fiber optic modules 190 in a 1-U space). Thus, the chassis 12 is capable of supporting up to one hundred forty-four (144) fiber optic connections in a 1-U space by twenty (24) simplex or twelve (12) duplex fiber optic adapters being disposed in the fiber optic modules 190. Supporting up to twenty-four (20) fiber optic connections per fiber optic module 190 equates to the chassis 12 supporting one hundred twenty (120) fiber optic connections, or sixty (60) duplex channels, in a 1-U space in the chassis 12 (i.e., twenty (20) fiber optic connections X six (6) fiber optic modules 190 in a 1-U space). Thus, the chassis 12 is also capable of supporting up to one hundred twenty (120) fiber optic connections in a 1-U space by twenty (20) simplex or ten (10) duplex fiber optic adapters being disposed in the fiber optic modules 190.

FIG. 21 illustrates a front view of the fiber optic module 190 of FIGS. 19-20 without loaded fiber optic components 23 in the front side 202 to further illustrate the form factor of the fiber optic module 190. Front openings 208A, 208B are disposed on each side of the receiver 192 and through the front side 202 of a main body 210 of the fiber optic module 190 to receive the fiber optic components 23. The widths W_1 and W_2 and the heights H_1 and H_2 are the same as in the fiber optic module 22 as illustrated in FIG. 13. Thus, in this embodiment, the width W_1 of front openings 208A, 208B is designed to be at least eighty-five percent (85%) of the width W_2 of the front side 202 of the main body 210 of the fiber optic module 190. The greater the percentage of the width W_1 to width W_2, the larger the area provided in the front openings 208A, 208B to receive fiber optic components 23 without increasing the width W_2.

The width W_1 of front openings 208A, 208B could each be designed to be greater than eighty-five percent (85%) of the width W_2 of the front side 202 of the main body 210 of the fiber optic module 190. For example, the width W_1 could be designed to be between ninety percent (90%) and ninety-nine percent (99%) of the width W_2. As an example, the width W_1 could be less than ninety (90) mm. As another example, the width W_1 could be less than eighty-five (85) mm or less than eighty (80) mm. For example, width W_1 may be eighty-three (83) mm and width W_2 may be eighty-five (85) mm, for a ratio of width W_1 to width W_2 of 97.6%. In this example, the front openings 208A, 208B may support twelve (12) fiber optic connections in the widths W_1 to support fiber optic connection density of at least one fiber optic connection per 7.0 mm of width W_1 of the front openings 208A, 208B. Further, each of the front openings 208A, 208B may support twelve (12) fiber optic connections in the widths W_1 to support a fiber optic connection density of at least one fiber optic connection per 6.9 mm of width W_1 of the front openings 208A, 208B.

Further as illustrated in FIG. 21, the height H_1 of front openings 208A, 208B could be designed to be at least ninety percent (90%) of the height H_2 of the front side 202 of the main body 210 of the fiber optic module 190. In this manner, the front openings 208A, 208B have sufficient height to receive the fiber optic components 23, while three (3) fiber optic modules 190 can be disposed in the height of a 1-U space. As an example, the height H_1 could be twelve (12) mm or less or ten (10) mm or less. As an example, the height H_1 could be ten (10) mm and the height H_2 could be eleven (11) mm, for a ratio of height H_1 to height H_2 of 90.9%.

FIG. 22 illustrates another alternate fiber optic module 220 that may be provided in a fiber optic equipment tray 20' to support a higher number of fiber optic connections and connection densities and bandwidths in a 1-U space. The fiber optic equipment tray 20' in this embodiment is similar to the fiber optic equipment tray 20 previously discussed above; however, the fiber optic equipment tray 20' only contains three (3) module rail guides 32 instead of five (5) module rail guides 32. Thus, the fiber optic equipment tray 20' only supports two fiber optic modules 220 across a 1-U width space. Thus, the fiber optic module 220 does not have to provide the channel 162 or receiver 192 of the fiber optic modules 160, 190, respectively, to be disposed within the fiber optic equipment tray 20'. FIG. 23 is a right front perspective view of the fiber optic module 220 of FIG. 22. The fiber optic module 220 is designed to fit across one set of module rail guides 32 in the fiber optic equipment tray 20'. Module rails 225A, 225B, similar to the module rails 28A, 28B of the fiber optic module 22 of FIGS. 1-13, are disposed on each side 228, 230 of the fiber optic module 220 that are configured to engage with tray channels 30 in the fiber optic equipment tray 20', as illustrated in FIG. 22.

Up to twenty-four (24) fiber optic components 23 can be disposed in a front side 232 of the fiber optic module 220. In this embodiment, the fiber optic components 23 are comprised of up to twelve (12) duplex LC fiber optic adapters, which are connected to one twenty-four (24) fiber MPO fiber optic connector 234 disposed in a rear end 236 of the fiber optic module 220. Thus, with three (3) fiber optic equipment trays 20' disposed in the height of the chassis 12, a total of six (6) fiber optic modules 220 can be supported in a given 1-U space. Supporting up to twenty-four (24) fiber optic connections per fiber optic module 220 equates to the chassis 12 supporting up to one hundred forty-four (144) fiber optic connections, or seventy-two (72) duplex channels, in a 1-U space in the chassis 12 (i.e., twenty-four (24) fiber optic connections X six (6) fiber optic modules 220 in a 1-U space). Thus, the chassis 12 is capable of supporting up to one hundred forty-four (144) fiber optic connections in a 1-U space by twenty (24) simplex or twelve (12) duplex fiber optic adapters being disposed in the fiber optic modules 220. Supporting up to twenty (20) fiber optic connections per fiber optic module 220 equates to the chassis 12 supporting one hundred twenty (120) fiber optic connections, or sixty (60) duplex channels, in a 1-U space in the chassis 12 (i.e., twenty (20) fiber optic connections X six (6) fiber optic modules 220 in a 1-U space). Thus, the chassis 12 is also capable of supporting up to one hundred twenty (120) fiber optic connections in a 1-U space by twenty (20) simplex or ten (10) duplex fiber optic adapters being disposed in the fiber optic modules 220.

FIG. 24 illustrates a front view of the fiber optic module 220 of FIGS. 22-23 without loaded fiber optic components 23 in the front side 232 to further illustrate the form factor of the fiber optic module 220 in this embodiment. A front opening 238 is through the front side 232 of a main body 240 of the fiber optic module 220 to receive the fiber optic components 23. Width W_4 of the front opening 238 is twice the width W_1 of the front opening 98 in the fiber optic module 22 illustrated in FIG. 13. Width W_5 of the front side 232 is one hundred eighty-eight (188) mm, the width W_2 of the front side 96 in the fiber optic module 22 illustrated in FIG. 13. The heights H_1 and H_2 are the same as in the fiber optic module 22 illustrated in FIG. 13. Thus, in this embodiment, the width W_4 of the front opening 238 is designed to be at least eighty-five percent (85%) of the width W_5 of the front side 232 of the main body 240 of the fiber optic module 220. The greater the percentage of the width W_4 to the width W_5, the larger the area provided in the front opening 238 to receive fiber optic components 23 without increasing the width W_4.

Width W_4 of the front opening 238 could be designed to be greater than eighty-five percent (85%) of the width W_5 of the front side 232 of the main body 240 of the fiber optic module 220. For example, the width W_4 could be designed to be between ninety percent (90%) and ninety-nine percent (99%) of the width of W_5. As an example, the width W_4 could be less than one hundred eighty (180) mm. As another example, the width W_4 could be less than one hundred seventy (170) mm or less than one hundred sixty (160) mm. For example, width W_4 may be one hundred sixty-six (166) mm and width W_5 may be 171 mm, for a ratio of width W_4 to width W_5 of 166/171 97%. In this example, the front opening 238 may support twenty-four (24) fiber optic connections in the width W_4 to support a fiber optic connection density of at least one fiber optic connection per 7.0 mm of width W_4 of the front opening 238. Further, the front opening 238 may support twenty-four (24) fiber optic connections in the width W_4 to support a fiber optic connection density of at least one fiber optic connection per 6.9 mm of width W_4 of the front opening 238.

Further, as illustrated in FIG. 24, the height H_1 of the front opening 238 could be designed to be at least ninety percent (90%) of the height H_2 of the front side 232 of the main body 240 of the fiber optic module 220. In this manner, the front opening 238 has sufficient height to receive the fiber optic

components 23, while three (3) fiber optic modules 220 can be disposed in the height of a 1-U space. As an example, the height H_1 could be twelve (12) mm or less or ten (10) mm or less. As an example, the height H_1 could be ten (10) mm and height H_2 could be eleven (11) mm, for a ratio of height H_1 to height H_2 of 90.9%.

FIG. 25 illustrates another embodiment of fiber optic equipment 260 that can include fiber optic equipment trays previously described above and illustrated to support fiber optic modules. The fiber optic equipment 260 in this embodiment includes a 4-U sized chassis 262 configured to hold fiber optic equipment trays each supporting one or more fiber optic modules. The supported fiber optic equipment trays may be any of the fiber optic equipment trays 20, 20' previously described above and thus will not be described again here. The supported fiber optic modules may be any of the fiber optic modules 22, 22', 22", 160, 190, 220 previously described above and thus will not be described again here. In this example, the chassis 262 is illustrated as supporting twelve (12) fiber optic equipment trays 20 each capable of supporting fiber optic modules 22.

The tray guides 58 previously described are used in the chassis 262 to support tray rails 56 of the fiber optic equipment trays 20 therein and to allow each fiber optic equipment tray 20 to be independently extended out from and retracted back into the chassis 262. A front door 264 is attached to the chassis 262 and is configured to close about the chassis 262 to secure the fiber optic equipment trays 20 contained in the chassis 262. A cover 266 is also attached to the chassis 262 to secure the fiber optic equipment trays 20. However, in the chassis 262, up to twelve (12) fiber optic equipment trays 20 can be provided. However, the fiber optic connection densities and connection bandwidths are still the same per 1-U space. The fiber optic connection densities and connection bandwidth capabilities have been previously described and equally applicable for the chassis 262 of FIG. 25, and thus will not be described again here.

Thus, in summary, the table below summarizes some of the fiber optic connection densities and bandwidths that are possible to be provided in a 1-U and 4-U space employing the various embodiments of fiber optic modules, fiber optic equipment trays, and chassis described above. For example, two (2) optical fibers duplexed for one (1) transmission/reception pair can allow for a data rate of ten (10) Gigabits per second in half-duplex mode or twenty (20) Gigabits per second in full-duplex mode. As another example, eight (8) optical fibers in a twelve (12) fiber MPO fiber optic connector duplexed for four (4) transmission/reception pairs can allow for a data rate of forty (40) Gigabits per second in half-duplex mode or eighty (80) Gigabits per second in full-duplex mode. As another example, twenty optical fibers in a twenty-four (24) fiber MPO fiber optic connector duplexed for ten (10) transmission/reception pairs can allow for a data rate of one hundred (100) Gigabits per second in half-duplex mode or two hundred (200) Gigabits per second in full-duplex mode. Note that this table is exemplary and the embodiments disclosed herein are not limited to the fiber optic connection densities and bandwidths provided below.

Connector Type	Max Fibers per 1RU	Max Fibers per 4RU	Number of Connectors per 1 RU Space	Number of Connectors per 4 RU Space	Bandwidth per 1U using 10 Gigabit Transceivers (duplex)	Bandwidth per 1U using 40 Gigabit Transceivers (duplex)	Bandwidth per 1U using 100 Gigabit Transceivers (duplex)
Duplexed LC	144	576	72	288	1,440 Gigabits/s.	960 Gigabits/s.	1,200 Gigabits/s.
12-F MPO	576	2,304	48	192	5,760 Gigabits/s.	3,840 Gigabits/s.	4,800 Gigabits/s.
24-F MPO	1,152	4,608	48	192	11,520 Gigabits/s.	7,680 Gigabits/s.	9,600 Gigabits/s.

Many modifications and other embodiments of the invention set forth herein will come to mind to one skilled in the art to which the invention pertains having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. These modifications include, but are not limited to, number or type of fiber optic equipment, fiber optic module, fiber optic equipment tray, features included in the fiber optic equipment tray. Any size equipment, including but not limited to 1-U, 2-U and 4-U sizes may include some or all of the aforementioned features and fiber optic modules disclosed herein and some or all of their features. Further, the modifications are not limited to the type of fiber optic equipment tray or the means or device to support fiber optic modules installed in the fiber optic equipment trays. The fiber optic modules can include any fiber optic connection type, including but not limited to fiber optic connectors and adapters, and number of fiber optic connections, density, etc.

Further, as used herein, the terms "fiber optic cables" and/or "optical fibers" include all types of single mode and multi-mode light waveguides, including one or more optical fibers that may be upcoated, colored, buffered, ribbonized and/or have other organizing or protective structure in a cable such as one or more tubes, strength members, jackets or the like. Likewise, other types of suitable optical fibers include bend-insensitive optical fibers, or any other expedient of a medium for transmitting light signals. An example of a bend-insensitive optical fiber is ClearCurve® Multimode fiber commercially available from Corning Incorporated.

Therefore, it is to be understood that the embodiments are not to be limited to the specific embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of the appended claims. It is intended that the embodiments cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.

What is claimed is:

1. A fiber optic apparatus, comprising:

a chassis; and

a fiber optic connection equipment provided in the chassis;

the fiber optic connection equipment configured to support a fiber optic connection density of at least ninety-eight (98) fiber optic connections per U space, based on using at least one simplex fiber optic component or at least one duplex fiber optic component.

2. The fiber optic apparatus of claim 1, wherein the fiber optic connection equipment is configured to support a fiber optic connection density of at least one hundred twenty (120) fiber optic connections per U space.

3. The fiber optic apparatus of claim 1, wherein the fiber optic connection equipment is configured to support a fiber optic connection density of at least one hundred forty-four (144) fiber optic connections per U space.

4. The fiber optic apparatus of claim 1, wherein the at least one simplex fiber optic component is comprised of at least ninety-eight (98) simplex fiber optic components.

5. The fiber optic apparatus of claim 1, wherein the at least one simplex fiber optic component is comprised of at least one hundred twenty (120) simplex fiber optic components.

6. The fiber optic apparatus of claim 1, wherein the at least one simplex fiber optic component is comprised of at least one hundred forty-four (144) simplex fiber optic components.

7. The fiber optic apparatus of claim 1, wherein the at least one duplex fiber optic component is comprised of at least forty-nine (49) duplex fiber optic components.

8. The fiber optic apparatus of claim 1, wherein the at least one duplex fiber optic component is comprised of at least sixty (60) duplex fiber optic components.

9. The fiber optic apparatus of claim 1, wherein the at least one duplex fiber optic component is comprised of at least seventy-two (72) duplex fiber optic components.

10. The fiber optic apparatus of claim 1, wherein the at least one simplex fiber optic component or at least one duplex fiber optic component is comprised of: at least one simplex fiber optic connector or at least one duplex fiber optic connector, or at least one simplex fiber optic adapter or at least one duplex fiber optic adapter.

11. The fiber optic apparatus of claim 1, wherein the at least one simplex fiber optic component or at least one duplex fiber optic component is disposed in at least one fiber optic module.

12. The fiber optic apparatus of claim 1, wherein the fiber optic connection equipment is further configured to support the fiber optic connection density in a fiber optic equipment drawer disposed in the fiber optic connection equipment.

13. A fiber optic apparatus, comprising:

a chassis; and

a fiber optic connection equipment provided in the chassis;

the fiber optic connection equipment supporting a full-duplex connection bandwidth of at least nine hundred sixty-two (962) Gigabits per second per U space using at least one simplex fiber optic component or at least one duplex fiber optic component.

14. The fiber optic apparatus of claim 13, wherein the at least one simplex fiber optic component is comprised of at least ninety-eight (98) simplex fiber optic components.

15. The fiber optic apparatus of claim 13, wherein the at least one duplex fiber optic component is comprised of at least forty-nine (49) duplex fiber optic components.

16. The fiber optic apparatus of claim 13, the fiber optic connection equipment supporting a full-duplex connection bandwidth of at least one thousand two hundred (1200) Gigabits per second per U space.

17. The fiber optic apparatus of claim 16, wherein the at least one simplex fiber optic component is comprised of at least one hundred twenty (120) simplex fiber optic components.

18. The fiber optic apparatus of claim 16, wherein the at least one duplex fiber optic component is comprised of at least sixty (60) duplex fiber optic components.

19. The fiber optic apparatus of claim **13**, wherein the fiber optic connection equipment is configured to support a full-duplex connection bandwidth of at least one thousand four hundred forty (1440) Gigabits per second per U space.

20. The fiber optic apparatus of claim **19**, wherein the at least one simplex fiber optic component is comprised of at least one hundred forty-four (144) simplex fiber optic components.

21. The fiber optic apparatus of claim **19**, wherein the at least one duplex fiber optic component is comprised of at least seventy-two (72) duplex fiber optic components.

22. The fiber optic apparatus of claim **13**, wherein the at least one simplex fiber optic component or at least one duplex fiber optic component is comprised of: at least one simplex fiber optic connector or at least one duplex fiber optic connector, or at least one simplex fiber optic adapter or at least one duplex fiber optic adapter.

23. The fiber optic apparatus of claim **13**, wherein the at least one simplex fiber optic component or at least one duplex fiber optic component is disposed in at least one fiber optic module.

24. The fiber optic apparatus of claim **13**, wherein the fiber optic connection equipment is configured to support the full-duplex connection bandwidth in a fiber optic equipment drawer disposed in the fiber optic connection equipment.

25. A method of supporting a fiber optic connection density comprising supporting a fiber optic connection density of at least ninety-eight (98) fiber optic connections per U space using at least one simplex fiber optic component or at least one duplex fiber optic component.

26. The method of claim **25**, wherein supporting the fiber optic connection density comprises supporting a fiber optic connection density of at least one hundred forty-four (144) fiber optic connections per U space using at least one simplex fiber optic component or at least one duplex fiber optic component.

27. A method of supporting a fiber optic bandwidth comprising supporting a full-duplex connection bandwidth of at least nine hundred sixty-two (962) Gigabits per second per U space using at least one simplex fiber optic component or at least one duplex fiber optic component.

28. The method of claim **27**, wherein supporting the full-duplex connection bandwidth comprises providing a bandwidth of at least one thousand four hundred forty (1440) Gigabits per second per U space using at least one simplex fiber optic component or at least one duplex fiber optic component.

* * * * *

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United States Patent
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(10) Number: US 9,020,320 K1
(45) Certificate Issued: Dec. 30, 2019

(54) **HIGH DENSITY AND BANDWIDTH FIBER OPTIC APPARATUSES AND RELATED EQUIPMENT AND METHODS**

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INTER PARTES REVIEW CERTIFICATE
U.S. Patent 9,020,320 K1
Trial No. IPR2017-00009
Certificate Issued Dec. 30, 2019

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AS A RESULT OF THE INTER PARTES REVIEW PROCEEDING, IT HAS BEEN DETERMINED THAT:

Claims **1-28** are found patentable.

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February 19, 2020

THIS IS TO CERTIFY THAT ANNEXED HERETO IS A TRUE COPY FROM THE RECORDS OF THIS OFFICE OF:

U.S. PATENT: *8,712,206*
ISSUE DATE: *April 29, 2014*

By Authority of the
Under Secretary of Commerce for Intellectual Property
and Director of the United States Patent and Trademark Office

John A Burson

JOHN A BURSON
Certifying Officer

US008712206B2

(12) **United States Patent**
Cooke et al.

(10) **Patent No.: US 8,712,206 B2**
(45) **Date of Patent: Apr. 29, 2014**

(54) **HIGH-DENSITY FIBER OPTIC MODULES AND MODULE HOUSINGS AND RELATED EQUIPMENT**

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G02B 6/00 (2006.01)

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USPC **385/135**; 385/134

(58) **Field of Classification Search**
USPC 385/134, 135
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

620,013	A	2/1899	Barnes
2,614,685	A	10/1952	Miller
3,175,873	A	3/1965	Blomquist et al.
3,212,192	A	10/1965	Bachmann et al.
3,433,886	A	3/1969	Myers
3,568,263	A	3/1971	Meehan

(Continued)

FOREIGN PATENT DOCUMENTS

CA	2029592	A1	5/1992
CA	2186314	A1	4/1997

(Continued)

OTHER PUBLICATIONS

Non-Final Office Action for U.S. Appl. No. 12/953,039 mailed Jan. 11, 2013, 6 pages.

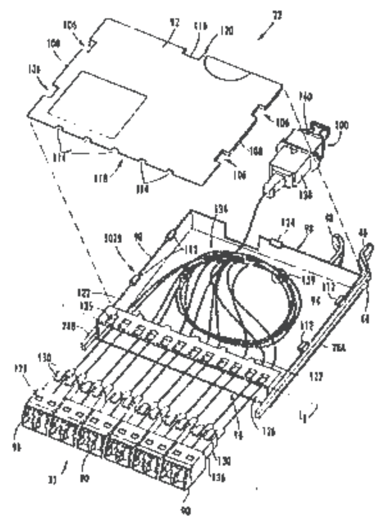
(Continued)

Primary Examiner — Sarah Hahm

(57) **ABSTRACT**

High-density fiber optic modules and fiber optic module housings and related equipment are disclosed. In certain embodiments, a front opening of a fiber optic module and/or fiber optic module housing is configured to receive fiber optic components. The width and/or height of the front opening can be provided according to a designed relationship to a width and/or height, respectively, of a front side of a main body of the fiber optic module and/or fiber optic module housing. In this manner, a high density of fiber optic components and/or connections for a given space of the front side of the fiber optic module can be supported by the fiber optic module and/or fiber optic module housing. The fiber optic modules and fiber optic module housings disclosed herein can be disposed in fiber optic equipment including but not limited to a fiber optic chassis and a fiber optic equipment drawer.

73 Claims, 26 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

3,646,244	A	2/1972	Cole
3,880,396	A	4/1975	Freiberger et al
3,906,592	A	9/1975	Sakasegawa et al.
3,991,960	A	11/1976	Tanaka
4,047,797	A	9/1977	Arnold et al.
4,059,872	A	11/1977	Delesandri
4,119,285	A	10/1978	Bisping et al
4,239,316	A	12/1980	Spaulding
4,285,486	A	8/1981	Von Osten et al
4,354,731	A	10/1982	Mouissie
4,457,482	A	7/1984	Kitagawa
4,525,012	A	6/1985	Dunner
4,540,222	A	9/1985	Burrell
4,564,163	A	1/1986	Barnett
4,597,173	A	7/1986	Chino et al.
4,611,875	A	9/1986	Clarke et al.
4,635,886	A	1/1987	Santucci et al.
4,645,292	A	2/1987	Sammueller
4,657,340	A	4/1987	Tanaka et al.
4,681,288	A	7/1987	Nakamura
4,702,551	A	10/1987	Coulombe
4,736,100	A	4/1988	Vastagh
4,744,629	A	5/1988	Bertoglio et al.
4,747,020	A	5/1988	Brickley et al.
4,752,110	A	6/1988	Blanchet et al.
4,787,706	A	11/1988	Cannon, Jr. et al
4,792,203	A	12/1988	Nelson et al.
4,798,432	A	1/1989	Becker et al.
4,808,774	A	2/1989	Crane
4,824,193	A	4/1989	Maeda et al.
4,824,196	A	4/1989	Bylander
4,826,277	A	5/1989	Weber et al.
4,838,643	A	6/1989	Hodges et al.
4,840,449	A	6/1989	Ghandeharizadeh
4,865,280	A	9/1989	Wollar
4,898,448	A	2/1990	Cooper
4,900,123	A	2/1990	Barlow et al.
4,911,662	A	3/1990	Debortoli et al.
4,948,220	A	8/1990	Violo et al.
4,949,376	A	8/1990	Nieves et al.
4,971,421	A	11/1990	Ori
4,991,928	A	2/1991	Zimmer
4,995,688	A	2/1991	Anton et al.
5,001,602	A	3/1991	Suffi et al.
5,005,941	A	4/1991	Barlow et al.
5,017,211	A	5/1991	Wenger et al.
5,023,646	A	6/1991	Ishida et al.
5,024,498	A	6/1991	Becker et al.
5,028,114	A	7/1991	Krausse et al.
5,037,175	A	8/1991	Weber
5,048,918	A	9/1991	Daems et al.
5,066,149	A	11/1991	Wheeler et al.
5,067,784	A	11/1991	Debortoli et al.
5,071,211	A	12/1991	Debortoli et al
5,071,220	A	12/1991	Ruello et al.
5,073,042	A	12/1991	Mulholland et al.
5,074,635	A	12/1991	Justice et al.
5,076,688	A	12/1991	Bowen et al.
5,080,459	A	1/1992	Wettengel et al.
5,100,221	A	3/1992	Carney et al.
5,104,336	A	4/1992	Hatanaka et al.
5,125,060	A	6/1992	Edmundson
5,127,082	A	6/1992	Below et al.
5,127,851	A	7/1992	Hilbert et al.
5,129,030	A	7/1992	Petrunia
5,129,607	A	7/1992	Satoh
5,133,039	A	7/1992	Dixit
5,138,678	A	8/1992	Briggs et al.
5,138,688	A	8/1992	Debortoli
5,142,598	A	8/1992	Tabone
5,142,607	A	8/1992	Petrotta et al.
5,150,277	A	9/1992	Bainbridge et al.
D330,368	S	10/1992	Bourgeois et al.
5,152,760	A	10/1992	Latina
5,153,910	A	10/1992	Mickelson et al.
5,157,749	A	10/1992	Briggs et al.
5,167,001	A	11/1992	Debortoli et al.
5,170,452	A	12/1992	Ott
5,189,723	A	2/1993	Johnson et al.
5,199,099	A	3/1993	Dalgoutte
5,204,929	A	4/1993	Machall et al.
5,209,572	A	5/1993	Jordan
5,214,735	A	5/1993	Henneberger et al.
5,224,186	A	6/1993	Kishimoto et al.
5,231,687	A	7/1993	Handley
5,231,688	A	7/1993	Zimmer
5,233,674	A	8/1993	Vladic
5,239,609	A	8/1993	Auteri
5,243,679	A	9/1993	Sharrow et al.
5,253,320	A	10/1993	Takahashi et al.
5,260,957	A	11/1993	Hakimi et al.
5,261,633	A	11/1993	Mastro
5,265,187	A	11/1993	Morin et al.
5,274,731	A	12/1993	White
5,280,138	A	1/1994	Preston et al.
5,285,515	A	2/1994	Milanowski et al.
5,315,679	A	5/1994	Baldwin et al.
5,317,663	A	5/1994	Beard et al.
5,323,478	A	6/1994	Milanowski et al.
5,323,480	A	6/1994	Mullaney et al.
5,333,193	A	7/1994	Cote et al.
5,333,221	A	7/1994	Briggs et al.
5,333,222	A	7/1994	Belenkiy et al.
5,337,400	A	8/1994	Morin et al.
5,339,379	A	8/1994	Kutsch et al.
5,347,603	A	9/1994	Belenkiy et al.
5,353,367	A	10/1994	Czosnowski et al.
5,359,688	A	10/1994	Underwood
5,363,466	A	11/1994	Milanowski et al.
5,363,467	A	11/1994	Keith
5,366,388	A	11/1994	Freeman et al.
5,367,598	A	11/1994	Devenish, III et al.
5,373,421	A	12/1994	Detsikas et al.
5,383,051	A	1/1995	Delrosso et al.
5,390,272	A	2/1995	Repta et al.
5,398,295	A	3/1995	Chang et al.
5,398,820	A	3/1995	Kiss
5,399,814	A	3/1995	Staber et al.
5,401,193	A	3/1995	Lo Cicero et al.
5,402,515	A	3/1995	Vidacovich et al.
5,408,557	A	4/1995	Hsu
RE34,955	E	5/1995	Anton et al.
5,412,751	A	5/1995	Siemon et al.
5,416,837	A	5/1995	Cote et al.
5,418,874	A	5/1995	Carlisle et al.
5,420,956	A	5/1995	Grugel et al.
5,420,958	A	5/1995	Henson et al.
5,421,532	A	6/1995	Richter
5,438,641	A	8/1995	Malacarne
5,442,725	A	8/1995	Peng
5,442,726	A	8/1995	Howard et al.
5,443,232	A	8/1995	Kesinger et al.
5,444,804	A	8/1995	Yui et al.
5,448,015	A	9/1995	Jamet et al.
5,450,518	A	9/1995	Burek et al.
5,458,019	A	10/1995	Trevino
5,471,555	A	11/1995	Braga et al.
5,479,505	A	12/1995	Butler et al.
5,481,634	A	1/1996	Anderson et al.
5,481,939	A	1/1996	Bernardini
5,490,229	A	2/1996	Ghandeharizadeh et al.
5,497,416	A	3/1996	Butler, III et al.
5,497,444	A	3/1996	Wheeler
5,511,144	A	4/1996	Hawkins et al.
5,511,798	A	4/1996	Kawamoto et al.
5,519,804	A	5/1996	Burek et al.
5,530,786	A	6/1996	Radliff et al.
5,535,970	A	7/1996	Gobbi
5,542,015	A	7/1996	Hultermans
5,546,495	A	8/1996	Bruckner et al.
5,548,641	A	8/1996	Butler et al.
5,553,183	A	9/1996	Bechamps
5,553,186	A	9/1996	Allen
5,572,617	A	11/1996	Bernhardt et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,575,680 A 11/1996 Suffi
5,577,151 A 11/1996 Hoffer
5,590,234 A 12/1996 Pulido
5,595,507 A 1/1997 Braun et al.
5,596,670 A 1/1997 Debortoli et al.
5,600,020 A 2/1997 Wehle et al.
5,602,954 A 2/1997 Nolf et al.
5,608,606 A 3/1997 Blaney
5,613,030 A 3/1997 Hoffer et al.
5,617,501 A 4/1997 Miller et al.
5,638,474 A 6/1997 Lampert et al.
5,640,476 A 6/1997 Womack et al.
5,640,482 A 6/1997 Barry et al.
5,647,043 A 7/1997 Anderson et al.
5,647,045 A 7/1997 Robinson et al.
5,650,334 A 7/1997 Zuk et al.
5,668,911 A 9/1997 Debortoli
5,671,273 A 9/1997 Lanquist
5,689,605 A 11/1997 Cobb et al.
5,689,607 A 11/1997 Vincent et al.
5,694,511 A 12/1997 Pimpinella et al.
5,701,380 A 12/1997 Larson et al.
5,704,573 A 1/1998 de Beers et al.
5,708,742 A 1/1998 Beun et al.
5,708,751 A 1/1998 Mattei
5,710,851 A 1/1998 Walter et al.
5,717,810 A 2/1998 Wheeler
5,734,776 A 3/1998 Puetz
5,740,300 A 4/1998 Hodge
5,742,982 A 4/1998 Dodd et al.
5,751,874 A 5/1998 Chudoba et al.
5,751,882 A 5/1998 Daems et al.
5,758,003 A 5/1998 Wheeler et al.
5,758,004 A 5/1998 Alarcon et al.
5,761,026 A 6/1998 Robinson et al.
5,769,908 A 6/1998 Koppelman
5,774,612 A 6/1998 Belenkiy et al.
5,778,122 A 7/1998 Giebel et al.
5,778,130 A 7/1998 Walters et al.
5,781,686 A 7/1998 Robinson et al.
5,790,741 A 8/1998 Vincent et al.
5,793,920 A 8/1998 Wilkins et al.
5,793,921 A 8/1998 Wilkins et al.
5,796,908 A 8/1998 Vicory
5,823,646 A 10/1998 Arizpe et al.
5,825,955 A 10/1998 Ernst et al.
5,825,961 A 10/1998 Wilkins et al.
5,828,807 A 10/1998 Tucker et al.
5,832,162 A 11/1998 Sarbell
5,835,657 A 11/1998 Suarez et al.
5,835,658 A 11/1998 Smith
5,862,290 A 1/1999 Burek et al.
5,870,519 A 2/1999 Jenkins et al.
5,874,733 A 2/1999 Silver et al.
5,877,565 A 3/1999 Hollenbach et al.
5,880,864 A 3/1999 Williams et al.
5,881,200 A 3/1999 Burt
5,883,995 A 3/1999 Lu
5,884,003 A 3/1999 Cloud et al.
5,887,095 A 3/1999 Nagase et al.
5,887,106 A 3/1999 Cheeseman et al.
5,892,877 A 4/1999 Meyerhoefer
5,894,540 A 4/1999 Drewing
5,901,220 A 5/1999 Garver et al.
5,903,693 A 5/1999 Brown
5,906,342 A 5/1999 Kraus
5,909,298 A 6/1999 Shimada et al.
5,913,006 A 6/1999 Summach
5,914,976 A 6/1999 Jayaraman et al.
5,915,055 A 6/1999 Bennett et al.
5,923,804 A 7/1999 Rosson
5,930,425 A 7/1999 Abel et al.
5,933,557 A 8/1999 Ott
5,943,460 A 8/1999 Mead et al.
5,945,633 A 8/1999 Ott et al.
5,946,440 A 8/1999 Puetz
5,949,946 A 9/1999 Debortoli et al.
5,953,962 A 9/1999 Hewson
5,956,439 A 9/1999 Pimpinella
5,956,444 A 9/1999 Duda et al.
5,956,449 A 9/1999 Otani et al.
5,966,492 A 10/1999 Bechamps et al.
5,969,294 A 10/1999 Eberle et al.
5,975,769 A 11/1999 Larson et al.
5,978,540 A 11/1999 Bechamps et al.
5,980,303 A 11/1999 Lee et al.
5,993,071 A 11/1999 Hultermans
5,995,700 A 11/1999 Burek et al.
5,999,393 A 12/1999 Brower
6,001,831 A 12/1999 Papenfuhs et al.
6,009,224 A 12/1999 Allen
6,009,225 A 12/1999 Ray et al.
6,011,831 A 1/2000 Nieves et al.
6,027,252 A 2/2000 Erdman et al.
6,044,193 A 3/2000 Szentesi et al.
6,058,235 A 5/2000 Hiramatsu et al.
6,061,492 A 5/2000 Strause et al.
6,078,661 A 6/2000 Arnett et al.
6,079,881 A 6/2000 Roth
6,127,627 A 10/2000 Daoud
6,130,983 A 10/2000 Cheng
6,134,370 A 10/2000 Childers et al.
6,149,313 A 11/2000 Giebel et al.
6,149,315 A 11/2000 Stephenson
6,151,432 A 11/2000 Nakajima et al.
6,160,946 A 12/2000 Thompson et al.
6,170,784 B1 1/2001 MacDonald et al.
6,175,079 B1 1/2001 Johnston et al.
6,181,861 B1 1/2001 Wenski et al.
6,188,687 B1 2/2001 Mussman et al.
6,188,825 B1 2/2001 Bandy et al.
6,192,180 B1 2/2001 Kim et al.
6,201,920 B1 3/2001 Noble et al.
6,208,796 B1 3/2001 Williams Vigliaturo
6,212,324 B1 4/2001 Lin et al.
6,215,938 B1 4/2001 Reitmeier et al.
6,216,987 B1 4/2001 Fukuo
6,227,717 B1 5/2001 Ott et al.
6,234,683 B1 5/2001 Waldron et al.
6,234,685 B1 5/2001 Carlisle et al.
6,236,795 B1 5/2001 Rodgers
6,240,229 B1 5/2001 Roth
6,243,522 B1 6/2001 Allan et al.
6,245,998 B1 6/2001 Curry et al.
6,263,141 B1 7/2001 Smith
6,265,680 B1 7/2001 Robertson
6,269,212 B1 7/2001 Schiattone
6,275,641 B1 8/2001 Daoud
6,278,829 B1 8/2001 BuAbbud et al.
6,278,831 B1 8/2001 Henderson et al.
D448,005 S 9/2001 Klein, Jr. et al.
6,292,614 B1 9/2001 Smith et al.
6,301,424 B1 10/2001 Hwang
6,307,997 B1 10/2001 Walters et al.
6,318,824 B1 11/2001 LaGrotta et al.
6,321,017 B1 11/2001 Janus et al.
6,322,279 B1 11/2001 Yamamoto et al.
6,325,549 B1 12/2001 Shevchuk
RE37,489 E 1/2002 Anton et al.
6,343,313 B1 1/2002 Salesky et al.
6,347,888 B1 2/2002 Puetz
6,353,696 B1 3/2002 Gordon et al.
6,353,697 B1 3/2002 Daoud
6,359,228 B1 3/2002 Strause et al.
6,363,200 B1 3/2002 Thompson et al.
6,370,309 B1 4/2002 Daoud
6,371,419 B1 4/2002 Ohnuki
6,375,129 B2 4/2002 Koziol
6,377,218 B1 4/2002 Nelson et al.
6,379,052 B1 4/2002 De Jong et al.
6,385,374 B2 5/2002 Kropp
6,385,381 B1 5/2002 Janus et al.
6,389,214 B1 5/2002 Smith et al.
6,397,166 B1 5/2002 Leung et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,398,149	B1	6/2002	Hines et al.
6,411,767	B1	6/2002	Burrous et al.
6,418,262	B1	7/2002	Puetz et al.
6,424,781	B1	7/2002	Puetz et al.
6,425,694	B1	7/2002	Szilagyi et al.
6,427,045	B1	7/2002	Matthes et al.
6,431,762	B1	8/2002	Taira et al.
6,434,313	B1	8/2002	Clapp, Jr. et al.
6,438,310	B1	8/2002	Lance et al.
6,452,925	B1	9/2002	Sistanizadeh et al.
6,456,773	B1	9/2002	Keys
6,464,402	B1	10/2002	Andrews et al.
6,466,724	B1	10/2002	Glover et al.
6,469,905	B1	10/2002	Hwang
D466,087	S	11/2002	Cuny et al.
6,478,472	B1	11/2002	Anderson et al.
6,480,487	B1	11/2002	Wegleitner et al.
6,480,660	B1	11/2002	Reitmeier et al.
6,483,977	B2	11/2002	Battey et al.
6,484,958	B1	11/2002	Xue et al.
6,496,640	B1	12/2002	Harvey et al.
6,504,988	B1	1/2003	Trebesch et al.
6,507,980	B2	1/2003	Bremicker
6,510,274	B1	1/2003	Wu et al.
6,532,332	B2	3/2003	Solheid et al.
6,533,472	B1	3/2003	Dinh et al.
6,535,397	B2	3/2003	Clark et al.
6,535,682	B1	3/2003	Puetz et al.
6,539,147	B1	3/2003	Mahony
6,539,160	B2	3/2003	Battey et al.
6,542,688	B1	4/2003	Battey et al.
6,550,977	B2 *	4/2003	Hizuka
6,554,485	B1	4/2003	Beatty et al.
6,560,334	B1	5/2003	Mullaney et al.
6,567,601	B2	5/2003	Daoud et al.
6,571,048	B1	5/2003	Bechamps et al.
6,577,595	B1	6/2003	Counterman
6,577,801	B2	6/2003	Broderick et al.
6,579,014	B2	6/2003	Melton et al.
6,584,267	B1	6/2003	Caveney et al.
6,587,630	B2	7/2003	Spence et al.
6,588,938	B1	7/2003	Lampert et al.
6,591,051	B2	7/2003	Solheid et al.
6,592,266	B1	7/2003	Hankins et al.
6,597,670	B1	7/2003	Tweedy et al.
6,600,866	B2	7/2003	Gatica et al.
6,601,997	B2	8/2003	Ngo
6,612,515	B1	9/2003	Tinucci et al.
6,614,978	B1	9/2003	Caveney
6,614,980	B1	9/2003	Mahony
6,621,975	B2	9/2003	Laporte et al.
6,625,374	B2	9/2003	Holman et al.
6,625,375	B1	9/2003	Mahony
6,631,237	B2	10/2003	Knudsen et al
6,640,042	B2	10/2003	Araki et al.
RE38,311	E	11/2003	Wheeler
6,644,863	B1	11/2003	Azami et al.
6,647,197	B1	11/2003	Marrs et al.
6,648,520	B2	11/2003	McDonald et al.
6,654,536	B2	11/2003	Battey et al.
6,668,127	B1	12/2003	Mahony
6,669,149	B2	12/2003	Akizuki
6,677,520	B1	1/2004	Kim et al.
6,679,604	B1	1/2004	Bove et al.
6,684,005	B1	1/2004	Egnell et al.
6,687,450	B1	2/2004	Kempeneers et al.
6,701,056	B2	3/2004	Burek et al.
6,710,366	B1	3/2004	Lee et al.
6,715,619	B2	4/2004	Kim et al.
6,719,149	B2	4/2004	Tomino
6,741,784	B1	5/2004	Guan
6,741,785	B2	5/2004	Barthel et al.
6,746,037	B1	6/2004	Kaplenski et al.
6,748,154	B2	6/2004	O'Leary et al.
6,748,155	B2	6/2004	Kim et al.
6,758,600	B2	7/2004	Del Grosso et al
6,768,860	B2	7/2004	Liberty
6,771,861	B2	8/2004	Wagner et al.
6,773,297	B2	8/2004	Komiya
6,778,525	B1	8/2004	Baum et al.
6,778,752	B2	8/2004	Laporte et al.
6,786,647	B1	9/2004	Hinds et al.
6,788,871	B2	9/2004	Taylor
6,792,190	B2	9/2004	Xin et al.
6,798,751	B1	9/2004	Voit et al.
6,804,447	B2	10/2004	Smith et al.
6,810,194	B2	10/2004	Griffiths et al.
6,813,412	B2	11/2004	Lin
6,816,660	B2	11/2004	Nashimoto
6,818,834	B1	11/2004	Lin
6,819,856	B2	11/2004	Dagley et al.
6,819,857	B2	11/2004	Douglas et al.
6,826,174	B1	11/2004	Erekson et al.
6,826,346	B2	11/2004	Sloan et al.
6,839,428	B2	1/2005	Brower et al.
6,839,438	B1	1/2005	Riegelsberger et al.
6,840,815	B2	1/2005	Musolf et al.
6,845,207	B2	1/2005	Schray
6,848,862	B1	2/2005	Schlig
6,850,685	B2	2/2005	Tinucci et al.
6,853,637	B1	2/2005	Norrell et al.
6,854,894	B1	2/2005	Yunker et al.
6,856,334	B1	2/2005	Fukui
6,865,331	B2	3/2005	Mertesdorf
6,865,334	B2	3/2005	Cooke et al.
6,866,541	B2	3/2005	Barker et al.
6,868,216	B1	3/2005	Gehrke
6,869,227	B2	3/2005	Del Grosso et al.
6,870,734	B2	3/2005	Mertesdorf et al.
6,870,997	B2	3/2005	Cooke
6,879,545	B2	4/2005	Cooke et al.
6,915,058	B2	7/2005	Pons
6,920,273	B2	7/2005	Knudsen
6,920,274	B2 *	7/2005	Rapp et al. 385/135
6,923,406	B2	8/2005	Akizuki
6,925,241	B2	8/2005	Bohle et al.
6,934,451	B2	8/2005	Cooke et al.
6,934,456	B2	8/2005	Ferris et al.
6,935,598	B2	8/2005	Sono et al.
6,937,807	B2	8/2005	Franklin et al.
6,944,383	B1	9/2005	Herzog et al.
6,944,389	B2	9/2005	Giraud et al.
6,952,530	B2	10/2005	Helvajian et al.
6,963,690	B1	11/2005	Kassal et al.
6,968,107	B2	11/2005	Belardi et al.
6,968,111	B2	11/2005	Trebesch et al.
6,985,665	B2	1/2006	Baechtle
6,993,237	B2	1/2006	Cooke et al.
7,000,784	B2	2/2006	Canty et al.
7,005,582	B2	2/2006	Muller et al.
7,006,748	B2	2/2006	Dagley et al.
7,007,296	B2	2/2006	Rakib
7,027,695	B2	4/2006	Cooke et al.
7,027,706	B2	4/2006	Diaz et al.
7,031,588	B2	4/2006	Cowley et al.
7,035,510	B2	4/2006	Zimmel et al.
7,038,137	B2	5/2006	Grubish et al.
7,054,513	B2	5/2006	Herz et al.
7,066,748	B2	6/2006	Bricaud et al.
7,068,907	B2	6/2006	Schray
7,070,459	B2	7/2006	Denovich et al.
7,079,744	B2	7/2006	Douglas et al.
7,090,406	B2	8/2006	Melton et al.
7,090,407	B2	8/2006	Melton et al.
7,094,095	B1	8/2006	Caveney
7,097,047	B2	8/2006	Lee et al.
7,101,093	B2	9/2006	Hsiao et al.
7,102,884	B2	9/2006	Mertesdorf et al.
7,103,255	B2	9/2006	Reagan et al.
7,110,654	B2	9/2006	Dillat
7,111,990	B2	9/2006	Melton et al.
7,113,679	B2	9/2006	Melton et al.
7,113,686	B2	9/2006	Bellekens et al.
7,113,687	B2	9/2006	Womack et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,116,491	B1	10/2006	Willey et al.
7,116,883	B2	10/2006	Kline et al.
7,118,281	B2	10/2006	Chiu et al.
7,118,405	B2	10/2006	Peng
7,120,347	B2	10/2006	Blackwell, Jr. et al.
7,120,348	B2	10/2006	Trebesch et al.
7,120,349	B2	10/2006	Elliott
7,128,471	B2	10/2006	Wilson
7,139,462	B1	11/2006	Richtman
7,140,903	B2	11/2006	Pulizzi et al.
7,171,099	B2	1/2007	Barnes et al.
7,171,121	B1	1/2007	Skarica et al.
7,181,142	B1	2/2007	Xu et al.
7,193,783	B2	3/2007	Willey et al.
7,194,181	B2	3/2007	Holmberg et al.
7,195,521	B2	3/2007	Musolf et al.
7,200,314	B2	4/2007	Womack et al.
7,200,316	B2	4/2007	Giraud et al.
7,220,065	B2	5/2007	Han et al.
7,221,832	B2	5/2007	Tinucci
7,228,036	B2	6/2007	Elkins, II et al.
7,231,125	B2	6/2007	Douglas et al.
7,234,878	B2	6/2007	Yamauchi et al.
7,236,677	B2	6/2007	Escoto et al.
7,239,789	B2	7/2007	Grubish et al.
7,245,809	B1	7/2007	Gniadek et al.
7,259,325	B2	8/2007	Pincu et al.
7,266,283	B2	9/2007	Kline et al.
7,270,485	B1	9/2007	Robinson et al.
7,272,291	B2	9/2007	Bayazit et al.
7,274,852	B1	9/2007	Smrha et al.
7,287,913	B2	10/2007	Keenum et al.
7,289,731	B2	10/2007	Thinguldstad
7,292,769	B2	11/2007	Watanabe et al.
7,298,950	B2	11/2007	Frohlich
7,300,216	B2	11/2007	Morse et al.
7,300,308	B2	11/2007	Laursen et al.
7,302,149	B2	11/2007	Swam et al.
7,302,153	B2	11/2007	Thom
7,302,154	B2	11/2007	Trebesch et al.
7,308,184	B2	12/2007	Barnes et al.
7,310,471	B2	12/2007	Bayazit et al.
7,310,472	B2	12/2007	Haberman
7,315,681	B2	1/2008	Kewitsch
7,325,975	B2	2/2008	Yamada et al.
7,330,625	B2	2/2008	Barth
7,330,626	B2	2/2008	Kowalczyk et al.
7,330,629	B2	2/2008	Cooke et al.
7,331,718	B2	2/2008	Yazaki et al.
7,340,145	B2	3/2008	Allen
7,349,615	B2	3/2008	Frazier et al.
7,373,071	B2	5/2008	Douglas et al.
7,376,321	B2	5/2008	Bolster et al.
7,376,323	B2	5/2008	Zimmel
7,391,952	B1	6/2008	Ugolini et al.
7,397,996	B2	7/2008	Herzog et al.
7,400,813	B2	7/2008	Zimmel
7,404,736	B2	7/2008	Herbst et al.
7,409,137	B2	8/2008	Barnes
7,414,198	B2	8/2008	Stansbie et al.
7,417,188	B2	8/2008	McNutt et al.
7,418,182	B2	8/2008	Krampotich
7,418,184	B1	8/2008	Gonzales et al.
7,421,182	B2	9/2008	Bayazit et al.
7,428,363	B2	9/2008	Leon et al.
7,437,049	B2	10/2008	Krampotich
7,439,453	B2	10/2008	Murano et al.
7,454,113	B2	11/2008	Barnes
7,460,757	B2	12/2008	Hoehne et al.
7,460,758	B2	12/2008	Xin
7,461,981	B2	12/2008	Yow, Jr. et al.
7,462,779	B2	12/2008	Caveney et al.
7,463,810	B2	12/2008	Bayazit et al.
7,463,811	B2	12/2008	Trebesch et al.
7,469,090	B2	12/2008	Ferris et al.
7,471,867	B2	12/2008	Vogel et al.
7,474,828	B2	1/2009	Leon et al.
7,477,824	B2	1/2009	Reagan et al.
7,477,826	B2	1/2009	Mullaney et al
7,480,438	B2	1/2009	Douglas et al.
7,488,205	B2	2/2009	Spisany et al.
7,493,002	B2	2/2009	Coburn et al.
7,496,269	B1	2/2009	Lee
7,499,622	B2	3/2009	Castonguay et al.
7,499,623	B2	3/2009	Barnes et al.
7,507,111	B2	3/2009	Togami et al.
7,509,015	B2	3/2009	Murano
7,509,016	B2	3/2009	Smith et al.
7,522,804	B2	4/2009	Araki et al.
7,523,898	B1	4/2009	Barry et al.
7,526,171	B2	4/2009	Caveney et al.
7,526,172	B2	4/2009	Gniadek et al.
7,526,174	B2	4/2009	Leon et al.
7,529,458	B2	5/2009	Spisany et al.
7,534,958	B2	5/2009	McNutt et al.
7,536,075	B2	5/2009	Zimmel
7,542,645	B1	6/2009	Hua et al.
7,555,193	B2	6/2009	Rapp et al.
7,558,458	B2	7/2009	Gronvall et al.
7,565,051	B2	7/2009	Vongseng
7,567,744	B2	7/2009	Krampotich et al.
7,570,860	B2	8/2009	Smrha et al.
7,570,861	B2	8/2009	Smrha et al.
7,577,331	B2	8/2009	Laurisch et al.
7,603,020	B1	10/2009	Wakileh et al.
7,607,938	B2	10/2009	Clark et al.
7,609,967	B2	10/2009	Hochbaum et al.
7,613,377	B2	11/2009	Gonzales et al.
7,620,272	B2	11/2009	Hino et al.
7,620,287	B2	11/2009	Appenzeller et al.
7,641,398	B2	1/2010	O'Riorden et al.
7,668,430	B2	2/2010	McClellan et al.
7,668,433	B2	2/2010	Bayazit et al.
7,672,561	B1	3/2010	Keith et al.
7,676,135	B2	3/2010	Chen
7,697,811	B2	4/2010	Murano et al.
7,715,125	B2	5/2010	Willey
7,715,683	B2	5/2010	Kowalczyk et al.
7,734,138	B2	6/2010	Bloodworth et al.
7,740,409	B2	6/2010	Bolton et al.
7,743,495	B2	6/2010	Mori et al.
7,756,382	B2	7/2010	Saravanos et al.
7,760,984	B2	7/2010	Solheid et al.
7,764,858	B2	7/2010	Bayazit et al.
7,764,859	B2	7/2010	Krampotich et al.
7,809,235	B2	10/2010	Reagan et al.
7,822,310	B2	10/2010	Castonguay et al.
7,850,372	B2	12/2010	Nishimura et al.
7,853,112	B2	12/2010	Zimmel et al.
7,856,166	B2	12/2010	Biribuze et al.
7,914,332	B2	3/2011	Song et al.
7,942,589	B2	5/2011	Yazaki et al.
7,945,135	B2	5/2011	Cooke et al.
7,945,136	B2	5/2011	Cooke et al.
7,970,250	B2	6/2011	Morris
8,014,171	B2	9/2011	Kelly et al.
8,014,646	B2	9/2011	Keith et al.
8,020,813	B1	9/2011	Clark et al.
8,059,932	B2	11/2011	Hill et al.
8,107,785	B2	1/2012	Berglund et al.
8,206,058	B2	6/2012	Vrondran et al.
8,472,773	B2	6/2013	de Jong
8,537,477	B2	9/2013	Shioda
2001/0010741	A1	8/2001	Hizuka
2001/0029125	A1	10/2001	Morita et al.
2002/0010818	A1	1/2002	Wei et al.
2002/0012353	A1	1/2002	Gerszberg et al.
2002/0034290	A1	3/2002	Pershan
2002/0037139	A1	3/2002	Asao et al.
2002/0064364	A1	5/2002	Battey et al.
2002/0131730	A1	9/2002	Keeble et al.
2002/0136519	A1	9/2002	Tinucci et al.
2002/0141724	A1	10/2002	Ogawa et al.
2002/0150372	A1	10/2002	Schray

(56) **References Cited**

U.S. PATENT DOCUMENTS

2002/0172467	A1	11/2002	Anderson et al.
2002/0181918	A1	12/2002	Spence et al.
2002/0181922	A1	12/2002	Xin et al.
2002/0191939	A1	12/2002	Daoud et al.
2002/0194596	A1	12/2002	Srivastava
2003/0007743	A1	1/2003	Asada
2003/0007767	A1	1/2003	Douglas et al.
2003/0021539	A1	1/2003	Kwon et al.
2003/0066998	A1	4/2003	Lee
2003/0086675	A1	5/2003	Wu et al.
2003/0095753	A1	5/2003	Wada et al.
2003/0147604	A1	8/2003	Tapia et al.
2003/0174996	A1	9/2003	Henschel et al.
2003/0180012	A1	9/2003	Deane et al.
2003/0183413	A1	10/2003	Kato
2003/0199201	A1	10/2003	Mullaney et al.
2003/0210882	A1	11/2003	Barthel et al.
2003/0223723	A1	12/2003	Massey et al.
2003/0223725	A1	12/2003	Laporte et al.
2003/0235387	A1	12/2003	Dufour
2004/0013389	A1	1/2004	Taylor
2004/0013390	A1	1/2004	Kim et al.
2004/0067036	A1	4/2004	Clark et al.
2004/0074852	A1	4/2004	Knudsen et al.
2004/0086238	A1	5/2004	Finona et al.
2004/0086252	A1	5/2004	Smith et al.
2004/0120679	A1	6/2004	Vincent et al.
2004/0147159	A1	7/2004	Urban et al.
2004/0151465	A1	8/2004	Krampotich et al.
2004/0175090	A1	9/2004	Vastmans et al.
2004/0192115	A1	9/2004	Bugg
2004/0208459	A1	10/2004	Mizue et al.
2004/0228598	A1	11/2004	Allen et al.
2004/0240827	A1	12/2004	Daoud et al.
2004/0240882	A1	12/2004	Lipski et al.
2004/0264873	A1	12/2004	Smith et al.
2005/0002633	A1	1/2005	Solheid et al.
2005/0008131	A1	1/2005	Cook
2005/0026497	A1	2/2005	Holliday
2005/0036749	A1	2/2005	Vogel et al.
2005/0074990	A1	4/2005	Shearman et al.
2005/0076149	A1	4/2005	McKown et al.
2005/0083959	A1	4/2005	Binder
2005/0107086	A1	5/2005	Tell et al.
2005/0111809	A1	5/2005	Giraud et al.
2005/0111810	A1	5/2005	Giraud et al.
2005/0123261	A1	6/2005	Bellekens et al.
2005/0129379	A1	6/2005	Reagan et al.
2005/0175293	A1	8/2005	Byers et al.
2005/0201073	A1	9/2005	Pincu et al.
2005/0232566	A1	10/2005	Rapp et al.
2005/0233647	A1	10/2005	Denovich et al.
2005/0254757	A1	11/2005	Ferretti, III et al.
2005/0281526	A1	12/2005	Vongseng et al.
2005/0281527	A1	12/2005	Wilson et al.
2006/0007562	A1	1/2006	Willey et al.
2006/0018448	A1	1/2006	Stevens et al.
2006/0018622	A1	1/2006	Caveney et al.
2006/0039290	A1	2/2006	Roden et al.
2006/0044774	A1	3/2006	Vasavda et al.
2006/0045458	A1	3/2006	Sasaki et al.
2006/0072606	A1	4/2006	Posthuma
2006/0077968	A1	4/2006	Pitsoulakis et al.
2006/0093303	A1	5/2006	Reagan et al.
2006/0110118	A1	5/2006	Escoto et al.
2006/0133759	A1	6/2006	Mullaney et al.
2006/0147172	A1	7/2006	Luther et al.
2006/0153517	A1	7/2006	Reagan et al.
2006/0160377	A1	7/2006	Huang
2006/0165365	A1	7/2006	Feustel et al.
2006/0165366	A1	7/2006	Feustel et al.
2006/0191700	A1	8/2006	Herzog et al.
2006/0193590	A1	8/2006	Puetz et al.
2006/0193591	A1	8/2006	Rapp et al.
2006/0198098	A1	9/2006	Clark et al.
2006/0215980	A1	9/2006	Bayazit et al.
2006/0269194	A1	11/2006	Luther et al.
2006/0269206	A1	11/2006	Zimmel
2006/0269208	A1	11/2006	Allen et al.
2006/0275008	A1	12/2006	Xin
2006/0275009	A1	12/2006	Ellison et al.
2006/0285812	A1	12/2006	Ferris et al.
2007/0003204	A1	1/2007	Makrides-Saravanos et al.
2007/0025070	A1	2/2007	Jiang et al.
2007/0031099	A1	2/2007	Herzog et al.
2007/0033629	A1	2/2007	McGranahan et al.
2007/0047894	A1	3/2007	Holmberg et al.
2007/0104447	A1	5/2007	Allen
2007/0127201	A1	6/2007	Mertesdorf et al.
2007/0131628	A1	6/2007	Mimlitch, III et al
2007/0189692	A1	8/2007	Zimmel et al.
2007/0196071	A1	8/2007	Laursen et al.
2007/0221793	A1	9/2007	Kusuda et al.
2007/0237484	A1	10/2007	Reagan et al.
2007/0274718	A1	11/2007	Bridges et al.
2008/0011514	A1	1/2008	Zheng et al.
2008/0025683	A1	1/2008	Murano
2008/0031585	A1	2/2008	Solheid et al.
2008/0063350	A1	3/2008	Trebesch et al.
2008/0068788	A1	3/2008	Ozawa et al
2008/0069511	A1	3/2008	Blackwell, Jr. et al.
2008/0069512	A1	3/2008	Barnes et al.
2008/0080826	A1	4/2008	Leon et al.
2008/0080827	A1	4/2008	Leon et al.
2008/0080828	A1	4/2008	Leon et al.
2008/0085094	A1	4/2008	Krampotich
2008/0089656	A1	4/2008	Wagner et al.
2008/0095541	A1	4/2008	Dallesasse
2008/0100440	A1	5/2008	Downie et al.
2008/0106871	A1	5/2008	James
2008/0112681	A1	5/2008	Battey et al.
2008/0118207	A1	5/2008	Yamamoto et al.
2008/0121423	A1	5/2008	Vogel et al.
2008/0124039	A1	5/2008	Gniadek et al.
2008/0131068	A1	6/2008	Mertesdorf et al.
2008/0145013	A1	6/2008	Escoto et al.
2008/0152294	A1	6/2008	Hirano et al.
2008/0166094	A1	7/2008	Bookbinder et al.
2008/0166131	A1	7/2008	Hudgins et al
2008/0175550	A1	7/2008	Coburn et al.
2008/0175551	A1	7/2008	Smrha et al.
2008/0175552	A1	7/2008	Smrha et al.
2008/0193091	A1	8/2008	Herbst
2008/0205823	A1	8/2008	Luther et al.
2008/0205844	A1	8/2008	Castonguay et al.
2008/0212928	A1	9/2008	Kowalczyk et al.
2008/0219632	A1	9/2008	Smith et al.
2008/0219634	A1	9/2008	Rapp et al.
2008/0236858	A1	10/2008	Quijano
2008/0247723	A1	10/2008	Herzog et al.
2008/0267573	A1	10/2008	Douglas et al.
2008/0285934	A1	11/2008	Standish et al.
2008/0292261	A1	11/2008	Kowalczyk et al.
2008/0298763	A1	12/2008	Appenzeller et al.
2008/0304803	A1	12/2008	Krampotich et al.
2008/0310810	A1	12/2008	Gallagher
2009/0010607	A1	1/2009	Elisson et al.
2009/0016685	A1	1/2009	Hudgins et al.
2009/0022470	A1	1/2009	Krampotich
2009/0060439	A1	3/2009	Cox et al.
2009/0060440	A1	3/2009	Wright et al.
2009/0067800	A1	3/2009	Vazquez et al.
2009/0080849	A1	3/2009	Hankins et al.
2009/0097813	A1	4/2009	Hill
2009/0136194	A1	5/2009	Barnes
2009/0136196	A1	5/2009	Trebesch et al.
2009/0146342	A1	6/2009	Haney et al.
2009/0148117	A1	6/2009	Laurisch
2009/0169163	A1	7/2009	Abbott, III et al.
2009/0175588	A1	7/2009	Brandt et al.
2009/0180749	A1	7/2009	Douglas et al.
2009/0185782	A1	7/2009	Parikh et al.
2009/0191891	A1	7/2009	Ma et al.
2009/0194647	A1	8/2009	Keith

(56) **References Cited**

U.S. PATENT DOCUMENTS

2009/0196563	A1	8/2009	Mullsteff et al.
2009/0202214	A1	8/2009	Holmberg et al.
2009/0207577	A1	8/2009	Fransen et al.
2009/0208178	A1	8/2009	Kowalczyk et al.
2009/0208210	A1	8/2009	Trojer et al.
2009/0214171	A1	8/2009	Coburn et al.
2009/0220200	A1	9/2009	Sheau Tung Wong et al.
2009/0220204	A1	9/2009	Ruiz
2009/0226142	A1	9/2009	Barnes et al.
2009/0238531	A1	9/2009	Holmberg et al.
2009/0245743	A1	10/2009	Cote et al.
2009/0252472	A1	10/2009	Solheid et al.
2009/0257726	A1	10/2009	Redmann et al.
2009/0257727	A1	10/2009	Laurisch et al.
2009/0257754	A1	10/2009	Theodoras, II et al.
2009/0263096	A1	10/2009	Solheid et al.
2009/0263122	A1	10/2009	Helkey et al.
2009/0267865	A1	10/2009	Miller et al.
2009/0269016	A1	10/2009	Korampally et al.
2009/0269018	A1	10/2009	Frohlich et al.
2009/0274429	A1	11/2009	Krampotich et al.
2009/0274430	A1	11/2009	Krampotich et al.
2009/0274432	A1	11/2009	Iwaya
2009/0290842	A1	11/2009	Bran de Leon et al.
2009/0297111	A1	12/2009	Reagan et al.
2009/0304342	A1	12/2009	Adomeit et al.
2009/0324189	A1	12/2009	Hill et al.
2010/0003000	A1	1/2010	Rapp et al.
2010/0012671	A1	1/2010	Vrondran et al.
2010/0054681	A1	3/2010	Biribuze et al.
2010/0054682	A1	3/2010	Cooke et al.
2010/0054685	A1	3/2010	Cooke et al.
2010/0054687	A1	3/2010	Ye et al.
2010/0061691	A1	3/2010	Murano et al.
2010/0061693	A1	3/2010	Bran de Leon et al.
2010/0074587	A1	3/2010	Loeffelholz et al.
2010/0080517	A1	4/2010	Cline et al.
2010/0086267	A1	4/2010	Cooke et al.
2010/0086274	A1	4/2010	Keith
2010/0111483	A1	5/2010	Reinhardt et al.
2010/0119201	A1	5/2010	Smrha et al.
2010/0142544	A1	6/2010	Chapel et al.
2010/0142910	A1	6/2010	Hill et al.
2010/0150518	A1	6/2010	Leon et al.
2010/0158467	A1	6/2010	Hou et al.
2010/0166377	A1	7/2010	Nair et al.
2010/0178022	A1	7/2010	Schroeder et al.
2010/0202745	A1	8/2010	Sokolowski et al.
2010/0220967	A1	9/2010	Cooke et al.
2010/0278499	A1	11/2010	Mures et al.
2010/0296790	A1	11/2010	Cooke et al.
2010/0310225	A1	12/2010	Anderson et al.
2010/0310226	A1	12/2010	Wakileh et al.
2010/0316334	A1	12/2010	Kewitsch
2010/0322582	A1	12/2010	Cooke et al.
2010/0322583	A1	12/2010	Cooke et al.
2010/0329624	A1	12/2010	Zhou et al.
2011/0069931	A1	3/2011	Cote et al.
2011/0073730	A1	3/2011	Kitchen
2011/0085774	A1	4/2011	Murphy et al.
2011/0085776	A1	4/2011	Biribuze et al.
2011/0097053	A1	4/2011	Smith et al.
2011/0097977	A1	4/2011	Bubnick et al.
2011/0211799	A1	9/2011	Conner et al.
2011/0217016	A1	9/2011	Mullsteff
2011/0268404	A1	11/2011	Cote et al.
2011/0280537	A1	11/2011	Cowen et al.
2012/0051707	A1	3/2012	Barnes et al.
2012/0183263	A1	7/2012	Wu
2013/0077927	A1	3/2013	O'Connor

FOREIGN PATENT DOCUMENTS

CH	688705	A5	1/1998
DE	8711970	U1	10/1987
DE	3726718	A1	2/1989
DE	3726719	A1	2/1989
DE	4030301	A1	3/1992
DE	4231181	C1	8/1993
DE	20115940	U1	1/2002
DE	10338848	A1	3/2005
DE	202005009932	U1	11/2005
EP	0105597	A2	4/1984
EP	0250900	A2	1/1988
EP	0408266	A2	1/1991
EP	1041417	A1	8/1991
EP	0468671	A1	1/1992
EP	0490698	A1	6/1992
EP	0529830	A1	3/1993
EP	0544004	A1	6/1993
EP	0547778	A1	6/1993
EP	0581527	A1	2/1994
EP	0620462	A1	10/1994
EP	0693699	A1	1/1996
EP	0720322	A2	7/1996
EP	0940700	A2	9/1999
EP	0949522	A2	10/1999
EP	1041417	A2	10/2000
EP	1056177	A1	11/2000
EP	1065542	A1	1/2001
EP	1203974	A2	5/2002
EP	1289319	A2	3/2003
EP	1316829	A2	6/2003
EP	1621907	A1	2/2006
EP	1777563	A1	4/2007
FR	2378378	A1	8/1978
GB	2241591	A	9/1991
GB	2277812	A	11/1994
GB	2367379	A	4/2002
JP	3172806	A	7/1991
JP	5045541	A	2/1993
JP	06018749	A	1/1994
JP	7308011	A	11/1995
JP	8007308	A	1/1996
JP	8248235	A	9/1996
JP	8248237	A	9/1996
JP	3487946	A	10/1996
JP	8254620	A	10/1996
JP	3279474	A	10/1997
JP	9258033	A	10/1997
JP	9258055	A	10/1997
JP	2771870	B2	7/1998
JP	3448448	A	8/1998
JP	10227919	A	8/1998
JP	3478944	A	12/1998
JP	10332945	A	12/1998
JP	10339817	A	12/1998
JP	11023858	A	1/1999
JP	2000098138	A	4/2000
JP	2000098139	A	4/2000
JP	2000241631	A	9/2000
JP	2001004849	A	1/2001
JP	3160322	B2	4/2001
JP	2001133636	A	5/2001
JP	3173962	B2	6/2001
JP	3176906	B2	6/2001
JP	2001154030	A	6/2001
JP	2001159714	A	6/2001
JP	2002022974	A	1/2002
JP	2002169035	A	6/2002
JP	3312893	B2	8/2002
JP	2002305389	A	10/2002
JP	3344701	B2	11/2002
JP	2003029054	A	1/2003
JP	3403573	B2	5/2003
JP	2003169026	A	6/2003
JP	2003215353	A	7/2003
JP	2003344701	A	12/2003
JP	3516765	B2	4/2004
JP	200414931	A	5/2004

(56) **References Cited**

FOREIGN PATENT DOCUMENTS

JP	2004144808 A	5/2004
JP	2004514931 A	5/2004
JP	3542939 B2	7/2004
JP	2004246147 A	9/2004
JP	2004361652 A	12/2004
JP	2004361893 A	12/2004
JP	3107704 U	2/2005
JP	2005055748 A	3/2005
JP	2005062569 A	3/2005
JP	2005084241 A	3/2005
JP	2005148327 A	6/2005
JP	3763645 B2	4/2006
JP	3778021 B2	5/2006
JP	2006126513 A	5/2006
JP	2006126516 A	5/2006
JP	3794540 B2	7/2006
JP	2006227041 A1	8/2006
JP	3833638 B2	10/2006
JP	3841344 B2	11/2006
JP	3847533 B2	11/2006
JP	200747336 A	2/2007
JP	3896035 B2	3/2007
JP	2007067458 A1	3/2007
JP	3934052 B2	6/2007
JP	3964191 B2	8/2007
JP	3989853 B2	10/2007
JP	4026244 B2	12/2007
JP	4029494 B2	1/2008
JP	4065223 B2	3/2008
JP	4093475 B2	6/2008
JP	4105696 B2	6/2008
JP	4112437 B2	7/2008
JP	4118862 B2	7/2008
JP	2008176118 A1	7/2008
JP	2008180817 A1	8/2008
JP	4184329 B2	11/2008
JP	2008542822 T	11/2008
JP	2009503582 T	1/2009
WO	9105281 A1	4/1991
WO	9326070 A1	12/1993
WO	9520175 A1	7/1995
WO	9636896 A1	11/1996
WO	9712268 A1	4/1997
WO	9744605 A1	11/1997
WO	9825416 A1	6/1998
WO	9927404 A1	6/1999
WO	0005611 A2	2/2000
WO	0127660 A2	4/2001
WO	0242818 A1	5/2002
WO	03009527 A2	1/2003
WO	2004052066 A1	6/2004
WO	2007050515 A1	5/2007
WO	2007079074 A2	7/2007
WO	2007149215 A2	12/2007
WO	2008063054 A2	5/2008
WO	2008113054 A2	9/2008
WO	2008157248 A1	12/2008
WO	2009120280 A2	10/2009
WO	2010080745 A1	7/2010
WO	2011011510 A2	1/2011

OTHER PUBLICATIONS

Non-Final Office Action for U.S. Appl. No. 12/952,912 mailed Dec. 28, 2012, 9 pages.

Non-Final Office Action for U.S. Appl. No. 12/953,118 mailed Jan. 7, 2013, 9 pages.

Non-Final Office Action for U.S. Appl. No. 12/707,889 mailed Jan. 2, 2013, 7 pages.

Non-Final Office Action for U.S. Appl. No. 12/953,536 mailed Jan. 2, 2013, 20 pages.

Final Office Action for U.S. Appl. No. 12/394,114 mailed Oct. 25, 2012, 8 pages.

Non-final Office Action for U.S. Appl. No. 12/732,487 mailed Sep. 19, 2012, 22 pages.

Non-final Office Action for U.S. Appl No. 12/818,986 mailed Feb. 3, 2012, 12 pages.

Final Office Action for U.S. Appl. No. 12/818,986 mailed Oct. 18, 2012, 13 pages.

Non-final Office Action for U.S. Appl. No. 12/952,960 mailed Oct. 4, 2012, 11 pages.

Non-final Office Action for U.S. Appl. No. 12/953,134 mailed Sep. 25, 2012, 8 pages.

Non-final Office Action for U.S. Appl. No. 12/915,682 mailed Oct. 24, 2012, 8 pages.

Non-final Office Action for U.S. Appl. No. 12/946,139 mailed Jul. 26, 2012, 12 pages.

European Search Report for patent application 10790017.7 mailed Nov. 8, 2012, 7 pages.

Final Office Action for U.S. Appl. No. 12/946,139 mailed Feb. 15, 2013, 17 pages.

Non-final Office Action for U.S. Appl. No. 12/751,884 mailed Feb. 15, 2013, 5 pages.

Non-final Office Action for U.S. Appl. No. 12/394,114 mailed Feb 27, 2013, 8 pages.

Non-final Office Action for U.S. Appl. No. 12/819,065 mailed Mar. 4, 2013, 7 pages.

Final Office Action for U.S. Appl. No. 12/952,960 mailed Mar. 7, 2013, 13 pages.

Notice of Allowance for U.S. Appl. No. 12/732,487 mailed Mar. 19, 2013, 11 pages.

Non-final Office Action for U.S. Appl. No. 12/953,134 mailed Mar. 21, 2013, 9 pages.

Final Office Action for U.S. Appl. No. 12/641,617 mailed May 10, 2013, 21 pages.

Annex to Form PCT/ISA/2006, Communication Relating to the Results of the Partial International Search, for PCT/US2009/004549 mailed Feb. 10, 2010, 2 pages.

Annex to Form PCT/ISA/206, Communication Relating to the Results of the Partial International Search, for PCT/ US2009/004548 mailed Jan. 19, 2010, 2 pages.

Corning Cable Systems, "Corning Cable Systems Products for BellSouth High Density Shelves," Jun. 2000, 2 pages.

Corning Cable Systems, "Corning Cable Systems Quick Reference Guide for Verizon FTTP FDH Products," Jun 2005, 4 pages.

Conner, M. "Passive Optical Design for RFOG and Beyond," Braodband Properties, Apr. 2009, pp. 78-81.

Corning Evolant, "Eclipse Hardware Family," Nov. 2009, 1 page.

Corning Evolant, "Enhanced Management Frame," Dec. 2009, 1 page.

Corning Evolant, "Enhanced Management Frame (EMF)," Specification Sheet, Nov. 2009, 24 pages.

Corning Cable Systems, "Evolant Solutions for Evolving Networks: Fiber Optic Hardware," Oct. 2002, 2 pages.

Corning Cable Systems, "Fiber Optic Hardware with Factory-Installed Pigtails: Features and Benefits," Nov. 2010, 12 pages

Corning Cable Systems, "FiberManager System 1- and 3-Position Compact Shelves," Jan. 2003, 4 pages.

Corning Cable Systems, "FiberManager System Frame and Components," Jan. 2003, 12 pages.

Corning Cable Systems, "High Density Frame," Jul. 2001, 2 pages

Corning Cable Systems, "High Density Frame (HDF) Connector-Splice Shelves and Housings," May 2003, 4 pages.

International Search Report for PCT/US10/35529 mailed Jul. 23, 2010, 2 pages.

International Search Report for PCT/US10/35563 mailed Jul. 23, 2012, 1 page.

International Search Report for PCT1US20081002514 mailed Aug. 8, 2008, 2 pages.

International Search Report for PCT1US20081010317 mailed Mar. 4, 2008, 2 pages.

International Search Report for PCT/US2009/001692 mailed Nov. 24, 2009, 5 pages.

International Search Report for PCT/US2010/024888 mailed Jun. 23, 2010, 5 pages.

International Search Report for PCT/US2010/027402 mailed Jun. 16, 2010, 2 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Corning Cable Systems, "MTX Frames and Accessories," Feb. 2006, 4 pages.
Panduit, "Lock-in LC Duplex Clip," Accessed Mar. 22, 2012, 1 page.
International Search Report for PCT/US06/49351 mailed Apr. 25, 2008, 1 page.
International Search Report for PCT/US09/57069 mailed Mar. 24, 2010, 2 pages.
International Search Report for PCT/US2009/057244 mailed Nov. 9, 2009 3 pages.
International Search Report for PCTUS2009004548 mailed Mar. 19, 2010, 5 pages.
International Search Report for PCTUS2009004549 mailed Apr. 20, 2010, 6 pages.
Siecor, "Single Shelf HDF with Slack Storage and Heat Shield (HH1-CSH-1238-1V-BS)," Jan. 1998, 12 pages.
Corning Cable Systems, "Mass Termination Xchange (MTX) Frame System Equipment Office Planning and Application Guide," SRP003-664, Issue 1, Mar. 2005, 57 pages.
Corning Cable Systems, "Mass Termination Xchange (MTX) Equipment Patch Cord Interbay Vertical Channel," SRP003-684, Issue 1, Mar. 2005, 8 pages.
Corning Cable Systems, "High Density Frame (HDF) Installation," SRP003-355, Issue 4, Sep. 2002, 18 pages.
Written Opinion for PCT/US2010/023901 mailed Aug. 25, 2011, 8 pages.
Advisory Action for U.S. Appl. No. 12/221,117 mailed Aug. 24, 2011, 3 pages.
Examiner's Answer to Appeal Brief for U.S. Appl. No. 12/221,117 mailed Mar. 29, 2012, 16 pages.
Final Office Action for U.S. Appl. No. 12/221,117 mailed Feb. 19, 2010, 7 pages.
Final Office Action for U.S. Appl. No. 12/221,117 mailed Jun. 10, 2011, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/221,117 mailed Jul. 14, 2010, 7 pages.
Non-final Office Action for U.S. Appl. No. 12/221,117 mailed Jun. 9, 2009, 5 pages.
Non-final Office Action for U.S. Appl. No. 12/221,117 mailed Dec. 21, 2010, 7 pages.
Advisory Action for U.S. Appl. No. 12/394,483 mailed Feb. 16, 2012, 3 pages.
Final Office Action for U.S. Appl. No. 12/394,483 mailed Dec. 6, 2011, 14 pages.
Non-final Office Action for U.S. Appl. No. 12/394,483 mailed Jun. 17, 2011, 11 pages.
Advisory Action for U.S. Appl. No. 12/950,234 mailed Dec. 21, 2011, 3 pages.
Non-final Office Action for U.S. Appl. No. 12/950,234 mailed Jun. 17, 2011, 7 pages.
Non-final Office Action for U.S. Appl. No. 12/950,234 mailed Mar. 12, 2012, 10 pages.
Final Office Action for U.S. Appl. No. 12/950,234 mailed Oct. 14, 2011, 10 pages.
Advisory Action mailed May 12, 2011, for U.S. Appl. No. 12/323,423, 3 pages.
Final Rejection mailed Mar. 3, 2011, for U.S. Appl. No. 12/323,423, 17 pages.
Non-Final Rejection mailed Aug. 5, 2011, for U.S. Appl. No. 12/323,423, 13 pages.
Non-Final Rejection mailed Sep. 7, 2010, for U.S. Appl. No. 12/323,423, 18 pages.
Notice of Allowance for U.S. Appl. No. 12/323,423 mailed Jan. 24, 2012, 8 pages.
Examiner's Answer mailed Mar. 4, 2011, for U.S. Appl. No. 12/323,415, 11 pages.
Final Rejection mailed Jun. 25, 2010, for U.S. Appl. No. 12/323,415, 10 pages.
Non-Final Rejection mailed Aug. 5, 2011, for U.S. Appl. No. 12/323,415, 41 pages.
Non-final Office Action for U.S. Appl. No. 12/323,415 mailed Apr 23, 2012, 11 pages.
Non-Final Rejection mailed Dec. 10, 2009, for U.S. Appl. No. 12/323,415, 7 pages.
Examiner's Answer to Appeal Brief for U.S. Appl. No. 11/320,062 mailed Dec. 8, 2011, 8 pages.
Final Office Action for U.S. Appl. No. 11/320,062 mailed Mar. 8, 2011, 8 pages.
Non-final Office Action for U.S. Appl. No. 11/320,062 mailed Jan. 15, 2010, 11 pages.
Non-final Office Action for U.S. Appl. No. 12/320,062 mailed Sep. 30, 2010, 7 pages.
Final Office Action for U.S. Appl. No. 11/439,086 mailed Feb. 4, 2010, 14 pages.
Non-final Office Action for U.S. Appl. No. 11/439,086 mailed May 3, 2010, 11 pages.
Non-final Office Action for U.S. Appl. No. 11/439,086 mailed Sep. 21, 2009, 10 pages.
Final Office Action for U.S. Appl. No. 12/079,481 mailed Mar. 18, 2010, 10 pages.
Non-final Office Action for U.S. Appl. No. 12/079,481 mailed Dec. 26, 2008, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/079,481 mailed Sep. 16, 2009, 10 pages.
Notice of Allowance for U.S. Appl. No. 12/079,481 mailed Jun. 3, 2010, 6 pages.
Notice of Allowance for U.S. Appl. No. 12/079,481 mailed Oct. 4, 2010, 4 pages.
Final Office Action for U.S. Appl. No. 12/394,114 mailed Dec. 22, 2011, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/394,114 mailed Mar. 16, 2012, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/394,114 mailed Sep. 1, 2011, 7 pages.
Non-final Office Action for U.S. Appl. No. 12/323,373 mailed May 3, 2012, 7 pages.
Non-final Office Action for U.S. Appl. No. 11/809,474 mailed Apr. 8, 2008, 13 pages.
Non-final Office Action for U.S. Appl. No. 11/809,474 mailed Nov. 13, 2008, 10 pages.
Notice of Allowance for U.S. Appl. No. 11/809,474 mailed Jul. 6, 2009, 6 pages.
Final Office Action for U.S. Appl. No. 11/320,031 mailed Mar. 8, 2011, 8 pages.
Non-final Office Action for U.S. Appl. No. 11/320,031 mailed Jan. 5, 2010, 16 pages.
Non-final Office Action for U.S. Appl. No. 11/320,031 mailed Sep. 30, 2010, 7 pages.
Notice of Allowance for U.S. Appl. No. 11/320,031 mailed Nov. 15, 2011, 7 pages.
Non-final Office Action for U.S. Appl. No. 12/157,622 mailed Mar 31, 2009, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/157,622 mailed Oct. 15, 2009, 9 pages.
Notice of Allowance for U.S. Appl. No. 12/157,622 mailed Apr. 22, 2010, 4 pages.
Non-final Office Action for U.S. Appl. No. 12/323,395 mailed Dec. 8, 2011, 7 pages.
Non-final Office Action for U.S. Appl. No. 12/415,454 mailed Mar. 2, 2012, 5 pages.
Non-final Office Action for U.S. Appl. No. 12/415,454 mailed Sep. 6, 2011, 7 pages.
Notice of Allowance for U.S. Appl. No. 12/415,454 mailed Jan. 13, 2012, 5 pages.
Non-final Office Action for U.S. Appl. No. 12/576,769 mailed Feb. 2, 2012, 23 pages.
Notice of Allowance for U.S. Appl. No. 12/415,454 mailed Jun. 19, 2012, 5 pages.
International Search Report for PCT/US2009/066779 mailed Aug. 27, 2010, 3 pages.
"MPO Fiber Optic Rack Panels now available from L-com Connectivity Products," article dated Jun. 4, 2007, 16 pages, http://www.l-com.com/content/Article.aspx?Type=P&ID=438.

(56) **References Cited**

OTHER PUBLICATIONS

"19 Rack Panel with 16 MPO Fiber Optic Couplers—1U high," product page, accessed Oct. 23, 2012, 2 pages, http://www.l-com.com/item.aspx?id=9767#.UIbgG8XXay5.
"Drawing for L-com 1U Panel with 16 MTP couplers," May 15, 2007, 1 page, http://www.l-com.com/multimedia/eng_drawings/PR17516MTP.pdf.
"RapidNet Fibre MTP VHD Cassette," Brochure, Date Unknown, 1 page, http://www.hellermanntyton.se/documents/5000/576_fiber_1U.pdf.
"MPO for Gigabit Ethernet/FAS-NET MTP Solution," Brochure, Date Unknown, 11 pages, http://www.infinique.com/upload/13182286190.pdf.
"Hubbell OptiChannel High Density 144 Port 1U Fiber Enclosure," Brochure, Date Unknown, 2 pages, http://www.hubbell-premise.com/literature/PLDF010.pdf.
Non-final Office Action for U.S. Appl. No. 12/819,034 mailed May 11, 2012, 7 pages.
Non-final Office Action for U.S. Appl. No. 12/819,081 mailed Aug. 21, 2012, 12 pages.
Notice of Allowance of for U.S. Appl. No. 12/819,034 mailed Sep. 11, 2012, 7 pages.
Notice of Allowance for U.S. Appl. No. 12/417,325 mailed Aug. 22, 2012, 7 pages.
Notice of Panel Decision for Pre-Appeal Brief for U.S. Appl. No. 12/417,325 mailed Aug. 8, 2012, 2 pages.
Advisory Action for U.S. Appl. No. 12/417,325 mailed Jun. 29, 2012, 3 pages.
Advisory Action for U.S. Appl. No. 12/417,325 mailed Jun. 12, 2012, 3 pages.
Final Office Action for U.S. Appl. No. 12/417,325 mailed Apr. 16, 2012, 6 pages.
Final Office Action for U.S. Appl. No. 12/417,325 mailed Feb. 7, 2012, 7 pages.
Non-final Office Action for U.S. Appl. No. 12/417,325 mailed Jun. 15, 2011, 6 pages.
Notice of Allowance for U.S. Appl. No. 12/487,929 mailed Sep. 12, 2012, 4 pages.
Notice of Allowance for U.S. Appl. No. 12/487,929 mailed Jun. 13, 2012, 8 pages.
Advisory Action for U.S. Appl. No. 12/487,929 mailed Apr. 17, 2012, 3 pages.
Final Office Action for U.S. Appl. No. 12/487,929 mailed Feb. 14, 2012, 6 pages.
Final Office Action for U.S. Appl. No. 12/487,929 mailed Dec. 5, 2011, 7 pages.
Non-final Office Action for U.S. Appl. No. 12/487,929 mailed May 23, 2011, 7 pages.
Notice of Allowance for U.S. Appl. No. 12/415,253 mailed Mar. 11, 2011, 7 pages.
Non-final Office Action for U.S. Appl. No. 12/415,253 mailed Jul. 12, 2010, 11 pages.
Final Office Action for U.S. Appl. No. 12/415,253 mailed Apr. 16, 2010, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/415,253 mailed Sep. 30, 2009, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/641,617 mailed Oct. 5, 2012, 21 pages.
Final Office Action for U.S. Appl. No. 12/630,938 mailed Jun. 1, 2012, 18 pages.
Non-final Office Action for U.S. Appl. No. 12/630,938 mailed Dec. 19, 2011, 15 pages.
Non-final Office Action for U.S. Appl. No. 12/751,884 mailed Jul. 2, 2012, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/871,052 mailed Aug. 13, 2012, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/576,806 mailed Dec. 13, 2011, 6 pages.
Notice of Allowance for U.S. Appl. No. 12/576,806 mailed Apr. 18, 2012, 5 pages.
Unknown, Author, "QuickNet SFQ Series MTP Fiber Optic Cassettes," Panduit Specification Sheet, Jan. 2009, 2 pages.
Unknown Author, "Cellular Specialties introduces the first simulated in-building location-based tracking solution," smart-grid.tmenet com/news, Sep. 14, 2009, 2 pages.
Unknown Author, "CDMA Co-Pilot Transmitter," Cellular Specialties, Inc., Aug. 2009, 2 pages.
International Search Report for PCT/US2010/038986 mailed Aug. 18, 2010, 1 page.
International Search Report for PCT/US2010/023901 mailed Jun. 11, 2010, 3 pages.
Non-final Office Action for U.S. Appl. No. 13/302,067 mailed Jun. 7, 2013, 13 pages.
Notice of Allowance for U.S. Appl. No. 12/751,884 mailed Jul. 17, 2013, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/940,585 mailed Aug. 16, 2013, 14 pages.
Final Office Action for U.S. Appl. No. 12/953,134 mailed Aug. 23, 2013, 11 pages.
Ex parte Quayle Action for U.S. Appl. No. 12/953,164 mailed Aug. 16, 2013, 5 pages.
Non-final Office Action for U.S. Appl. No. 12/732,487 mailed Jul. 17, 2013, 22 pages.
Non-final Office Action and Interview Summary for U.S. Appl. No. 12/707,889 mailed Aug. 8, 2013, 15 pages.
Advisory Action for U.S. Appl. No. 12/953,039 mailed Jul. 12, 2013, 3 pages.
Advisory Action for U.S. Appl. No. 12/953,118 mailed Jul. 12, 2013, 3 pages.
Advisory Action for U.S. Appl. No. 12/641,617 mailed Jul. 29, 2013, 3 pages.
Final Office Action for U.S. Appl. No. 12/952,912 mailed Aug. 30, 2013, 15 pages.
Non-final Office Action for U.S. Appl. No. 12/956,475 mailed Oct. 4, 2012, 7 pages.
Notice of Allowance for U.S. Appl. No. 12/871,052 mailed Sep. 18, 2013, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/953,039 mailed Sep. 12, 2013, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/946,139 mailed Oct. 2, 2013, 18 pages.
Final Office Action for U.S. Appl. No. 12/394,114 mailed Oct. 4, 2013, 10 pages.
Non-final Office Action for U.S. Appl. No. 12/818,986 mailed Oct. 4, 2013, 19 pages.
Notice of Allowance for U.S. Appl. No. 12/641,617 mailed Sep. 4, 2013, 9 pages.
Examination Report for European patent application 09789090.9-2216 mailed Aug. 29, 2011, 4 pages.
Examination Report for European patent application 09789090.9-2216 mailed Mar. 30, 2012, 6 pages.
Written Opinion of the International Searching Authority for International patent application PCT/US2009004548, mailed Apr. 5, 2011, 6 pages.
European Search Report for European patent application 09789090.9-2217 mailed Jan. 24, 2013, 5 pages.
Notice of Allowance for U.S. Appl. No. 13/090,621 mailed Apr. 22, 2013, 8 pages.
Final Office Action for U.S. Appl. No. 12/953,039 mailed May 1, 2013, 8 pages.
Final Office Action for U.S. Appl. No. 12/953,118 mailed May 3, 2013, 11 pages.
Final Office Action for U.S. Appl. No. 12/915,682 mailed Apr. 18, 2013, 9 pages.
Advisory Action for U.S. Appl. No. 12/952,960 mailed May 15, 2013, 2 pages.
Non-final Office Action for U.S. Appl. No. 12/952,960 mailed Jun. 20, 2013, 13 pages.
Non-final Office Action for U.S. Appl. No. 12/953,536 mailed Jun. 6, 2013, 21 pages.
Non-final Office Action for U.S. Appl. No. 11/820,300 mailed Apr. 25, 2012, 10 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Final Office Action for U.S. Appl. No. 12/871,052 mailed Jul. 1, 2013, 12 pages.
Non-final Office Action for U.S. Appl. No. 12/940,699 mailed Jun. 26, 2013, 9 pages.
Notice of Allowance for U.S. Appl. No. 13/090,621 mailed Jun. 25, 2013, 8 pages.
International Search Report and Written Opinion for PCT/US2011/035683 mailed Sep. 8, 2011, 15 pages.
International Search Report and Written Opinion for PCT/US2010/039218 mailed Oct. 27, 2010, 13 pages.
International Search Report and Written Opinion for PCT/US2011/035684 mailed Jul. 1, 2011, 11 pages.
International Search Report and Written Opinion for PCT/US11/61754 mailed Mar. 26, 2012, 9 pages.
First Office Action for Chinese patent application 201080032453.2 issued Mar. 26, 2013, 6 pages.
Chinese Search Report for Chinese patent application 201080032453.2 mailed May 15, 2013, 2 pages.
First Office Action for Chinese patent application 201080031621.6 mailed Sep. 26, 2013, 9 pages.
Chinese Search Report for Chinese patent application 201080031621.6 mailed Sep. 13, 2013, 2 pages.
Ramdas, "Modern File Systems and Storage," Proceedings of the 2nd International Sane Conference, May 22-25, 2000, MECC, Maastricht, The Netherlands, Copyright Rodney R. Ramdas, 10 pages.
Author Unknown, "144 Fiber Patch Panel 1U," Technical Data, ADTEK Group Limited, 2009, 2 pages.
Non-final Office Action for U.S. Appl. No. 13/603,894 mailed Oct. 3, 2013, 9 pages.
Advisory Action for U.S. Appl. No. 12/394,114 mailed Jan. 2, 2014, 3 pages.
Notice of Allowance for U.S. Appl. No. 12/871,052 mailed Dec. 24, 2013, 9 pages.
Final Office Action for U.S. Appl. No. 12/953,039 mailed Dec. 27, 2013, 10 pages.
Advisory Action for U.S. Appl. No. 12/952,960 mailed Jan. 8, 2014, 3 pages.
Advisory Action for U.S. Appl. No. 12/952.912 mailed Nov. 26, 2013, 3 pages.
Examiner's Answer to the Appeal Brief for U.S. Appl. No. 12/953,118 mailed Dec. 3, 2013, 6 pages.
Non-final Office Action for U.S. Appl. No. 13/597,549 mailed Jan. 14, 2014, 9 pages.
Final Office Action for U.S. Appl. No. 12/732,487 mailed Dec. 6, 2013, 24 pages.
Final Office Action for U.S. Appl. No. 12/956,446 mailed Dec. 23, 2013, 12 pages.
Non-final Office Action for U.S. Appl. No. 12/953,536 mailed Dec. 17, 2013, 21 pages.
Non-final Office Action for U.S. Appl. No. 12/819,065 mailed Dec. 3, 2013, 8 pages.
International Search Report and Written Opinion for PCT/US2011/062353 mailed Apr. 10, 2012, 15 pages.
Non-final Office Action for U.S. Appl. No. 13/901,074 mailed Oct. 9, 2013, 6 pages.
Advisory Action for U.S. Appl. No. 12/953,134 mailed Nov. 4, 2013, 3 pages.
Final Office Action for U.S. Appl. No. 12/952,960 mailed Oct. 29, 2013, 8 pages.
Notice of Allowance for U.S. Appl. No. 13/292,130 mailed Oct. 18, 2013, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/956,446 mailed Sep. 6, 2013, 10 pages.

* cited by examiner

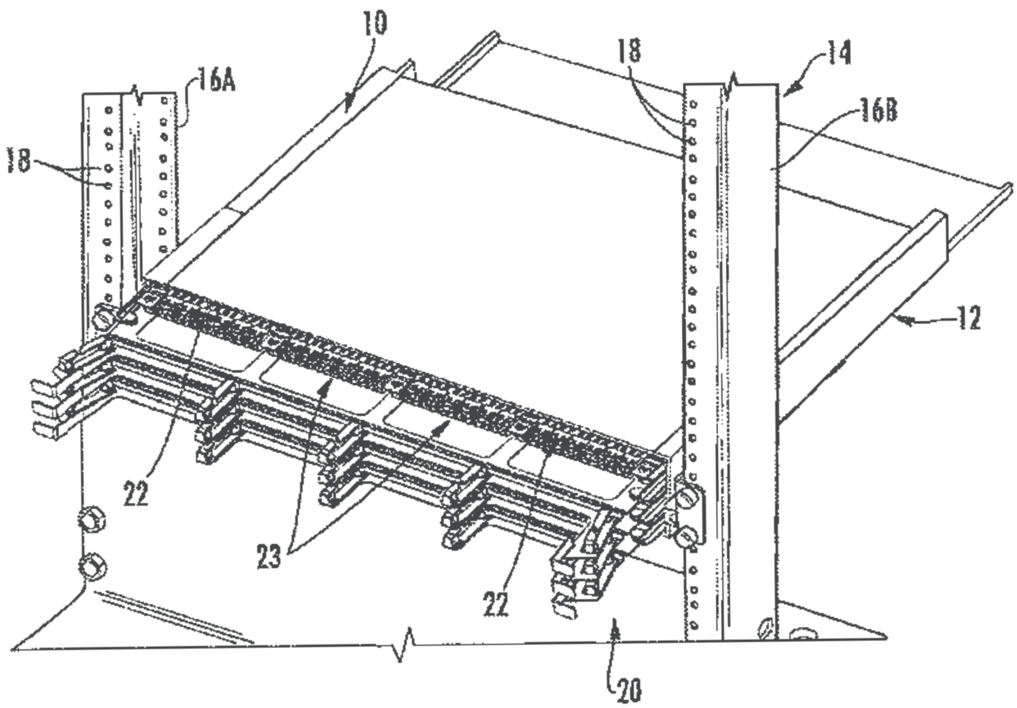


FIG. 1

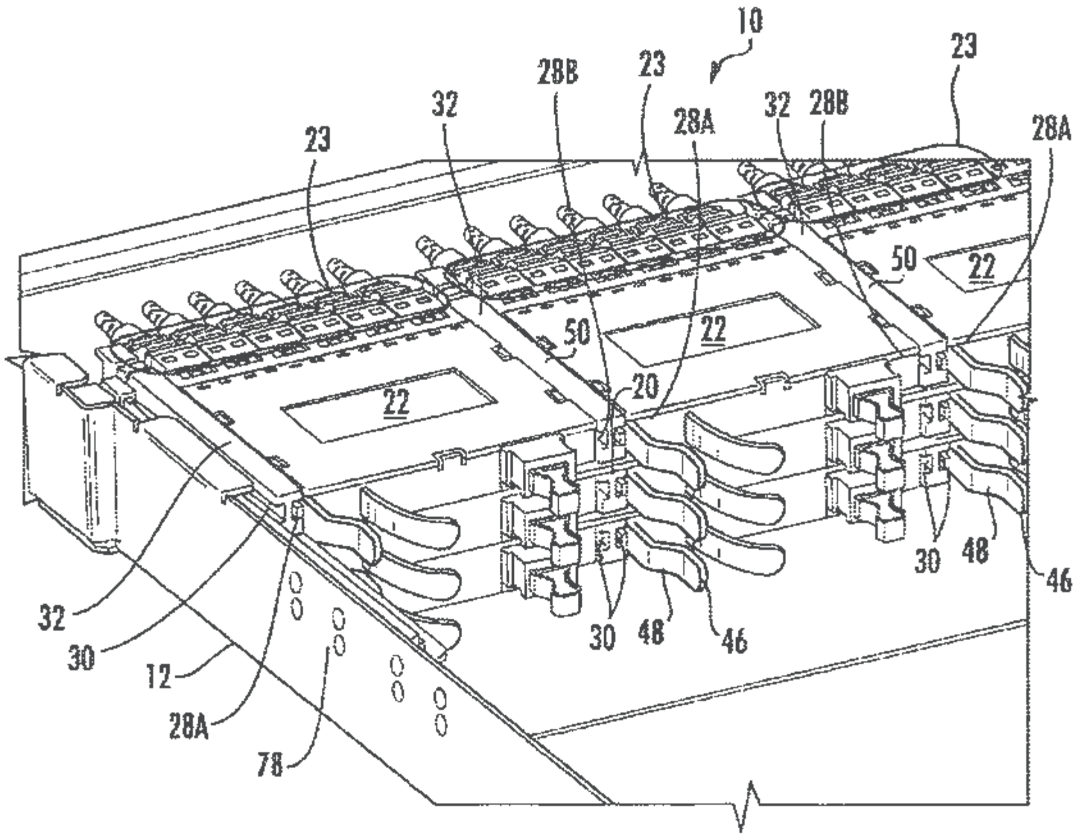

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FIG. 2

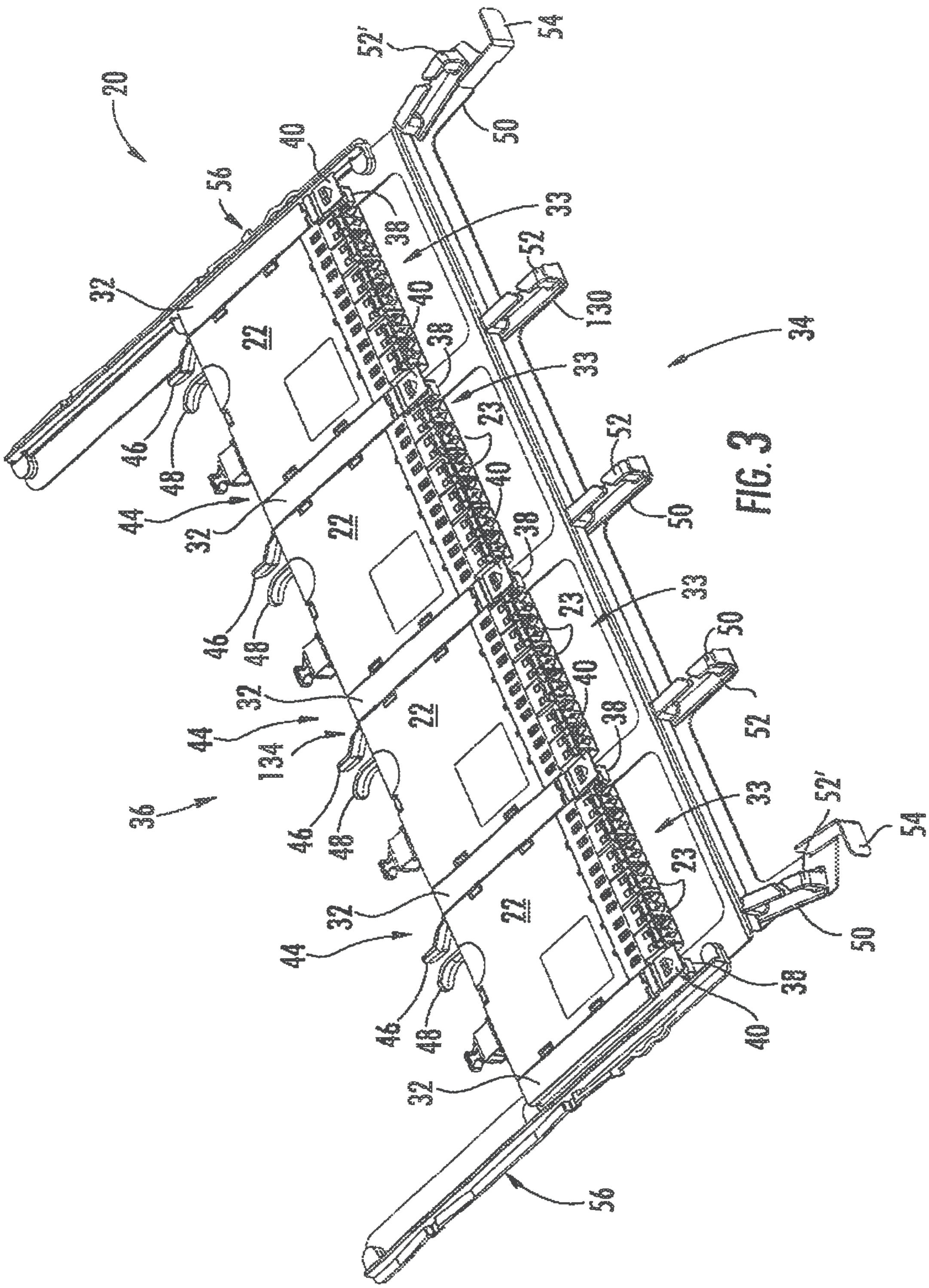
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FIG. 3

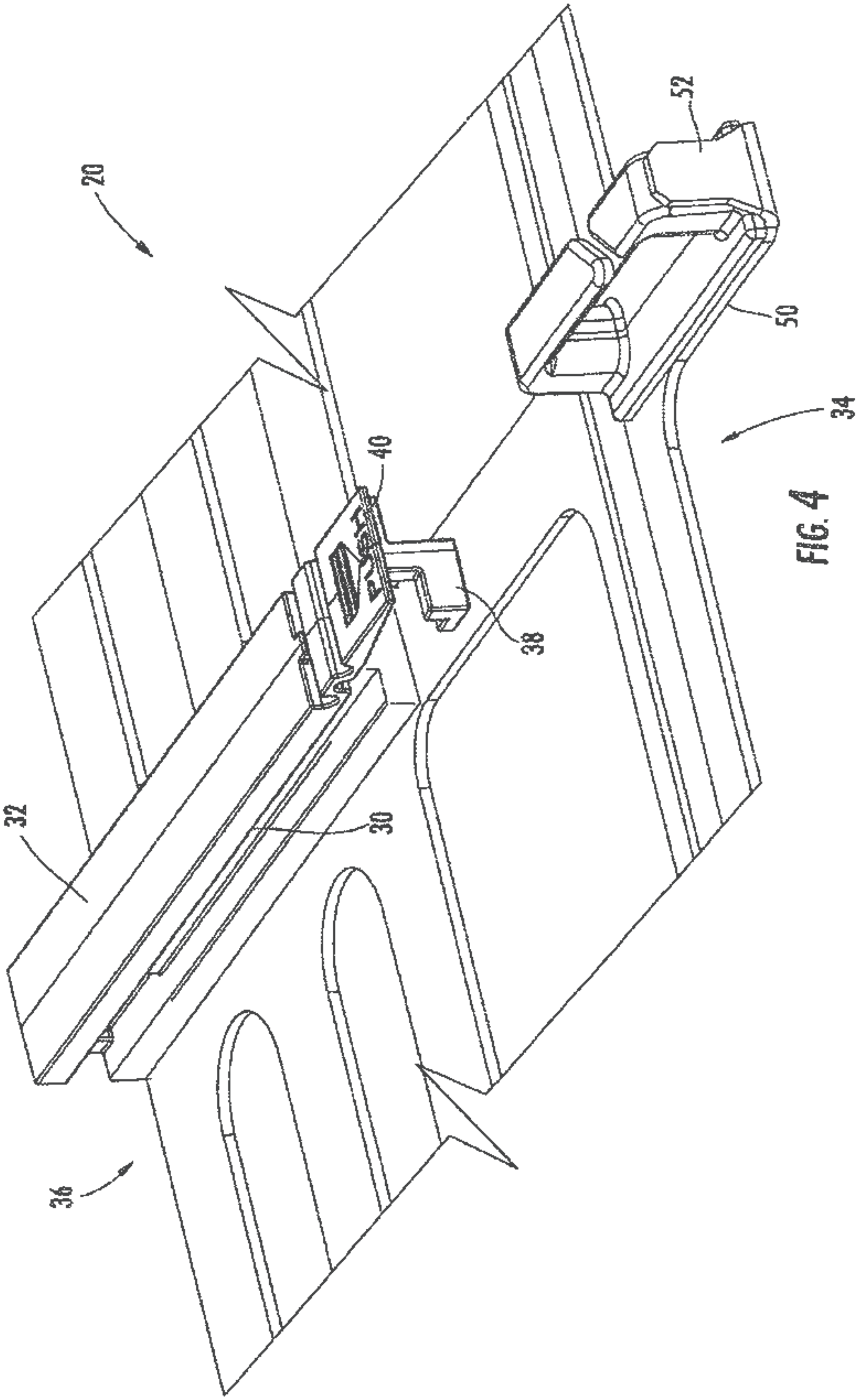
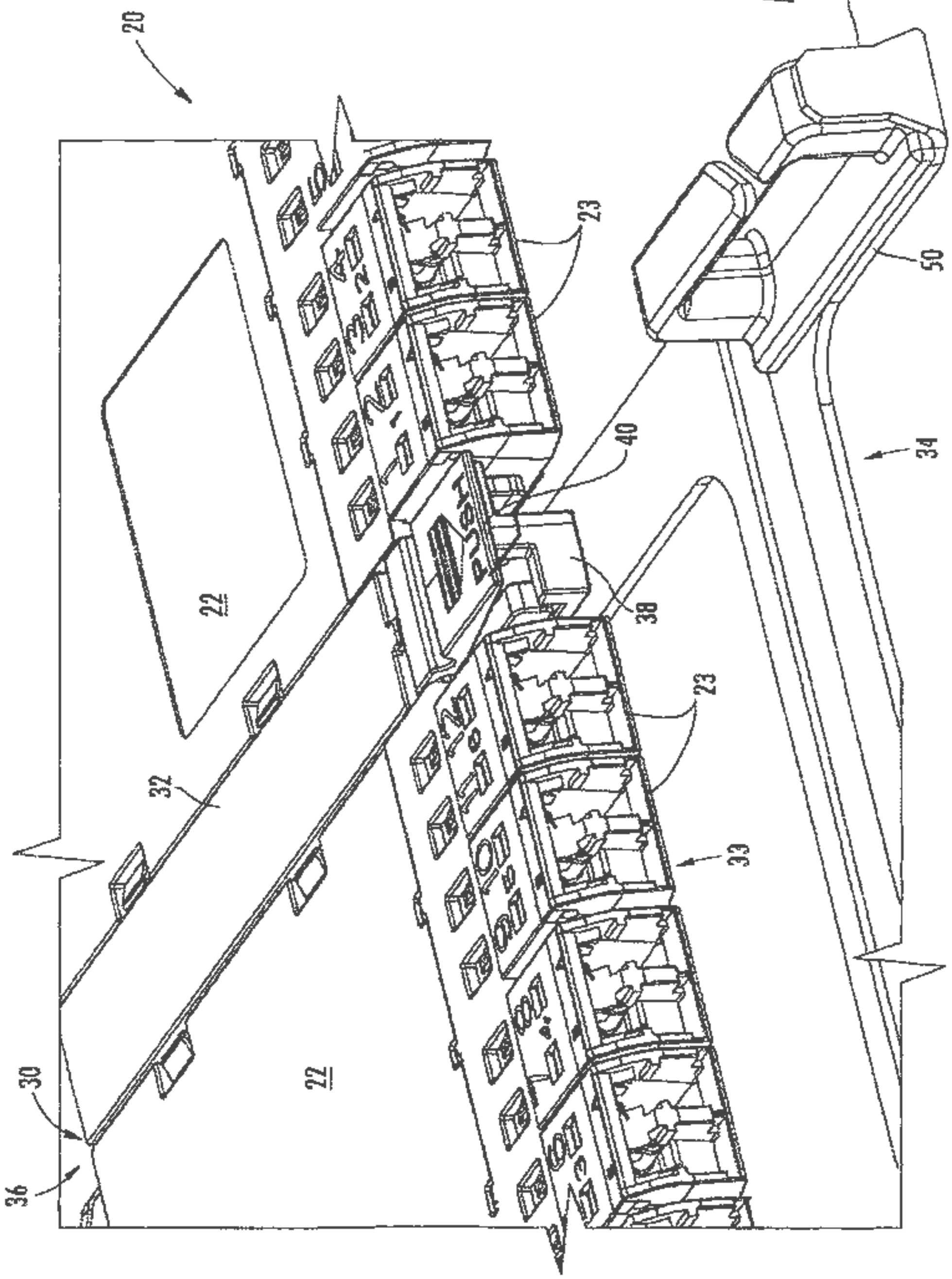


FIG. 4

FIG. 5



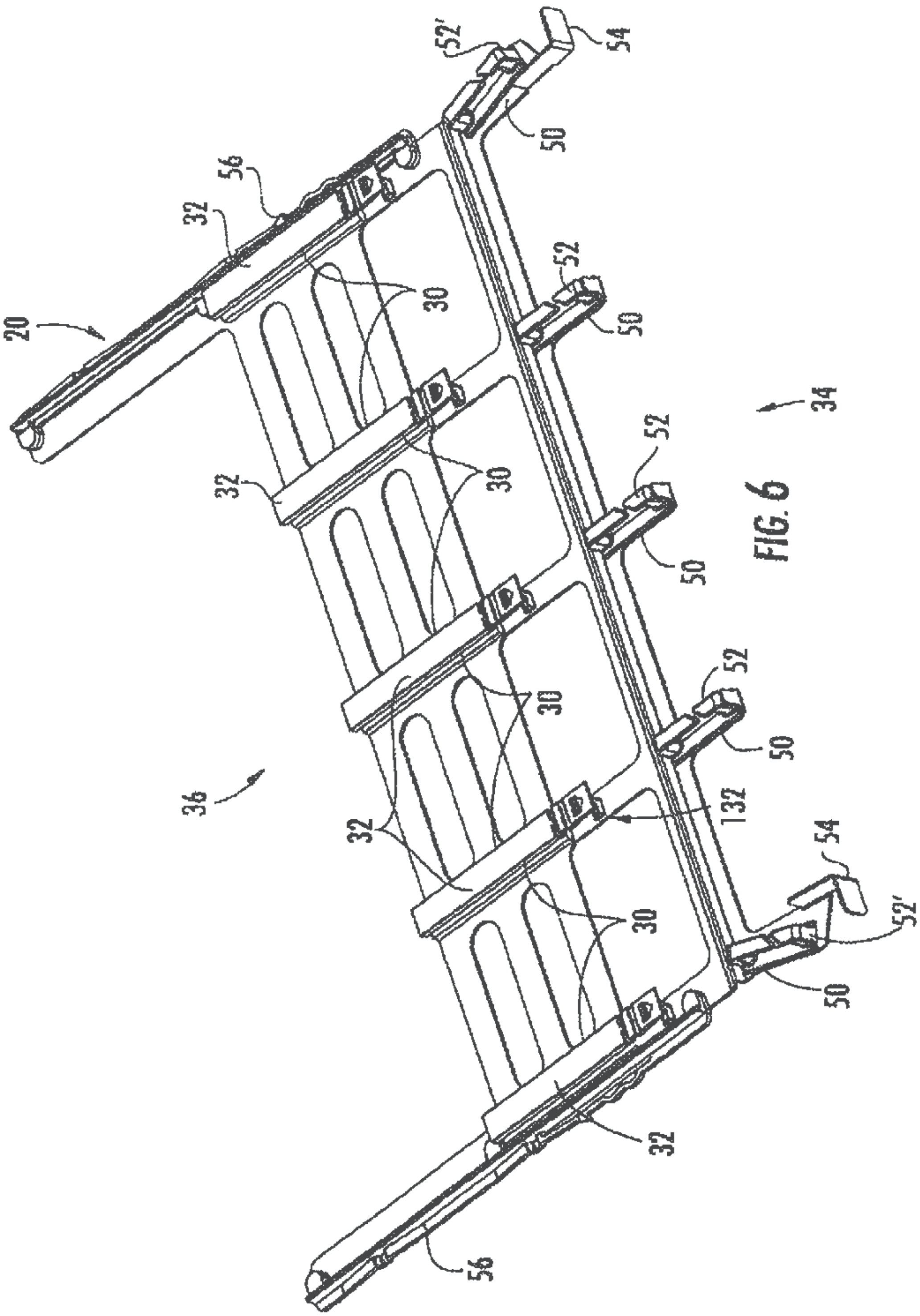
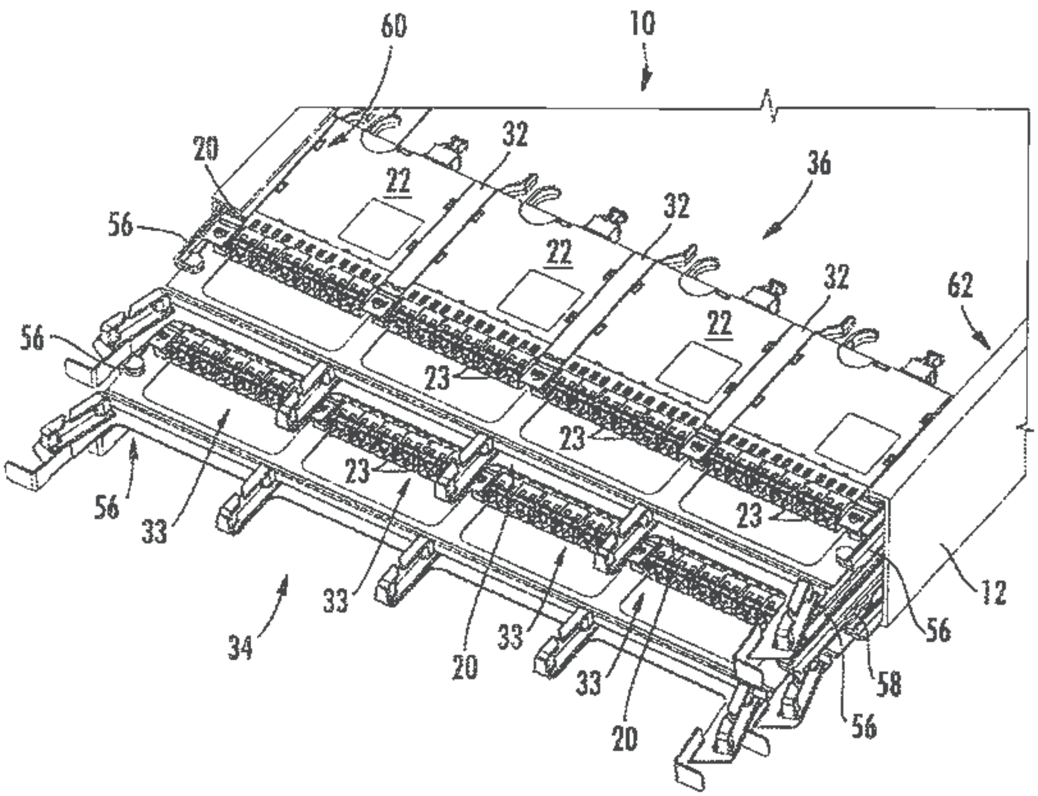


FIG. 6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20
33
33
12
56
34
20
58
56
20

FIG. 7

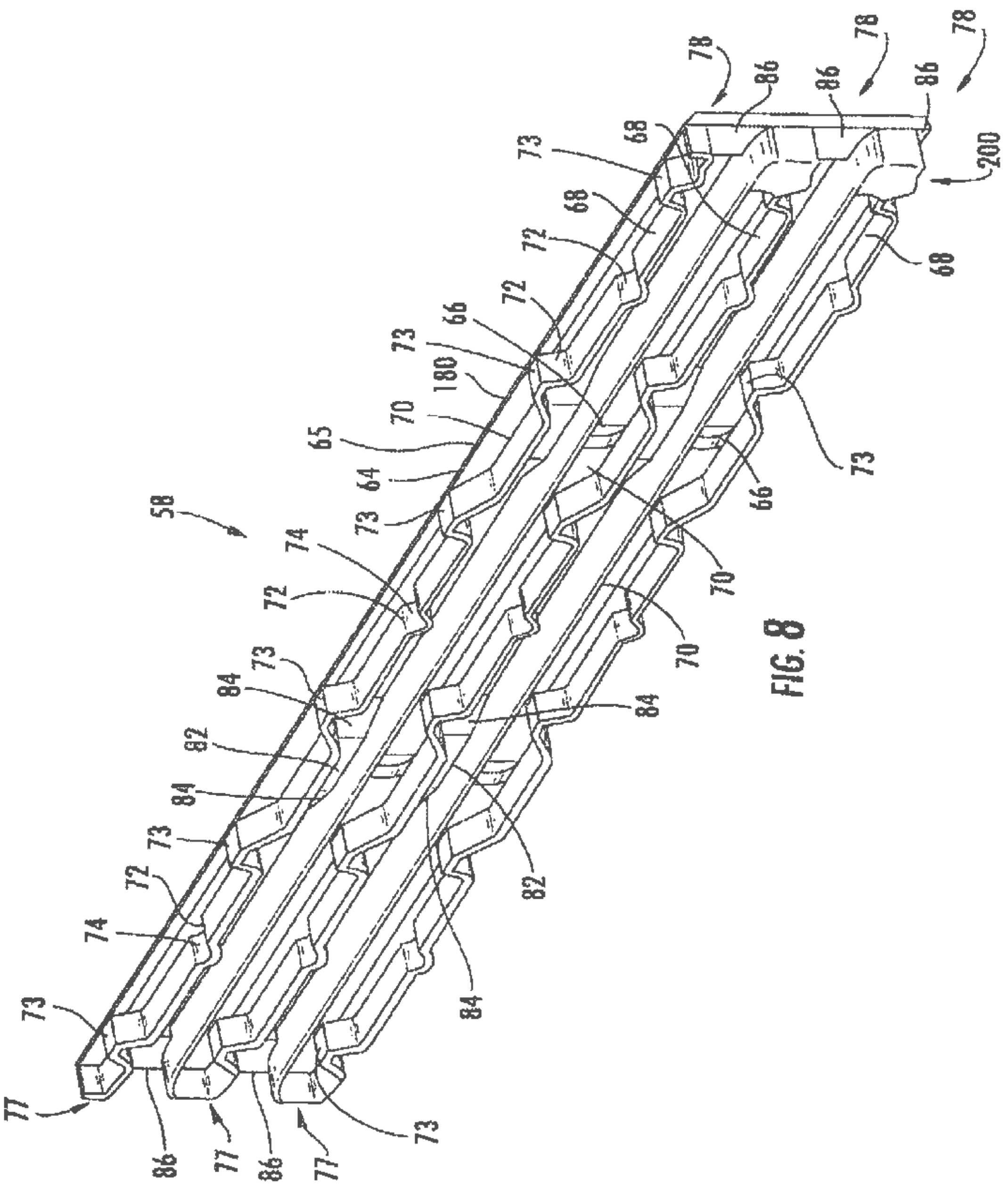

78
78
78
86
86
86
200
68
73
68
72
72
68
66
73
180
70
65
64
73
58
74
72
73
84
82
84
73
72
74
73
77
86
77
86
77
73
66
70
70
84
82
84
73

FIG. 8

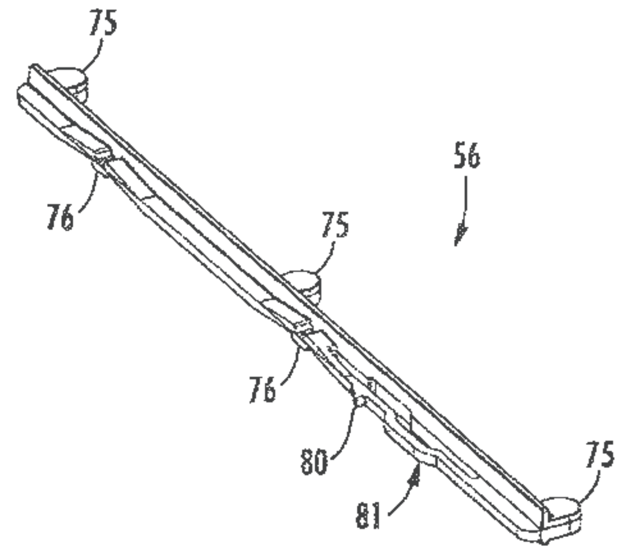


FIG. 9A

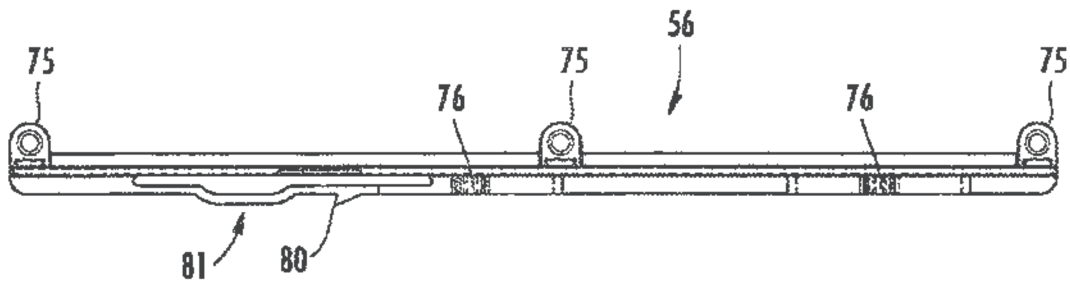


FIG. 9B

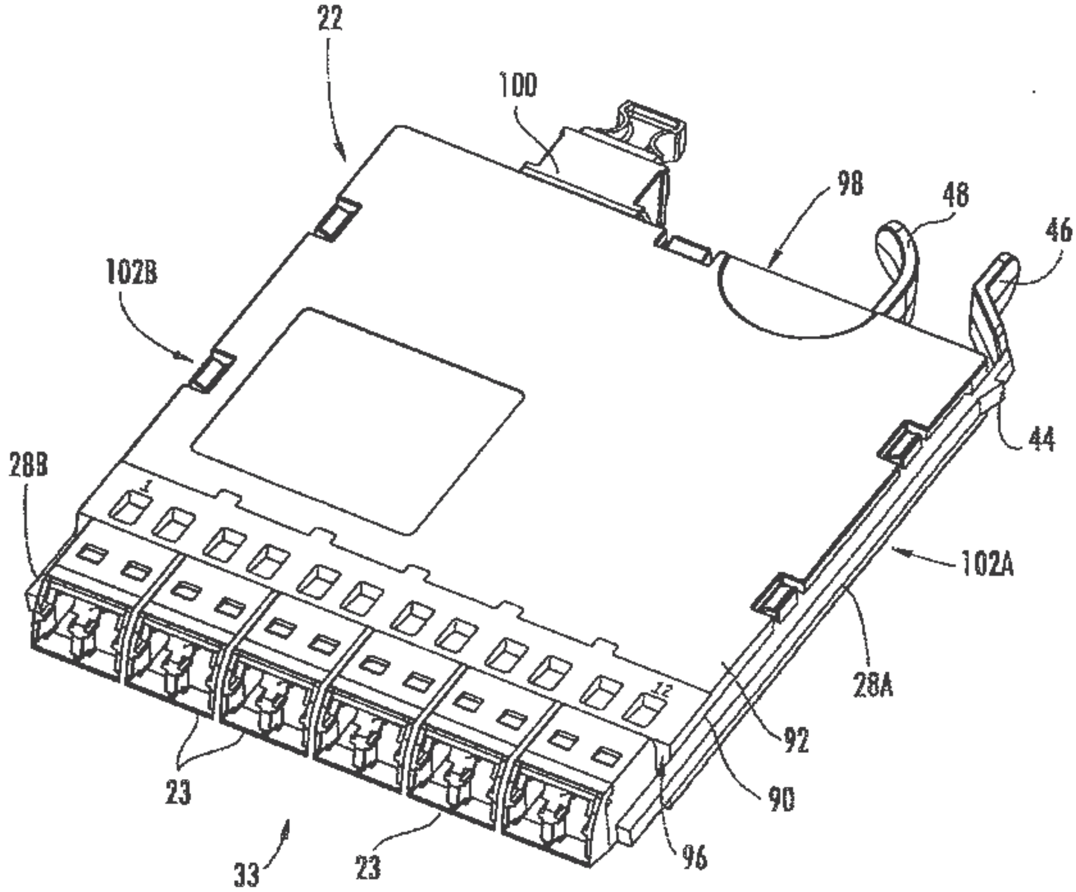


FIG. 10A

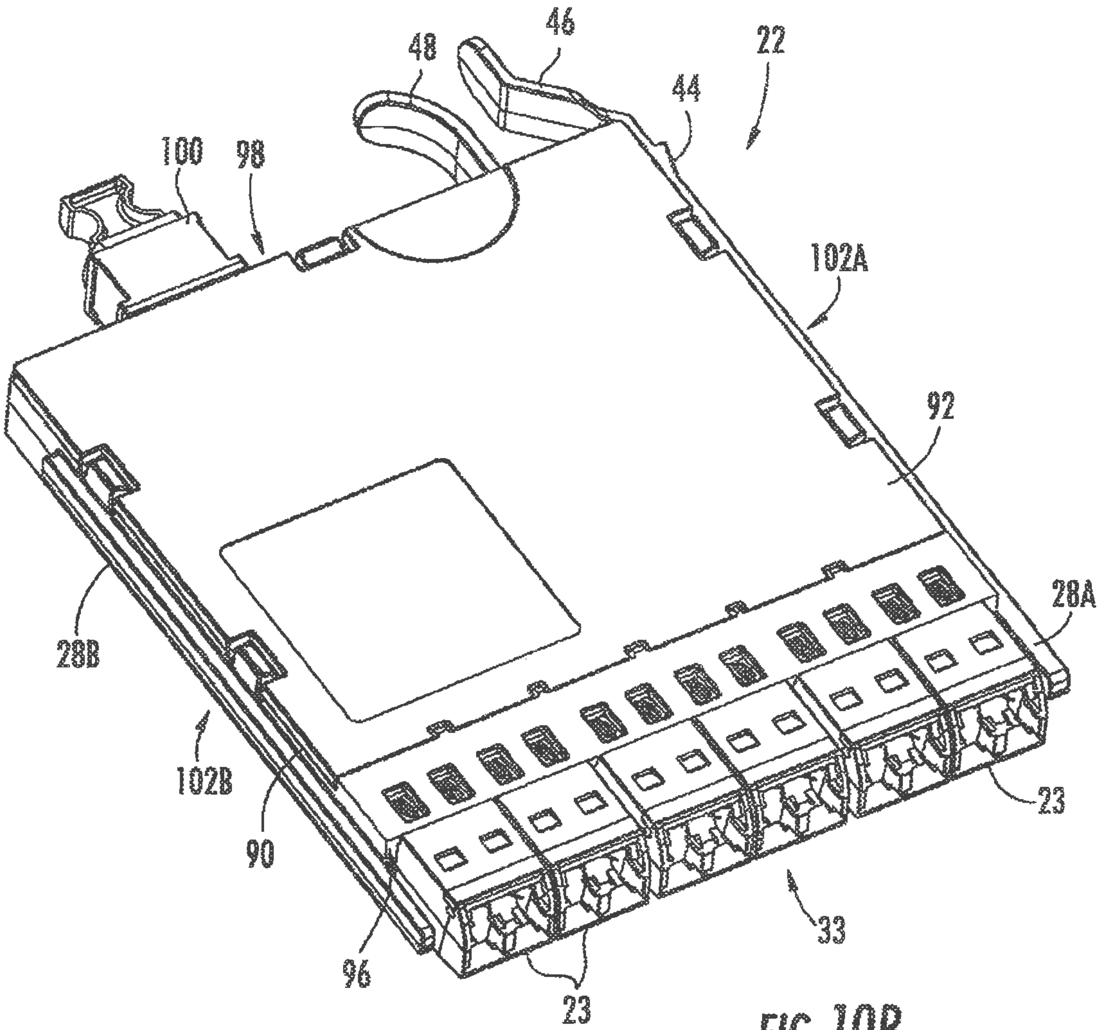


FIG. 10B

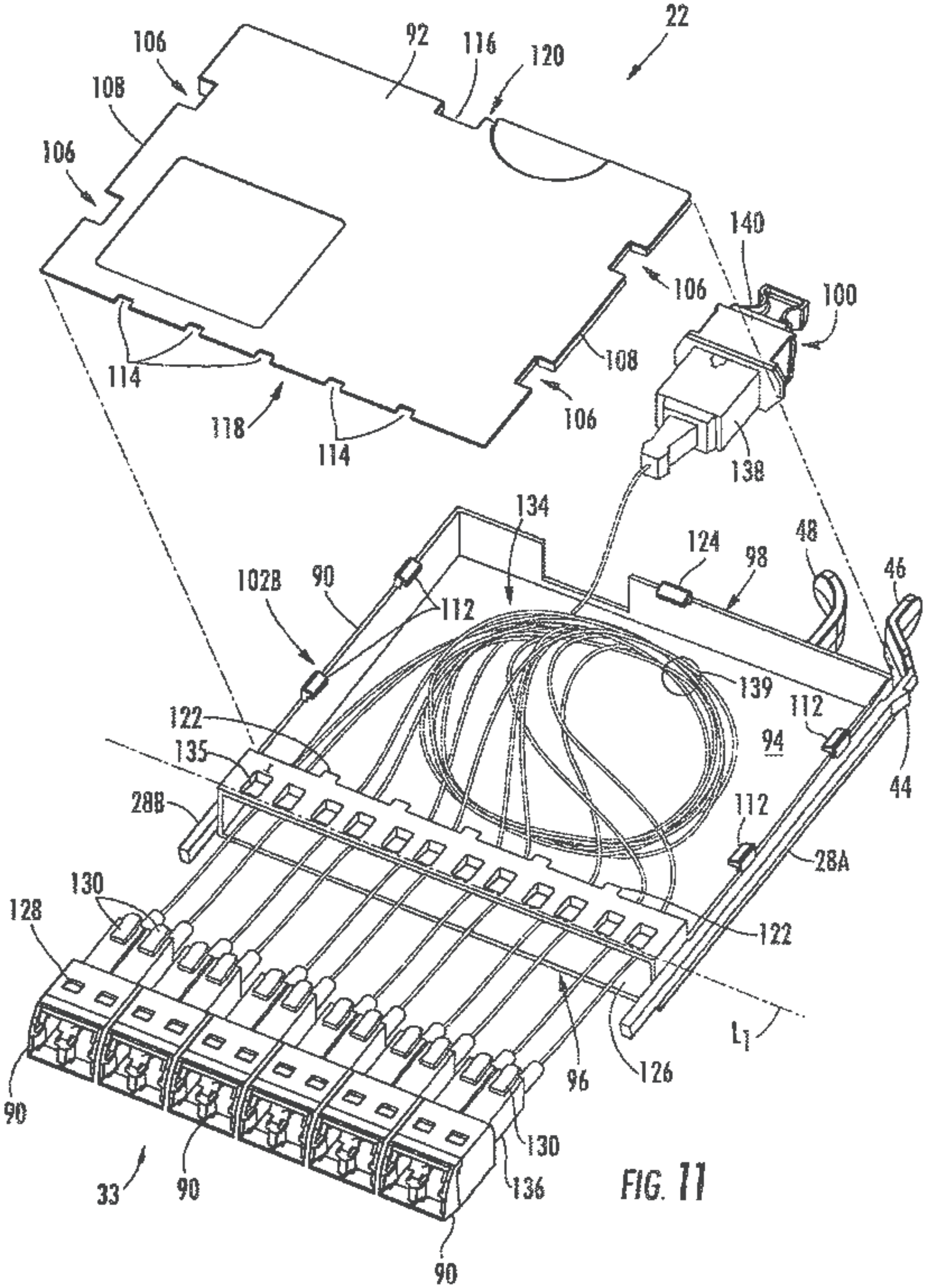

22
106
92
116
120
108
106
140
100
106
114
108
118
106
114
138
134
124
48
98
102B
90
112
46
139
122
112
135
94
288
112
28A
130
128
122
96
126
L1
90
130
33
90
136
90

FIG. 11

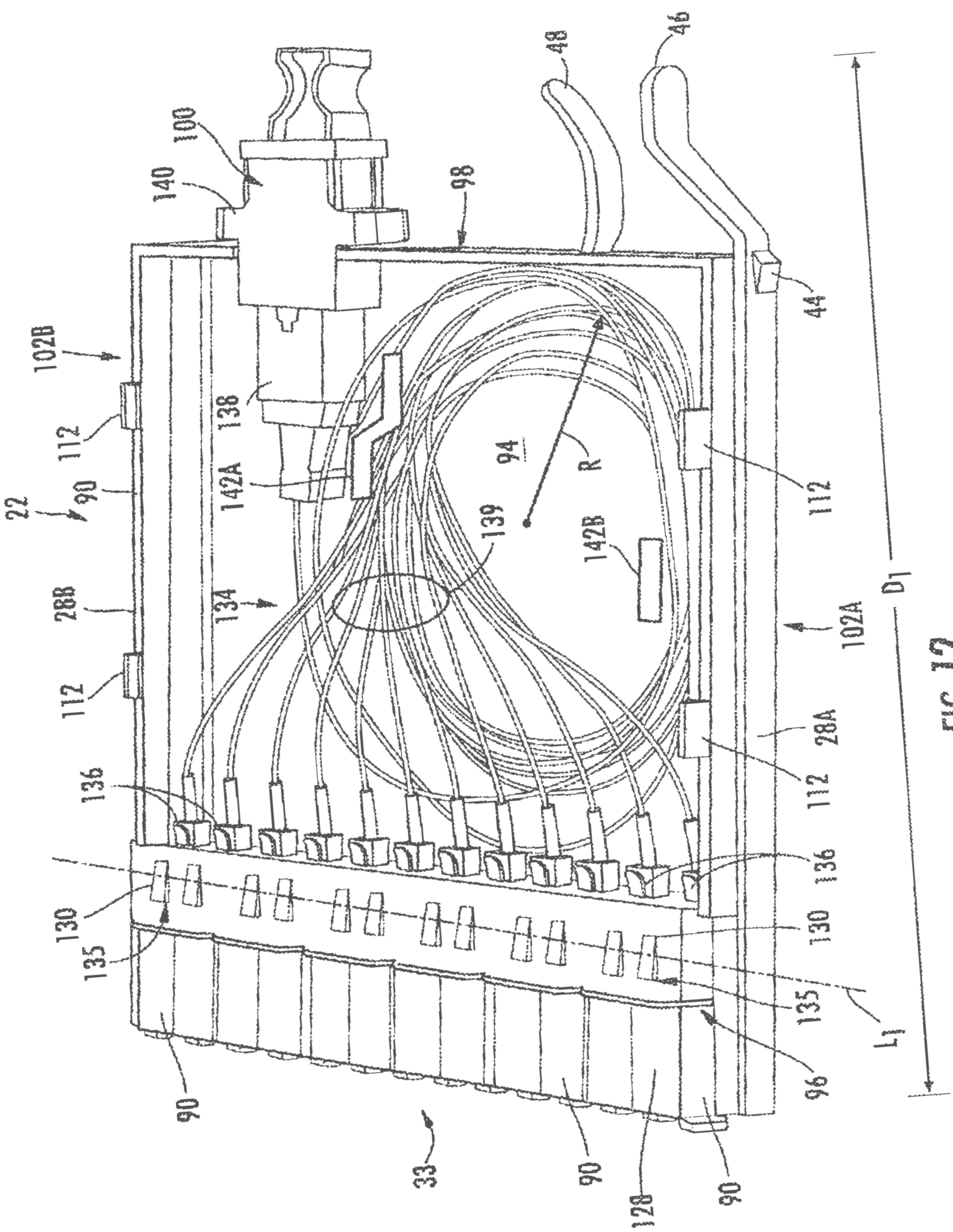
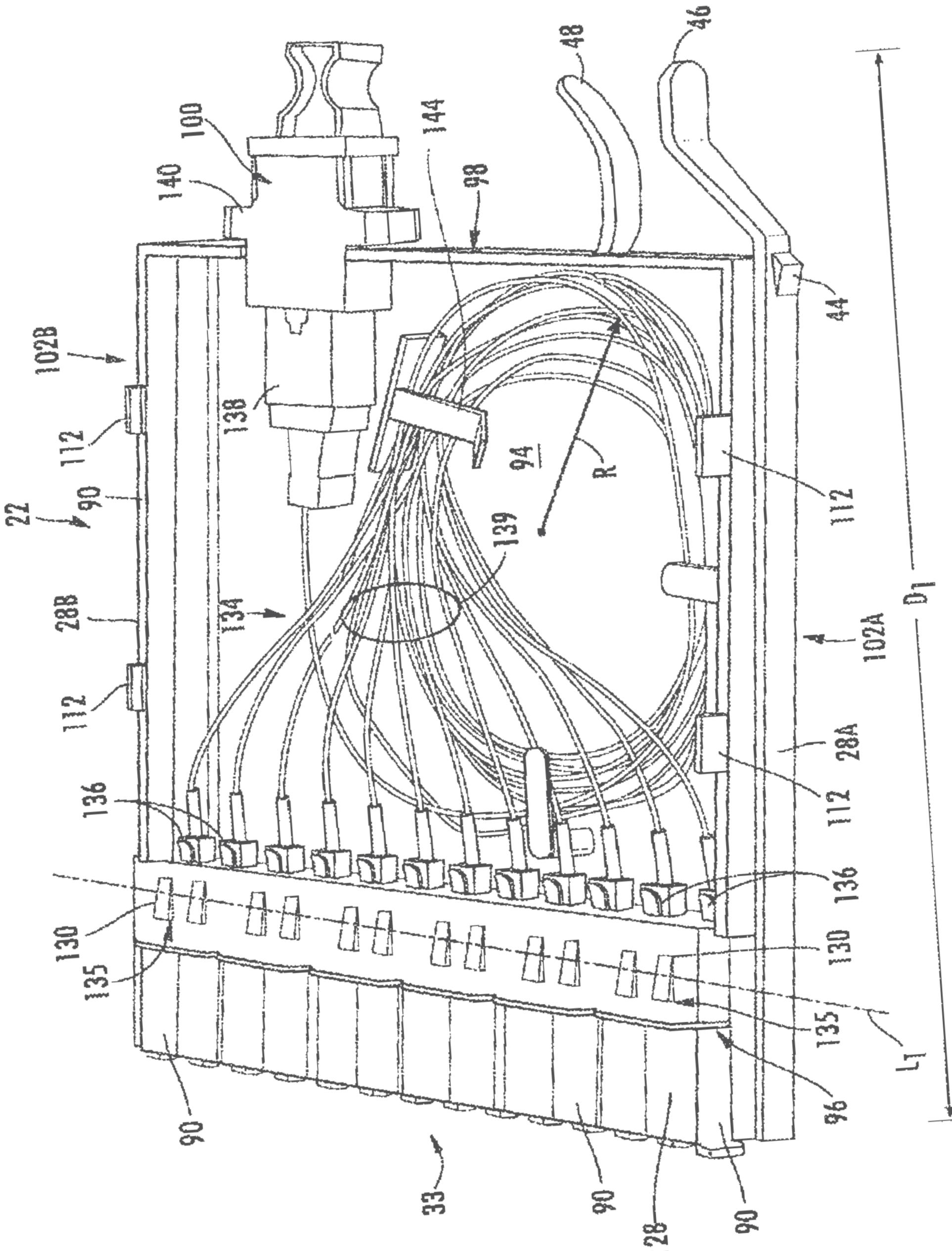

100
140
98
48
46
44
102B
138
112
90
22
142A
94
R
139
142B
28B
134
112
102A
D1
28A
136
136
130
130
135
135
L1
96
90
33
90
128
90

FIG. 12



100
140
144
98
48
46
44
102B
112
138
94
R
22
90
139
28B
134
102A
D1
112
28A
136
130
135
L1
96
33
128

FIG. 12A

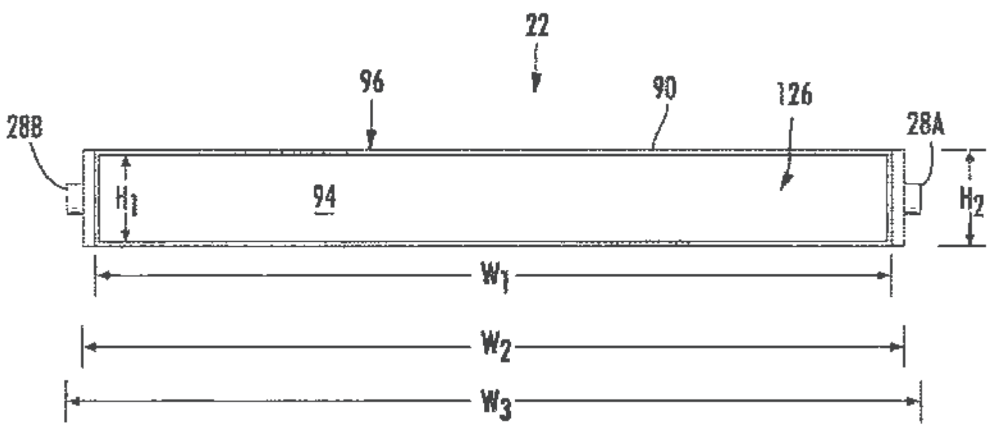


FIG. 13

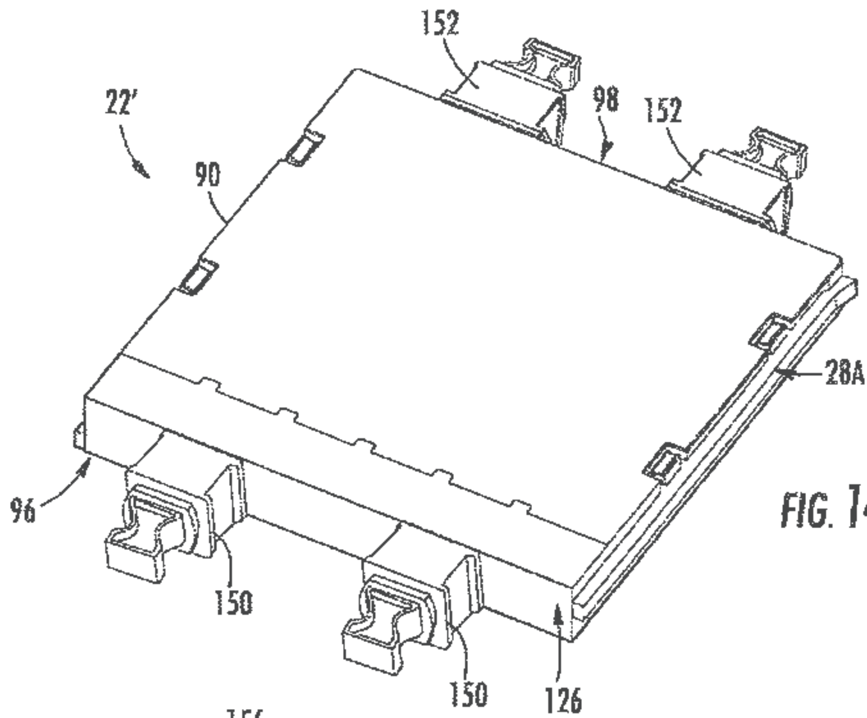

152
22'
98
152
90
28A
96
150
150
126

FIG. 14

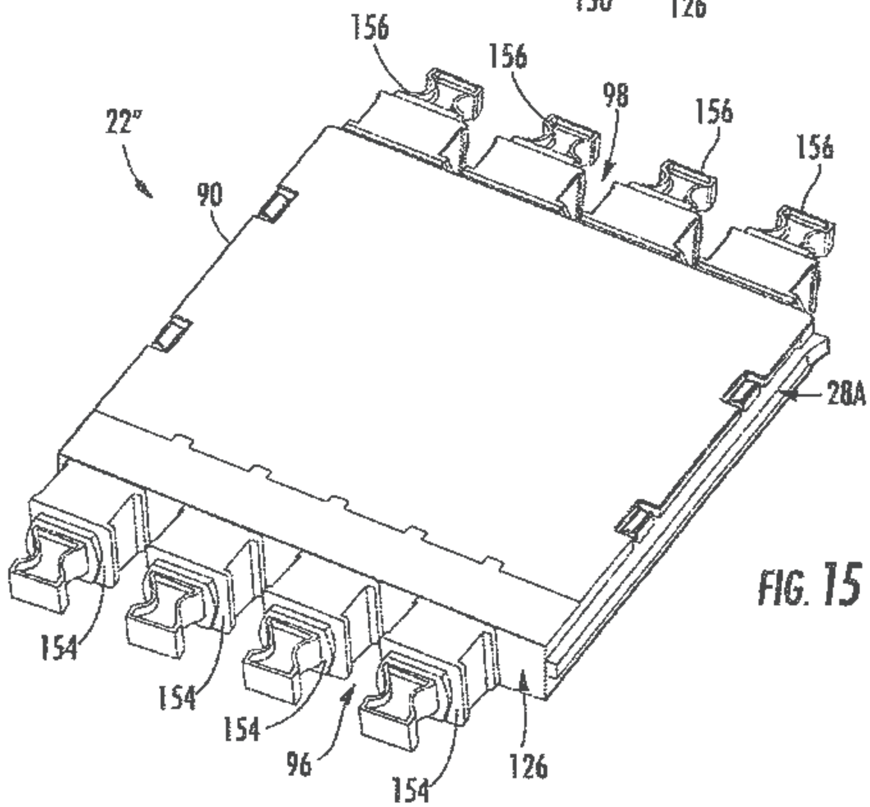
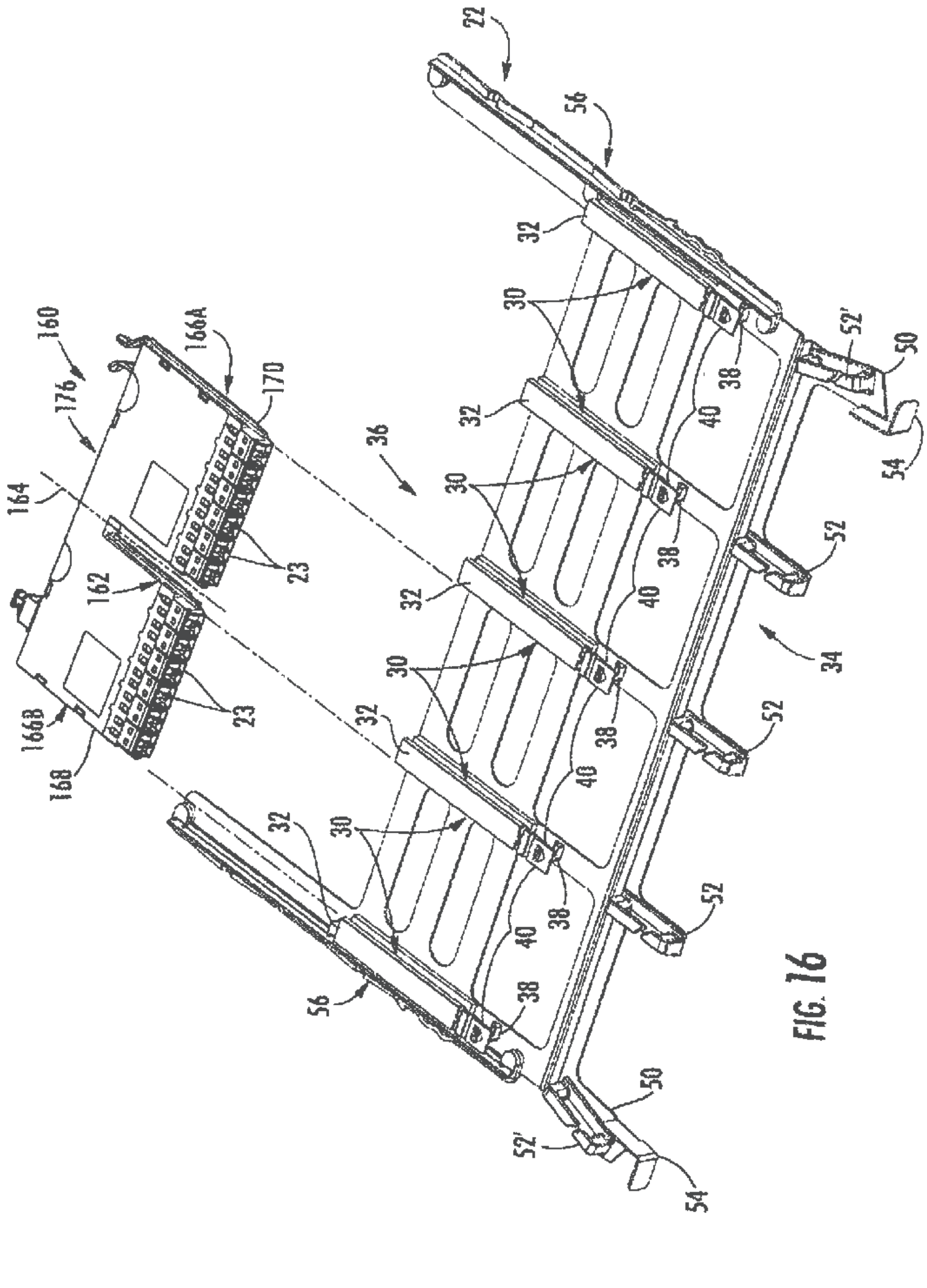

156
156
98
156
156
22"
90
28A
154
154
154
96
154
126

FIG. 15



22
56
32
30
38
40
52'
50
54
36
30
32
38
40
52
34
160
166A
176
170
164
162
23
166B
168
23
32
30
38
40
52
32
30
38
40
52
56
32
30
40
38
50
52'
54

FIG. 16

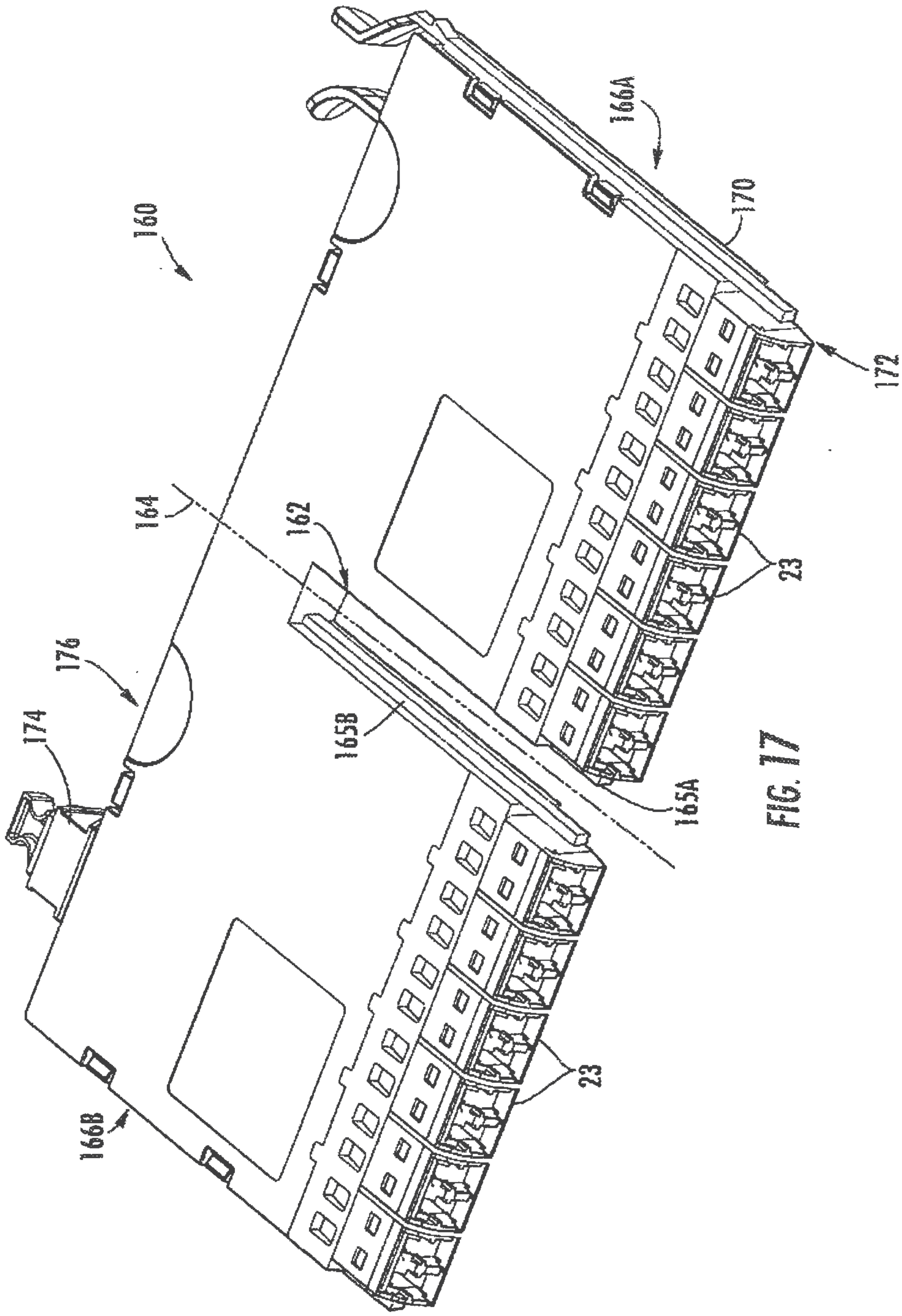


FIG. 17

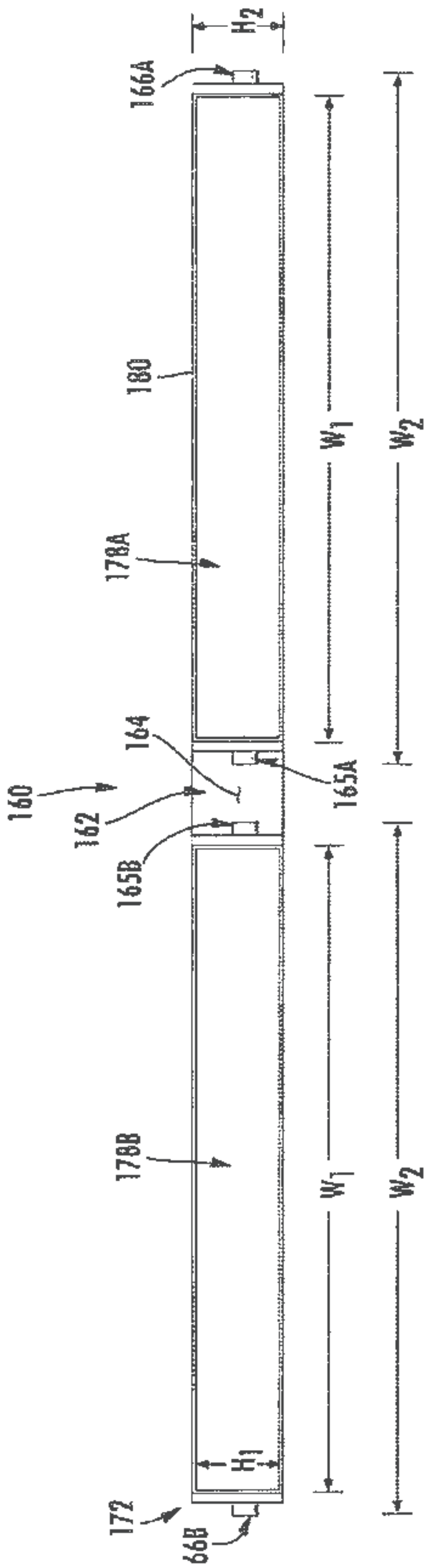

H2
166A
180
W1
W2
178A
164
165A
160
162
165B
178B
W1
W2
H1
172
166B

FIG. 18

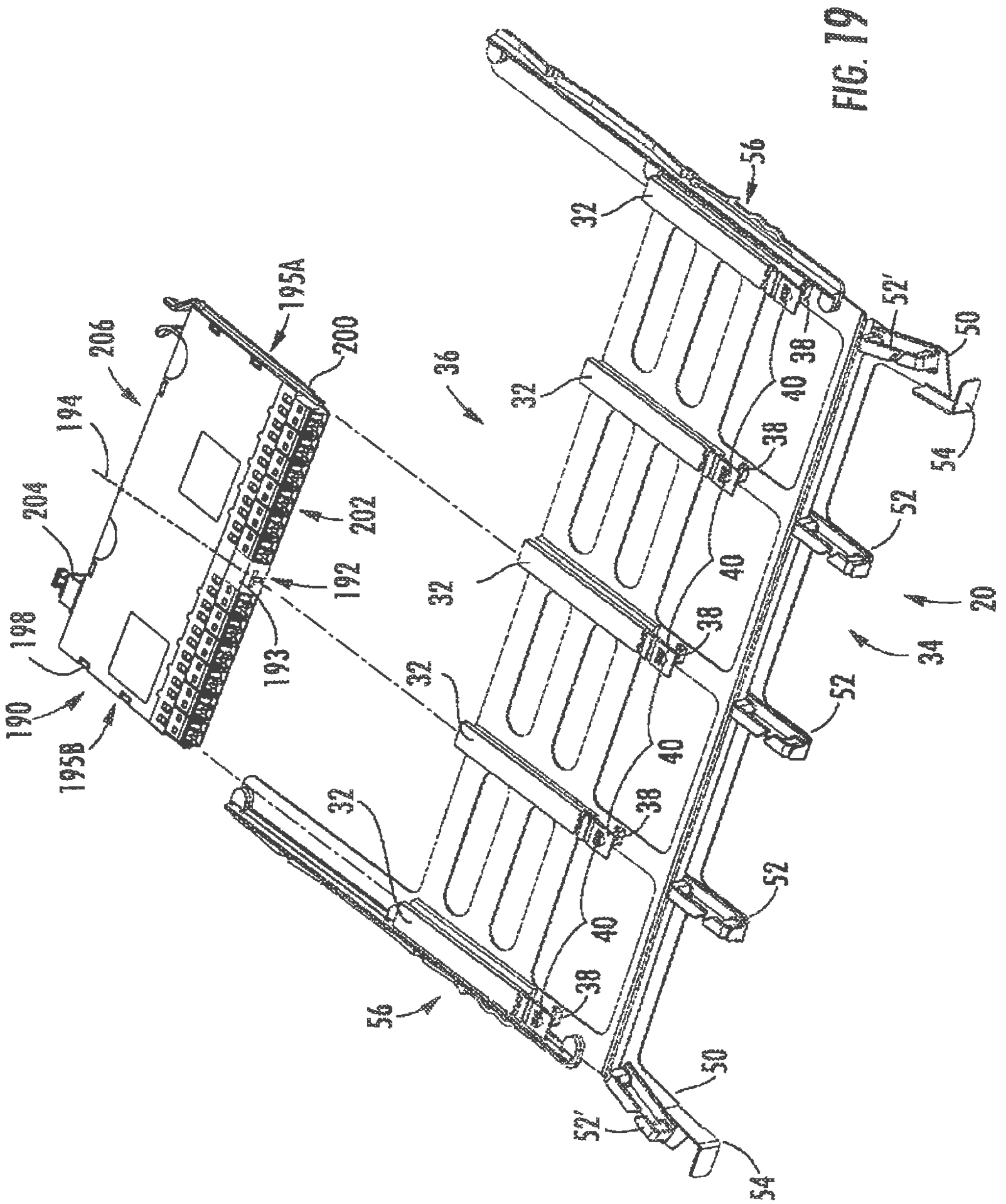

195A
206
200
194
36
32
56
204
202
192
198
193
190
195B
38
40
52'
50
54
52
20
34

FIG. 19

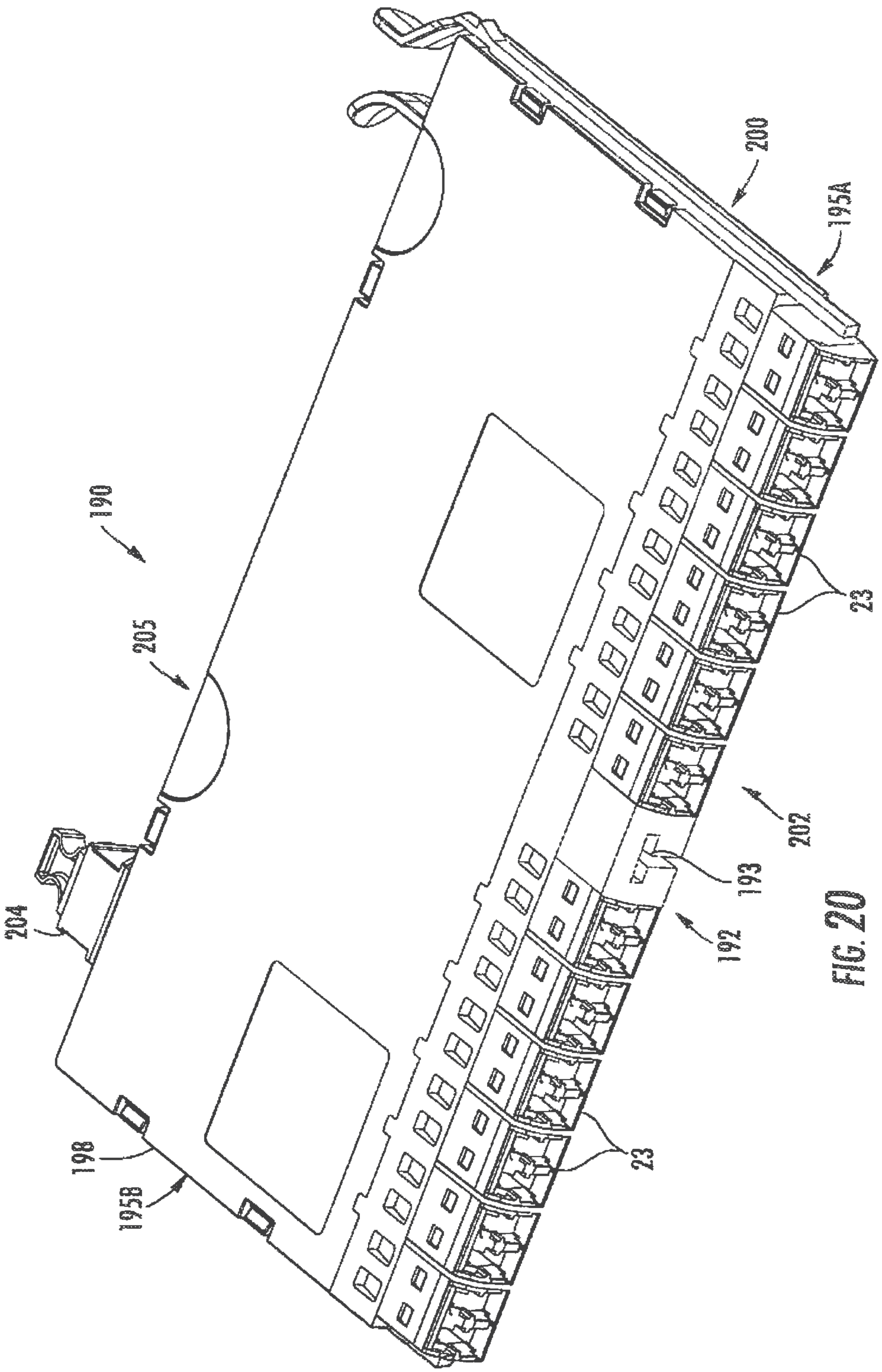


FIG. 20

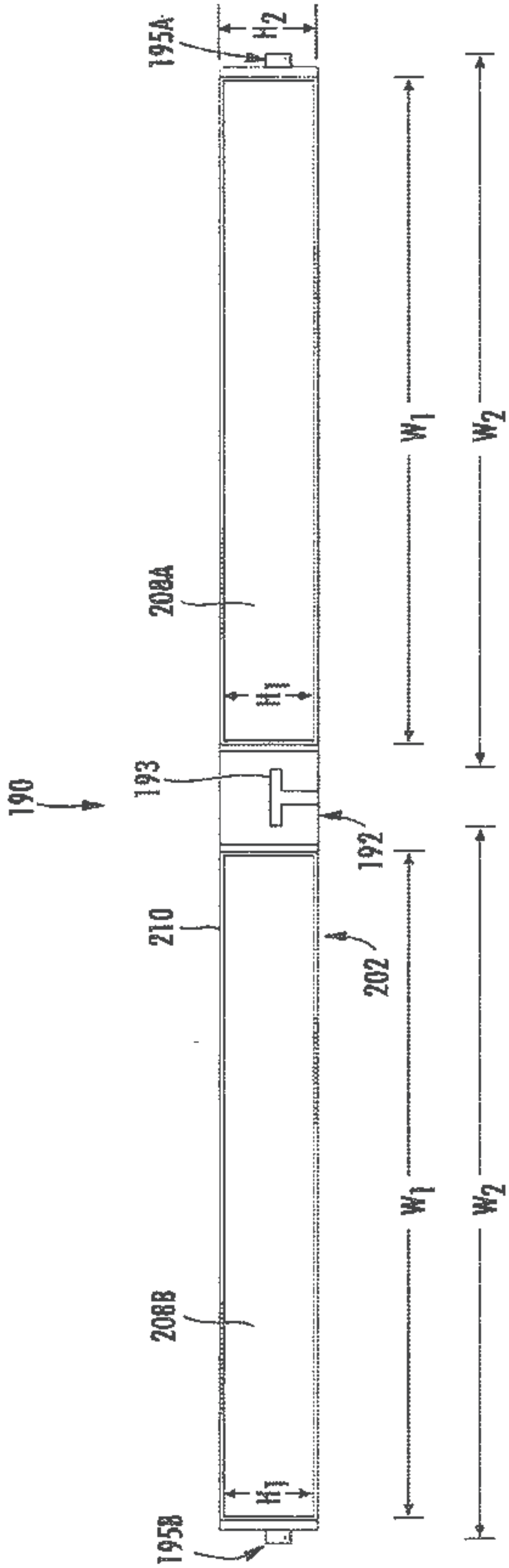


FIG. 21

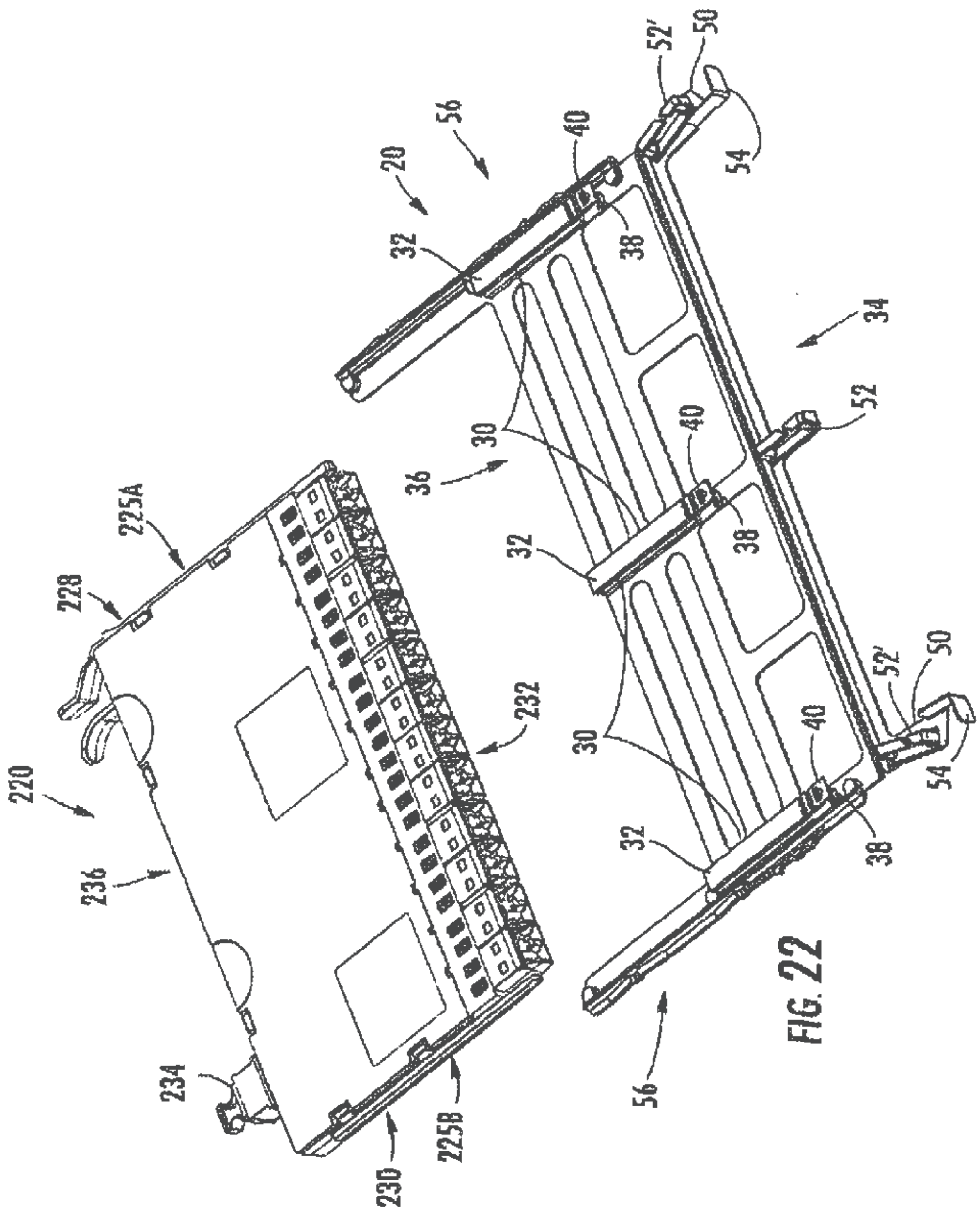

20
56
32
40
52'
50
54
38
34
30
36
52
225A
228
232
220
236
234
230
225B

FIG. 22

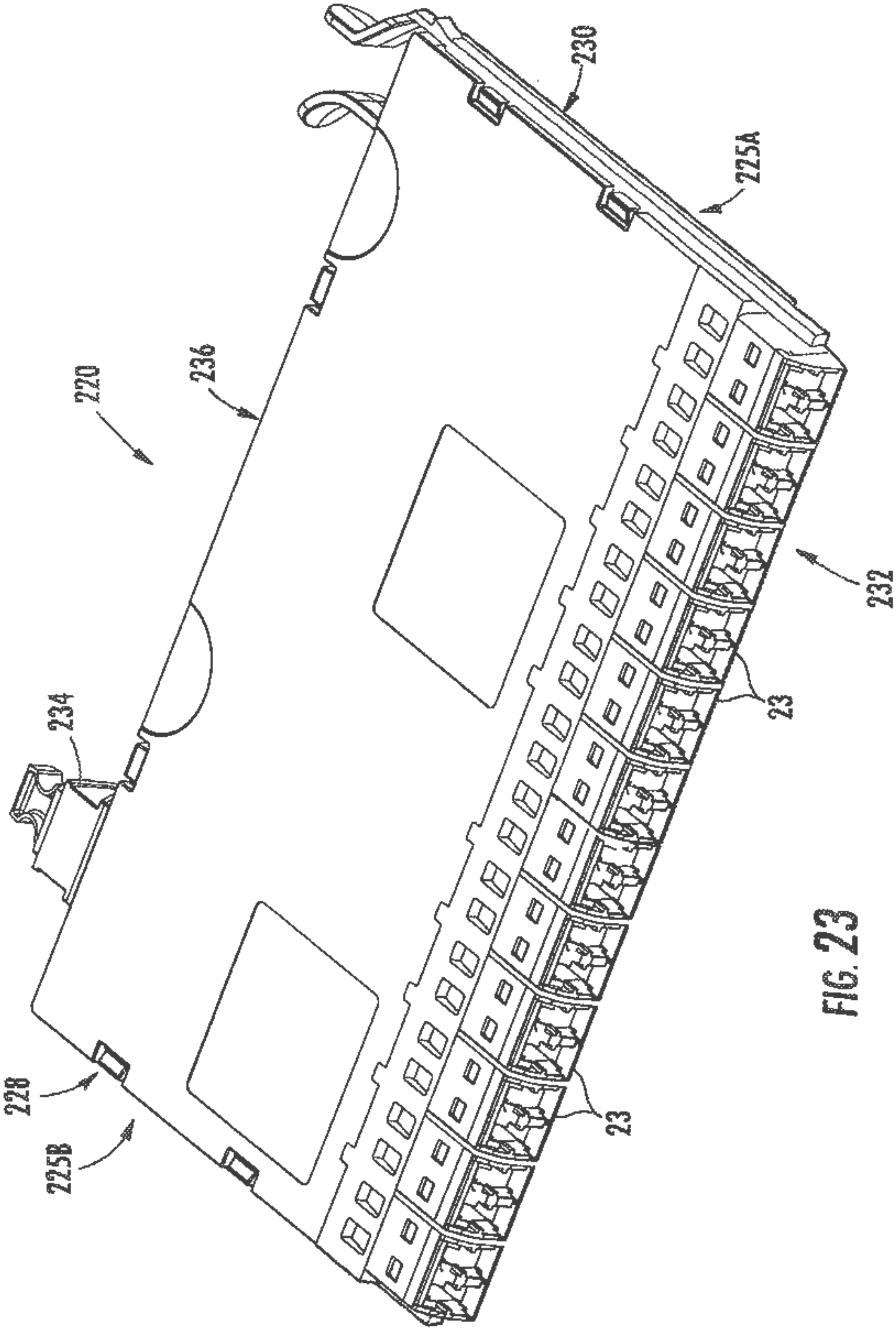


FIG. 23

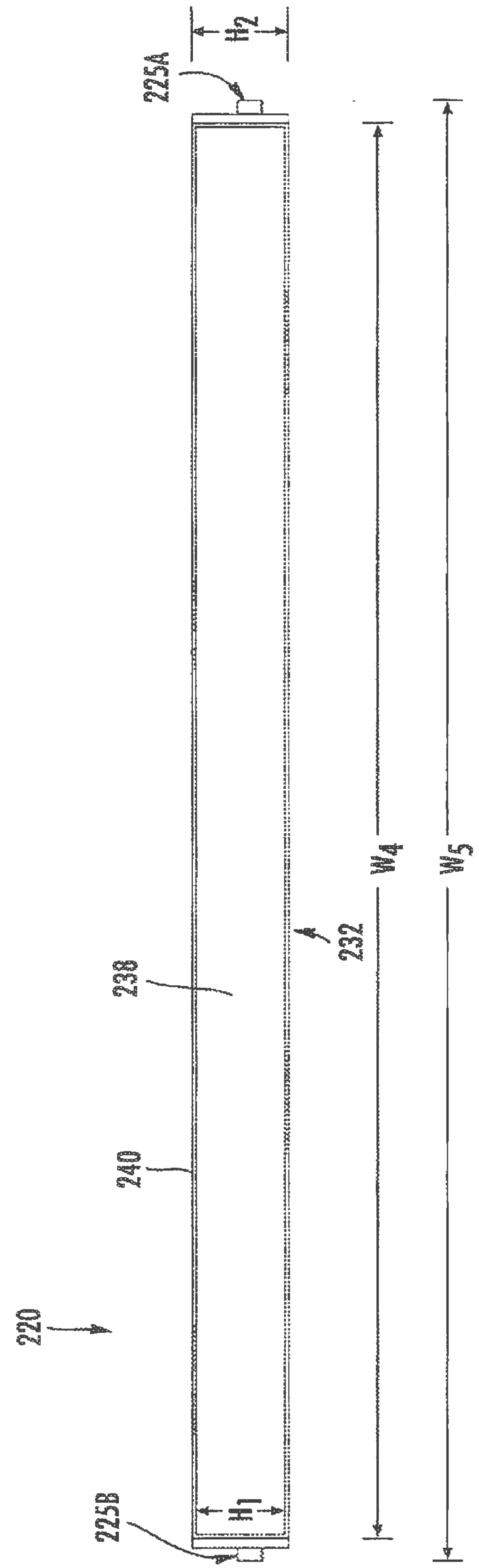


FIG. 24

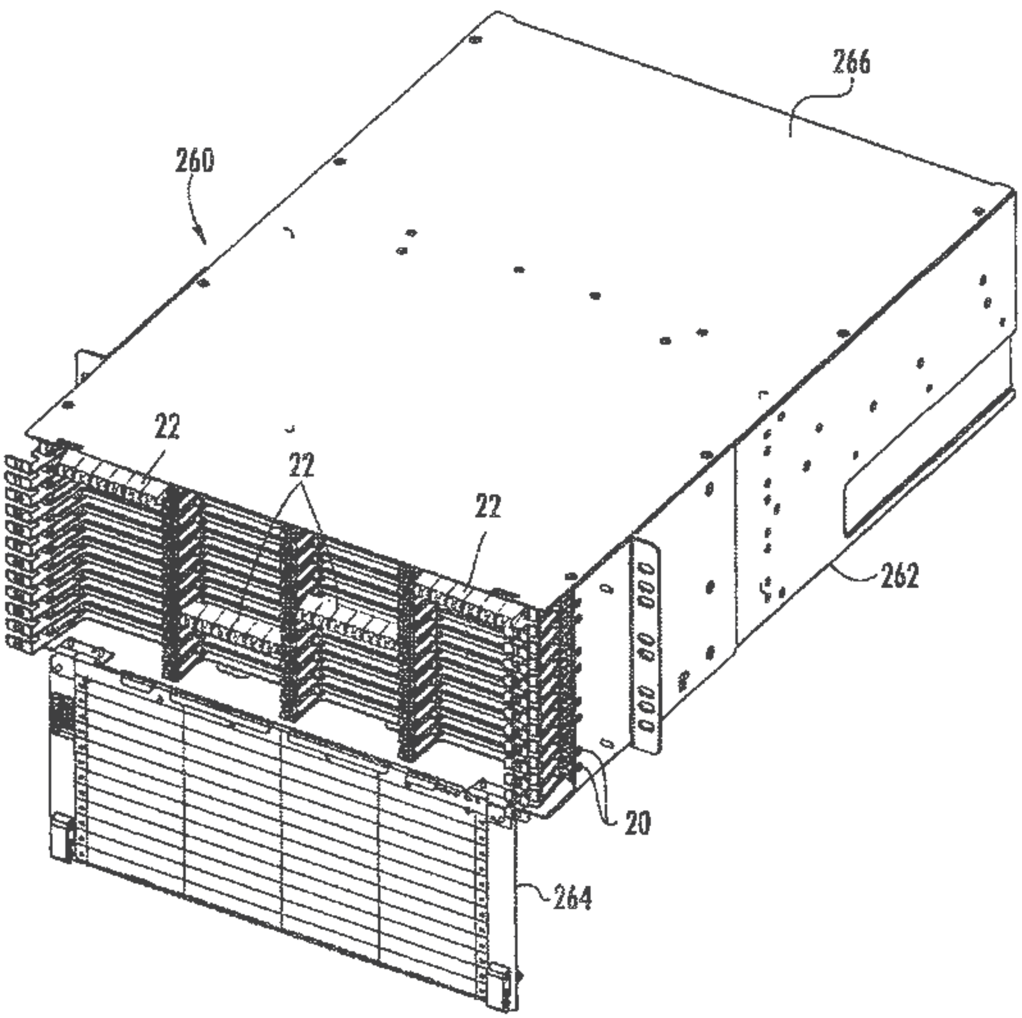


FIG. 25

HIGH-DENSITY FIBER OPTIC MODULES AND MODULE HOUSINGS AND RELATED EQUIPMENT

PRIORITY APPLICATIONS

This application claims the benefit of priority under 35 U.S.C. §119 of U.S. Provisional Application Ser. No. 61/218,870 filed on Jun. 19, 2009 and entitled "High-Density Fiber Optic Modules and Module Housings and Related Equipment", the content of which is relied upon and incorporated herein by reference in its entirety.

BACKGROUND

1. Field of the Disclosure

The technology of the disclosure relates to fiber optic modules and fiber optic modules housings provided in fiber optic equipment to support fiber optic connections.

2. Technical Background

Benefits of optical fiber include extremely wide bandwidth and low noise operation. Because of these advantages, optical fiber is increasingly being used for a variety of applications, including but not limited to broadband voice, video, and data transmission. Fiber optic networks employing optical fiber are being developed and used to deliver voice, video, and data transmissions to subscribers over both private and public networks. These fiber optic networks often include separated connection points linking optical fibers to provide "live fiber" from one connection point to another connection point. In this regard, fiber optic equipment is located in data distribution centers or central offices to support interconnections.

The fiber optic equipment is customized based on application need. The fiber optic equipment is typically included in housings that are mounted in equipment racks to optimize use of space. One example of such fiber optic equipment is a fiber optic module. A fiber optic module is designed to provide cable-to-cable fiber optic connections and/or manage the polarity of fiber optic cable connections. A fiber optic module is typically mounted to a chassis or housing which is then mounted inside an equipment rack or cabinet. A technician establishes fiber optic connections to the fiber optic modules mounted in the equipment rack. Due to increasing bandwidth needs and the need to provide a larger number of connections in data centers for increased revenue generating opportunities, a need exists to provide fiber optic modules that can facilitate larger numbers of fiber optic connections in a given space.

SUMMARY OF THE DETAILED DESCRIPTION

Embodiments disclosed in the detailed description include high-density fiber optic modules and fiber optic module housings and related equipment. In certain embodiments, the fiber optic modules and fiber optic module housings comprise a main body defining an internal chamber disposed between a front side and a rear side. A front opening is disposed along a longitudinal axis in the front side of the main body. A plurality of fiber optic components is disposed through the front opening. In certain embodiments, the width and/or height of the front opening can be provided according to a designed relationship to the width and/or height, respectively, of the front side of the main body to support fiber optic components or connections within the fiber optic module and/or fiber optic module housing. In this manner, fiber optic components can be installed in a given percentage or area of the front side of the fiber optic module to provide a high density of fiber optic connections for a given fiber optic component type(s). In other embodiments, the front opening can be provided to support a designed connection density capacity of fiber optic components or connections for a given width and/or height of the front opening of the fiber optic module and/or fiber optic module housing. The fiber optic components and connections can be provided by fiber optic adapters and/or fiber optic connectors as examples. The fiber optic modules and fiber optic module housings disclosed herein can be disposed in fiber optic equipment including but not limited to a chassis and fiber optic equipment drawer.

Additional features and advantages will be set forth in the detailed description which follows, and in part will be readily apparent to those skilled in the art from that description or recognized by practicing the invention as described herein, including the detailed description that follows, the claims, as well as the appended drawings.

It is to be understood that both the foregoing general description and the following detailed description present embodiments, and are intended to provide an overview or framework for understanding the nature and character of the disclosure. The accompanying drawings are included to provide a further understanding, and are incorporated into and constitute a part of this specification. The drawings illustrate various embodiments, and together with the description serve to explain the principles and operation of the concepts disclosed.

BRIEF DESCRIPTION OF THE FIGURES

FIG. **1** is a front perspective view of an exemplary fiber optic equipment rack with an installed exemplary 1-U size chassis supporting high-density fiber optic modules to provide a given fiber optic connection density and bandwidth capability, according to one embodiment;

FIG. **2** is a rear perspective close-up view of the chassis of FIG. **1** with fiber optic modules installed in fiber optic equipment trays installed in the fiber optic equipment;

FIG. **3** is a front perspective view of one fiber optic equipment tray with installed fiber optic modules configured to be installed in the chassis of FIG. **1**;

FIG. **4** is a close-up view of the fiber optic equipment tray of FIG. **3** without fiber optic modules installed;

FIG. **5** is a close-up view of the fiber optic equipment tray of FIG. **3** with fiber optic modules installed;

FIG. **6** is a front perspective view of the fiber optic equipment tray of FIG. **3** without fiber optic modules installed;

FIG. **7** is a front perspective view of fiber optic equipment trays supporting fiber optic modules with one fiber optic equipment tray extended out from the chassis of FIG. **1**;

FIG. **8** is a left perspective view of an exemplary tray guide disposed in the chassis of FIG. **1** configured to receive fiber optic equipment trays of FIG. **6** capable of supporting one or more fiber optic modules;

FIGS. **9A** and **9B** are perspective and top views, respectively, of an exemplary tray rail disposed on each side of the fiber optic equipment tray of FIG. **3** and configured to be received in the chassis of FIG. **1** by the tray guide of FIG. **8**;

FIGS. **10A** and **10B** are front right and left perspective views, respectively, of an exemplary fiber optic module that can be disposed in the fiber optic equipment trays of FIG. **3**;

FIG. **11** is a perspective, exploded view of the fiber optic module in FIGS. **10A** and **10B**;

FIG. **12** is a perspective top view of the fiber optic module of FIG. **11** with the cover removed and showing a fiber optic harness installed therein;

FIG. 12A is a perspective top view of another fiber optic module with the cover removed showing the fiber optic harness installed within guides;

FIG. 13 is a front view of the fiber optic module of FIG. 11 without fiber optic components installed;

FIG. 14 is a front right perspective view of another alternate fiber optic module that supports twelve (12) fiber MPO fiber optic components and which can be installed in the fiber optic equipment tray of FIG. 3;

FIG. 15 is front right perspective view of another alternate fiber optic module that supports twenty-four (24) fiber MPO fiber optic components and which can be installed in the fiber optic equipment tray of FIG. 3;

FIG. 16 is a front perspective view of an alternate fiber optic module being installed in the fiber optic equipment tray of FIG. 3;

FIG. 17 is front right perspective view of the fiber optic module of FIG. 16;

FIG. 18 is a front view of the fiber optic module of FIGS. 16 and 17;

FIG. 19 is a front perspective view of another alternate fiber optic module being installed in the fiber optic equipment tray of FIG. 3;

FIG. 20 is front right perspective view of the fiber optic module of FIG. 19;

FIG. 21 is a front view of the fiber optic module of FIGS. 19 and 20;

FIG. 22 is a front perspective view of another alternate fiber optic module being installed in an alternate fiber optic equipment tray that can be installed in the chassis of FIG. 1;

FIG. 23 is front right perspective view of the fiber optic module of FIG. 22;

FIG. 24 is a front view of the fiber optic module of FIGS. 22 and 23; and

FIG. 25 is a front perspective view of alternate exemplary 4-U size fiber optic chassis that can support the fiber optic equipment trays and fiber optic modules according to the fiber optic equipment tray and fiber optic modules disclosed.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Reference will now be made in detail to certain embodiments, examples of which are illustrated in the accompanying drawings, in which some, but not all features are shown. Indeed, embodiments disclosed herein may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will satisfy applicable legal requirements. Whenever possible, like reference numbers will be used to refer to like components or parts.

Embodiments disclosed in the detailed description include high-density fiber optic modules and fiber optic module housings and related equipment. In certain embodiments, the width and/or height of the front opening of fiber optic modules and/or fiber optic module housings can be provided according to a designed relationship to the width and/or height, respectively, of a front side of the main body of the fiber optic modules and fiber optic module housings to support fiber optic components or connections. In this manner, fiber optic components can be installed in a given percentage or area of the front side of the fiber optic module to provide a high density of fiber optic connections for a given fiber optic component type(s). In another embodiment, the front openings of the fiber optic modules and/or fiber optic module housings can be provided to support a designed connection density of fiber optic components or connections for a given width and/or height of the front opening of the fiber optic module and/or fiber optic module housing. Embodiments disclosed in the detailed description also include high connection density and bandwidth fiber optic apparatuses and related equipment. In certain embodiments, fiber optic apparatuses are provided and comprise a chassis defining one or more U space fiber optic equipment units, wherein at least one of the one or more U space fiber optic equipment units is configured to support a given fiber optic connection density or bandwidth in a 1-U space, and for a given fiber optic component type(s).

In this regard, FIG. 1 illustrates exemplary 1-U size fiber optic equipment 10 from a front perspective view. The fiber optic equipment 10 supports high-density fiber optic modules that support a high fiber optic connection density and bandwidth in a 1-U space, as will be described in greater detail below. The fiber optic equipment 10 may be provided at a data distribution center or central office to support cable-to-cable fiber optic connections and to manage a plurality of fiber optic cable connections. As will be described in greater detail below, the fiber optic equipment 10 has one or more fiber optic equipment trays that each support one or more fiber optic modules. However, the fiber optic equipment 10 could also be adapted to support one or more fiber optic patch panels or other fiber optic equipment that supports fiber optic components and connectivity.

The fiber optic equipment 10 includes a fiber optic equipment chassis 12 ("chassis 12"). The chassis 12 is shown as being installed in a fiber optic equipment rack 14. The fiber optic equipment rack 14 contains two vertical rails 16A, 16B that extend vertically and include a series of apertures 18 for facilitating attachment of the chassis 12 inside the fiber optic equipment rack 14. The chassis 12 is attached and supported by the fiber optic equipment rack 14 in the form of shelves that are stacked on top of each other within the vertical rails 16A, 16B. As illustrated, the chassis 12 is attached to the vertical rails 16A, 16B. The fiber optic equipment rack 14 may support 1-U-sized shelves, with "U" equal to a standard 1.75 inches in height and seventeen (19) inches in width. In certain applications, the width of "U" may be twenty-three (23) inches. In this embodiment, the chassis 12 is 1-U in size; however, the chassis 12 could be provided in a size greater than 1-U as well.

As will be discussed in greater detail later below, the fiber optic equipment 10 includes a plurality of extendable fiber optic equipment trays 20 that each carries one or more fiber optic modules 22. The chassis 12 and fiber optic equipment trays 20 support fiber optic modules 22 that support high-density fiber optic modules and a fiber optic connection density and bandwidth connections in a given space, including in a 1-U space. FIG. 1 shows exemplary fiber optic components 23 disposed in the fiber optic modules 22 that support fiber optic connections. For example, the fiber optic components 23 may be fiber optic adapters or fiber optic connectors. As will also be discussed in greater detail later below, the fiber optic modules 22 in this embodiment can be provided such that the fiber optic components 23 can be disposed through at least eighty-five percent (85%) of the width of the front side or face of the fiber optic module 22, as an example. This fiber optic module 22 configuration may provide a front opening of approximately 90 millimeters (mm) or less wherein fiber optic components can be disposed through the front opening and at a fiber optic connection density of at least one fiber optic connection per 7.0 mm of width of the front opening of the fiber optic modules 22 for simplex or duplex fiber optic components 23. In this example, six (6) duplex or twelve (12) simplex fiber optic components may be installed in each fiber optic module 22. The fiber optic equipment trays 20 in this embodiment support up to four (4) of the fiber optic modules 22 in approximately the width of a 1-U space, and three (3) fiber optic equipment trays 20 in the height of a 1-U space for a total of twelve (12) fiber optic modules 22 in a 1-U space. Thus, for example, if six (6) duplex fiber optic components were disposed in each of the twelve (12) fiber optic modules 22 installed in fiber optic equipment trays 20 of the chassis 12 as illustrated in FIG. 1, a total of one hundred forty-four (144) fiber optic connections, or seventy-two (72) duplex channels (i.e., transmit and receive channels), would be supported by the chassis 12 in a 1-U space. If five (5) duplex fiber optic adapters are disposed in each of the twelve (12) fiber optic modules 22 installed in fiber optic equipment trays 20 of the chassis 12, a total of one hundred twenty (120) fiber optic connections, or sixty (60) duplex channels, would be supported by the chassis 12 in a 1-U space. The chassis 12 also supports at least ninety-eight (98) fiber optic components in a 1-U space wherein at least one of the fiber optic components is a simplex or duplex fiber optic component.

If multi-fiber fiber optic components were installed in the fiber optic modules 22, such as MPO components for example, higher fiber optic connection density and bandwidths would be possible over other chassis 12 that use similar fiber optic components. For example, if up to four (4) twelve (12) fiber MPO fiber optic components were disposed in each fiber optic module 22, and twelve (12) of the fiber optic modules 22 were disposed in the chassis 12 in a 1-U space, the chassis 12 would support up to five hundred seventy-six (576) fiber optic connections in a 1-U space. If up to four (4) twenty-four (24) fiber MPO fiber optic components were disposed in each fiber optic module 22, and twelve (12) of the fiber optic modules 22 were disposed in the chassis 12, up to one thousand one hundred fifty-two (1152) fiber optic connections in a 1-U space.

FIG. 2 is a rear perspective close-up view of the chassis 12 of FIG. 1 with fiber optic modules 22 loaded with fiber optic components 23 and installed in fiber optic equipment trays 20 installed in the chassis 12. Module rails 28A, 28B are disposed on each side of each fiber optic module 22. The module rails 28A, 28B are configured to be inserted within tray channels 30 of module rail guides 32 disposed in the fiber optic equipment tray 20, as illustrated in more detail in FIGS. 3-5. Note that any number of module rail guides 32 can be provided. The fiber optic module 22 can be installed from both a front end 34 and a rear end 36 of the fiber optic equipment tray 20 in this embodiment. If it is desired to install the fiber optic module 22 in the fiber optic equipment tray 20 from the rear end 36, a front end 33 of the fiber optic module 22 can be inserted from the rear end 36 of the fiber optic equipment tray 20. More specifically, the front end 33 of the fiber optic module 22 is inserted into the tray channels 30 of the module rail guides 32. The fiber optic module 22 can then be pushed forward within the tray channels 30 until the fiber optic module 22 reaches the front end 34 of the module rail guides 32. The fiber optic modules 22 can be moved towards the front end 34 until the fiber optic modules 22 reach a stop or locking feature disposed in the front end 34 as will described later in this application. FIG. 6 also illustrates the fiber optic equipment tray 20 without installed fiber optic modules 22 to illustrate the tray channels 30 and other features of the fiber optic equipment tray 20.

The fiber optic module 22 can be locked into place in the fiber optic equipment tray 20 by pushing the fiber optic module 22 forward to the front end 33 of the fiber optic equipment tray 20. A locking feature in the form of a front stop 38 is disposed in the module rail guides 32, as illustrated in FIG. 3 and in more detail in the close-up view in FIG. 4. The front stop 38 prevents the fiber optic module 22 from extending beyond the front end 34, as illustrated in the close-up view of the fiber optic equipment tray 20 with installed fiber optic modules 22 in FIG. 5. When it is desired to remove a fiber optic module 22 from the fiber optic equipment tray 20, a front module tab 40 also disposed in the module rail guides 32 and coupled to the front stop 38 can be pushed downward to engage the front stop 38. As a result, the front stop 38 will move outward away from the fiber optic module 22 such that the fiber optic module 22 is not obstructed from being pulled forward. The fiber optic module 22, and in particular its module rails 28A, 28B (FIG. 2), can be pulled forward along the module rail guides 32 to remove the fiber optic module 22 from the fiber optic equipment tray 20.

The fiber optic module 22 can also be removed from the rear end 36 of the fiber optic equipment tray 20. To remove the fiber optic module 22 from the rear end 36 of the fiber optic equipment tray 20, a latch 44 is disengaged by pushing a lever 46 (see FIGS. 2 and 3; see also, FIGS. 10A and 10B) inward towards the fiber optic module 22 to release the latch 44 from the module rail guide 32. To facilitate pushing the lever 46 inward towards the fiber optic module 22, a finger hook 48 is provided adjacent to the lever 46 so the lever 46 can easily be squeezed into the finger hook 48 by a thumb and index finger.

With continuing reference to FIG. 3-6, the fiber optic equipment tray 20 may also contain extension members 50. Routing guides 52 may be conveniently disposed on the extension members 50 to provide routing for optical fibers or fiber optic cables connected to fiber optic components 23 disposed in the fiber optic modules 22 (FIG. 3). The routing guides 52' on the ends of the fiber optic equipment tray 20 may be angled with respect to the module rail guides 32 to route optical fibers or fiber optic cables at an angle to the sides of the fiber optic equipment tray 20. Pull tabs 54 may also be connected to the extension members 50 to provide a means to allow the fiber optic equipment tray 20 to easily be pulled out from and pushed into the chassis 12.

As illustrated in FIGS. 3 and 6, the fiber optic equipment tray 20 also contains tray rails 56. The tray rails 56 are configured to be received in tray guides 58 disposed in the chassis 12 to retain and allow the fiber optic equipment trays 20 to move in and out of the chassis 12, as illustrated in FIG. 7. More detail regarding the tray rails 56 and their coupling to the tray guides 58 in the chassis 12 is discussed below with regard to FIGS. 8 and 9A-9B. The fiber optic equipment trays 20 can be moved in and out of the chassis 12 by their tray rails 56 moving within the tray guides 58. In this manner, the fiber optic equipment trays 20 can be independently movable about the tray guides 58 in the chassis 12. FIG. 7 illustrates a front perspective view of one fiber optic equipment tray 20 pulled out from the chassis 12 among three (3) fiber optic equipment trays 20 disposed within the tray guides 58 of the chassis 12. The tray guides 58 may be disposed on both a left side end 60 and a right side end 62 of the fiber optic equipment tray 20. The tray guides 58 are installed opposite and facing each other in the chassis 12 to provide complementary tray guides 58 for the tray rails 56 of the fiber optic equipment trays 20 received therein. If it is desired to access a particular fiber optic equipment tray 20 and/or a particular fiber optic module 22 in a fiber optic equipment tray 20, the pull tab 54 of the desired fiber optic equipment tray 20 can be pulled forward to cause the fiber optic equipment tray 20 to extend forward out from the chassis 12, as illustrated in FIG. 7. The fiber optic module 22 can be removed from the fiber optic equipment tray 20 as previously discussed. When access is completed, the fiber optic equipment tray 20 can be pushed back into the chassis 12 wherein the tray rails 56 move within the tray guides 58 disposed in the chassis 12.

FIG. 8 is a left perspective view of an exemplary tray guide 58 disposed in the chassis 12 of FIG. 1. As discussed above, the tray guides 58 are configured to receive fiber optic equipment trays 20 supporting one or more fiber optic modules 22 in the chassis 12. The tray guides 58 allow the fiber optic equipment trays 20 to be pulled out from the chassis 12, as illustrated in FIG. 7. The tray guide 58 in this embodiment is comprised of a guide panel 64. The guide panel 64 may be constructed out of any material desired, including but not limited to a polymer or metal. The guide panel 64 contains a series of apertures 66 to facilitate attachment of the guide panel 64 to the chassis 12, as illustrated in FIG. 8. Guide members 68 are disposed in the guide panel 64 and configured to receive the tray rail 56 of the fiber optic equipment tray 20. Three (3) guide members 68 are disposed in the guide panel 64 in the embodiment of FIG. 8 to be capable of receiving up to three (3) tray rails 56 of three (3) fiber optic equipment trays 20 in a 1-U space. However, any number of guide members 68 desired may be provided in the tray guide 58 to cover sizes less than or greater than a 1-U space. In this embodiment, the guide members 68 each include guide channels 70 configured to receive and allow tray rails 56 to move along the guide channels 70 for translation of the fiber optic equipment trays 20 about the chassis 12.

Leaf springs 72 are disposed in each of the guide members 68 of the tray guide 58 and are each configured to provide stopping positions for the tray rails 56 during movement of the fiber optic equipment tray 20 in the guide members 68. The leaf springs 72 each contain detents 74 that are configured to receive protrusions 76 (FIG. 9A-9D) disposed in the tray rails 56 to provide stopping or resting positions. The tray rails 56 contain mounting platforms 75 that are used to attach the tray rails 56 to the fiber optic equipment trays 20. It may be desirable to provide stopping positions in the tray guide 56 to allow the fiber optic equipment trays 20 to have stopping positions when moved in and out of the chassis 12. Two (2) protrusions 76 in the tray rail 56 are disposed in two (2) detents 74 in the tray guide 58 at any given time. When the fiber optic equipment tray 20 is fully retracted into the chassis 12 in a first stopping position, the two (2) protrusions 76 of the tray rail 56 are disposed in the one detent 74 adjacent a rear end 77 of the guide channel 70 and the middle detent 74 disposed between the rear end 77 and a front end 78 of the guide channel 70. When the fiber optic equipment tray 20 is pulled out from the chassis 12, the two (2) protrusions 76 of the tray rail 56 are disposed in the one detent 74 adjacent the front end 78 of the guide channel 70 and the middle detent 74 disposed between the rear end 77 and the front end 78 of the guide channel 70.

As the tray rail 56 is pulled within the guide channel 70, a protrusion 80 disposed in the tray rail 56 and illustrated in FIGS. 9A and 9B is biased to pass over transition members 82 disposed between the leaf springs 72, as illustrated in FIG. 8. The protrusion 80 is provided in a leaf spring 81 disposed in the tray rail 56, as illustrated in FIGS. 9A and 9B. The transition members 82 have inclined surfaces 84 that allow the protrusion 80 to pass over the transition members 82 as the fiber optic equipment tray 20 is being translated with the guide channel 70. As the protrusion 80 contains the transition members 82, the force imparted onto the protrusion 80 causes the leaf spring 81 to bend inward to allow the protrusion 80 to pass over the transition member 82. To prevent the tray rail 56 and thus the fiber optic equipment tray 20 from being extended beyond the front end 78 and rear end 77 of the guide channel 70, stopping members 86 are disposed at the front

end 78 and rear end 77 of the guide channel 70. The stopping members 86 do not have an inclined surface; thus the protrusion 80 in the tray rail 56 abuts against the stopping member 86 and is prevented from extending over the stopping member 86 and outside of the front end 78 of the guide channel 70.

Against the background of the above disclosed embodiment of a 1-U chassis 12 and fiber optic equipment trays 20 and fiber optic modules 22 that can installed therein, the form factor of the fiber optic module 22 will now be described. The form factor of the fiber optic module 22 allows a high density of fiber optic components 23 to be disposed within a certain percentage area of the front of the fiber optic module 22 thus supporting a particular fiber optic connection density and bandwidth for a given type of fiber optic component 23. When this fiber optic module 22 form factor is combined with the ability to support up to twelve (12) fiber optic modules 22 in a 1-U space, as described by the exemplary chassis 12 example above, a higher fiber optic connection density and bandwidth is supported and possible.

In this regard, FIGS. 10A and 10B are right and left perspective views of the exemplary fiber optic module 22. As discussed above, the fiber optic module 22 can be installed in the fiber optic equipment trays 20 to provide fiber optic connections in the chassis 12. The fiber optic module 22 is comprised of a main body 90 receiving a cover 92. An internal chamber 94 (FIG. 11) disposed inside the main body 90 and the cover 92 and is configured to receive or retain optical fibers or a fiber optic cable harness, as will be described in more detail below. The main body 90 is disposed between a front side 96 and a rear side 98 of the main body 90. Fiber optic components 23 can be disposed through the front side 96 of the main body 90 and configured to receive fiber optic connectors connected to fiber optic cables (not shown). In this example, the fiber optic components 23 are duplex LC fiber optic adapters that are configured to receive and support connections with duplex LC fiber optic connectors. However, any fiber optic connection type desired can be provided in the fiber optic module 22. The fiber optic components 23 are connected to a fiber optic component 100 disposed through the rear side 98 of the main body 90. In this manner, a connection to the fiber optic component 23 creates a fiber optic connection to the fiber optic component 100. In this example, the fiber optic component 100 is a multi-fiber MPO fiber optic adapter equipped to establish connections to multiple optical fibers (e.g., either twelve (12) or twenty-four (24) optical fibers). The fiber optic module 22 may also manage polarity between the fiber optic components 23, 100.

The module rails 28A, 28B are disposed on each side 102A, 102B of the fiber optic module 22. As previously discussed, the module rails 28A, 28B are configured to be inserted within the module rail guides 32 in the fiber optic equipment tray 20, as illustrated in FIG. 3. In this manner, when it is desired to install a fiber optic module 22 in the fiber optic equipment tray 20, the front side 96 of the fiber optic module 22 can be inserted from either the front end 33 or the rear end 36 of the fiber optic equipment tray 20, as previously discussed.

FIG. 11 illustrates the fiber optic module 22 in an exploded view with the cover 92 of the fiber optic module 22 removed to illustrate the internal chamber 94 and other internal components of the fiber optic module 22. FIG. 12 illustrates the fiber optic module 22 assembled, but without the cover 92 installed on the main body 90. The cover 92 includes notches 106 disposed in sides 108, 110 that are configured to interlock with protrusions 112 disposed on the sides 102A, 102B of the main body 90 of the fiber optic modules 22 when the cover 92 is attached to the main body 90 to secure the cover 92 to the main body **90**. The cover **92** also contains notches **114**, **116** disposed on a front side **118** and rear side **120**, respectively, of the cover **92**. The notches **114**, **116** are configured to interlock with protrusions **122**, **124** disposed in the front side **96** and the rear end **98**, respectively, of the main body **90** when the cover **92** is attached to the main body **90** to also secure the cover **92** to the main body **90**. FIG. **12** does not show protrusions **122**, **124**.

With continuing reference to FIG. **11**, the fiber optic components **23** are disposed through a front opening **126** disposed along a longitudinal axis L_1 in the front side **96** of the main body **90**. In this embodiment, the fiber optic components **23** are duplex LC adapters **128**, which support single or duplex fiber connections and connectors. The duplex LC adapters **128** in this embodiment contain protrusions **130** that are configured to engage with orifices **135** disposed on the main body **90** to secure the duplex LC adapters **128** in the main body **90** in this embodiment. A cable harness **134** is disposed in the internal chamber **94** with fiber optic connectors **136**, **138** disposed on each end of optical fibers **139** connected to the duplex LC adapters **128** and the fiber optic component **100** disposed in the rear side **98** of the main body **90**. The fiber optic component **100** in this embodiment is a twelve (12) fiber MPO fiber optic adapter **140** in this embodiment. Two vertical members **142A**, **142B** (i.e., fiber guides) are disposed in the internal chamber **94** of the main body **90**, as illustrated in FIG. **12**, to retain the looping of the optical fibers **139** of the cable harness **134**. The vertical members **142A**, **142B** and the distance therebetween are designed to provide a bend radius R in the optical fibers **139** no greater than forty (40) millimeters and preferably twenty-five (25) millimeters or less, thereby aiding in maintaining a high fiber optic connector density.

Other structures besides vertical members **142A**,**142B** of FIG. **12** are possible for fiber guides that retain and/or route the cable harness **134** within the module to inhibit damage, organize, maintain a bend radius and/or make the device easier to assemble. The fiber guide structure is also useful for maintaining a bend radius R for the optical fibers. By way of example, FIG. **12A** shows a perspective top view of another fiber optic module **22** with the cover removed showing the fiber optic harness **134** installed within a plurality of fiber guides **143**,**144** for retaining and routing the optical fibers of fiber optic harness **134**. Any suitable shape for the fiber guides are possible along with a suitable number of fiber guides in the module. Moreover, one or more of the fiber guides can be shaped to accommodate a furcation body for the ribbon to individual fiber transition or the like. In this embodiment, fiber guides **143**,**144** have two different shapes and have three different locations. Specifically, fiber guides **143** are configured as L-guides and are located at a suitably spaced apart locations and fiber guide **144** is a J-guide spaced apart from fiber guides **143**. Consequently, the assembler can easily and quickly install the cable harness **134** into the internal chamber **94** of main body **90** using fiber guides **143**,**144**. Moreover, the fiber guides **143**,**144** ensure an adequate bend radius for the optical fibers of the fiber optic harness **134** and inhibits pinching of the optical fibers when installing the cover. Fiber guides **143**,**144** may be configured in any suitable arrangement such molded with main body **90** or configured separate components. For instance, other arrangements may have retention pins molded into main body **90** for receiving and securing discrete fiber guides using a friction fit and/or adhesive; however, this adds manufacturing complexity.

FIG. **13** illustrates a front view of the fiber optic module **22** without loaded fiber optic components **23** in the front side **96** to further illustrate the form factor of the fiber optic module **22**. As previously discussed, the front opening **126** is disposed through the front side **96** of the main body **90** to receive the fiber optic components **23**. The greater the width W_1 of the front opening **126**, the greater the number of fiber optic components **23** that may be disposed in the fiber optic module **22**. Greater numbers of fiber optic components **23** equates to more fiber optic connections, which supports higher fiber optic connectivity and bandwidth. However, the larger the width W_1 of the front opening **126**, the greater the area required to be provided in the chassis **12** for the fiber optic module **22**. Thus, in this embodiment, the width W_1 of the front opening **126** is design to be at least eighty-five percent (85%) of the width W_2 of the front side **96** of the main body **90** of the fiber optic module **22**. The greater the percentage of the width W_1 to width W_2, the larger the area provided in the front opening **126** to receive fiber optic components **23** without increasing width W_2. Width W_3, the overall width of the fiber optic module **22**, may be 86.6 mm or 3.5 inches in this embodiment. The overall depth D_1 of the fiber optic module **22** is 113.9 mm or 4.5 inches in this embodiment (FIG. **12**). As previously discussed, the fiber optic module **22** is designed such that four (4) fiber optic modules **22** can be disposed in a 1-U width space in the fiber optic equipment tray **20** in the chassis **12**. The width of the chassis **12** is designed to accommodate a 1-U space width in this embodiment.

With three (3) fiber optic equipment trays **20** disposed in the 1-U height of the chassis **12**, a total of twelve (12) fiber optic modules **22** can be supported in a given 1-U space. Supporting up to twelve (12) fiber optic connections per fiber optic module **22** as illustrated in the chassis **12** in FIG. **1** equates to the chassis **12** supporting up to one hundred forty-four (144) fiber optic connections, or seventy-two (72) duplex channels, in a 1-U space in the chassis **12** (i.e., twelve (12) fiber optic connections X twelve (12) fiber optic modules **22** in a 1-U space). Thus, the chassis **12** is capable of supporting up to one hundred forty-four (144) fiber optic connections in a 1-U space by twelve (12) simplex or six (6) duplex fiber optic adapters being disposed in the fiber optic modules **22**. Supporting up to ten (10) fiber optic connections per fiber optic module **22** equates to the chassis **12** supporting one hundred twenty (120) fiber optic connections, or sixty (60) duplex channels, in a 1-U space in the chassis **12** (i.e., ten (10) fiber optic connections X twelve (12) fiber optic modules **22** in a 1-U space). Thus, the chassis **12** is also capable of supporting up to one hundred twenty (120) fiber optic connections in a 1-U space by ten (10) simplex or five (5) duplex fiber optic adapters being disposed in the fiber optic modules **22**.

This embodiment of the chassis **12** and fiber optic module **22** disclosed herein can support a fiber optic connection density within a 1-U space wherein the area occupied by the fiber optic component **23** in twelve (12) fiber optic modules **22** in a 1-U space represents at least fifty percent (50%) of the total fiber optic equipment rack **14** area in a 1-U space (see FIG. **1**). In the case of twelve (12) fiber optic modules **22** provided in a 1-U space in the chassis **12**, the 1-U space is comprised of the fiber optic components **23** occupying at least seventy-five percent (75%) of the area of the front side **96** of the fiber optic module **22**.

Two (2) duplexed optical fibers to provide one (1) transmission/reception pair can allow for a data rate of ten (10) Gigabits per second in half-duplex mode or twenty (20) Gigabits per second in full-duplex mode. Thus, with the above-described embodiment, providing at least seventy-two (72) duplex transmission and reception pairs in a 1-U space employing at least one duplex or simplex fiber optic component can support a data rate of at least seven hundred twenty (720) Gigabits per second in half-duplex mode in a 1-U space or at least one thousand four hundred forty (1440) Gigabits per second in a 1-U space in full-duplex mode if employing a ten (10) Gigabit transceiver. This configuration can also support at least six hundred (600) Gigabits per second in half-duplex mode in a 1-U space and at least one thousand two hundred (1200) Gigabits per second in full-duplex mode in a 1-U space, respectively, if employing a one hundred (100) Gigabit transceiver. This configuration can also support at least four hundred eighty (480) Gigabits per second in half-duplex mode in a 1-U space and nine hundred sixty (960) Gigabits per second in full duplex mode in a 1-U space, respectively, if employing a forty (40) Gigabit transceiver. At least sixty (60) duplex transmission and reception pairs in a 1-U space can allow for a data rate of at least six hundred (600) Gigabits per second in a 1-U space in half-duplex mode or at least one thousand two hundred (1200) Gigabits per second in a 1-U space in full-duplex mode when employing a ten (10) Gigabit transceiver. At least forty nine (49) duplex transmission and reception pairs in a 1-U space can allow for a data rate of at least four hundred eighty-one (481) Gigabits per second in half-duplex mode or at least nine hundred sixty-two (962) Gigabits per second in a 1-U space in full-duplex mode when employing a ten (10) Gigabit transceiver.

The width W_1 of front opening **126** could be designed to be greater than eighty-five percent (85%) of the width W_2 of the front side **96** of the main body **90** of the fiber optic module **22**. For example, the width W_1 could be designed to be between ninety percent (90%) and ninety-nine percent (99%) of the width W_2. As an example, the width W_1 could be less than ninety (90) mm. As another example, the width W_1 could be less than eighty-five (85) mm or less than eighty (80) mm. For example, the width W_1 may be eighty-three (83) mm and width W_2 may be eighty-five (85) mm, for a ratio of width W_1 to width W_2 of 97.6%. In this example, the front opening **126** may support twelve (12) fiber optic connections in the width W_1 to support a fiber optic connection density of at least one fiber optic connection per 7.0 mm of width W_1 of the front opening **126**. Further, the front opening **126** of the fiber optic module **22** may support twelve (12) fiber optic connections in the width W_1 to support a fiber optic connection density of at least one fiber optic connection per 6.9 mm of width W_1 of the front opening **126**.

Further as illustrated in FIG. **13**, height H_1 of front opening **126** could be designed to be at least ninety percent (90%) of height H_2 of the front side **96** of the main body **90** of the fiber optic module **22**. In this manner, the front opening **126** has sufficient height to receive the fiber optic components **23**, and such that three (3) fiber optic modules **22** can be disposed in a 1-U space height. As an example, height H_1 could be twelve (12) mm or less or ten (10) mm or less. As an example, height H_1 could be ten (10) mm and height H_2 could be eleven (11) mm (or 7/16 inches), for a ratio of height H_1 to width H_2 of 90.9%.

Alternate fiber optic modules with alternative fiber optic connection densities are possible. FIG. **14** is a front perspective view of an alternate fiber optic module **22'** that can be installed in the fiber optic equipment tray **20** of FIG. **1**. The form factor of the fiber optic module **22'** is the same as the form factor of the fiber optic module **22** illustrated in FIGS. **1-13**. However, in the fiber optic module **22'** of FIG. **14**, two (2) MPO fiber optic adapters **150** are disposed through the front opening **126** of the fiber optic module **22'**. The MPO fiber optic adapters **150** are connected to two (2) MPO fiber optic adapters **152** disposed in the rear side **98** of the main body **90** of the fiber optic module **22'**. Thus, if the MPO fiber optic adapters **150** each support twelve (12) fibers, the fiber optic module **22'** can support up to twenty-four (24) fiber optic connections. Thus, in this example, if up to twelve (12)

fiber optic modules **22'** are provided in the fiber optic equipment trays **20** of the chassis **12**, up to two hundred eighty-eight (288) fiber optic connections can be supported by the chassis **12** in a 1-U space. Further in this example, the front opening **126** of the fiber optic module **22'** may support twenty-four (24) fiber optic connections in the width W_1 (FIG. **13**) to support a fiber optic connection density of at least one fiber optic connection per 3.4-3.5 mm of width W_1 of the front opening **126**. It should be understood that the discussion with regard to modules may also apply to a panel. For purposes of this disclosure, a panel may have one or more adapters on one side and no adapters on the opposite side.

Thus, with the above-described embodiment, providing at least two-hundred eighty-eight (288) duplex transmission and reception pairs in a 1-U space employing at least one twelve (12) fiber MPO fiber optic components can support a data rate of at least two thousand eight hundred eighty (2880) Gigabits per second in half-duplex mode in a 1-U space or at least five thousand seven hundred sixty (5760) Gigabits per second in a 1-U space in full-duplex mode if employing a ten (10) Gigabit transceiver. This configuration can also support at least four thousand eight hundred (4800) Gigabits per second in half-duplex mode in a 1-U space and nine thousand six hundred (9600) Gigabits per second in full-duplex mode in a 1-U space, respectively, if employing a one hundred (100) Gigabit transceiver. This configuration can also support at least one thousand nine hundred twenty (1920) Gigabits per second in half-duplex mode in a 1-U space and three thousand eight hundred forty (3840) Gigabits per second in full-duplex mode in a 1-U space, respectively, if employing a forty (40) Gigabit transceiver. This configuration also supports a data rate of at least four thousand three hundred twenty-two (4322) Gigabits per second in full-duplex mode in a 1-U space when employing a ten (10) Gigabit transceiver employing at least one twelve (12) fiber MPO fiber optic component, or two thousand one hundred sixty-one (2161) Gigabits per second in full-duplex mode in a 1-U space when employing a ten (10) Gigabit transceiver employing at least one twenty-four (24) fiber MPO fiber optic component.

If the MPO fiber optic adapters **150** in the fiber optic module **22'** support twenty-four (24) fibers, the fiber optic module **22'** can support up to forty-eight (48) fiber optic connections. Thus, in this example, if up to twelve (12) fiber optic modules **22'** are provided in the fiber optic equipment trays **20** of the chassis **12**, up to five hundred seventy-six (576) fiber optic connections can be supported by the chassis **12** in a 1-U space if the fiber optic modules **22'** are disposed in the fiber optic equipment trays **20**. Further, in this example, the front opening **126** of the fiber optic module **22'** may support up to forty-eight (48) fiber optic connections in the width W_1 to support a fiber optic connection density of at least one fiber optic connection per 1.7 mm of width W_1 of the front opening **126**.

FIG. **15** is a front perspective view of another alternate fiber optic module **22"** that can be installed in the fiber optic equipment tray **20** of FIG. **1**. The form factor of the fiber optic module **22"** is the same as the form factor of the fiber optic module **22** illustrated in FIGS. **1-13**. However, in the fiber optic module **22"**, four (4) MPO fiber optic adapters **154** are disposed through the front opening **126** of the fiber optic module **22"**. The MPO fiber optic adapters **154** are connected to four (4) MPO fiber optic adapters **156** disposed in the rear end **98** of the main body **90** of the fiber optic module **22'**. Thus, if the MPO fiber optic adapters **150** support twelve (12) fibers, the fiber optic module **22"** can support up to forty-eight (48) fiber optic connections. Thus, in this example, if up to twelve (12) fiber optic modules **22"** are provided in the fiber optic equipment trays **20** of the chassis **12**, up to five hundred seventy-six (756) fiber optic connections can be supported by the chassis **12** in a 1-U space. Further in this example, the front opening **126** of the fiber optic module **22"** may support twenty-four (24) fiber optic connections in the width W_1 to support a fiber optic connection density of at least one fiber optic connection per 1.7 mm of width W_1 of the front opening **126**.

If the four (4) MPO fiber optic adapters **154** disposed in the fiber optic module **22"** support twenty-four (24) fibers, the fiber optic module **22"** can support up to ninety-six (96) fiber optic connections. Thus, in this example, if up to twelve (12) fiber optic modules **22"** are provided in the fiber optic equipment trays **20** of the chassis **12**, up to one thousand one hundred fifty-two (1152) fiber optic connections can be supported by the chassis **12** in a 1-U space. Further, in this example, the front opening **126** of the fiber optic module **22"** may support up to ninety-six (96) fiber optic connections in the width W_1 to support a fiber optic connection density of at least one fiber optic connection per 0.85 mm of width W_1 of the front opening **126**.

Further, with the above-described embodiment, providing at least five hundred seventy-six (576) duplex transmission and reception pairs in a 1-U space employing at least one twenty-four (24) fiber MPO fiber optic component can support a data rate of at least five thousand seven hundred sixty (5760) Gigabits per second in half-duplex mode in a 1-U space or at least eleven thousand five hundred twenty (11520) Gigabits per second in a 1-U space in full-duplex mode if employing a ten (10) Gigabit transceiver. This configuration can also support at least four thousand eight hundred (4800) Gigabits per second in half-duplex mode in a 1-U space and at least nine thousand six hundred (9600) Gigabits per second in full-duplex mode in a 1-U space, respectively, if employing a one hundred (100) Gigabit transceiver. This configuration can also support at least three thousand eight hundred forty (3840) Gigabits per second in half-duplex mode in a 1-U space and at least seven thousand six hundred eighty (7680) Gigabits per second in full-duplex mode in a 1-U space, respectively, if employing a forty (40) Gigabit transceiver. This configuration also supports a data rate of at least eight thousand six hundred forty two (8642) Gigabits per second in full-duplex mode in a 1-U space when employing a ten (10) Gigabit transceiver employing at least one twenty-four (24) fiber MPO fiber optic component, or four thousand three hundred twenty one (4321) Gigabits per second in full-duplex mode in a 1-U space when employing a ten (10) Gigabit transceiver employing at least one twenty-four (24) fiber MPO fiber optic component.

FIG. **16** illustrates an alternate fiber optic module **160** that may be provided in the fiber optic equipment trays **20** to support fiber optic connections and connection densities and bandwidths. FIG. **17** is a right front perspective view of the fiber optic module **160** of FIG. **16**. In this embodiment, the fiber optic module **160** is designed to fit across two sets of module rail guides **32**. A channel **162** is disposed through a center axis **164** of the fiber optic module **160** to receive a module rail guide **32** in the fiber optic equipment tray **20**. Module rails **165A**, **165B**, similar to the module rails **28A**, **28B** of the fiber optic module **22** of FIGS. **1-13**, are disposed on the inside the channel **162** of the fiber optic module **160** and configured to engage with tray channels **30** in the fiber optic equipment tray **20**. Module rails **166A**, **166B**, similar to the module rails **28A**, **28B** of the fiber optic module **22** of FIGS. **1-13**, are disposed on each side **168**, **170** of the fiber optic module **160** that are configured to engage with tray channels **30** in the fiber optic equipment tray **20**. The module

rails **166A**, **166B** are configured to engage with tray channels **30** in a module rail guide **32** disposed between module rail guides **32** engaged with the module rail guides **32** disposed on the sides **168**, **170** of the fiber optic module **160**.

Up to twenty-four (24) fiber optic components **23** can be disposed in a front side **172** of the fiber optic module **160**. In this embodiment, the fiber optic components **23** are comprised of up to twelve (12) duplex LC fiber optic adapters, which are connected to one twenty-four (24) fiber MPO fiber optic connector **174** disposed in a rear end **176** of the fiber optic module **160**. Thus, with three (3) fiber optic equipment trays **20** disposed in the height of the chassis **12**, a total of six (6) fiber optic modules **160** can be supported in a given 1-U space. Supporting up to twenty-four (24) fiber optic connections per fiber optic module **160** equates to the chassis **12** supporting up to one hundred forty-four (144) fiber optic connections, or seventy-two (72) duplex channels, in a 1-U space in the chassis **12** (i.e., twenty-four (24) fiber optic connections X six (6) fiber optic modules **160** in a 1-U space). Thus, the chassis **12** is capable of supporting up to one hundred forty-four (144) fiber optic connections in a 1-U space by twenty-four (24) simplex or twelve (12) duplex fiber optic adapters being disposed in the fiber optic modules **160**. Supporting up to twenty (20) fiber optic connections per fiber optic module **160** equates to the chassis **12** supporting one hundred twenty (120) fiber optic connections, or sixty (60) duplex channels, in a 1-U space in the chassis **12** (i.e., twenty (20) fiber optic connections X six (6) fiber optic modules **160** in a 1-U space). Thus, the chassis **12** is also capable of supporting up to one hundred twenty (120) fiber optic connections in a 1-U space by twenty (20) simplex or ten (10) duplex fiber optic adapters being disposed in the fiber optic modules **160**.

FIG. **18** illustrates a front view of the fiber optic module **160** of FIGS. **16-17** without loaded fiber optic components **23** in the front side **172** to further illustrate the form factor of the fiber optic module **160** in this embodiment. Front openings **178A**, **178B** disposed on each side of the channel **162** are disposed through the front side **172** of a main body **180** of the fiber optic module **160** to receive the fiber optic components **23**. The widths W_1 and W_2 and the heights H_1 and H_2 are the same as in the fiber optic module **22** illustrated in FIG. **13**. Thus, in this embodiment, the widths W_1 of front openings **178A**, **178B** are designed to be at least eighty-five percent (85%) of the width W_2 of the front side **172** of the main body **180** of the fiber optic module **160**. The greater the percentage of the width W_1 to width W_2, the larger the area provided in the front openings **178A**, **178B** to receive fiber optic components **23** without increasing width W_2.

The width W_1 of the front openings **178A**, **178B** could each be designed to be greater than eighty-five percent (85%) of the width W_2 of the front side **172** of the main body **180** of the fiber optic module **160**. For example, the width W_1 could be designed to be between ninety percent (90%) and ninety-nine percent (99%) of the width W_2. As an example, the width W_1 could be less than ninety (90) mm. As another example, the width W_1 could be less than eighty-five (85) mm or less than eighty (80) mm. For example, width W_1 may be eighty-three (83) mm and width W_2 may be eighty-five (85) mm, for a ratio of width W_1 to width W_2 of 97.6%. In this example, the front openings **178A**, **178B** may support twelve (12) fiber optic connections in the widths W_1 to support a fiber optic connection density of at least one fiber optic connection per 7.0 mm of width W_1 of the front openings **178A**, **178B**. Further, each of the front openings **178A**, **178B** may support twelve (12) fiber optic connections in the widths W_1 to support a fiber optic connection density of at least one fiber optic connection per 6.9 mm of width W_1 of the front openings 178A, 178B.

Further as illustrated in FIG. 18, the height H_1 of front openings 178A, 178B could be designed to be at least ninety percent (90%) of the height H_2 of the front side 172 of the main body 180 of the fiber optic module 160. In this manner, the front openings 178A, 178B have sufficient height to receive the fiber optic components 23, while three (3) fiber optic modules 160 can be disposed in the height of a 1-U space. As an example, the height H_1 could be twelve (12) mm or less or ten (10) mm or less. As an example, the height H_1 could be ten (10) mm and height H_2 could be eleven (11) mm, for a ratio of height H_1 to height H_2 of 90.9%.

FIG. 19 illustrates another alternate fiber optic module 190 that may be provided in the fiber optic equipment trays 20 to support fiber optic connections and connection densities and bandwidths. FIG. 20 is a right front perspective view of the fiber optic module 190 of FIG. 19. In this embodiment, the fiber optic module 190 is designed to fit across two sets of module rail guides 32. A longitudinal receiver 192 is disposed through a center axis 194 and is configured to receive a module rail guide 32 in the fiber optic equipment tray 20 through an opening 193 in the receiver 192. Module rails 195A, 195B, similar to the module rails 28A, 28B of the fiber optic module 22 of FIGS. 1-13, are disposed on each side 198, 200 of the fiber optic module 190 that are configured to engage with tray channels 30 in the fiber optic equipment tray 20.

Up to twenty-four (24) fiber optic components 23 can be disposed in a front side 202 of the fiber optic module 190. In this embodiment, the fiber optic components 23 are comprised of up to twelve (12) duplex LC fiber optic adapters, which are connected to one twenty-four (24) fiber MPO fiber optic connector 204 disposed in a rear end 206 of the fiber optic module 190. Thus, with three (3) fiber optic equipment trays 20 disposed in the height of the chassis 12, a total of six (6) fiber optic modules 190 can be supported in a given 1-U space. Supporting up to twenty-four (24) fiber optic connections per fiber optic module 190 equates to the chassis 12 supporting up to one hundred forty-four (144) fiber optic connections, or seventy-two (72) duplex channels, in a 1-U space in the chassis 12 (i.e., twenty-four (24) fiber optic connections X six (6) fiber optic modules 190 in a 1-U space). Thus, the chassis 12 is capable of supporting up to one hundred forty-four (144) fiber optic connections in a 1-U space by twenty (24) simplex or twelve (12) duplex fiber optic adapters being disposed in the fiber optic modules 190. Supporting up to twenty-four (20) fiber optic connections per fiber optic module 190 equates to the chassis 12 supporting one hundred twenty (120) fiber optic connections, or sixty (60) duplex channels, in a 1-U space in the chassis 12 (i.e., twenty (20) fiber optic connections X six (6) fiber optic modules 190 in a 1-U space). Thus, the chassis 12 is also capable of supporting up to one hundred twenty (120) fiber optic connections in a 1-U space by twenty (20) simplex or ten (10) duplex fiber optic adapters being disposed in the fiber optic modules 190.

FIG. 21 illustrates a front view of the fiber optic module 190 of FIGS. 19-20 without loaded fiber optic components 23 in the front side 202 to further illustrate the form factor of the fiber optic module 190. Front openings 208A, 208B are disposed on each side of the receiver 192 and through the front side 202 of a main body 210 of the fiber optic module 190 to receive the fiber optic components 23. The widths W_1 and W_2 and the heights H_1 and H_2 are the same as in the fiber optic module 22 as illustrated in FIG. 13. Thus, in this embodiment, the width W_1 of front openings 208A, 208B is designed to be at least eighty-five percent (85%) of the width W_2 of the front side 202 of the main body 210 of the fiber optic module 190. The greater the percentage of the width W_1 to width W_2, the larger the area provided in the front openings 208A, 208B to receive fiber optic components 23 without increasing the width W_2.

The width W_1 of front openings 208A, 208B could each be designed to be greater than eighty-five percent (85%) of the width W_2 of the front side 202 of the main body 210 of the fiber optic module 190. For example, the width W_1 could be designed to be between ninety percent (90%) and ninety-nine percent (99%) of the width W_2. As an example, the width W_1 could be less than ninety (90) mm. As another example, the width W_1 could be less than eighty-five (85) mm or less than eighty (80) mm. For example, width W_1 may be eighty-three (83) mm and width W_2 may be eighty-five (85) mm, for a ratio of width W_1 to width W_2 of 97.6%. In this example, the front openings 208A, 208B may support twelve (12) fiber optic connections in the widths W_1 to support fiber optic connection density of at least one fiber optic connection per 7.0 mm of width W_1 of the front openings 208A, 208B. Further, each of the front openings 208A, 208B may support twelve (12) fiber optic connections in the widths W_1 to support a fiber optic connection density of at least one fiber optic connection per 6.9 mm of width W_1 of the front openings 208A, 208B.

Further as illustrated in FIG. 21, the height H_1 of front openings 208A, 208B could be designed to be at least ninety percent (90%) of the height H_2 of the front side 202 of the main body 210 of the fiber optic module 190. In this manner, the front openings 208A, 208B have sufficient height to receive the fiber optic components 23, while three (3) fiber optic modules 190 can be disposed in the height of a 1-U space. As an example, the height H_1 could be twelve (12) mm or less or ten (10) mm or less. As an example, the height H_1 could be ten (10) mm and the height H_2 could be eleven (11) mm, for a ratio of height H_1 to height H_2 of 90.9%.

FIG. 22 illustrates another alternate fiber optic module 220 that may be provided in a fiber optic equipment tray 20' to support a higher number of fiber optic connections and connection densities and bandwidths in a 1-U space. The fiber optic equipment tray 20' in this embodiment is similar to the fiber optic equipment tray 20 previously discussed above; however, the fiber optic equipment tray 20' only contains three (3) module rail guides 32 instead of five (5) module rail guides 32. Thus, the fiber optic equipment tray 20' only supports two fiber optic modules 220 across a 1-U width space. Thus, the fiber optic module 220 does not have to provide the channel 162 or receiver 192 of the fiber optic modules 160, 190, respectively, to be disposed within the fiber optic equipment tray 20'. FIG. 23 is a right front perspective view of the fiber optic module 220 of FIG. 22. The fiber optic module 220 is designed to fit across one set of module rail guides 32 in the fiber optic equipment tray 20'. Module rails 225A, 225B, similar to the module rails 28A, 28B of the fiber optic module 22 of FIGS. 1-13, are disposed on each side 228, 230 of the fiber optic module 220 that are configured to engage with tray channels 30 in the fiber optic equipment tray 20', as illustrated in FIG. 22.

Up to twenty-four (24) fiber optic components 23 can be disposed in a front side 232 of the fiber optic module 220. In this embodiment, the fiber optic components 23 are comprised of up to twelve (12) duplex LC fiber optic adapters, which are connected to one twenty-four (24) fiber MPO fiber optic connector 234 disposed in a rear end 236 of the fiber optic module 220. Thus, with three (3) fiber optic equipment trays 20' disposed in the height of the chassis 12, a total of six (6) fiber optic modules 220 can be supported in a given 1-U space. Supporting up to twenty-four (24) fiber optic connections per fiber optic module **220** equates to the chassis **12** supporting up to one hundred forty-four (144) fiber optic connections, or seventy-two (72) duplex channels, in a 1-U space in the chassis **12** (i.e., twenty-four (24) fiber optic connections X six (6) fiber optic modules **220** in a 1-U space). Thus, the chassis **12** is capable of supporting up to one hundred forty-four (144) fiber optic connections in a 1-U space by twenty (24) simplex or twelve (12) duplex fiber optic adapters being disposed in the fiber optic modules **220**. Supporting up to twenty (20) fiber optic connections per fiber optic module **220** equates to the chassis **12** supporting one hundred twenty (120) fiber optic connections, or sixty (60) duplex channels, in a 1-U space in the chassis **12** (i.e., twenty (20) fiber optic connections X six (6) fiber optic modules **220** in a 1-U space). Thus, the chassis **12** is also capable of supporting up to one hundred twenty (120) fiber optic connections in a 1-U space by twenty (20) simplex or ten (10) duplex fiber optic adapters being disposed in the fiber optic modules **220**.

FIG. **24** illustrates a front view of the fiber optic module **220** of FIGS. **22-23** without loaded fiber optic components **23** in the front side **232** to further illustrate the form factor of the fiber optic module **220** in this embodiment. A front opening **238** is through the front side **232** of a main body **240** of the fiber optic module **220** to receive the fiber optic components **23**. Width W_4 of the front opening **238** is about twice the width W_1 of the front opening **98** in the fiber optic module **22** illustrated in FIG. **13**. Width W_5 of the front side **232** is about one-hundred eighty-eight (188) millimeters, which is slightly greater than about twice the width W_3 of the fiber optic module **22** illustrated in FIG. **13**. The heights H_1 and H_2 are the same as in the fiber optic module **22** illustrated in FIG. **13**. Thus, in this embodiment, the width W_4 of the front opening **238** is designed to be at least eighty-five percent (85%) of the width W_5 of the front side **232** of the main body **240** of the fiber optic module **220**. The greater the percentage of the width W_4 to the width W_5, the larger the area provided in the front opening **238** to receive fiber optic components **23** without increasing the width W_4.

Width W_4 of the front opening **238** could be designed to be greater than eighty-five percent (85%) of the width W_5 of the front side **232** of the main body **240** of the fiber optic module **220**. For example, the width W_4 could be designed to be between ninety percent (90%) and ninety-nine percent (99%) of the width of W_5. As an example, the width W_4 could be less than one hundred eighty (180) mm. As another example, the width W_4 could be less than one hundred seventy (170) mm or less than one hundred sixty (160) mm. For example, width W_4 may be one hundred sixty-six (166) mm and width W_5 may be 171 millimeters, for a ratio of width W_4 to width W_5 of 166/171=97%. In this example, the front opening **238** may support twenty-four (24) fiber optic connections in the width W_4 to support a fiber optic connection density of at least one fiber optic connection per 7.0 mm of width W_4 of the front opening **238**. Further, the front opening **238** may support twenty-four (24) fiber optic connections in the width W_4 to support a fiber optic connection density of at least one fiber optic connection per 6.9 mm of width W_4 of the front opening **238**.

Further, as illustrated in FIG. **24**, the height H_1 of the front opening **238** could be designed to be at least ninety percent (90%) of the height H_2 of the front side **232** of the main body **240** of the fiber optic module **220**. In this manner, the front opening **238** has sufficient height to receive the fiber optic components **23**, while three (3) fiber optic modules **220** can be disposed in the height of a 1-U space. As an example, the height H_1 could be twelve (12) mm or less or ten (10) mm or less. As an example, the height H_1 could be ten (10) mm and height H_2 could be eleven (11) mm, for a ratio of height H_1 to height H_2 of 90.9%.

FIG. **25** illustrates another embodiment of fiber optic equipment **260** that can include fiber optic equipment trays previously described above and illustrated to support fiber optic modules. The fiber optic equipment **260** in this embodiment includes a 4-U sized chassis **262** configured to hold fiber optic equipment trays each supporting one or more fiber optic modules. The supported fiber optic equipment trays may be any of the fiber optic equipment trays **20**, **20'** previously described above and thus will not be described again here. The supported fiber optic modules may be any of the fiber optic modules **22**, **22'**, **22"**, **160**, **190**, **220** previously described above and thus will not be described again here. In this example, the chassis **262** is illustrated as supporting twelve (12) fiber optic equipment trays **20** each capable of supporting fiber optic modules **22**.

The tray guides **58** previously described are used in the chassis **262** to support tray rails **56** of the fiber optic equipment trays **20** therein and to allow each fiber optic equipment tray **20** to be independently extended out from and retracted back into the chassis **262**. A front door **264** is attached to the chassis **262** and is configured to close about the chassis **262** to secure the fiber optic equipment trays **20** contained in the chassis **262**. A cover **266** is also attached to the chassis **262** to secure the fiber optic equipment trays **20**. However, in the chassis **262**, up to twelve (12) fiber optic equipment trays **20** can be provided. However, the fiber optic connection densities and connection bandwidths are still the same per 1-U space. The fiber optic connection densities and connection bandwidth capabilities have been previously described and equally applicable for the chassis **4262** of FIG. **25**, and thus will not be described again here.

Thus, in summary, the table below summarizes some of the fiber optic connection densities and bandwidths that are possible to be provided in a 1-U and 4-U space employing the various embodiments of fiber optic modules, fiber optic equipment trays, and chassis described above. For example, two (2) optical fibers duplexed for one (1) transmission/reception pair can allow for a data rate of ten (10) Gigabits per second in half-duplex mode or twenty (20) Gigabits per second in full-duplex mode. As another example, eight (8) optical fibers in a twelve (12) fiber MPO fiber optic connector duplexed for four (4) transmission/reception pairs can allow for a data rate of forty (40) Gigabits per second in half-duplex mode or eighty (80) Gigabits per second in full-duplex mode. As another example, twenty optical fibers in a twenty-four (24) fiber MPO fiber optic connector duplexed for ten (10) transmission/reception pairs can allow for a data rate of one hundred (100) Gigabits per second in half-duplex mode or two hundred (200) Gigabits per second in full-duplex mode. Note that this table is exemplary and the embodiments disclosed herein are not limited to the fiber optic connection densities and bandwidths provided below.

Connector Type	Max Fibers per 1 RU	Max Fibers per 4 RU	Number of Connectors per 1 RU Space	Number of Connectors per 4 RU Space	Bandwidth per 1 U using 10 Gigabit Transceivers (duplex)	Bandwidth per 1 U using 40 Gigabit Transceivers (duplex)	Bandwidth per 1 U using 100 Gigabit Transceivers (duplex)
Duplexed LC	144	576	72	288	1,440 Gigabits/s.	960 Gigabits/s.	1,200 Gigabits/s.
12-F MPO	576	2,304	48	192	5,760 Gigabits/s.	3,840 Gigabits/s.	4,800 Gigabits/s.
24-F MPO	1,152	4,608	48	192	11,520 Gigabits/s.	7,680 Gigabits/s.	9,600 Gigabits/s.

Many modifications and other embodiments of the invention set forth herein will come to mind to one skilled in the art to which the invention pertains having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. These modifications include, but are not limited to, number or type of fiber optic equipment, fiber optic module, fiber optic equipment tray, features included in the fiber optic equipment tray. Any size equipment, including but not limited to 1-U, 2-U and 4-U sizes may include some or all of the aforementioned features and fiber optic modules disclosed herein and some or all of their features. Further, the modifications are not limited to the type of fiber optic equipment tray or the means or device to support fiber optic modules installed in the fiber optic equipment trays. The fiber optic modules can include any fiber optic connection type, including but not limited to fiber optic connectors and adapters, and number of fiber optic connections, density, etc.

Further, as used herein, it is intended that the terms "fiber optic cables" and/or "optical fibers" include all types of single mode and multi-mode light waveguides, including one or more bare optical fibers, loose-tube optical fibers, tight-buffered optical fibers, ribbonized optical fibers, bend-insensitive optical fibers, or any other expedient of a medium for transmitting light signals.

Therefore, it is to be understood that the embodiments are not to be limited to the specific embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of the appended claims. It is intended that the embodiments cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.

What is claimed is:

1. A fiber optic module, comprising:
- a main body defining an internal chamber disposed between a front side and a rear side;
- a plurality of optical fibers disposed in the internal chamber;
- a front opening disposed along a longitudinal axis in the front side;
- a first plurality of fiber optic components optically connected to the plurality of optical fibers, the first plurality of fiber optic components disposed through the front opening; and
- at least one second fiber optic component optically connected to at least one of the plurality of optical fibers to provide optical connection between the at least one second fiber optic component and at least one of the first plurality of fiber optic components;
- wherein the width of the front opening is at least eighty-five percent (85%) of the width of the front side.

2. The fiber optic module of claim 1, wherein the width of the front opening is between ninety percent (90%) and ninety-nine percent (99%) of the width of the front side.

3. The fiber optic module of claim 1, wherein a height of the front opening is at least eighty-five percent (85%) of the height of the front side.

4. The fiber optic module of claim 1, wherein a height of the front opening is at least ninety-five percent (95%) of the height of the front side.

5. The fiber optic module of claim 1, wherein the at least one second fiber optic component is disposed through the rear side of the main body.

6. The fiber optic module of claim 1, wherein the first plurality of fiber optic components is comprised of at least a first plurality of fiber optic connectors and a first plurality of fiber optic adapters.

7. The fiber optic module of claim 1, wherein the first plurality of fiber optic components is comprised of first single fiber, fiber optic components.

8. The fiber optic module of claim 1, wherein the plurality of optical fibers are further disposed in a fiber optic harness disposed in the internal chamber and connected to the first plurality of fiber optic components and the at least one second fiber optic component.

9. The fiber optic module of claim 8, wherein the fiber optic harness is comprised of a plurality of optical fibers having a bend radius of forty millimeters or less.

10. The fiber optic module of claim 1, further comprising at least one rail disposed on the main body.

11. The fiber optic module of claim 10, further comprising at least one latch attached to the at least one rail and configured to engage the at least one rail.

12. The fiber optic module of claim 10 disposed in fiber optic equipment comprised from the group consisting of a fiber optic chassis and a fiber optic equipment drawer.

13. The fiber optic module of claim 1, further including a fiber guide.

14. A fiber optic module, comprising:
- a main body defining an internal chamber disposed between a front side and a rear side;
- a plurality of optical fibers disposed in the internal chamber;
- a front opening disposed along a longitudinal axis in the front side;
- a first plurality of fiber optic components optically connected to the plurality of optical fibers, the first plurality of fiber optic components disposed through the front opening providing a fiber optic connection density of at least one fiber optic connection per 7.0 millimeters (mm) of width of the front opening; and
- at least one second fiber optic component optically connected to at least one of the plurality of optical fibers to provide optical connection between the at least one second fiber optic component and at least one of the first plurality of fiber optic components.

15. The fiber optic module of claim 14, wherein the first plurality of fiber optic components provides a fiber optic

connection density of at least one fiber optic connection per 6.9 mm of width of the front opening.

16. The fiber optic module of claim 14, wherein the first plurality of fiber optic components provides a fiber optic connection density of at least one fiber optic connection per 1.7 mm of width of the front opening.

17. The fiber optic module of claim 14, wherein the first plurality of fiber optic components provides a fiber optic connection density of at least one fiber optic connection per 0.85 mm of width of the front opening.

18. The fiber optic module of claim 14, wherein the first plurality of fiber optic components is comprised of at least a first plurality of fiber optic connectors and a first plurality of fiber optic adapters.

19. The fiber optic module of claim 14, wherein the first plurality of fiber optic components is comprised of first single fiber, fiber optic components.

20. The fiber optic module of claim 14, wherein the plurality of optical fibers are further disposed in a fiber optic harness disposed in the internal chamber and connected to the first plurality of fiber optic components and the at least one second fiber optic component.

21. The fiber optic module of claim 20, wherein the fiber optic harness is comprised of a plurality of optical fibers having a bend radius of 40 millimeters or less.

22. The fiber optic module of claim 14, further comprising at least one rail disposed on the main body.

23. The fiber optic module of claim 22, further comprising at least one latch attached to the at least one rail and configured to engage the at least one rail.

24. The fiber optic module of claim 14 disposed in fiber optic equipment comprised from the group consisting of a fiber optic chassis and a fiber optic equipment drawer.

25. The fiber optic module of claim 14, further including a fiber guide.

26. A fiber optic module, comprising:

a main body defining an internal chamber disposed between a front side and a rear side;

a plurality of optical fibers disposed in the internal chamber;

a front opening disposed along a longitudinal axis in the front side; and

a first plurality of fiber optic components optically connected to the plurality of optical fibers, the first plurality of fiber optic components disposed through the front opening providing at least twelve (12) fiber optic connections;

wherein the width of the front opening is 90 mm or less; and

at least one second fiber optic component optically connected to at least one of the plurality of optical fibers to provide optical connection between the at least one second fiber optic component and at least one of the first plurality of fiber optic components.

27. The fiber optic module of claim 26, wherein the width of the front opening is 85 mm or less.

28. The fiber optic module of claim 26, wherein the width of the front opening is 80 mm or less.

29. The fiber optic module of claim 26, wherein the height of the front opening is 12 mm or less.

30. The fiber optic module of claim 26, wherein the height of the front opening is 10 mm or less.

31. The fiber optic module of claim 26, wherein the first plurality of fiber optic components provides at least forty-eight (48) fiber optic connections.

32. The fiber optic module of claim 26, wherein the first plurality of fiber optic components provides at least ninety-six (96) fiber optic connections.

33. The fiber optic module of claim 26, wherein the first plurality of fiber optic components is comprised of at least a first plurality of fiber optic connectors and a first plurality of fiber optic adapters.

34. The fiber optic module of claim 26, wherein the first plurality of fiber optic components is comprised of first single fiber, fiber optic components.

35. The fiber optic module of claim 26, wherein the plurality of optical fibers are further disposed in a fiber optic harness disposed in the internal chamber and connected to the first plurality of fiber optic components and the at least one second fiber optic component.

36. The fiber optic module of claim 35, wherein the fiber optic harness is comprised of a plurality of optical fibers having a bend radius of 40 millimeters or less.

37. The fiber optic module of claim 26, further comprising at least one rail disposed on the main body.

38. The fiber optic module of claim 37, further comprising at least one latch attached to the at least one rail and configured to engage the at least one rail.

39. The fiber optic module of claim 26 disposed in fiber optic equipment comprised from the group consisting of a fiber optic chassis and a fiber optic equipment drawer.

40. The fiber optic module of claim 26, further including a fiber guide.

41. A fiber optic module housing, comprising:

a main body defining an internal chamber disposed between a front side and a rear side; and

a plurality of optical fibers disposed in the internal chamber;

a front opening disposed along a longitudinal axis in the front side and configured to receive a first plurality of fiber optic components optically connected to the plurality of optical fibers;

wherein the width of the front opening is at least eighty-five percent (85%) of the width of the front side; and

at least one second fiber optic component optically connected to at least one of the plurality of optical fibers to provide optical connection between the at least one second fiber optic component and at least one of the first plurality of fiber optic components.

42. The fiber optic module housing of claim 41, wherein the width of the front opening is between ninety percent (90%) and ninety-nine percent (99%) of the width of the front side.

43. The fiber optic module housing of claim 41, wherein the height of the front opening is at least eighty-five percent (85%) of the height of the front side.

44. The fiber optic module housing of claim 41, wherein the height of the front opening is at least ninety percent (90%) of the height of the front side.

45. The fiber optic module of claim 41, further including a fiber guide.

46. A fiber optic module housing, comprising:

a main body defining an internal chamber disposed between a front side and a rear side, the internal chamber configured to support a plurality of optical fibers disposed therein; and

a front opening disposed along a longitudinal axis in the front side and configured to support a first plurality of fiber optic components having a fiber optic connection density of at least one fiber optic connection per 7.0 millimeters (mm) of width of the front opening; and the main body further configured to support at least one second fiber optic component optically connected to at least one of the plurality of optical fibers to provide optical connection between the at least one second fiber optic component and at least one of the first plurality of fiber optic components.

47. The fiber optic module housing of claim 46, wherein the front opening supports the fiber optic connection density of at least one fiber optic connection per 6.9 mm of width of the front opening.

48. A fiber optic module housing, comprising:

a main body defining an internal chamber disposed between a front side and a rear side; and

a front opening disposed along a longitudinal axis in the front side and configured to support at least twelve (12) first fiber optic connections to at least twelve (12) optical fibers;

wherein the width of the front opening is 90 mm or less; and

wherein the main body is further configured to support at least one second fiber optic connection optically connected to the at least twelve (12) optical fibers to provide at least twelve (12) optical connections between the at least one second fiber optic component and the at least twelve (12) first fiber optic connections.

49. The fiber optic module housing of claim 48, wherein the width of the front opening is 80 mm or less.

50. The fiber optic module housing of claim 48, wherein the height of the front opening is 12 mm or less.

51. The fiber optic module housing of claim 48, wherein the height of the front opening is 10 mm or less.

52. A fiber optic module, comprising:

a main body defining an internal chamber disposed between a front side and a rear side, wherein the front side has a width;

a plurality of optical fibers disposed in the internal chamber;

a first plurality of fiber optic components optically connected to the plurality of optical fibers, the first plurality of fiber optic components disposed though at least eighty-five percent (85%) of the width of the front side; and

at least one second fiber optic component optically connected to at least one of the plurality of optical fibers to provide optical connection between the at least one second fiber optic component and at least one of the first plurality of fiber optic components.

53. The fiber optic module of claim 52, wherein the width of the front opening is between ninety percent (90%) and ninety-nine percent (99%) of the width of the front side.

54. The fiber optic module of claim 52, wherein a height of the front opening is at least eighty-five percent (85%) of the height of the front side.

55. The fiber optic module of claim 52, wherein the at least one second fiber optic component is disposed through the rear side of the main body.

56. The fiber optic module of claim 52, wherein the first plurality of fiber optic components is comprised of at least a first plurality of fiber optic connectors and a first plurality of fiber optic adapters.

57. The fiber optic module of claim 52, wherein the first plurality of fiber optic components is comprised of first single fiber, fiber optic components.

58. The fiber optic module of claim 52, wherein the plurality of optical fibers are further disposed in a fiber optic harness disposed in the internal chamber and connected to the first plurality of fiber optic components and the at least one second fiber optic component.

59. The fiber optic module of claim 52, further comprising at least one rail disposed on the main body.

60. The fiber optic module of claim 59, further comprising at least one latch attached to the at least one rail and configured to engage the at least one rail.

61. The fiber optic module of claim 59 disposed in fiber optic equipment comprised from the group consisting of a fiber optic chassis and a fiber optic equipment drawer.

62. The fiber optic module of claim 52, further including a fiber guide.

63. A fiber optic module, comprising:

a main body defining an internal chamber disposed between a front side and a rear side, wherein the front side has a width;

a plurality of optical fibers disposed in the internal chamber;

front openings having a width being at least eighty-five percent (85%) of the width of the front side of the main body;

a first plurality of fiber optic components optically connected to the plurality of optical fibers, the fiber optic components disposed through the front openings; and

at least one second fiber optic component optically connected to at least one of the plurality of optical fibers to provide optical connection between the at least one second fiber optic component and at least one of the first plurality of fiber optic components.

64. The fiber optic module of claim 63, wherein the width of the front openings being between ninety percent (90%) and ninety-nine percent (99%) of the width of the front side.

65. The fiber optic module of claim 63, wherein a height of the front openings is at least eighty-five percent (855) of the height of the front side.

66. The fiber optic module of claim 63, wherein the at least one second fiber optic component is disposed through the rear side of the main body.

67. The fiber optic module of claim 63, wherein the first plurality of fiber optic components is comprised of at least a first plurality of fiber optic connectors and a first plurality of fiber optic adapters.

68. The fiber optic module of claim 63, wherein the first plurality of fiber optic components is comprised of first single fiber, fiber optic components.

69. The fiber optic module of claim 63, wherein the plurality of optical fibers are further disposed in a fiber optic harness disposed in the internal chamber and connected to the first plurality of fiber optic components and the at least one second fiber optic component.

70. The fiber optic module of claim 63, further comprising at least one rail disposed on the main body.

71. The fiber optic module of claim 70, further comprising at least one latch attached to the at least one rail and configured to engage the at least one rail.

72. The fiber optic module of claim 70 disposed in fiber optic equipment comprised from the group consisting of a fiber optic chassis and a fiber optic equipment drawer.

73. The fiber optic module of claim 63, further including a fiber guide.

* * * * *

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(12) **United States Patent**
Cooke et al.

(10) **Patent No.: US 10,120,153 B2**
(45) **Date of Patent: *Nov. 6, 2018**

(54) **INDEPENDENTLY TRANSLATABLE MODULES AND FIBER OPTIC EQUIPMENT TRAYS IN FIBER OPTIC EQUIPMENT**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

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(52) **U.S. Cl.**
CPC ***G02B 6/4455*** (2013.01); ***G02B 6/3897*** (2013.01); ***G02B 6/4452*** (2013.01); ***G02B 6/4453*** (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

620,013 A	2/1899	Barnes
864,761 A	8/1907	Erickson

(Continued)

FOREIGN PATENT DOCUMENTS

AU	2010270959 A1	2/2012
CA	2029592 A1	5/1992

(Continued)

OTHER PUBLICATIONS

International Search Report for PCT/US2012/023622 dated Mar. 9, 2012, 4 pages.

(Continued)

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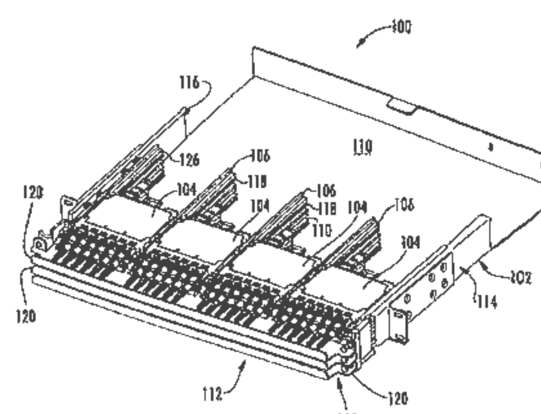
(57) **ABSTRACT**

Fiber optic equipment that supports independently translatable fiber optic modules and/or fiber optic equipment trays containing one or more fiber optic modules is disclosed. In some embodiments, one or more fiber optic modules are disposed in a plurality of independently translatable fiber optic equipment trays which are received in a tray guide system. In this manner, each fiber optic equipment tray is independently translatable within the guide system. One or more fiber optic modules may also be disposed in one or more module guides disposed in the fiber optic equipment trays to allow each fiber optic module to translate indepen-
(Continued)



dently of other fiber optic modules in the same fiber optic equipment tray. In other embodiments, a plurality of fiber optic modules are disposed in a module guide system disposed in the fiber optic equipment that translate independently of other fiber optic modules disposed within the module guide system.

29 Claims, 33 Drawing Sheets

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(56) **References Cited**

U.S. PATENT DOCUMENTS

2,528,910 A 11/1950 Poe
2,614,685 A 10/1952 Miller
3,057,525 A 10/1962 Malachick
3,081,717 A 3/1963 Yurevich
3,175,873 A 3/1965 Blomquist et al.
3,212,192 A 10/1965 Bachmann et al.
3,433,886 A 3/1969 Myers
3,494,306 A 2/1970 Aguilar
3,545,712 A 12/1970 Ellis
3,568,263 A 3/1971 Meehan
3,646,244 A 2/1972 Cole
3,664,514 A 5/1972 Drake
3,683,238 A 8/1972 Olds et al.
3,701,835 A 10/1972 Eisele et al.
3,880,396 A 4/1975 Freiberger et al.
3,906,592 A 9/1975 Sakasegawa et al.
3,991,960 A 11/1976 Tanaka
4,047,797 A 9/1977 Arnold et al.
4,059,872 A 11/1977 Delesandri
4,119,285 A 10/1978 Bisping et al.
4,148,454 A 4/1979 Carlson et al.
4,239,316 A 12/1980 Spaulding
4,244,638 A 1/1981 Little et al.
4,266,853 A 5/1981 Hutchins et al.
4,285,486 A 8/1981 Von Osten et al.
4,303,296 A 12/1981 Spaulding
4,354,731 A 10/1982 Mouissie
4,457,482 A 7/1984 Kitagawa
4,525,012 A 6/1985 Dunner
4,540,222 A 9/1985 Burrell
4,561,615 A 12/1985 Medlin, Jr.
4,564,163 A 1/1986 Barnett
4,597,173 A 7/1986 Chino et al.
4,611,875 A 9/1986 Clarke et al.
4,634,214 A 1/1987 Cannon, Jr. et al.
4,635,886 A 1/1987 Santucci et al.
4,645,292 A 2/1987 Sammueller
4,657,340 A 4/1987 Tanaka et al.
4,681,288 A 7/1987 Nakamura
4,702,551 A 10/1987 Coulombe
4,711,518 A 12/1987 Shank et al.
4,736,100 A 4/1988 Vastagh
4,744,629 A 5/1988 Bertoglio et al.
4,747,020 A 5/1988 Brickley et al.
4,752,110 A 6/1988 Blanchet et al.
4,753,510 A 6/1988 Sezerman
4,787,706 A 11/1988 Cannon, Jr. et al.
4,792,203 A 12/1988 Nelson et al.
4,798,432 A 1/1989 Becker et al.
4,805,979 A 2/1989 Bossard et al.
4,808,774 A 2/1989 Crane
4,824,193 A 4/1989 Maeda et al.
4,824,196 A 4/1989 Bylander
4,826,277 A 5/1989 Weber et al.
4,838,643 A 6/1989 Hodges et al.
4,840,449 A 6/1989 Ghandeharizadeh
4,865,280 A 9/1989 Wollar
4,889,403 A 12/1989 Zucker et al.
4,898,448 A 2/1990 Cooper
4,900,123 A 2/1990 Barlow
4,911,662 A 3/1990 Debortoli et al.
4,913,514 A 4/1990 Then
4,948,220 A 8/1990 Violo et al.
4,949,376 A 8/1990 Nieves et al.
4,971,421 A 11/1990 Ori
4,986,625 A 1/1991 Yamada et al.
4,988,831 A 1/1991 Wilson et al.
4,991,928 A 2/1991 Zimmer
4,995,688 A 2/1991 Anton et al.
5,001,602 A 3/1991 Suffi et al.
5,005,941 A 4/1991 Barlow et al.
5,011,257 A 4/1991 Wettengel et al.
5,017,211 A 5/1991 Wenger et al.
5,023,646 A 6/1991 Ishida et al.
5,024,498 A 6/1991 Becker et al.
5,028,114 A 7/1991 Krausse et al.
5,037,175 A 8/1991 Weber
5,048,918 A 9/1991 Daems et al.
5,060,897 A 10/1991 Thalenfeld
5,066,149 A 11/1991 Wheeler et al.
5,067,784 A 11/1991 Debortoli et al.
5,071,211 A 12/1991 Debortoli et al.
5,071,220 A 12/1991 Ruello et al.
5,073,042 A 12/1991 Mulholland et al.
5,074,635 A 12/1991 Justice et al.
5,076,688 A 12/1991 Bowen et al.
5,080,459 A 1/1992 Wettengel et al.
5,100,221 A 3/1992 Carney et al.
5,104,336 A 4/1992 Hatanaka et al.
5,125,060 A 6/1992 Edmundson
5,127,082 A 6/1992 Below et al.
5,127,851 A 7/1992 Hilbert et al.
5,129,030 A 7/1992 Petrunia
5,129,607 A 7/1992 Satoh
5,129,842 A 7/1992 Morgan et al.
5,133,039 A 7/1992 Dixit
5,138,678 A 8/1992 Briggs et al.
5,138,688 A 8/1992 Debortoli
5,142,598 A 8/1992 Tabone
5,142,607 A 8/1992 Petrotta et al.
5,150,277 A 9/1992 Bainbridge et al.
D330,368 S 10/1992 Bourgeois et al.
5,152,760 A 10/1992 Latina
5,153,910 A 10/1992 Mickelson et al.
5,157,749 A 10/1992 Briggs et al.
5,167,001 A 11/1992 Debortoli et al.
5,170,452 A 12/1992 Ott
5,189,723 A 2/1993 Johnson et al.
5,199,099 A 3/1993 Dalgoutte
5,204,929 A 4/1993 Machall et al.
5,209,572 A 5/1993 Jordan
5,214,735 A 5/1993 Henneberger et al.
5,224,186 A 6/1993 Kishimoto et al.
5,230,492 A 7/1993 Zwart et al.
5,231,687 A 7/1993 Handley
5,231,688 A 7/1993 Zimmer
5,233,674 A 8/1993 Vladic
5,239,609 A 8/1993 Auteri
5,243,679 A 9/1993 Sharrow et al.
5,253,320 A 10/1993 Takahashi et al.
5,260,957 A 11/1993 Hakimi et al.
5,261,633 A 11/1993 Mastro
5,265,187 A 11/1993 Morin et al.
5,274,729 A 12/1993 King et al.
5,274,731 A 12/1993 White
5,278,933 A 1/1994 Hunsinger et al.
5,280,138 A 1/1994 Preston et al.
5,285,515 A 2/1994 Milanowski et al.
5,291,570 A 3/1994 Filgas et al.
5,315,679 A 5/1994 Baldwin et al.
5,317,663 A 5/1994 Beard et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,323,478 A 6/1994 Milanowski et al.
5,323,480 A 6/1994 Mullaney et al.
5,329,520 A 7/1994 Richardson
5,333,193 A 7/1994 Cote et al.
5,333,221 A 7/1994 Briggs et al.
5,333,222 A 7/1994 Belenkiy et al.
5,337,400 A 8/1994 Morin et al.
5,339,379 A 8/1994 Kutsch et al.
5,347,603 A 9/1994 Belenkiy et al.
5,353,367 A 10/1994 Czosnowski et al.
5,359,688 A 10/1994 Underwood
5,363,466 A 11/1994 Milanowski et al.
5,363,467 A 11/1994 Keith
5,366,388 A 11/1994 Freeman et al.
5,367,598 A 11/1994 Devenish, III et al.
5,373,421 A 12/1994 Detsikas et al.
5,383,051 A 1/1995 Delrosso et al.
5,390,272 A 2/1995 Repta et al.
5,398,295 A 3/1995 Chang et al.
5,398,820 A 3/1995 Kiss
5,399,814 A 3/1995 Staber et al.
5,401,193 A 3/1995 Lo Cicero et al.
5,402,515 A 3/1995 Vidacovich et al.
5,408,557 A 4/1995 Hsu
5,408,570 A 4/1995 Cook et al.
RE34,955 E 5/1995 Anton et al.
5,412,751 A 5/1995 Siemon et al.
5,416,837 A 5/1995 Cote et al.
5,418,874 A 5/1995 Carlisle et al.
5,420,956 A 5/1995 Grugel et al.
5,420,958 A * 5/1995 Henson G02B 6/3806 385/135
5,421,532 A 6/1995 Richter
5,438,641 A 8/1995 Malacarne
5,442,725 A 8/1995 Peng
5,442,726 A 8/1995 Howard et al.
5,443,232 A 8/1995 Kesinger et al.
5,444,804 A 8/1995 Yui et al.
5,448,015 A 9/1995 Jamet et al.
5,450,518 A 9/1995 Burek et al.
5,458,019 A 10/1995 Trevino
5,471,555 A 11/1995 Braga et al.
5,479,505 A 12/1995 Butler et al.
5,481,634 A 1/1996 Anderson et al.
5,481,939 A 1/1996 Bernardini
5,490,229 A 2/1996 Ghandeharizadeh et al.
5,495,549 A 2/1996 Schneider et al.
5,497,416 A 3/1996 Butler, III et al.
5,497,444 A * 3/1996 Wheeler G02B 6/4452 385/134
5,511,144 A * 4/1996 Hawkins G02B 6/4452 385/134
5,511,798 A 4/1996 Kawamoto et al.
5,519,804 A 5/1996 Burek et al.
5,530,786 A 6/1996 Radliff et al.
5,535,970 A 7/1996 Gobbi
5,538,213 A 7/1996 Brown
5,542,015 A 7/1996 Hultermans
5,546,495 A 8/1996 Bruckner et al.
5,548,641 A 8/1996 Butler et al.
5,553,183 A 9/1996 Bechamps
5,553,186 A 9/1996 Allen
5,563,971 A 10/1996 Abendschein
5,572,617 A 11/1996 Bernhardt et al.
5,575,680 A 11/1996 Suffi
5,577,151 A 11/1996 Hoffer
5,590,234 A 12/1996 Pulido
5,595,507 A 1/1997 Braun et al.
5,596,670 A 1/1997 Debortoli et al.
5,600,020 A 2/1997 Wehle et al.
5,602,954 A 2/1997 Nolf et al.
5,608,606 A 3/1997 Blaney
5,613,030 A 3/1997 Hoffer et al.
5,617,501 A 4/1997 Miller et al.
5,638,474 A 6/1997 Lampert et al.
5,640,476 A 6/1997 Womack et al.
5,640,482 A 6/1997 Barry et al.
5,647,043 A 7/1997 Anderson et al.
5,647,045 A 7/1997 Robinson et al.
5,650,334 A 7/1997 Luk et al.
5,668,910 A 9/1997 Arnett
5,668,911 A 9/1997 Debortoli
5,671,273 A 9/1997 Lanquist
5,689,605 A 11/1997 Cobb et al.
5,689,607 A 11/1997 Vincent et al.
5,692,079 A 11/1997 Iso
5,694,511 A 12/1997 Pimpinella et al.
5,701,380 A 12/1997 Larson et al.
5,704,573 A 1/1998 de Beers et al.
5,708,742 A 1/1998 Beun et al.
5,708,751 A 1/1998 Mattei
5,710,851 A 1/1998 Walter et al.
5,717,810 A 2/1998 Wheeler
5,734,776 A 3/1998 Puetz
5,734,779 A 3/1998 Okino
5,740,300 A 4/1998 Hodge
5,742,982 A 4/1998 Dodd et al.
5,751,874 A 5/1998 Chudoba et al.
5,751,882 A 5/1998 Daems et al.
5,754,724 A 5/1998 Peterson et al.
5,758,003 A 5/1998 Wheeler et al.
5,758,004 A 5/1998 Alarcon et al.
5,761,026 A 6/1998 Robinson et al.
5,765,698 A 6/1998 Bullivant
5,769,908 A 6/1998 Koppelman
5,774,612 A 6/1998 Belenkiy et al.
5,778,122 A 7/1998 Giebel et al.
5,778,130 A 7/1998 Walters et al.
5,781,686 A 7/1998 Robinson et al.
5,788,087 A 8/1998 Orlando
5,790,741 A 8/1998 Vincent et al.
5,793,920 A 8/1998 Wilkins et al.
5,793,921 A 8/1998 Wilkins et al.
5,796,908 A 8/1998 Vicory
5,806,687 A 9/1998 Ballesteros et al.
5,823,646 A 10/1998 Arizpe et al.
5,825,955 A 10/1998 Ernst et al.
5,825,961 A 10/1998 Wilkins et al.
5,828,807 A 10/1998 Tucker et al.
5,832,162 A 11/1998 Sarbell
5,835,657 A 11/1998 Suarez et al.
5,835,658 A 11/1998 Smith
5,862,290 A 1/1999 Burek et al.
5,870,519 A 2/1999 Jenkins et al.
5,874,733 A 2/1999 Silver et al.
5,877,565 A 3/1999 Hollenbach et al.
5,880,864 A 3/1999 Williams et al.
5,881,200 A 3/1999 Burt
5,883,995 A 3/1999 Lu et al.
5,884,003 A 3/1999 Cloud et al.
5,887,095 A 3/1999 Nagase et al.
5,887,106 A 3/1999 Cheeseman et al.
5,892,877 A 4/1999 Meyerhoefer
5,894,540 A 4/1999 Drewing
5,901,220 A 5/1999 Garver et al.
5,903,693 A 5/1999 Brown
5,906,342 A 5/1999 Kraus
5,909,298 A 6/1999 Shimada et al.
5,913,006 A 6/1999 Summach
5,914,976 A 6/1999 Jayaraman et al.
5,915,055 A 6/1999 Bennett et al.
5,923,804 A 7/1999 Rosson
5,930,425 A 7/1999 Abel et al.
5,933,557 A 8/1999 Ott
5,940,563 A 8/1999 Kobayashi et al.
5,943,460 A 8/1999 Mead et al.
5,945,633 A 8/1999 Ott et al.
5,946,440 A 8/1999 Puetz
5,949,946 A 9/1999 Debortoli et al.
5,953,962 A 9/1999 Hewson
5,956,439 A 9/1999 Pimpinella
5,956,444 A 9/1999 Duda et al.
5,956,449 A 9/1999 Otani et al.
5,966,492 A 10/1999 Bechamps et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,969,294 A	10/1999	Eberle et al.	
5,975,769 A	11/1999	Larson et al.	
5,978,540 A *	11/1999	Bechamps	G02B 6/4455 385/134
5,980,303 A	11/1999	Lee et al.	
5,984,531 A	11/1999	Lu	
5,987,203 A	11/1999	Abel et al.	
5,993,071 A	11/1999	Hultermans	
5,995,700 A	11/1999	Burek et al.	
5,999,393 A	12/1999	Brower	
6,001,831 A	12/1999	Papenfuhs et al.	
6,009,224 A	12/1999	Allen	
6,009,225 A	12/1999	Ray et al.	
6,011,831 A	1/2000	Nieves et al.	
6,027,252 A	2/2000	Erdman et al.	
6,027,352 A	2/2000	Byrne	
6,041,042 A	3/2000	Bussiere	
6,044,193 A	3/2000	Szentesi et al.	
6,044,194 A	3/2000	Meyerhoefer	
6,049,963 A	4/2000	Boe	
6,058,235 A	5/2000	Hiramatsu et al.	
6,061,492 A	5/2000	Strause et al.	
6,078,661 A	6/2000	Arnett et al.	
6,079,881 A	6/2000	Roth	
6,088,497 A	7/2000	Phillips et al.	
6,118,075 A	9/2000	Baker et al.	
6,118,868 A	9/2000	Daoud	
6,127,627 A	10/2000	Daoud	
6,130,983 A	10/2000	Cheng	
6,134,370 A	10/2000	Childers et al.	
6,141,222 A	10/2000	Toor et al.	
6,142,676 A	11/2000	Lu	
6,149,313 A	11/2000	Giebel et al.	
6,149,315 A	11/2000	Stephenson	
6,151,432 A	11/2000	Nakajima et al.	
6,160,946 A	12/2000	Thompson et al.	
6,170,784 B1	1/2001	MacDonald et al.	
6,172,782 B1	1/2001	Kobayashi	
6,175,079 B1	1/2001	Johnston et al.	
6,181,861 B1	1/2001	Wenski et al.	
6,188,687 B1	2/2001	Mussman et al.	
6,188,825 B1	2/2001	Bandy et al.	
6,192,180 B1	2/2001	Kim et al.	
6,200,170 B1	3/2001	Amberg et al.	
6,201,919 B1	3/2001	Puetz et al.	
6,201,920 B1	3/2001	Noble et al.	
6,208,796 B1	3/2001	Williams Vigliaturo	
6,212,324 B1	4/2001	Lin et al.	
6,215,938 B1	4/2001	Reitmeier et al.	
6,216,987 B1	4/2001	Fukuo	
6,227,717 B1	5/2001	Ott et al.	
6,229,948 B1	5/2001	Blee et al.	
6,234,683 B1	5/2001	Waldron et al.	
6,234,685 B1	5/2001	Carlisle et al.	
6,236,795 B1	5/2001	Rodgers	
6,240,229 B1	5/2001	Roth	
6,243,522 B1	6/2001	Allan et al.	
6,245,998 B1	6/2001	Curry et al.	
6,247,851 B1	6/2001	Ichihara	
6,250,816 B1	6/2001	Johnston et al.	
6,256,210 B1	7/2001	Strijker et al.	
6,259,850 B1	7/2001	Crosby, Jr. et al.	
6,263,141 B1	7/2001	Smith	
6,265,680 B1	7/2001	Robertson	
6,269,212 B1	7/2001	Schiattone	
6,273,532 B1	8/2001	Chen et al.	
6,275,641 B1	8/2001	Daoud	
6,278,829 B1	8/2001	BuAbbud et al.	
6,278,831 B1	8/2001	Henderson et al.	
D448,005 S	9/2001	Klein, Jr. et al.	
6,289,618 B1	9/2001	Kump et al.	
6,292,614 B1	9/2001	Smith et al.	
6,301,424 B1	10/2001	Hwang	
6,305,848 B1	10/2001	Gregory	
6,307,997 B1	10/2001	Walters et al.	
6,318,824 B1	11/2001	LaGrotta et al.	
6,321,017 B1	11/2001	Janus et al.	
6,322,279 B1	11/2001	Yamamoto et al.	
6,324,575 B1	11/2001	Jain et al.	
6,325,549 B1	12/2001	Shevchuk	
6,327,059 B1	12/2001	Bhalla et al.	
RE37,489 E	1/2002	Anton et al.	
6,343,313 B1	1/2002	Salesky et al.	
6,344,615 B1	2/2002	Nolf et al.	
6,347,888 B1	2/2002	Puetz	
6,351,587 B1	2/2002	Holland	
6,353,696 B1	3/2002	Gordon et al.	
6,353,697 B1	3/2002	Daoud	
6,357,712 B1	3/2002	Lu	
6,359,228 B1	3/2002	Strause et al.	
6,362,422 B1	3/2002	Vavrik et al.	
6,363,198 B1	3/2002	Braga et al.	
6,363,200 B1	3/2002	Thompson et al.	
6,370,309 B1	4/2002	Daoud	
6,371,419 B1	4/2002	Ohnuki	
6,375,129 B2	4/2002	Koziol	
6,377,218 B1	4/2002	Nelson et al.	
6,379,052 B1	4/2002	De Jong et al.	
6,381,642 B1	4/2002	O'Donnell et al.	
6,385,374 B2	5/2002	Kropp	
6,385,381 B1	5/2002	Janus et al.	
6,389,214 B1	5/2002	Smith et al.	
6,392,140 B1	5/2002	Yee et al.	
6,397,166 B1	5/2002	Leung et al.	
6,398,149 B1	6/2002	Hines et al.	
6,406,314 B1	6/2002	Byrne	
6,410,850 B1	6/2002	Abel et al.	
6,411,767 B1	6/2002	Burrous et al.	
6,412,986 B1	7/2002	Ngo et al.	
6,418,262 B1	7/2002	Puetz et al.	
6,419,519 B1	7/2002	Young	
6,424,781 B1	7/2002	Puetz et al.	
6,425,694 B1	7/2002	Szilagyi et al.	
6,427,045 B1	7/2002	Matthes et al.	
6,431,762 B1	8/2002	Taira et al.	
6,434,313 B1	8/2002	Clapp, Jr. et al.	
6,438,310 B1 *	8/2002	Lance	G02B 6/4452 385/135
6,452,925 B1	9/2002	Sistanizadeh et al.	
6,456,773 B1	9/2002	Keys	
6,464,402 B1	10/2002	Andrews et al.	
6,466,724 B1	10/2002	Glover et al.	
6,469,905 B1	10/2002	Hwang	
D466,087 S	11/2002	Cuny et al.	
6,478,472 B1	11/2002	Anderson et al.	
6,480,487 B1	11/2002	Wegleitner et al.	
6,480,660 B1	11/2002	Reitmeier et al.	
6,483,977 B2	11/2002	Battey et al.	
6,484,958 B1	11/2002	Xue et al.	
6,494,550 B1	12/2002	Chen et al.	
6,496,640 B1	12/2002	Harvey et al.	
6,504,988 B1	1/2003	Trebesch et al.	
6,507,980 B2	1/2003	Bremicker	
6,510,274 B1	1/2003	Wu et al.	
6,532,332 B2	3/2003	Solheid et al.	
6,533,472 B1	3/2003	Dinh et al.	
6,535,397 B2	3/2003	Clark et al.	
6,537,106 B1	3/2003	Follingstad	
6,539,147 B1	3/2003	Mahony	
6,539,160 B2	3/2003	Battey et al.	
6,542,688 B1	4/2003	Battey et al.	
6,544,075 B1	4/2003	Liao	
6,545,611 B2	4/2003	Hayashi et al.	
6,550,977 B2	4/2003	Hizuka	
6,554,485 B1	4/2003	Beatty et al.	
6,560,334 B1	5/2003	Mullaney et al.	
6,567,601 B2	5/2003	Daoud et al.	
6,568,542 B1	5/2003	Chen	
6,571,048 B1	5/2003	Bechamps et al.	
6,577,595 B1	6/2003	Counterman	
6,577,801 B2	6/2003	Broderick et al.	
6,579,014 B2	6/2003	Melton et al.	
6,584,267 B1	6/2003	Caveney et al.	
6,585,423 B1	7/2003	Vergeest	

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,587,630 B2	7/2003	Spence et al.
6,588,938 B1	7/2003	Lampert et al.
6,591,051 B2	7/2003	Solheid et al.
6,591,053 B2	7/2003	Fritz
6,592,266 B1	7/2003	Hankins et al.
6,597,670 B1	7/2003	Tweedy et al.
6,600,106 B2	7/2003	Standish et al.
6,600,866 B2	7/2003	Gatica et al.
6,601,997 B2	8/2003	Ngo
6,612,515 B1	9/2003	Tinucci et al.
6,612,874 B1	9/2003	Stout et al.
6,614,978 B1	9/2003	Caveney
6,614,980 B1	9/2003	Mahony
6,621,975 B2	9/2003	Laporte et al.
6,622,873 B2	9/2003	Hegrenes et al.
6,624,389 B1	9/2003	Cox
6,625,374 B2	9/2003	Holman et al.
6,625,375 B1	9/2003	Mahony
6,631,237 B2	10/2003	Knudsen et al.
6,640,042 B2	10/2003	Araki et al.
RE38,311 E	11/2003	Wheeler
6,644,863 B1	11/2003	Azami et al.
6,647,197 B1 *	11/2003	Marrs G02B 6/4455 385/134
6,648,520 B2	11/2003	McDonald et al.
6,654,536 B2	11/2003	Battey et al.
6,668,127 B1	12/2003	Mahony
6,669,149 B2	12/2003	Akizuki
6,677,520 B1	1/2004	Kim et al.
6,679,604 B1	1/2004	Bove et al.
6,687,450 B1	2/2004	Kempeneers et al.
6,693,552 B1	2/2004	Herzig et al.
6,695,620 B1	2/2004	Huang
6,701,056 B2	3/2004	Burek et al.
6,710,366 B1	3/2004	Lee et al.
6,715,619 B2	4/2004	Kim et al.
6,719,149 B2	4/2004	Tomino
6,721,482 B1	4/2004	Glynn
6,728,462 B2	4/2004	Wu et al.
6,736,670 B2	5/2004	Clark et al.
6,741,784 B1	5/2004	Guan
6,741,785 B2	5/2004	Barthel et al.
6,746,037 B1	6/2004	Kaplenski et al.
6,748,154 B2	6/2004	O'Leary et al.
6,748,155 B2	6/2004	Kim et al.
6,758,600 B2 *	7/2004	Del Grosso G02B 6/4471 385/59
6,761,585 B2	7/2004	Clark et al.
6,768,860 B2	7/2004	Liberty
6,771,861 B2	8/2004	Wagner et al.
6,773,297 B2	8/2004	Komiya
6,778,525 B1	8/2004	Baum et al.
6,778,752 B2	8/2004	Laporte et al.
6,786,647 B1	9/2004	Hinds et al.
6,786,743 B2	9/2004	Huang
6,786,896 B1	9/2004	Madhani et al.
6,788,871 B2	9/2004	Taylor
6,792,190 B2	9/2004	Xin et al.
6,792,191 B1	9/2004	Clapp, Jr. et al.
6,798,751 B1	9/2004	Voit et al.
6,804,447 B2	10/2004	Smith et al.
6,810,194 B2	10/2004	Griffiths et al.
6,813,412 B2	11/2004	Lin
6,816,660 B2	11/2004	Nashimoto
6,818,834 B1	11/2004	Lin
6,819,856 B2	11/2004	Dagley et al.
6,819,857 B2	11/2004	Douglas et al.
6,822,874 B1	11/2004	Marler
6,826,174 B1	11/2004	Erekson et al.
6,826,346 B2	11/2004	Sloan et al.
6,826,631 B2	11/2004	Webb
6,830,489 B2	12/2004	Aoyama
6,839,428 B2	1/2005	Brower et al.
6,839,438 B1	1/2005	Riegelsberger et al.
6,840,815 B2	1/2005	Musolf et al.
6,845,207 B2	1/2005	Schray
6,847,614 B2	1/2005	Banker et al.
6,848,862 B1	2/2005	Schlig
6,850,685 B2	2/2005	Tinucci et al.
6,853,637 B1	2/2005	Norrell et al.
6,854,894 B1	2/2005	Yunker et al.
6,856,334 B1	2/2005	Fukui
6,856,505 B1	2/2005	Venegas et al.
6,863,444 B2	3/2005	Anderson et al.
6,865,331 B2	3/2005	Mertesdorf
6,865,334 B2	3/2005	Cooke et al.
6,866,541 B2	3/2005	Barker et al.
6,868,216 B1	3/2005	Gehrke
6,869,227 B2	3/2005	Del Grosso et al.
6,870,734 B2	3/2005	Mertesdorf et al.
6,870,997 B2	3/2005	Cooke et al.
6,879,545 B2	4/2005	Cooke et al.
6,915,058 B2	7/2005	Pons
6,916,199 B2	7/2005	Follingstad
6,918,786 B2	7/2005	Barker et al.
6,920,273 B2	7/2005	Knudsen
6,920,274 B2 *	7/2005	Rapp G02B 6/4453 385/135
6,923,406 B2	8/2005	Akizuki
6,925,241 B2	8/2005	Bohle et al.
6,934,451 B2	8/2005	Cooke
6,934,456 B2	8/2005	Ferris et al.
6,935,598 B2	8/2005	Sono et al.
6,937,807 B2	8/2005	Franklin et al.
6,944,383 B1	9/2005	Herzog et al.
6,944,389 B2 *	9/2005	Giraud G02B 6/4455 385/134
6,945,701 B2	9/2005	Trezza et al.
6,952,530 B2	10/2005	Helvajian et al.
6,963,690 B1	11/2005	Kassal et al.
6,968,107 B2	11/2005	Belardi et al.
6,968,111 B2	11/2005	Trebesch et al.
6,971,909 B2	12/2005	Levesque et al.
6,974,348 B2	12/2005	Bentley
6,980,725 B1 *	12/2005	Swieconek G02B 6/4452 385/135
6,981,893 B2	1/2006	Barker et al.
6,985,665 B2	1/2006	Baechtle
6,993,237 B2	1/2006	Cooke et al.
7,000,784 B2	2/2006	Canty et al.
7,005,582 B2	2/2006	Muller et al.
7,006,748 B2	2/2006	Dagley et al.
7,007,296 B2	2/2006	Rakib
7,025,275 B2	4/2006	Huang et al.
7,027,695 B2	4/2006	Cooke et al.
7,027,706 B2	4/2006	Diaz et al.
7,031,588 B2	4/2006	Cowley et al.
7,035,510 B2	4/2006	Zimmel et al.
7,038,137 B2	5/2006	Grubish et al.
7,048,447 B1	5/2006	Patel et al.
7,054,513 B2	5/2006	Herz et al.
7,059,887 B1 *	6/2006	Liu H01R 13/65802 385/136
7,066,748 B2	6/2006	Bricaud et al.
7,066,771 B2	6/2006	Clark et al.
7,068,907 B2	6/2006	Schray
7,070,459 B2	7/2006	Denovich et al.
7,077,710 B2	7/2006	Haggay et al.
7,079,744 B2	7/2006	Douglas et al.
7,090,406 B2	8/2006	Melton et al.
7,090,407 B2	8/2006	Melton et al.
7,094,095 B1	8/2006	Caveney
7,097,047 B2	8/2006	Lee et al.
7,101,093 B2	9/2006	Hsiao et al.
7,102,884 B2	9/2006	Mertesdort et al.
7,103,255 B2	9/2006	Reagan et al.
7,110,654 B2	9/2006	Dillat
7,111,990 B2	9/2006	Melton et al.
7,113,679 B2	9/2006	Melton et al.
7,113,686 B2	9/2006	Bellekens et al.
7,113,687 B2	9/2006	Womack et al.
7,116,491 B1	10/2006	Willey et al.
7,116,883 B2	10/2006	Kline et al.
7,118,281 B2	10/2006	Chiu et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,118,405	B2	10/2006	Peng
7,120,347	B2	10/2006	Blackwell, Jr. et al.
7,120,348	B2	10/2006	Trebesch et al.
7,120,349	B2	10/2006	Elliott
7,127,143	B2	10/2006	Elkins, II et al.
7,128,471	B2	10/2006	Wilson
7,136,555	B2	11/2006	Theuerkorn et al.
7,139,462	B1	11/2006	Richtman
7,140,903	B2	11/2006	Pulizzi et al.
7,147,383	B2	12/2006	Sullivan
7,170,466	B2	1/2007	Janoschka
7,171,099	B2	1/2007	Barnes et al.
7,171,121	B1	1/2007	Skarica et al.
7,179,119	B2	2/2007	Follingstad
7,181,142	B1	2/2007	Xu et al.
7,186,134	B2	3/2007	Togami et al.
7,193,783	B2	3/2007	Willey et al.
7,194,181	B2	3/2007	Holmberg et al.
7,195,521	B2	3/2007	Musolf et al.
7,200,314	B2	4/2007	Womack et al.
7,200,316	B2	4/2007	Giraud et al.
7,201,595	B1	4/2007	Morello
7,207,835	B2	4/2007	Levesque et al.
7,217,040	B2	5/2007	Crews et al.
7,218,526	B2	5/2007	Mayer
7,220,065	B2	5/2007	Han et al.
7,221,832	B2	5/2007	Tinucci
7,228,036	B2	6/2007	Elkins, II et al.
7,228,047	B1	6/2007	Szilagyi et al.
7,231,125	B2	6/2007	Douglas et al.
7,234,878	B2	6/2007	Yamauchi et al.
7,236,677	B2	6/2007	Escoto et al.
7,239,789	B2	7/2007	Grubish et al.
7,241,182	B2	7/2007	Clark et al.
7,244,144	B2	7/2007	Follingstad
7,245,809	B1	7/2007	Gniadek et al.
7,259,325	B2	8/2007	Pincu et al.
7,266,283	B2	9/2007	Kline et al.
7,270,485	B1	9/2007	Robinson et al.
7,272,291	B2	9/2007	Bayazit et al.
7,274,852	B1	9/2007	Smrha et al.
7,284,785	B2	10/2007	Gotou et al.
7,287,913	B2	10/2007	Keenum et al.
7,289,731	B2	10/2007	Thinguldstad
7,292,769	B2	11/2007	Watanabe et al.
7,298,950	B2	11/2007	Frohlich
7,300,216	B2	11/2007	Morse et al.
7,300,308	B2	11/2007	Laursen et al.
7,302,149	B2	11/2007	Swam et al.
7,302,153	B2	11/2007	Thom
7,302,154	B2	11/2007	Trebesch et al.
7,308,184	B2	12/2007	Barnes et al.
7,310,471	B2	12/2007	Bayazit et al.
7,310,472	B2	12/2007	Haberman
7,315,681	B2	1/2008	Kewitsch
7,325,975	B2	2/2008	Yamada et al.
7,330,624	B2	2/2008	Isenhour et al.
7,330,625	B2	2/2008	Barth
7,330,626	B2	2/2008	Kowalczyk et al.
7,330,629	B2	2/2008	Cooke et al.
7,331,718	B2	2/2008	Yazaki et al.
D565,205	S	3/2008	Lo et al.
7,340,145	B2	3/2008	Allen
7,349,615	B2	3/2008	Frazier et al.
7,352,946	B2	4/2008	Heller et al.
7,352,947	B2	4/2008	Phung et al.
7,357,667	B2	4/2008	Clark et al.
7,373,071	B2	5/2008	Douglas et al.
7,376,321	B2	5/2008	Bolster et al.
7,376,323	B2	5/2008	Zimmel
7,376,325	B1	5/2008	Cloud et al.
7,391,952	B1	6/2008	Ugolini et al.
7,397,996	B2	7/2008	Herzog et al.
7,400,813	B2	7/2008	Zimmel
7,404,736	B2	7/2008	Herbst et al.
7,409,137	B2	8/2008	Barnes
7,414,198	B2	8/2008	Stansbie et al.
7,417,188	B2	8/2008	McNutt et al.
7,418,182	B2	8/2008	Krampotich
7,418,184	B1	8/2008	Gonzales et al.
7,421,182	B2	9/2008	Bayazit et al.
7,428,363	B2	9/2008	Leon et al.
7,435,090	B1	10/2008	Schriefer et al.
7,437,049	B2	10/2008	Krampotich
7,439,453	B2	10/2008	Murano et al.
7,454,113	B2	11/2008	Barnes
7,460,757	B2	12/2008	Hoehne et al.
7,460,758	B2	12/2008	Xin
7,461,981	B2	12/2008	Yow, Jr. et al.
7,462,779	B2	12/2008	Caveney et al.
7,463,810	B2	12/2008	Bayazit et al.
7,463,811	B2	12/2008	Trebesch et al.
7,469,090	B2	12/2008	Ferris et al.
7,471,867	B2	12/2008	Vogel et al.
7,474,828	B2	1/2009	Leon et al.
7,477,824	B2	1/2009	Reagan et al.
7,477,826	B2	1/2009	Mullaney et al.
7,480,438	B2	1/2009	Douglas et al.
7,488,205	B2	2/2009	Spisany et al.
7,493,002	B2	2/2009	Coburn et al.
7,495,269	B1	2/2009	Lee
7,499,622	B2	3/2009	Castonguay et al.
7,499,623	B2	3/2009	Barnes et al.
7,507,111	B2	3/2009	Togami et al.
7,509,015	B2	3/2009	Murano
7,509,016	B2	3/2009	Smith et al.
7,510,421	B2	3/2009	Fransen et al.
7,522,804	B2	4/2009	Araki et al.
7,523,898	B1	4/2009	Barry et al.
7,526,171	B2	4/2009	Caveney et al.
7,526,172	B2	4/2009	Gniadek et al.
7,526,174	B2	4/2009	Leon et al.
7,529,458	B2	5/2009	Spisany et al.
7,529,485	B2	5/2009	Farmer et al.
7,534,958	B2	5/2009	McNutt et al.
7,536,075	B2	5/2009	Zimmel
7,540,666	B2	6/2009	Luther et al.
7,542,645	B1	6/2009	Hua et al.
7,544,085	B2	6/2009	Baldwin et al.
7,552,899	B2	6/2009	Chen et al.
7,555,193	B2	6/2009	Rapp et al.
7,558,458	B2	7/2009	Gronvall et al.
7,565,051	B2	7/2009	Vongseng
7,567,744	B2	7/2009	Krampotich et al.
7,570,860	B2 *	8/2009	Smrha G02B 6/4452 385/134
7,570,861	B2	8/2009	Smrha et al.
7,577,331	B2	8/2009	Laurisch et al.
7,596,293	B2	9/2009	Isenhour et al.
7,603,020	B1	10/2009	Wakileh et al.
7,607,938	B2	10/2009	Clark et al.
7,609,967	B2	10/2009	Hochbaum et al.
7,613,377	B2	11/2009	Gonzales et al.
7,614,903	B1	11/2009	Huang
7,620,287	B2	11/2009	Appenzeller et al.
7,641,398	B2	1/2010	O'Riorden et al.
7,668,430	B2	2/2010	McClellan et al.
7,668,433	B2	2/2010	Bayazit et al.
7,672,561	B1	3/2010	Keith et al.
7,676,135	B2	3/2010	Chen
7,689,079	B2	3/2010	Burnham et al.
7,689,089	B2	3/2010	Wagner et al.
7,694,926	B2	4/2010	Allen et al.
7,697,811	B2	4/2010	Murano et al.
7,706,294	B2	4/2010	Natarajan et al.
7,715,125	B2	5/2010	Willey
7,715,683	B2	5/2010	Kowalczyk et al.
7,734,138	B2	6/2010	Bloodworth et al.
7,740,409	B2	6/2010	Bolton et al.
7,743,495	B2	6/2010	Mori et al.
7,748,911	B2	7/2010	Keenum et al.
7,751,674	B2	7/2010	Hill
7,751,675	B2	7/2010	Holmberg et al.
7,756,371	B1	7/2010	Burnham et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,756,382	B2	7/2010	Saravanos et al.	
7,760,984	B2	7/2010	Solheid et al.	
7,764,858	B2	7/2010	Bayazit et al.	
7,764,859	B2	7/2010	Krampotich et al.	
7,769,266	B2	8/2010	Morris	
7,805,044	B2	9/2010	Reagan et al.	
7,809,232	B2	10/2010	Reagan et al.	
7,809,235	B2	10/2010	Reagan et al.	
7,811,136	B1	10/2010	Hsieh et al.	
7,822,310	B2	10/2010	Castonguay et al.	
7,822,340	B2	10/2010	Matityahu et al.	
7,837,495	B2	11/2010	Baldwin et al.	
7,850,372	B2	12/2010	Nishimura et al.	
7,853,112	B2 *	12/2010	Zimmel	G02B 6/4452 385/134
7,856,166	B2	12/2010	Biribuze et al.	
7,862,369	B2	1/2011	Gimenes et al.	
7,869,685	B2	1/2011	Hendrickson et al.	
7,876,580	B2	1/2011	Mayer	
7,899,298	B2	3/2011	Cox et al.	
7,914,332	B2	3/2011	Song et al.	
7,941,053	B2	5/2011	Dallesasse	
7,942,589	B2	5/2011	Yazaki et al.	
7,945,135	B2	5/2011	Cooke et al.	
7,945,136	B2	5/2011	Cooke et al.	
7,945,138	B2	5/2011	Hill et al.	
7,970,250	B2	6/2011	Morris	
7,991,252	B2	8/2011	Cheng et al.	
8,009,959	B2	8/2011	Barnes et al.	
8,014,171	B2	9/2011	Kelly et al.	
8,014,646	B2	9/2011	Keith et al.	
8,020,813	B1	9/2011	Clark et al.	
8,059,932	B2	11/2011	Hill et al.	
8,093,499	B2	1/2012	Hoffer et al.	
8,107,785	B2	1/2012	Berglund et al.	
8,131,126	B2	3/2012	Kowalczyk et al.	
8,184,938	B2	5/2012	Cooke et al.	
8,206,043	B2	6/2012	Thirugnanam et al.	
8,206,058	B2	6/2012	Vrondran et al.	
8,220,881	B2	7/2012	Keith	
8,226,305	B2	7/2012	Thirugnanam et al.	
8,249,410	B2	8/2012	Andrus et al.	
8,251,591	B2	8/2012	Barnes et al.	
8,270,798	B2	9/2012	Dagley et al.	
8,280,216	B2	10/2012	Cooke et al.	
8,285,104	B2	10/2012	Davis et al.	
8,301,004	B2	10/2012	Cooke et al.	
8,331,752	B2	12/2012	Biribuze	
8,353,494	B2	1/2013	Peng et al.	
8,369,679	B2	2/2013	Wakileh et al.	
8,391,666	B2	3/2013	Hertzer et al.	
8,452,148	B2	5/2013	Cooke et al.	
8,472,773	B2	6/2013	de Jong	
8,491,331	B2	7/2013	Follingstad	
8,528,872	B2	9/2013	Mattlin et al.	
8,537,477	B2	9/2013	Shioda	
8,538,226	B2	9/2013	Makrides-Saravanos et al.	
8,559,783	B2	10/2013	Campos et al.	
8,712,206	B2	4/2014	Cooke et al.	
8,824,850	B2	9/2014	Garcia et al.	
8,861,918	B2	10/2014	Vazquez et al.	
8,879,991	B2	11/2014	Kim	
9,020,320	B2	4/2015	Cooke et al.	
2001/0010741	A1	8/2001	Hizuka	
2001/0029125	A1	10/2001	Morita et al.	
2002/0010818	A1	1/2002	Wei et al.	
2002/0012353	A1	1/2002	Gerszberg et al.	
2002/0014571	A1	2/2002	Thompson	
2002/0034290	A1	3/2002	Pershan	
2002/0037139	A1	3/2002	Asao et al.	
2002/0064364	A1	5/2002	Battey et al.	
2002/0117942	A1	8/2002	Audibert et al.	
2002/0131730	A1	9/2002	Keeble et al.	
2002/0136519	A1	9/2002	Tinucci et al.	
2002/0141724	A1	10/2002	Ogawa et al.	
2002/0145858	A1 *	10/2002	Hayashi	H05K 7/1425 361/798
2002/0150370	A1	10/2002	Battey et al.	
2002/0150372	A1	10/2002	Schray	
2002/0172467	A1	11/2002	Anderson et al.	
2002/0180163	A1	12/2002	Muller et al.	
2002/0181918	A1	12/2002	Spence et al.	
2002/0181922	A1	12/2002	Xin et al.	
2002/0191939	A1	12/2002	Daoud et al.	
2002/0194596	A1	12/2002	Srivastava	
2003/0002802	A1	1/2003	Trezza et al.	
2003/0007743	A1	1/2003	Asada	
2003/0007767	A1	1/2003	Douglas et al.	
2003/0011855	A1	1/2003	Fujiwara	
2003/0021539	A1	1/2003	Kwon et al.	
2003/0022552	A1	1/2003	Barker et al.	
2003/0036748	A1	2/2003	Cooper et al.	
2003/0047524	A1	3/2003	Sato et al.	
2003/0051026	A1	3/2003	Carter et al.	
2003/0066998	A1	4/2003	Lee	
2003/0086675	A1	5/2003	Wu et al.	
2003/0095753	A1	5/2003	Wada et al.	
2003/0096536	A1	5/2003	Clark et al.	
2003/0123834	A1	7/2003	Burek et al.	
2003/0129871	A1	7/2003	Follingstad	
2003/0134541	A1 *	7/2003	Johnsen	H01R 13/514 439/668
2003/0147604	A1	8/2003	Tapia et al.	
2003/0156552	A1	8/2003	Banker et al.	
2003/0174996	A1	9/2003	Henschel et al.	
2003/0180004	A1	9/2003	Cox et al.	
2003/0180012	A1	9/2003	Deane et al.	
2003/0183413	A1	10/2003	Kato	
2003/0199201	A1	10/2003	Mullaney et al.	
2003/0210882	A1	11/2003	Barthel et al.	
2003/0223723	A1	12/2003	Massey et al.	
2003/0223725	A1	12/2003	Laporte et al.	
2003/0235387	A1	12/2003	Dufour	
2004/0001717	A1	1/2004	Bennett et al.	
2004/0008984	A1	1/2004	Gerrish et al.	
2004/0013389	A1	1/2004	Taylor	
2004/0013390	A1	1/2004	Kim et al.	
2004/0022494	A1	2/2004	Liddle et al.	
2004/0024934	A1	2/2004	Webb	
2004/0038594	A1	2/2004	Clark et al.	
2004/0067036	A1	4/2004	Clark et al.	
2004/0074852	A1	4/2004	Knudsen et al.	
2004/0086238	A1	5/2004	Finona et al.	
2004/0086252	A1	5/2004	Smith et al.	
2004/0120259	A1	6/2004	Jones et al.	
2004/0120679	A1	6/2004	Vincent et al.	
2004/0120681	A1	6/2004	Bohle et al.	
2004/0147159	A1	7/2004	Urban et al.	
2004/0151465	A1	8/2004	Krampotich et al.	
2004/0175090	A1	9/2004	Vastmans et al.	
2004/0192115	A1	9/2004	Bugg	
2004/0196841	A1	10/2004	Tudor et al.	
2004/0208459	A1	10/2004	Mizue et al.	
2004/0219829	A1	11/2004	Clark et al.	
2004/0228598	A1	11/2004	Allen et al.	
2004/0240827	A1	12/2004	Daoud et al.	
2004/0240882	A1	12/2004	Lipski et al.	
2004/0256138	A1	12/2004	Grubish et al.	
2004/0264873	A1	12/2004	Smith et al.	
2005/0002633	A1	1/2005	Solheid et al.	
2005/0008131	A1	1/2005	Cook	
2005/0025444	A1	2/2005	Barnes et al.	
2005/0026497	A1	2/2005	Holliday	
2005/0036749	A1	2/2005	Vogel et al.	
2005/0041947	A1	2/2005	Barker et al.	
2005/0067358	A1	3/2005	Lee et al.	
2005/0069248	A1	3/2005	Jasti et al.	
2005/0074990	A1	4/2005	Shearman et al.	
2005/0076149	A1	4/2005	McKown et al	
2005/0083959	A1	4/2005	Binder	
2005/0103515	A1	5/2005	Fuller et al.	
2005/0107086	A1	5/2005	Tell et al.	
2005/0111809	A1	5/2005	Giraud et al.	
2005/0123261	A1	6/2005	Bellekens et al.	

(56) **References Cited**

U.S. PATENT DOCUMENTS

2005/0129379	A1	6/2005	Reagan et al.
2005/0142910	A1	6/2005	Levesque et al.
2005/0142932	A1	6/2005	Levesque et al.
2005/0178573	A1	8/2005	James
2005/0185912	A1	8/2005	Levesque et al.
2005/0191901	A1	9/2005	Follingstad
2005/0201073	A1	9/2005	Pincu et al.
2005/0215112	A1	9/2005	Barker et al.
2005/0232566	A1	10/2005	Rapp et al.
2005/0233647	A1	10/2005	Denovich et al.
2005/0237721	A1	10/2005	Cowley et al.
2005/0254757	A1	11/2005	Ferretti, III et al.
2005/0265013	A1	12/2005	Keith et al.
2005/0281526	A1	12/2005	Vongseng et al.
2005/0285493	A1	12/2005	Hu et al.
2006/0007562	A1	1/2006	Willey et al.
2006/0018448	A1	1/2006	Stevens et al.
2006/0018622	A1	1/2006	Caveney
2006/0025011	A1	2/2006	Follingstad
2006/0029353	A1	2/2006	Bolster et al.
2006/0034048	A1	2/2006	Xu
2006/0039290	A1	2/2006	Roden et al.
2006/0044774	A1	3/2006	Vasavda et al.
2006/0045458	A1	3/2006	Sasaki et al.
2006/0062538	A1	3/2006	Araki et al.
2006/0063421	A1	3/2006	Barker et al.
2006/0072606	A1	4/2006	Posthuma
2006/0077968	A1	4/2006	Pitsoulakis et al.
2006/0093303	A1	5/2006	Reagan et al.
2006/0103270	A1	5/2006	Bergesch et al.
2006/0127026	A1	6/2006	Beck
2006/0133736	A1	6/2006	Sullivan
2006/0133759	A1	6/2006	Mullaney et al.
2006/0134972	A1	6/2006	Barker et al.
2006/0147171	A1	7/2006	Dofher
2006/0147172	A1	7/2006	Luther et al.
2006/0153517	A1	7/2006	Reagan et al.
2006/0154513	A1	7/2006	Barker et al.
2006/0160377	A1	7/2006	Huang
2006/0165365	A1	7/2006	Feustel et al.
2006/0165366	A1	7/2006	Feustel et al.
2006/0191700	A1	8/2006	Herzog et al.
2006/0193590	A1	8/2006	Puetz et al.
2006/0193591	A1	8/2006	Rapp et al.
2006/0194470	A1	8/2006	Caveney
2006/0194471	A1	8/2006	Clark et al.
2006/0198098	A1	9/2006	Clark et al.
2006/0204179	A1	9/2006	Patel et al.
2006/0215980	A1	9/2006	Bayazit et al.
2006/0225912	A1	10/2006	Clark et al.
2006/0228087	A1	10/2006	Bayazit et al.
2006/0228940	A1	10/2006	Follingstad
2006/0269194	A1	11/2006	Luther et al.
2006/0269205	A1	11/2006	Zimmel
2006/0269206	A1	11/2006	Zimmel
2006/0269208	A1	11/2006	Allen et al.
2006/0275008	A1	12/2006	Xin
2006/0275009	A1	12/2006	Ellison et al.
2006/0285812	A1	12/2006	Ferris et al.
2007/0003204	A1	1/2007	Makrides-Saravanos et al.
2007/0020991	A1	1/2007	Murano
2007/0025070	A1	2/2007	Jiang et al.
2007/0031099	A1	2/2007	Herzog et al.
2007/0033629	A1	2/2007	McGranahan et al.
2007/0047891	A1	3/2007	Bayazit et al.
2007/0047893	A1	3/2007	Kramer et al.
2007/0047894	A1	3/2007	Holmberg et al.
2007/0047896	A1	3/2007	Kowalczyk et al.
2007/0053385	A1	3/2007	Tollbom
2007/0058641	A1	3/2007	Cicchetti et al.
2007/0086723	A1	4/2007	Sasaki et al.
2007/0104447	A1	5/2007	Allen
2007/0110373	A1	5/2007	Dudek et al.
2007/0131628	A1	6/2007	Mimlitch, III et al.
2007/0183732	A1	8/2007	Wittmeier et al.
2007/0189692	A1	8/2007	Zimmel et al.
2007/0190853	A1	8/2007	Caveney
2007/0196071	A1	8/2007	Laursen et al.
2007/0221793	A1	9/2007	Kusuda et al.
2007/0237484	A1	10/2007	Reagan et al.
2007/0257159	A1	11/2007	Nelson et al.
2007/0266192	A1	11/2007	Campini et al.
2007/0274718	A1	11/2007	Bridges et al.
2007/0298652	A1	12/2007	Clark et al.
2008/0009182	A1	1/2008	Follingstad
2008/0011514	A1	1/2008	Zheng et al.
2008/0025683	A1	1/2008	Murano
2008/0031585	A1	2/2008	Solheid et al.
2008/0037209	A1	2/2008	Niazi et al.
2008/0063350	A1	3/2008	Trebesch et al.
2008/0068788	A1	3/2008	Ozawa et al.
2008/0069511	A1	3/2008	Blackwell, Jr. et al.
2008/0069512	A1	3/2008	Barnes et al.
2008/0078899	A1	4/2008	Chen et al.
2008/0080826	A1	4/2008	Leon et al.
2008/0080827	A1	4/2008	Leon et al.
2008/0080828	A1	4/2008	Leon et al.
2008/0085092	A1	4/2008	Barnes
2008/0085094	A1	4/2008	Krampotich
2008/0089656	A1	4/2008	Wagner
2008/0095502	A1	4/2008	McColloch
2008/0095541	A1	4/2008	Dallesasse
2008/0100440	A1	5/2008	Downie et al.
2008/0106871	A1	5/2008	James
2008/0108253	A1	5/2008	Clark et al.
2008/0112681	A1	5/2008	Battey et al.
2008/0115956	A1	5/2008	Fransen et al.
2008/0118207	A1	5/2008	Yamamoto et al.
2008/0121423	A1	5/2008	Vogel et al.
2008/0124039	A1	5/2008	Gniadek et al.
2008/0131068	A1	6/2008	Mertesdorf et al.
2008/0145013	A1	6/2008	Escoto et al.
2008/0146079	A1	6/2008	Spisany et al.
2008/0152294	A1	6/2008	Hirano et al.
2008/0166094	A1	7/2008	Bookbinder et al.
2008/0166131	A1	7/2008	Hudgins et al.
2008/0175541	A1	7/2008	Lu et al.
2008/0175550	A1	7/2008	Coburn et al.
2008/0175551	A1	7/2008	Smrha et al.
2008/0175552	A1 *	7/2008	Smrha G02B 6/4452 385/135
2008/0193091	A1	8/2008	Herbst
2008/0205823	A1	8/2008	Luther et al.
2008/0205843	A1	8/2008	Castonguay et al.
2008/0205844	A1	8/2008	Castonguay et al.
2008/0212928	A1	9/2008	Kowalczyk et al.
2008/0219632	A1	9/2008	Smith et al.
2008/0219634	A1	9/2008	Rapp et al.
2008/0236858	A1	10/2008	Quijano
2008/0240653	A1	10/2008	King et al.
2008/0247723	A1	10/2008	Herzog et al.
2008/0267573	A1	10/2008	Douglas et al.
2008/0285934	A1	11/2008	Standish et al.
2008/0292261	A1	11/2008	Kowalczyk et al.
2008/0296060	A1	12/2008	Hawley et al.
2008/0298763	A1	12/2008	Appenzeller et al.
2008/0310810	A1	12/2008	Gallagher
2009/0010607	A1	1/2009	Elisson et al.
2009/0016685	A1	1/2009	Hudgins et al.
2009/0022470	A1	1/2009	Krampotich
2009/0034912	A1	2/2009	Sepe, Jr.
2009/0038845	A1	2/2009	Fransen et al.
2009/0060439	A1	3/2009	Cox et al.
2009/0060440	A1	3/2009	Wright et al.
2009/0067800	A1	3/2009	Vazquez et al.
2009/0074371	A1	3/2009	Bayazit et al.
2009/0080849	A1	3/2009	Hankins et al.
2009/0097813	A1	4/2009	Hill
2009/0110347	A1	4/2009	Jacobsson
2009/0110391	A1	4/2009	Matityahu et al.
2009/0121092	A1	5/2009	Keith
2009/0129033	A1 *	5/2009	Smrha H04Q 1/142 361/732
2009/0136194	A1	5/2009	Barnes

(56) **References Cited**

U.S. PATENT DOCUMENTS

2009/0136195 A1 5/2009 Smrha et al.
2009/0136196 A1 5/2009 Trebesch et al.
2009/0146342 A1 6/2009 Haney et al.
2009/0148117 A1 6/2009 Laurisch
2009/0166404 A1 7/2009 German et al.
2009/0169163 A1 7/2009 Abbott, III et al
2009/0175588 A1 7/2009 Brandt et al.
2009/0180737 A1 7/2009 Burnham et al.
2009/0180749 A1 7/2009 Douglas et al.
2009/0184221 A1 7/2009 Sculler
2009/0185782 A1 7/2009 Parikh et al.
2009/0191891 A1 7/2009 Ma et al.
2009/0194647 A1 8/2009 Keith
2009/0196563 A1 8/2009 Mullsteff et al.
2009/0202214 A1 8/2009 Holmberg et al.
2009/0207577 A1 8/2009 Fransen et al.
2009/0208178 A1 8/2009 Kowalczyk et al.
2009/0208210 A1 8/2009 Trojer et al.
2009/0212679 A1 8/2009 Frousiakis et al.
2009/0214171 A1 8/2009 Coburn et al.
2009/0220200 A1 9/2009 Sheau Tung Wong et al.
2009/0220204 A1 9/2009 Ruiz
2009/0226142 A1 9/2009 Barnes et al.
2009/0238531 A1 9/2009 Holmberg et al.
2009/0245743 A1* 10/2009 Cote G02B 6/4454 385/135
2009/0252472 A1 10/2009 Solheid et al.
2009/0257726 A1 10/2009 Redmann et al.
2009/0257727 A1 10/2009 Laurisch et al.
2009/0257754 A1 10/2009 Theodoras, II et al.
2009/0263096 A1 10/2009 Solheid et al
2009/0263122 A1 10/2009 Helkey et al.
2009/0267865 A1 10/2009 Miller et al.
2009/0269016 A1 10/2009 Korampally et al.
2009/0269018 A1 10/2009 Frohlich et al.
2009/0269019 A1 10/2009 Andrus et al.
2009/0274429 A1 11/2009 Krampotich et al.
2009/0274430 A1 11/2009 Krampotich et al.
2009/0274432 A1 11/2009 Iwaya
2009/0290842 A1 11/2009 Bran de Leon et al.
2009/0290843 A1 11/2009 Reagan et al.
2009/0297111 A1 12/2009 Reagan et al.
2009/0304342 A1 12/2009 Adomeit et al.
2009/0324189 A1 12/2009 Hill et al.
2010/0003000 A1* 1/2010 Rapp G02B 6/4453 385/137
2010/0012671 A1 1/2010 Vrondran et al.
2010/0027953 A1 2/2010 Russell
2010/0054681 A1 3/2010 Biribuze et al.
2010/0054682 A1 3/2010 Cooke et al.
2010/0054683 A1 3/2010 Cooke et al.
2010/0054684 A1 3/2010 Cooke et al.
2010/0054685 A1 3/2010 Cooke et al.
2010/0054686 A1 3/2010 Cooke et al.
2010/0054687 A1 3/2010 Ye et al.
2010/0061693 A1 3/2010 Bran de Leon et al.
2010/0074587 A1 3/2010 Loeffelholz et al.
2010/0080517 A1 4/2010 Cline et al.
2010/0086267 A1 4/2010 Cooke et al.
2010/0086274 A1 4/2010 Keith
2010/0111483 A1 5/2010 Reinhardt et al.
2010/0119201 A1 5/2010 Smrha et al.
2010/0129035 A1 5/2010 Teo
2010/0142544 A1 6/2010 Chapel et al.
2010/0142910 A1 6/2010 Hill et al.
2010/0150518 A1 6/2010 Leon et al.
2010/0158467 A1 6/2010 Hou et al.
2010/0166377 A1 7/2010 Nair et al.
2010/0178022 A1 7/2010 Schroeder et al.
2010/0183270 A1 7/2010 Davis et al.
2010/0202740 A1 8/2010 Barlowe et al.
2010/0202745 A1 8/2010 Sokolowski et al.
2010/0202748 A1 8/2010 Pierce et al.
2010/0215330 A1 8/2010 Sokolowski et al.
2010/0220967 A1 9/2010 Cooke et al.
2010/0220968 A1 9/2010 Dagley et al.
2010/0247051 A1 9/2010 Kowalczyk et al.
2010/0266245 A1 10/2010 Sabo
2010/0278499 A1 11/2010 Mures et al.
2010/0296790 A1 11/2010 Cooke et al.
2010/0296791 A1 11/2010 Makrides-Saravanos et al.
2010/0310225 A1 12/2010 Anderson et al.
2010/0310226 A1 12/2010 Wakileh et al.
2010/0316334 A1 12/2010 Kewitsch
2010/0322554 A1 12/2010 Barnes et al.
2010/0322579 A1 12/2010 Cooke et al.
2010/0322580 A1 12/2010 Beaman et al.
2010/0322581 A1 12/2010 Cooke et al.
2010/0322582 A1 12/2010 Cooke et al.
2010/0322583 A1 12/2010 Cooke et al.
2010/0329624 A1 12/2010 Zhou et al.
2011/0008004 A1 1/2011 Liao et al.
2011/0058786 A1 3/2011 Zimmel
2011/0069931 A1 3/2011 Cote et al.
2011/0073730 A1 3/2011 Kitchen
2011/0085774 A1 4/2011 Murphy et al.
2011/0085776 A1 4/2011 Biribuze et al.
2011/0097053 A1 4/2011 Smith et al.
2011/0097977 A1 4/2011 Bubnick et al.
2011/0129185 A1 6/2011 Lewallen et al.
2011/0129186 A1 6/2011 Lewallen et al.
2011/0186532 A1 8/2011 Wu
2011/0192631 A1 8/2011 Burek et al.
2011/0211799 A1 9/2011 Conner et al.
2011/0217014 A1 9/2011 Dominique
2011/0217016 A1 9/2011 Mullsteff
2011/0222821 A1 9/2011 Pitwon et al.
2011/0235985 A1 9/2011 Cote et al.
2011/0249950 A1 10/2011 Chapa Ramirez et al.
2011/0262096 A1 10/2011 Fabrykowski et al.
2011/0268404 A1 11/2011 Cote et al.
2011/0268405 A1 11/2011 Cote et al.
2011/0268406 A1 11/2011 Giraud et al.
2011/0268407 A1 11/2011 Cowen et al.
2011/0268408 A1 11/2011 Giraud et al.
2011/0268409 A1 11/2011 Giraud et al.
2011/0268410 A1 11/2011 Giraud et al.
2011/0268411 A1 11/2011 Giraud et al.
2011/0268412 A1 11/2011 Giraud et al.
2011/0268413 A1 11/2011 Cote et al.
2011/0268414 A1 11/2011 Giraud et al.
2011/0274402 A1 11/2011 Giraud et al.
2011/0280535 A1 11/2011 Womack
2011/0280537 A1 11/2011 Cowen et al.
2012/0020629 A1 1/2012 Shiratori et al.
2012/0025683 A1 2/2012 Mattlin et al.
2012/0051707 A1 3/2012 Barnes et al.
2012/0057836 A1 3/2012 Andrzejewski et al.
2012/0057838 A1 3/2012 Hill et al.
2012/0106897 A1 5/2012 Cline et al.
2012/0106899 A1 5/2012 Choi
2012/0106911 A1 5/2012 Cooke et al.
2012/0134639 A1 5/2012 Giraud et al.
2012/0183263 A1 7/2012 Wu
2012/0183289 A1 7/2012 Lou et al.
2012/0219263 A1 8/2012 Beamon et al.
2012/0288244 A1 11/2012 Wu et al.
2012/0288248 A1 11/2012 Chapa Ramirez et al.
2012/0301083 A1 11/2012 Carter et al.
2013/0004136 A1 1/2013 Brower et al.
2013/0056599 A1 3/2013 Baker et al.
2013/0058616 A1 3/2013 Cote et al.
2013/0072053 A1 3/2013 Fabrykowski et al.
2013/0077927 A1 3/2013 O'Connor
2013/0134115 A1 5/2013 Hernandez-Ariguznaga
2013/0214108 A1 8/2013 Irudayaraj et al.
2013/0243386 A1 9/2013 Pimentel et al.
2013/0251326 A1 9/2013 Cooke et al.
2013/0266282 A1 10/2013 Cote et al.
2013/0308908 A1 11/2013 Isenhour et al.
2013/0308915 A1 11/2013 Buff et al.
2013/0308916 A1 11/2013 Buff et al.
2013/0328258 A1 12/2013 Mutsuno
2014/0003782 A1 1/2014 Blackwell, Jr. et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2014/0010510	A1	1/2014	Blackard
2014/0029907	A1	1/2014	Isenhour et al.
2014/0037251	A1	2/2014	Isenhour et al.
2014/0079366	A1	3/2014	Rodriguez et al.
2014/0112628	A1	4/2014	Keenum et al.
2014/0226946	A1	8/2014	Cooke et al.
2015/0027967	A1	1/2015	Vazquez et al.
2015/0185429	A1	7/2015	Cooke et al.
2017/0131504	A1	5/2017	Cooke et al.
2017/0131505	A1	5/2017	Cooke et al.
2017/0131506	A1	5/2017	Cooke et al.
2017/0131508	A1	5/2017	Cooke et al

FOREIGN PATENT DOCUMENTS

CA	2186314	A1	4/1997
CA	2765835	A1	1/2011
CH	688705	A5	1/1998
CN	1471649	A	1/2004
CN	1690745	A	11/2005
CN	2849745	Y	12/2006
CN	102460258	A	5/2012
DE	8711970	U1	10/1987
DE	3726718	A1	2/1989
DE	3726719	A1	2/1989
DE	4030301	A1	3/1992
DE	4112871	A1	10/1992
DE	4231181	C1	8/1993
DE	4321815	A1	1/1995
DE	20115940	U1	1/2002
DE	10338848	A1	3/2005
DE	202005009932	U1	11/2005
DE	202007000556	U1	10/2007
DE	102007024476	A1	11/2008
DE	202010009385	U1	9/2010
EP	29512	A1	3/1981
EP	0105597	A2	4/1984
EP	0250900	A2	1/1988
EP	0349290	A1	1/1990
EP	0408266	A2	1/1991
EP	0474091	A1	8/1991
EP	0468671	A1	1/1992
EP	0490698	A1	6/1992
EP	0529830	A1	3/1993
EP	0544004	A1	6/1993
EP	0547778	A1	6/1993
EP	0581527	A1	2/1994
EP	0620462	A1	10/1994
EP	0693699	A1	1/1996
EP	0720322	A2	7/1996
EP	0730178	A2	9/1996
EP	0776557	B1	6/1997
EP	0940700	A2	9/1999
EP	0949522	A2	10/1999
EP	1041417	A2	10/2000
EP	1056177	A1	11/2000
EP	1065542	A1	1/2001
EP	1162485	A2	12/2001
EP	1203974	A2	5/2002
EP	1280363	A2	1/2003
EP	1289319	A2	3/2003
EP	1310816	A2	5/2003
EP	1316829	A2	6/2003
EP	1367308	A1	12/2003
EP	1621907	A1	2/2006
EP	1557061	B1	3/2006
EP	1777563	A1	4/2007
EP	2060942	A2	5/2009
EP	2159613	A2	3/2010
FR	1586331	A	2/1970
FR	2123728	A5	9/1972
FR	2378378	A1	8/1978
GB	2241591	A	9/1991
GB	2277812	A	11/1994
GB	2367379	A	4/2002
GB	2377839	A	1/2003
JP	3060994	A	3/1991
JP	3172806	A	7/1991
JP	3281378	A	12/1991
JP	5045541	A	2/1993
JP	06018749	A	1/1994
JP	7308011	A	11/1995
JP	7318761	A	12/1995
JP	8007308	A	1/1996
JP	8248235	A	9/1996
JP	8248237	A	9/1996
JP	3487946	A	10/1996
JP	8254620	A	10/1996
JP	H09178998	A	7/1997
JP	H09197139	A	7/1997
JP	3279474	A	10/1997
JP	9258033	A	10/1997
JP	9258055	A	10/1997
JP	2771870	B2	7/1998
JP	3448448	A	8/1998
JP	10227919	A	8/1998
JP	3478944	A	12/1998
JP	10332945	A	12/1998
JP	10339817	A	12/1998
JP	11023858	A	1/1999
JP	H11202146	A	7/1999
JP	2000098138	A	4/2000
JP	2000098139	A	4/2000
JP	2000241631	A	9/2000
JP	2001004849	A	1/2001
JP	3160322	B2	4/2001
JP	2001119177	A	4/2001
JP	2001133636	A	5/2001
JP	3173962	B2	6/2001
JP	3176906	B2	6/2001
JP	2001154030	A	6/2001
JP	2001159714	A	6/2001
JP	2002022974	A	1/2002
JP	2002032153	A	1/2002
JP	2002077236	A	3/2002
JP	2002116337	A	4/2002
JP	2002169035	A	6/2002
JP	3312893	B2	8/2002
JP	2002305389	A	10/2002
JP	3344701	B2	11/2002
JP	2003029054	A	1/2003
JP	3403573	B2	5/2003
JP	2003149458	A	5/2003
JP	2003169026	A	6/2003
JP	2003215353	A	7/2003
JP	2003344701	A	12/2003
JP	2004086060	A	3/2004
JP	3516765	B2	4/2004
JP	2004118091	A	4/2004
JP	2004144808	A	5/2004
JP	2004514931	A	5/2004
JP	3542939	B2	7/2004
JP	2004246147	A	9/2004
JP	2004361652	A	12/2004
JP	2004361890	A	12/2004
JP	2004361893	A	12/2004
JP	3107704	U	2/2005
JP	2005055748	A	3/2005
JP	2005062569	A	3/2005
JP	2005084241	A	3/2005
JP	2005148327	A	6/2005
JP	2005165158	A	6/2005
JP	2005181600	A	7/2005
JP	2005257937	A	9/2005
JP	2005338618	A	12/2005
JP	2006507606	A	3/2006
JP	3763645	B2	4/2006
JP	3778021	B2	5/2006
JP	2006126513	A	5/2006
JP	2006126516	A	5/2006
JP	3794540	B2	7/2006
JP	2006227041	A1	8/2006
JP	3833638	B2	10/2006
JP	2006276782	A	10/2006

(56) **References Cited**

FOREIGN PATENT DOCUMENTS

JP	2006292924	A	10/2006
JP	3841344	B2	11/2006
JP	3847533	B2	11/2006
JP	200747336	A	2/2007
JP	3896035	B2	3/2007
JP	2007067458	A1	3/2007
JP	2007093760	A	4/2007
JP	2007511959	A	5/2007
JP	3934052	B2	6/2007
JP	2007179046	A	7/2007
JP	3964191	B2	8/2007
JP	3989853	B2	10/2007
JP	4026244	B2	12/2007
JP	2007324441	A	12/2007
JP	4029494	B2	1/2008
JP	4065223	B2	3/2008
JP	4093475	B2	6/2008
JP	4105696	B2	6/2008
JP	4112437	B2	7/2008
JP	4118862	B2	7/2008
JP	2008176118	A1	7/2008
JP	2008180817	A1	8/2008
JP	2008533583	A	8/2008
JP	4184329	B2	11/2008
JP	2008271017	A	11/2008
JP	2008542822	T	11/2008
JP	2009503582	T	1/2009
JP	2009515242	A	4/2009
JP	2009115962	A	5/2009
JP	2009229506	A	10/2009
JP	2012065019	A	3/2012
KR	20110037404	A	4/2011
WO	9000261	A1	1/1990
WO	9105281	A1	4/1991
WO	9326070	A1	12/1993
WO	9520175	A1	7/1995
WO	9636896	A1	11/1996
WO	9638752	A1	12/1996
WO	9712268	A1	4/1997
WO	9722025	A1	6/1997
WO	9736197	A1	10/1997
WO	9744605	A1	11/1997
WO	9825416	A1	6/1998
WO	9927404	A1	6/1999
WO	9959295	A1	11/1999
WO	9963628	A1	12/1999
WO	0005611	A2	2/2000
WO	0127660	A2	4/2001
WO	0130007	A2	4/2001
WO	0180596	A1	10/2001
WO	0242818	A1	5/2002
WO	03009527	A2	1/2003
WO	2003014943	A1	2/2003
WO	03044902	A1	5/2003
WO	2004041525	A2	5/2004
WO	2004052066	A1	6/2004
WO	2005020400	A1	3/2005
WO	2005069448	A1	7/2005
WO	2005091030	A1	9/2005
WO	2005107275	A1	11/2005
WO	2006012389	A1	2/2006
WO	2006076062	A	7/2006
WO	2006091850	A1	8/2006
WO	2006108024	A1	10/2006
WO	2007050515	A1	5/2007
WO	2007079074	A2	7/2007
WO	2007089682	A2	8/2007
WO	2007149215	A2	12/2007
WO	2008027201	A2	3/2008
WO	2008063054	A2	5/2008
WO	2008074013	A2	6/2008
WO	2008113054	A2	9/2008
WO	2008157248	A1	12/2008
WO	2009026688	A1	3/2009
WO	2009029485	A1	3/2009
WO	2009030360	A1	3/2009
WO	2009032245	A1	3/2009
WO	2009091465	A2	7/2009
WO	2009120280	A2	10/2009
WO	2010024842	A1	3/2010
WO	2010024847	A2	3/2010
WO	2010036549	A1	4/2010
WO	2010080745	A1	7/2010
WO	2011005461	A1	1/2011

OTHER PUBLICATIONS

International Search Report for PCT/US2012/023635 dated Sep. 14, 2012, 3 pages.

International Search Report for PCT/US2012/023626 dated May 22, 2012, 4 pages.

Notice of Allowance for U.S. Appl. No. 13/951,916 dated Dec. 16, 2013, 12 pages.

International Preliminary Report on Patentability for PCT/US2012/052958 dated Mar. 13, 2014, 14 pages.

Non-final Office Action for U.S. Appl. No. 12/947,883 dated Sep. 6, 2013, 9 pages.

Final Office Action for U.S. Appl. No. 12/947,883 dated Mar. 31, 2014, 13 pages.

International Search Report for PCT/US2011/030446 dated Jul. 14, 2011, 2 pages.

International Search Report for PCT/US2011/030448 dated Jul. 20, 2011, 2 pages.

International Search Report for PCT/US2011/030466 dated Aug. 5, 2011, 2 pages.

International Search Report for PCT/US2012/052958 dated Mar. 1, 2013, 7 pages.

International Search Report for PCT/US2013/041266 dated Aug. 20, 2013, 4 pages.

Non-final Office Action for U.S. Appl. No. 13/621,958 dated Feb. 13, 2014, 10 pages.

Non-final Office Action for U.S. Appl. No. 13/649,417 dated Feb. 13, 2014, 10 pages.

Non-final Office Action for U.S. Appl. No. 13/663,949 dated Feb. 3, 2014, 19 pages.

Non-final Office Action for U.S. Appl. No. 12/953,003 dated Apr. 14, 2014, 13 pages.

Non-final Office Action for U.S. Appl. No. 12/953,039 dated Apr. 15, 2014, 8 pages.

Final Office Action for U.S. Appl. No. 12/946,139 dated Apr. 22, 2014, 18 pages.

Final Office Action for U.S. Appl. No. 13/597,549 dated Apr. 24, 2014, 10 pages.

Final Office Action for U.S. Appl. No. 13/901,074 dated May 9, 2014, 7 pages.

Notice of Panel Decision for Pre-Appeal Brief for U.S. Appl. No. 12/417,325 dated Aug. 8, 2012, 2 pages.

Advisory Action for U.S. Appl. No. 12/417,325 dated Jun. 29, 2012, 3 pages.

Advisory Action for U.S. Appl. No. 12/417,325 dated Jun. 12, 2012, 3 pages.

Final Office Action for U.S. Appl. No. 12/417,325 dated Apr. 16, 2012, 6 pages.

Final Office Action for U.S. Appl. No. 12/417,325 dated Feb. 7, 2012, 7 pages.

Non-final Office Action for U.S. Appl. No. 12/417,325 dated Jun. 15, 2011, 6 pages.

Notice of Allowance for U.S. Appl. No. 12/487,929 dated Sep. 12, 2012, 4 pages.

Notice of Allowance for U.S. Appl. No. 12/487,929 dated Jun. 13, 2012, 8 pages.

Advisory Action for U.S. Appl. No. 12/487,929 dated Apr. 17, 2012, 3 pages.

Final Office Action for U.S. Appl. No. 12/487,929 dated Feb. 14, 2012, 6 pages.

Final Office Action for U.S. Appl. No. 12/487,929 dated Dec. 5, 2011, 7 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Non-final Office Action for U.S. Appl. No. 12/487,929 dated May 23, 2011, 7 pages.
Notice of Allowance for U.S. Appl. No. 12/415,253 dated Mar. 11, 2011, 7 pages.
Non-final Office Action for U.S. Appl. No. 12/415,253 dated Jul. 12, 2010, 11 pages.
Final Office Action for U.S. Appl. No. 12/415,253 dated Apr. 16, 2010, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/415,253 dated Sep. 30, 2009, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/641,617 dated Oct. 5, 2012, 21 pages.
Final Office Action for U.S. Appl. No. 12/630,938 dated Jun. 1, 2012, 18 pages.
Non-final Office Action for U.S. Appl. No. 12/630,938 dated Dec. 19, 2011, 15 pages.
Non-final Office Action for U.S. Appl. No. 12/751,884 dated Jul. 2, 2012, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/871,052 dated Aug. 13, 2012, 8 pages.
Decision on Appeal for U.S. Appl. No. 12/221,117 dated Jul. 1, 2014, 7 pages.
Notice of Allowance for U.S. Appl. No. 12/221,117 dated Jul. 16, 2014, 7 pages.
Final Office Action for U.S. Appl. No. 13/081,856 dated Jul. 2, 2014, 8 pages.
Final Office Action for U.S. Appl. No. 12/818,986 dated Jul. 18, 2014, 27 pages.
Non-final Office Action for U.S. Appl. No. 12/819,065 dated Jul. 18, 2014, 10 pages.
Notice of Allowance for U.S. Appl. No. 13/455,646 dated Jun. 2, 2014, 9 pages.
Notice of Allowance for U.S. Appl. No. 13/597,549 dated Jul. 8, 2014, 8 pages.
Notice of Allowance for U.S. Appl. No. 13/533,093 dated Jul. 8, 2014, 9 pages.
Notice of Allowance for U.S. Appl. No. 13/688,675 dated Jan. 26, 2015, 7 pages.
Final Office Action for U.S. Appl. No. 12/394,114 dated Oct. 25, 2012, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/915,682 dated Oct. 24, 2012, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/818,986 dated Feb. 3, 2012, 12 pages.
Final Office Action for U.S. Appl. No. 12/818,986 dated Oct. 18, 2012, 13 pages.
Non-final Office Action for U.S. Appl. No. 12/952,960 dated Oct. 4, 2012, 11 pages.
Non-final Office Action for U.S. Appl. No. 12/953,134 dated Sep. 25, 2012, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/953,039 dated Jan 11, 2013, 6 pages.
Non-final Office Action for U.S. Appl. No. 12/952,912 dated Dec. 28, 2012, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/953,118 dated Jan. 7, 2013, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/953,536 dated Jan. 2, 2013, 20 pages.
Non-final Office Action for U.S. Appl. No. 12/707,889 dated Jan. 2, 2013, 7 pages.
European Search Report for patent application 10790017.7 dated Nov. 8, 2012, 7 pages.
Examination Report for European patent application 09789090.9-2216 dated Aug. 29, 2011, 4 pages.
Examination Report for European patent application 09789090.9-2216 dated Mar. 30, 2012, 6 pages.
Written Opinion of the International Searching Authority for International patent application PCT/US2009004548, dated Apr. 5, 2011, 6 pages.
European Search Report for European patent application 09789090.9-2217 dated Jan. 24, 2013, 5 pages.
Non-final Office Action for U.S. Appl. No. 12/946,139 dated Jul. 26, 2012, 12 pages.
Final Office Action for U.S. Appl. No. 12/946,139 dated Feb. 15, 2013, 17 pages.
Non-final Office Action for U.S. Appl. No. 12/751,884 dated Feb. 15, 2013, 5 pages.
Non-final Office Action for U.S. Appl. No. 12/394,114 dated Feb. 27, 2013, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/819,065 dated Mar. 4, 2013, 7 pages.
Final Office Action for U.S. Appl. No. 12/952,960 dated Mar. 7, 2013, 13 pages.
Notice of Allowance for U.S. Appl. No. 12/732,487 dated Mar. 19, 2013, 11 pages.
Non-final Office Action for U.S. Appl. No. 12/953,134 dated Mar. 21, 2013, 9 pages.
Final Office Action for U.S. Appl. No. 12/641,617 dated May 10, 2013, 21 pages.
Notice of Allowance for U.S. Appl. No 13/090,621 dated Apr. 22, 2013, 8 pages.
Final Office Action for U.S. Appl. No. 12/953,039 dated May 1, 2013, 8 pages.
Final Office Action for U.S. Appl. No. 12/953,118 dated May 3, 2013, 11 pages.
Final Office Action for U.S. Appl. No. 12/915,682 dated Apr. 18, 2013, 9 pages.
Advisory Action for U.S. Appl. No. 12/952,960 dated May 15, 2013, 2 pages.
Non-final Office Action for U.S. Appl. No. 12/952,960 dated Jun. 20, 2013, 13 pages.
Non-final Office Action for U.S. Appl. No. 12/953,536 dated Jun. 6, 2013, 21 pages.
Non-final Office Action for U.S. Appl. No. 11/820,300 dated Apr. 25, 2012, 10 pages.
Final Office Action for U.S. Appl. No. 12/871,052 dated Jul. 1, 2013, 12 pages.
Non-final Office Action for U.S. Appl. No. 12/940,699 dated Jun. 26, 2013, 9 pages.
Notice of Allowance for U.S. Appl. No. 13/090,621 dated Jun. 25, 2013, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/956,475 dated Oct. 4, 2012, 7 pages.
Non-final Office Action for U.S. Appl. No. 13/302,067 dated Jun. 7, 2013, 13 pages.
Final Office Action for U.S. Appl. No. 12/771,473 dated Jul. 19, 2013, 7 pages.
Notice of Allowance for U.S. Appl. No. 12/751,884 dated Jul. 17, 2013, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/940,585 dated Aug. 16, 2013, 14 pages.
Final Office Action for U.S. Appl. No. 12/953,134 dated Aug. 23, 2013, 11 pages.
Ex parte Quayle Action for U.S. Appl. No. 12/953,164 dated Aug. 16, 2013, 5 pages.
Non-final Office Action for U.S. Appl. No. 12/732,487 dated Jul. 17, 2013, 22 pages.
Advisory Action for U.S. Appl. No. 12/953,039 dated Jul. 12, 2013, 3 pages.
Advisory Action for U.S. Appl. No. 12/953,118 dated Jul. 12, 2013, 3 pages.
Advisory Action for U.S. Appl. No. 12/641,617 dated Jul. 29, 2013, 3 pages.
Final Office Action for U.S. Appl. No. 12/952,912 dated Aug. 30, 2013, 15 pages.
Advisory Action for U.S. Appl. No. 12/771,473 dated Oct. 2, 2013, 3 pages.
Notice of Allowance for U.S. Appl. No. 12/641,617 dated Sep. 4, 2013, 9 pages.
Annex to Form PCT/ISA/2006, Communication Relating to the Results of the Partial International Search, for PCT/US2009/004549 dated Feb. 10, 2010, 2 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Annex to Form PCT/ISA/206, Communication Relating to the Results of the Partial International Search, for PCT/US2009/004548 dated Jan. 19, 2010, 2 pages.
Corning Cable Systems, "Corning Cable Systems Products for BellSouth High Density Shelves." Jun. 2000. 2 pages.
Corning Cable Systems, "Corning Cable Systems Quick Reference Guide for Verizon FTTP FDH Products," Jun. 2005, 4 pages.
Conner, M. "Passive Optical Design for RFOG and Beyond," Braodband Properties, Apr. 2009, pp. 78-81.
Corning Evolant, "Eclipse Hardware Family," Nov. 2009, 1 page.
Corning Evolant, "Enhanced Management Frame," Dec. 2009, 1 page.
Corning Evolant, "Enhanced Management Frame (EMF)," Specification Sheet, Nov. 2009, 24 pages.
Corning Cable Systems, "Evolant Solutions for Evolving Networks: Fiber Optic Hardware," Oct. 2002, 2 pages.
Corning Cable Systems, "Fiber Optic Hardware with Factory-Installed Pigtails: Features and Benefits," Nov. 2010, 12 pages.
Corning Cable Systems, "FiberManager System 1- and 3-Position Compact Shelves," Jan. 2003, 4 pages.
Corning Cable Systems, "FiberManager System Frame and Components," Jan. 2003, 12 pages.
Corning Cable Systems, "High Density Frame," Jul. 2001, 2 pages.
Corning Cable Systems, "High Density Frame (HDF) Connector-Splice Shelves and Housings," May 2003, 4 pages.
International Search Report for PCT/US10/35529 dated Jul. 23, 2010, 2 pages.
International Search Report for PCT/US10/35563 dated Jul. 23, 2012, 1 page.
International Search Report for PCT/US2008/002514 dated Aug. 8, 2008, 2 pages.
International Search Report for PCT/US2008/010317 dated Mar. 4, 2008, 2 pages.
International Search Report for PCT/US2009/001692 dated Nov. 24, 2009, 5 pages.
International Search Report for PCT/US2010/024888 dated Jun. 23, 2010, 5 pages.
International Search Report for PCT/US2010/027402 dated Jun. 16, 2010, 2 pages.
Corning Cable Systems, "MTX Frames and Accessories," Feb. 2006, 4 pages.
Panduit, "Lock-in LC Duplex Clip," Accessed Mar. 22, 2012, 1 page.
International Search Report for PCT/US06/49351 dated Apr. 25, 2008, 1 page.
International Search Report for PCT/US09/57069 dated Mar. 24, 2010, 2 pages.
International Search Report for PCT/US2009/057244 dated Nov. 9, 2009 3 pages.
International Search Report for PCTUS2009004548 dated Mar. 19, 2010, 5 pages.
International Search Report for PCTUS2009004549 dated Apr. 20, 2010, 6 pages.
Siecor, "Single Shelf HDF with Slack Storage and Heat Shield (HH1-CSH-1238-1V-BS)," Jan. 1998, 12 pages.
Corning Cable Systems, "Mass Termination Xchange (MTX) Frame System Equipment Office Planning and Application Guide," SRP003-664, Issue 1, Mar. 2005, 57 pages.
Corning Cable Systems, "Mass Termination Xchange (MTX) Equipment Patch Cord Interbay Vertical Channel," SRP003-684, Issue 1, Mar. 2005, 8 pages.
Corning Cable Systems, "High Density Frame (HDF) Installation," SRP003-355, Issue 4, Sep. 2002, 18 pages.
Written Opinion for PCT/US2010/023901 dated Aug. 25, 2011, 8 pages.
Advisory Action for U.S. Appl. No. 12/221,117 dated Aug. 24, 2011, 3 pages.
Examiner's Answer to Appeal Brief for U.S. Appl. No. 12/221,117 dated Mar. 29, 2012. 16 pages.
Final Office Action for U.S. Appl. No. 12/221,117 dated Feb. 19, 2010, 7 pages.
Final Office Action for U.S. Appl. No 12/221,117 dated Jun. 10, 2011, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/221,117 dated Jul. 14, 2010, 7 pages.
Non-final Office Action for U.S. Appl. No. 12/221,117 dated Jun. 9, 2009, 5 pages.
Non-final Office Action for U.S. Appl. No. 12/221,117 dated Dec. 21, 2010, 7 pages.
Advisory Action for U.S. Appl. No. 12/394,483 dated Feb. 16, 2012, 3 pages.
Final Office Action for U.S. Appl. No. 12/394,483 dated Dec. 6, 2011, 14 pages.
Non-final Office Action for U.S. Appl. No. 12/394,483 dated Jun. 17, 2011, 11 pages.
Advisory Action for U.S. Appl. No. 12/950,234 dated Dec. 21, 2011, 3 pages.
Non-final Office Action for U.S. Appl. No. 12/950,234 dated Jun. 17, 2011, 7 pages.
Non-final Office Action for U.S. Appl. No. 12/950.234 dated Mar. 12, 2012, 10 pages.
Final Office Action for U.S. Appl. No. 12/950,234 dated Oct. 14, 2011, 10 pages.
Advisory Action dated May 12, 2011, for U.S. Appl. No. 12/323,423, 3 pages
Final Rejection dated Mar 3, 2011, for U.S. Appl. No. 12/323,423, 17 pages.
Non-Final Rejection dated Aug. 5, 2011, for U.S. Appl. No. 12/323,423, 13 pages.
Non-Final Rejection dated Sep. 7, 2010, for U.S. Appl. No. 12/323,423, 18 pages.
Notice of Allowance for U.S. Appl. No. 12/323,423 dated Jan. 24, 2012, 8 pages.
Examiner's Answer dated Mar. 4, 2011, for U.S. Appl. No. 12/323,415, 11 pages
Final Rejection dated Jun 25, 2010. for U.S. Appl. No. 12/323,415, 10 pages.
Non-Final Rejection dated Aug 5, 2011, for U.S. Appl. No. 12/323,415, 41 pages
Non-final Office Action for U.S. Appl. No. 12/323,415 dated Apr. 23, 2012, 11 pages.
Non-Final Rejection dated Dec. 10, 2009, for U.S. Appl. No. 12/323,415, 7 pages.
Examiner's Answer to Appeal Brief for U.S. Appl. No. 11/320,062 dated Dec. 8, 2011, 8 pages.
Final Office Action for U.S. Appl. No. 11/320,062 dated Mar. 8, 2011, 8 pages.
Non-final Office Action for U.S. Appl. No. 11/320,062 dated Jan. 15, 2010, 11 pages
Non-final Office Action for U.S. Appl. No. 12/320,062 dated Sep. 30, 2010, 7 pages.
Final Office Action for U.S. Appl. No. 11/439,086 dated Feb. 4, 2010, 14 pages.
Non-final Office Action for U.S. Appl. No. 11/439,086 dated May 3, 2010, 11 pages.
Non-final Office Action for U.S. Appl. No. 11/439,086 dated Sep. 21, 2009, 10 pages.
Final Office Action for U.S. Appl. No. 12/079,481 dated Mar. 18, 2010, 10 pages.
Non-final Office Action for U.S. Appl. No. 12/079,481 dated Dec. 26, 2008, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/079,481 dated Sep. 16, 2009, 10 pages.
Notice of Allowance for U.S. Appl. No. 12/079,481 dated Jun. 3, 2010. 6 pages.
Notice of Allowance for U.S. Appl. No. 12/079,481 dated Oct. 4, 2010, 4 pages.
Final Office Action for U.S. Appl. No. 12/394,114 dated Dec. 22, 2011, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/394,114 dated Mar. 16, 2012, 8 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Non-final Office Action for U.S. Appl. No. 12/394,114 dated Sep. 1, 2011, 7 pages.
Non-final Office Action for U.S. Appl. No. 12/323,373 dated May 3, 2012, 7 pages.
Non-final Office Action for U.S. Appl. No. 11/809,474 dated Apr. 8, 2008, 13 pages.
Non-final Office Action for U.S. Appl. No. 11/809,474 dated Nov. 13, 2008, 10 pages.
Notice of Allowance for U.S. Appl. No. 11/809,474 dated Jul. 6, 2009, 6 pages.
Final Office Action for U.S. Appl. No. 11/320,031 dated Mar. 8, 2011, 8 pages.
Non-final Office Action for U.S. Appl. No. 11/320,031 dated Jan. 5, 2010, 16 pages.
Non-final Office Action for U.S. Appl. No. 11/320,031 dated Sep. 30, 2010, 7 pages.
Notice of Allowance for U.S. Appl. No. 11/320,031 dated Nov. 15, 2011, 7 pages.
Non-final Office Action for U.S. Appl. No. 12/157,622 dated Mar. 31, 2009, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/157,622 dated Oct. 15, 2009, 9 pages.
Notice of Allowance for U.S. Appl. No. 12/157,622 dated Apr. 22, 2010, 4 pages.
Non-final Office Action for U.S. Appl. No. 12/323,395 dated Dec. 8, 2011, 7 pages.
Non-final Office Action for U.S. Appl. No. 12/415,454 dated Mar. 2, 2012, 5 pages.
Non-final Office Action for U.S. Appl. No. 12/415,454 dated Sep. 6, 2011, 7 pages.
Notice of Allowance for U.S. Appl. No. 12/415,454 dated Jan. 13, 2012, 5 pages.
Non-final Office Action for U.S. Appl. No. 12/576,769 dated Feb. 2, 2012, 23 pages.
Notice of Allowance for U.S. Appl. No. 12/415,454 dated Jun. 19, 2012, 5 pages.
Non-final Office Action for U.S. Appl. No. 13/603,894 dated Oct. 3, 2013, 9 pages.
International Search Report for PCT/US2009/066779 dated Aug. 27, 2010, 3 pages.
"MPO Fiber Optic Rack Panels now available from L-com Connectivity Products," article dated Jun. 4, 2007, 16 pages, http://www.l-com.com/content/Article.aspx?Type=P&ID=438.
"19" Rack Panel with 16 MPO Fiber Optic Couplers—1U high," product page, accessed Oct. 23, 2012, 2 pages, http://www.l-com.com/item.aspx?id=9767#.UlbgG8XXay5.
"Drawing for L-com 1U Panel with 16 MTP couplers," May 15, 2007, 1 page, http://www.l-com.com/multimedia/eng_drawings/PR17516MTP.pdf.
"RapidNet Fibre MTP VHD Cassette," Brochure, Date Unknown, 1 page, http://www.hellermanntyton.se/documents/5000/576_fiber_1U.pdf.
"MPO for Gigabit Ethernet/FAS-NET MTP Solution," Brochure, Date Unknown, 11 pages, http://www.infinique.com/upload/13182286190.pdf.
"Hubbell OptiChannel High Density 144 Port 1U Fiber Enclosure," Brochure, Date Unknown, 2 pages, http://www.hubbell-premise.com/literature/PLDF010.pdf.
Non-final Office Action for U.S. Appl. No. 12/771,473 dated Oct. 4, 2012, 6 pages.
Non-final Office Action for U.S. Appl. No. 12/819,081 dated Aug. 21, 2012, 12 pages.
International Search Report for PCT/US2010/038986 dated Aug. 18, 2010, 1 page.
Unknown, Author, "QuickNet SFQ Series MTP Fiber Optic Cassettes," Panduit Specification Sheet, Jan. 2009, 2 pages.
Unknown Author, "Cellular Specialties introduces the first simulated in-building location-based tracking solution," smart-grid.tmenet.com/news, Sep. 14, 2009, 2 pages.
Unknown Author, "CDMA Co-Pilot Transmitter," Cellular Specialties, Inc., Aug. 2009, 2 pages.
Notice of Allowance for U.S. Appl. No. 12/871,052 dated Sep. 18, 2013, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/953,039 dated Sep. 12, 2013, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/946,139 dated Oct 2, 2013, 18 pages.
Final Office Action for U.S. Appl. No. 12/394,114 dated Oct. 4, 2013, 10 pages.
Non-final Office Action for U.S. Appl. No. 12/818,986 dated Oct. 4, 2013, 19 pages.
Non-final Office Action for U.S. Appl. No. 13/901,074 dated Oct. 9, 2013, 6 pages.
Advisory Action for U.S. Appl No. 12/953,134 dated Nov. 4, 2013, 3 pages.
Final Office Action for U.S. Appl. No. 12/952,960 dated Oct. 29, 2013, 8 pages.
Notice of Allowance for U.S. Appl. No. 13/292,130 dated Oct. 18, 2013, 9 pages.
International Search Report and Written Opinion for PCT/US2011/035683 dated Sep. 8, 2011, 15 pages.
International Search Report and Written Opinion for PCT/US2010/039218 dated Oct. 27, 2010, 13 pages.
First Office Action for Chinese patent application 201080032453.2 dated Mar. 26, 2013, 6 pages.
Chinese Search Report for Chinese patent application 201080032453.2 dated May 15, 2013, 2 pages.
First Office Action for Chinese patent application 201080031621.6 dated Sep. 26, 2013, 9 pages.
Chinese Search Report for Chinese patent application 201080031621.6 dated Sep. 13, 2013, 2 pages.
Ramdas, "Modern File Systems and Storage," Proceedings of the 2nd International SANE Conference, May 22-25, 2000, MECC, Maastricht, The Netherlands, Copyright Rodney R. Ramdas, 10 pages.
International Search Report and Written Opinion for PCT/US2011/035684 dated Jul. 1, 2011, 11 pages.
International Search Report and Written Opinion for PCT/US11/61754 dated Mar. 26, 2012, 9 pages.
Author Unknown, "144 Fiber Patch Panel 1U," Technical data, ADTEK Group Limited, 2009, 2 pages.
Advisory Action for U S. Appl. No. 12/394,114 dated Jan. 2, 2014, 3 pages.
Notice of Allowance for U.S. Appl. No. 12/871,052 dated Dec. 24, 2013, 9 pages.
Final Office Action for U.S. Appl. No. 12/953,039 dated Dec. 27, 2013, 10 pages.
Advisory Action for U.S. Appl. No. 12/952,960 dated Jan. 8, 2014, 3 pages.
Advisory Action for U.S. Appl. No. 12/952,912 dated Nov. 26, 2013, 3 pages.
Examiner's Answer to the Appeal Brief for U.S. Appl. No. 12/953,118 dated Dec. 3, 2013, 6 pages.
Non-final Office Action for U.S. Appl. No. 13/597,549 dated Jan. 14, 2014, 9 pages.
Final Office Action for U.S. Appl. No. 12/732,487 dated Dec. 6, 2013, 24 pages.
Final Office Action for U.S. Appl. No. 12/956,446 dated Dec. 23, 2013, 12 pages.
Non-final Office Action for U.S. Appl. No. 12/953,536 dated Dec. 17, 2013, 21 pages.
Non-final Office Action for U.S. Appl. No. 12/819,065 dated Dec. 3, 2013, 8 pages.
International Search Report and Written Opinion for PCT/US2011/062353 dated Apr. 10, 2012, 15 pages.
International Search Report for PCT/US2013/041268 dated Aug. 20, 2013, 5 pages.
Notice of Allowance for U.S. Appl. No. 13/292,130 dated Feb. 14, 2014, 7 pages.
Final Office Action for U.S. Appl. No. 12/707,889 dated Feb. 11, 2014, 17 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Non-final Office Action for U.S. Appl. No. 12/940,699 dated Feb. 3, 2014, 10 pages.
Notice of Allowance for U.S. Appl. No. 12/952,960 dated Feb. 13, 2014, 7 pages.
Notice of Allowance and Applicant-Initiated Interview Summary for U.S. Appl. No. 12/771,473 dated Feb. 27, 2014, 8 pages.
Non-final Office Action for U.S. Appl. No. 13/081,856 dated Nov. 26, 2013, 11 pages.
Non-final Office Action for U.S. Appl. No. 13/663,975 dated Jan. 31, 2014, 18 pages.
Non-final Office Action for U.S. Appl. No. 12/394,114 dated Mar. 21, 2014, 9 pages.
Final Office Action for U.S. Appl. No. 12/940,585 dated Mar. 18, 2014, 15 pages.
Non-final Office Action for U.S. Appl. No. 12/953,101 dated Apr. 3, 2014, 9 pages.
Advisory Action for U.S. Appl. No. 12/953,039 dated Mar. 6, 2014, 3 pages.
Advisory Action for U.S. Appl. No. 12/956,446 dated Mar. 20, 2014, 3 pages.
Final Office Action for U.S. Appl. No. 13/603,894 dated Mar. 20, 2014, 15 pages.
Notice of Allowance for U.S. Appl. No. 12/417,325 dated Aug. 22, 2012, 7 pages.
International Search Report for PCT/US2010/023901 dated Jun. 11, 2010, 3 pages.
Notice of Allowance for U.S. Appl. No. 12/576,769 dated May 31, 2012, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/576,806 dated Dec. 13, 2011, 6 pages.
Notice of Allowance for U.S. Appl. No. 12/576,806 dated Apr. 18, 2012, 5 pages.
Non-final Office Action for U.S. Appl. No. 13/688,675 dated Jan. 31, 2014, 13 pages.
Non-final Office Action for U.S. Appl. No. 12/946,217 dated Jul. 26, 2012, 25 pages.
Final Office Action for U.S. Appl. No. 12/946,217 dated Mar. 18, 2013, 48 pages.
Non-final Office Action for U.S. Appl. No. 12/946,217 dated Oct. 3, 2013, 47 pages.
Final Office Action for U.S. Appl. No. 12/946,217 dated Apr. 25, 2014, 40 pages.
Non-final Office Action for U.S. Appl. No. 13/833,876 dated Apr. 24, 2014, 7 pages.
Notice of Allowance for U.S. Appl. No. 12/953,536 dated May 20, 2014, 9 pages.
Advisory Action for U.S. Appl. No. 12/707,889 dated Jun. 11, 2014, 4 pages.
Advisory Action for U.S. Appl. No. 12/940,585 dated Jun. 17, 2014, 3 pages.
Advisory Action for U.S. Appl. No. 12/947,883 dated Jun. 19, 2014, 3 pages.
Non-final Office Action for U.S. Appl. No. 12/732,487 dated Jun. 20, 2014, 24 pages.
Non-final Office Action for U.S. Appl. No. 13/621,958 dated Jun. 20, 2014, 13 pages.
Final Office Action for U.S. Appl. No. 13/649,417 dated Jun. 25, 2014, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/952,960 dated Jun. 26, 2014, 13 pages.
Non-final Office Action for U.S. Appl. No. 13/746,938 dated Jul. 11, 2014, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/751,895 dated May 20, 2014, 9 pages.
Final Office Action for U.S. Appl. No. 12/953,039 dated Jul. 25, 2014, 10 pages.
Notice of Allowance for U.S. Appl. No. 12/953,536 dated Aug. 28, 2014, 9 pages.
Final Office Action for U.S. Appl. No. 13/901,074 dated Sep. 5, 2014, 7 pages.
Final Office Action for U.S. Appl. No. 13/663,975 dated Aug. 14, 2014, 42 pages.
Corrected Notice of Allowance for U.S. Appl. No. 13/533,093 dated Sep. 2, 2014, 7 pages.
Notice of Allowance for U.S. Appl. No. 13/649,417 dated Sep. 8, 2014, 7 pages.
Examiner's Answer to the Appeal for U.S. Appl. No. 12/952,912 dated Sep. 11, 2014, 15 pages.
Advisory Action and Examiner-Initiated Interview Summary for U.S. Appl. No. 13/081,856 dated Sep. 16, 2014, 4 pages.
Notice of Allowance for U.S. Appl. No. 13/455,646 dated Sep. 26, 2014, 9 pages.
Non-Final Office Action for U.S. Appl. No. 13/663,949 dated Sep. 25, 2014, 21 pages.
Non-Final Office Action for U.S. Appl. No. 13/688,675 dated Sep. 30, 2014, 9 pages.
Advisory Action for U.S. Appl. No. 12/953,039 dated Oct. 3, 2014, 3 pages.
Notice of Allowance for U.S. Appl. No. 13/597,549 dated Oct. 3, 2014, 8 pages.
Decision on Appeal for U.S. Appl. No. 11/320,062 dated Aug. 14, 2014, 8 pages.
Final Office Action for U.S. Appl. No. 12/953,101 dated Oct. 20, 2014, 14 pages.
Notice of Allowance for U.S. Appl. No. 13/533,093 dated Oct. 17, 2014, 9 pages.
Notice of Allowance for U.S. Appl. No. 12/732,487 dated Oct. 7, 2014, 8 pages.
Non-Final Office Action for U.S. Appl. No. 13/567,288 dated Oct. 8, 2014, 7 pages.
Advisory Action for U.S. Appl. No. 12/818,986 dated Oct. 15, 2014, 5 pages.
Examiner's Answer to the Appeal Brief for U.S. Appl. No. 12/953,134 dated Aug. 1, 2014, 7 pages.
Final Office Action for U.S. Appl. No. 12/394,114 dated Oct. 31, 2014, 10 pages.
Non-final Office Action for U.S. Appl. No. 12/940,699 dated Oct. 28, 2014, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/953,039 dated Nov. 12, 2014, 8 pages.
Notice of Allowance for U.S. Appl. No. 12/952,960 dated Nov. 10, 2014, 7 pages.
Notice of Allowance for U.S. Appl. No. 13/081,856 dated Oct. 29, 2014, 10 pages.
Notice of Allowance for U.S. Appl. No. 13/833,876 dated Nov. 7, 2014, 7 pages.
Advisory Action for U.S. Appl. No. 13/901,074 dated Nov. 24, 2014, 3 pages.
Notice of Allowance for U.S Appl. No. 12/751,895 dated Nov. 19, 2014, 8 pages.
Final Office Action for U.S. Appl. No. 12/953,003 dated Feb. 12, 2015, 14 pages.
Final Office Action for U.S. Appl. No. 12/953,039 dated Feb. 23, 2015, 9 pages.
Non-Final Office Action for U.S. Appl. No. 15/412,839, dated Mar. 9, 2017, 9 pages.
Non-final Office Action for U.S. Appl. No. 13/952,014 dated Jul. 30, 2015, 9 pages.
Final Office Action for U.S. Appl. No. 12/818,986 dated Jul. 23, 2015, 24 pages.
Non-final Office Action for U.S. Appl. No. 12/956,446 dated Jul. 31, 2015, 14 pages.
Notice of Allowance for U S. Appl. No. 13/902,012 dated Aug. 5, 2015, 8 pages.
Final Office Action for U.S. Appl. No. 12/946,217, dated Jul. 16, 2015, 50 pages.
Non-final Office Action for U.S. Appl. No. 12/394,114 dated Aug. 12, 2015, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/953,039 dated Sep. 3, 2015, 8 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Final Office Action for U.S. Appl. No. 13/081,856 dated Sep. 8, 2015, 10 pages.
Examiner's Answer to the Appeal Brief for U.S. Appl. No. 13/663,975 dated Oct. 5, 2015, 14 pages.
Non-final Office Action for U.S. Appl. No. 12/819,065 dated Aug. 26, 2015, 13 pages.
Final Office Action for U.S. Appl. No. 13/567,288 dated May 8, 2015, 13 pages.
Non-final Office Action for U S. Appl. No. 14/263,751 dated Oct. 30, 2015, 6 pages.
Decision on Appeal for U.S. Appl. No. 12/953,118, dated Apr. 5, 2016, 11 pages.
Notice of Allowance for U.S. Appl. No. 12/953,118, dated Apr. 8, 2016, 8 pages.
Final Office Action for U.S. Appl. No. 13/663,949 dated Dec. 23, 2015, 24 pages.
Final Office Action for U.S. Appl. No. 14/263,751 dated Jun. 8, 2016, 6 pages.
Decision on Appeal for U.S. Appl. No. 12/953,134 dated Jun. 24, 2016, 6 page.
Decision on Appeal for U.S. Appl. No. 12/952,912 dated Jun. 28, 2016, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/940,699 dated Jul. 1, 2016, 10 pages.
Non-final Office Action for U.S. Appl. No. 13/901,074 dated Jun. 22, 2016, 8 pages.
Decision on Appeal for U.S. Appl. No. 12/946,139, dated Oct. 13, 2016, 8 pages.
Notice of Allowance for U.S. Appl. No. 12/953,118, dated Aug. 1, 2016, 7 pages.
Non-Final Office Action for U.S. Appl. No. 14/660,074, dated Sep. 15, 2016, 13 pages.
Notice of Allowance for U.S. Appl. No. 14/512,899, dated Mar. 1, 2017, 9 pages.
Non-Final Office Action for U.S. Appl. No. 14/512,899, dated Aug. 16, 2016, 8 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC*, Declaration of Casimer Decusatis in Support of Petition for Inter Partes Review of U.S. Pat. No. 8,452,148, dated Aug. 31, 2016, 62 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC*, Patent Owner's Preliminary Response, Case IPR2016-01703, U.S. Pat. No. 8,452,148 B2, dated Dec. 6, 2016, 42 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC* (Patent Owner), Decision for Institution of Inter Partes Review, Case IPR2016-01703, U.S. Pat. No. 8,452,148, Paper No. 7, dated Mar. 2, 2017, 30 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC* (Patent Owner), Petition for Inter Partes Review of U.S. Pat. No. 8,452,148, dated Aug. 31, 2016, 83 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC* (Patent Owner), Declaration of Casimer Decusatis in Support of Petition for Inter Partes Review of U.S. Pat. No. 8,184,938, dated Aug. 31, 2016, 56 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC* (Patent Owner), Petition for Inter Partes Review of U.S. Pat. No. 8,184,938, dated Aug. 31, 2016, 73 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC* (Patent Owner), Patent Owner's Preliminary Response, Case IPR2016-01709, U.S. Pat. No. 8,184,938, B2, dated Dec. 6, 2016, 36 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC* (Patent Owner), Decision for Institution of Inter Partes Review, Case IPR2016-01709, U.S. Pat. No. 8,184,938 B2, Paper No. 7, dated Mar. 1, 2017, 30 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC* (Patent Owner), Patent Owner's Preliminary Response, Case IPR2017-00009, U.S. Pat. No. 9,020,320 B2, dated Jan. 18, 2017, 33 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC* (Patent Owner), Petition for Inter Partes Review of U.S. Pat. No. 9,020,320, dated Oct. 4, 2016, 88 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC* (Patent Owner), Declaration of Casimer Decusatis in Support of Petition for Inter Partes Review of U.S. Pat. No. 9,020,320, dated Sep. 30, 2016, 113 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC* (Patent Owner), Declaration of Casimer Decusatis in Support of Petition for Inter Partes Review of U.S. Pat. No. 8,538,226, dated Oct. 6, 2016, 57 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC* (Patent Owner), Petition for Inter Partes Review of U.S. Pat No. 8,538,226, dated Oct. 6, 2016, 87 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC* (Patent Owner), Patent Owner's Preliminary Response, Case IPR2017-00029, U.S. Pat. No. 8,538,226 B2, dated Jan. 13, 2017, 34 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC* (Patent Owner), Declaration of Casimer Decusatis in Support of, Petition for Inter Partes Review of U.S. Pat. No. 8,712,206, dated Dec. 22, 2016, 117 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC*, Petition for Inter Partes Review of U.S. Pat. No. 8,712,206, dated Dec. 22, 2016, 89 pages.
Author Unknown, "Cabinets, Racks, Panels, and Associated Equipment," EIA/ECA-310-E Standard, Dec. 2005, Electronic Industries Alliance, Arlington, Virginia, 26 pages.
Author Unknown, "Fiber Optic Connector Intermateability Standard—Type LC ," TIA/EIA-604-10A, FOCIS 10, Mar. 2002, Telecommunications Industry Association, Arlington, Virginia, 36 pages.
Author Unknown, "Fiber Optic Connector Intermateability Standard—Type MPO ," TIA/EIA-604-5-A, FOCIS-5, Sep. 2001, Telecommunications Industry Association, Arlington, Virginia, 24 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC* (Patent Owner), Decision Denying Institution of Inter Partes Review, Case IPR2017-00528, U.S. Pat. No. 8,712,206 B2, dated May 31, 2017, 28 pages.
Final Office Action for U.S. Appl. No. 14/660,074, dated May 18, 2017, 4 pages.
Notice of Allowance for U.S. Appl. No. 12/952,912, dated Mar. 29, 2017, 9 pages.
Non-Final Office Action for U.S. Appl. No. 15/413,883, dated Mar. 17, 2017, 8 pages.
Non-Final Office Action for U.S. Appl. No. 15/413,919, dated Mar. 14, 2017, 9 pages.
Non-Final Office Action for U.S. Appl. No. 15/413,962, dated Mar. 24, 2017, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/956,446 dated Dec. 5, 2014, 12 pages.
Advisory Action for U.S. Appl. No. 13/663,975 dated Dec. 24, 2014, 7 pages.
Author Unknown, "Living Hinge—From Wikipedia, the free encyclopedia," Retrieved from the internet on Mar. 19, 2015, http://en.eikipedia.org/wiki/Living_Hinge, 3 pages.
Bigo, Sebastien, et al., "10.2Tbit/s (256x42.7Gbit/s PDM/WDM) transmission over 100km TeraLight fiber with 1.28 bit/s/Hz spectral efficiency," Optical Fiber Communication Conference, Mar. 17-22, 2001, 3 pages.
McEachern, "Gigabit Networking on the Public Transmission Network," IEEE Communications Magazine, Apr. 1992, IEEE, pp. 70-78.
Author Unknown, "U-Space System for Brocade 48000," Product Specifications, LAN-904-EN, Apr. 2008, Communications Supply Corporation, pp. 1-16.
Patent Examination Report No. 1 for Australian Patent Application No. 2015242945, dated Sep. 1, 2016, 5 pages.
Translation of the Notification of the Office Rejection for Chinese Patent Application No. 200980134014.X, dated Dec. 18, 2014, 8 pages.
Translation of the Second Office Action for Chinese Patent Application No. 200980134014.X, dated Jul 17, 2013, 8 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Translation of Notification of Reason for Rejection for Japanese Patent Application No. 2011-524963, dated Jul. 14, 2014, 3 pages.
Translation of Notification of Reason for Rejection for Japanese Patent Application No. 2011-524963, dated Sep. 17, 2013, 4 pages.
English Translation of Second Office Action for Chinese Patent Application No. 201080018761.X, dated Apr. 3, 2015, 5 pages.
English Translation of Second Office Action for Chinese Patent Application No. 201180022996.0, dated Jul. 28, 2015, 10 pages.
English Translation of Search Report for Chinese Patent Application No. 201280009252.X, dated Jun. 25, 2015, 2 pages.
English Translation of Search Report for Chinese Patent Application No. 201280010672.X, dated Dec. 15, 2014, 2 pages.
English Translation of Notification of Reason for Rejection for Japanese Patent Application No. 2012-516298, dated Jul. 6, 2015, 6 pages.
Examination Report for European Patent Application No. 107071532, dated Mar. 25, 2015, 6 pages.
Examination Report for European patent application 09789090.9-1562 dated Aug. 2, 2013, 4 pages.
Examination Report for European patent application 09789090.9-1562 dated Feb. 25, 2014, 5 pages.
Examination Report for European patent application 09789090 9-1562 dated Oct. 2, 2014, 6 pages.
Examination Report for European patent application 09789090.9-1562 dated May 5, 2015, 5 pages.
Examination Report for European patent application 09789090.9-1562 dated Dec. 18, 2015, 4 pages.
Partial European Search Report for European Patent Application 15184772.0, dated Jan. 22, 2016, 7 pages.
Patent Examination Report No. 1 for Australian patent application 2011245168 dated Sep. 9, 2014, 3 pages.
English Translation of Notice on the First Office Action for Chinese patent application 201180021566.7 dated Jul. 3, 2014, 7 pages.
English Translation of Notice on the Second Office Action for Chinese patent application 201180021566.7 dated May 26, 2015, 7 pages.
International Search Report for PCT/US2011/057582 dated Jan. 27, 2012, 3 pages.
International Search Report and Written Opinion for PCT/US2011/034581 dated Jul. 13, 2011, 13 pages.
Advisory Action for U.S. Appl. No. 12/394,114 dated Jan. 16, 2015, 3 pages.
Notice of Allowance and Examiner-Initiated Interview Summary for U.S. Appl. No. 12/947,883 dated Jan. 13, 2015, 11 pages.
Non-final Office Action for U.S. Appl. No. 12/818,986 dated Jan. 5, 2015, 21 pages.
Notice of Allowance for U.S. Appl. No. 13/649,417 dated Jan. 8, 2015, 7 pages.
Non-final Office Action for U.S. Appl. No. 12/946,217 dated Dec. 29, 2014, 50 pages.
Notice of Allowance and Examiner-Initiated Interview Summary for U.S. Appl. No. 12/940,585 dated Feb. 27, 2015, 16 pages.
Notice of Allowance for U.S. Appl. No. 12/953,101 dated Feb. 20, 2015, 9 pages.
Final Office Action for U.S. Appl. No. 12/819,065 dated Mar. 12, 2015, 13 pages.
Examiner's Answer to the Appeal Brief for U.S. Appl. No. 12/946,139 dated Feb. 5, 2015, 12 pages.
Notice of Allowance for U.S. Appl. No. 12/707,889 dated Feb. 17, 2015, 7 pages.
Non-final Office Action for U.S. Appl. No. 13/902,012 dated Feb. 17, 2015, 9 pages.
Non-final Office Action for U S. Appl. No. 13/081,856 dated Feb. 9, 2015, 8 pages.
Non-final Office Action for U.S. Appl. No. 13/901,074 dated May 30, 2015, 8 pages.
Notice of Allowance for U.S. Appl. No. 12/947,883 dated May 21, 2015, 11 pages.
Final Office Action for U.S. Appl. No. 12/940,699 dated Jun. 1, 2015, 10 pages.
Non-final Office Action for U.S. Appl. No. 13/663,949 dated May 5, 2015, 19 pages.
Notice of Allowance for U.S. Appl. No. 13/663,975, dated Oct. 4, 2017, 8 pages.
Final Office Action for U.S. Appl. No. 15/412,839, dated Nov 3, 2017, 14 pages.
Final Office Action for U.S. Appl. No. 15/413,883, dated Oct 6, 2017, 13 pages.
Final Office Action for U.S. Appl. No. 15/413,919, dated Oct. 6, 2017, 14 pages.
Final Office Action for U.S. Appl. No. 15/413,962, dated Oct. 10, 2017, 16 pages.
Decision on Appeal for U.S. Appl. No. 13/663,975, dated Aug. 24, 2017, 6 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC* (Patent Owner), Final Written Decision, Case IPR2016-01703, U.S. Pat. No. 8,452,148 B2, dated Feb. 27, 2018, 44 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC* (Patent Owner), Final Written Decision, Case IPR2016-01709, U.S. Pat. No. 8,184,938 B2, dated Feb. 27, 2018, 41 pages.
Extended European Search Report for European Patent Application No. 10790017.7, dated Oct. 22, 2012, 6 pages.
International Search Report and Written Opinion for PCT/US2009/004548, dated Mar. 19, 2010, 18 pages.
International Search Report and Written Opinion for PCT/US10/035529, dated Jul. 23, 2010, 10 pages.
International Search Report and Written Opinion for PCT/US2010/038580, dated Aug. 18, 2010, 8 pages.
International Search Report and Written Opinion for PCT/US2010/039225, dated Oct. 14, 2010, 17 pages.
International Preliminary Report on Patentability for PCT/US2009/004549, dated Mar. 1, 2011, 10 pages.
International Preliminary Report on Patentability for PCT/US2009/004548, dated Mar. 1, 2011, 8 pages.
International Preliminary Report on Patentability for PCT/US2010/035529, dated Dec. 1, 2011, 9 pages.
English Translation of the First Office Action for Chinese Patent Application No. 2009101715265, dated Jan. 31, 2012, 20 pages
English Translation of the First Office Action for Chinese Patent Application No. 200980134014X, dated Oct. 16, 2012, 7 pages.
English Translation of the First Office Action for Chinese Patent Application No. 200980134013.5, dated Nov. 5, 2012, 3 pages.
English Translation of the First Office Action for Chinese Patent Application No. 201080022305.2, dated Feb. 25, 2013, 8 pages.
English Translation of the First Office Action for Chinese Patent Application No. 2010800314136, dated Feb. 27, 2013, 9 pages
Notification of Reason for Rejection for Japanese Patent Application No. 2011-524964, dated Sep. 17, 2013, 8 pages.
English Translation of the Second Office Action for Chinese Patent Application No. 200980134013.5, dated Sep. 26, 2013, 9 pages.
English Translation of the Second Office Action for Chinese Patent Application No. 201080031413.6, dated Dec. 31, 2013, 10 pages.
English Translation of the Second Office Action for Chinese Patent Application No. 201080022305.2, dated Jan. 16, 2014, 5 pages.
Notification of Reason for Rejection for Japanese Patent Application No. 2012-516180, dated Feb. 24, 2014, 4 pages.
English Translation of the First Office Action for Chinese Patent Application No. 201080031967.6, dated Jan. 15, 2014, 6 pages.
Notification of Reason for Rejection for Japanese Patent Application No. 2012-512020, dated Mar. 3, 2014, 5 pages.
Examination Report for European Patent Application No. 10778368.0, dated Jan. 13, 2014, 4 pages.
Patent Examination Report No. 1 for Australian Patent Application No. 2010260251, dated Jun. 12, 2014, 3 pages.
English Translation of the Third Office Action for Chinese Patent Application No. 200980134013.5, dated Jun. 9, 2014, 5 pages.
Patent Examination Report No. 1 for Australian Patent Application No. 2009286118, dated Jun. 26, 2014, 3 pages.
Patent Examination Report No. 1 for Australian Patent Application No. 2010249538, dated Jun. 26, 2014, 4 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Decision for Final Rejection for Japanese Patent Application No. 2011-524964, dated Jul. 14, 2014, 6 pages.
English Translation of the Third Office Action for Chinese Patent Application No. 201080022305.2, dated Oct. 8, 2014, 5 pages.
English Translation of Decision of Rejection for Chinese Patent Application No. 201080031413.6, dated Sep. 2, 2014, 10 pages.
Notification of Reason for Rejection for Japanese Patent Application No. 2012-516180, dated Sep. 22, 2014, 3 pages.
English Translation of the Second Office Action for Chinese Patent Application No. 201080031967.6, dated Oct. 17, 2014, 7 pages.
English Translation of the Notification of the Office Rejection for Chinese Patent Application No. 200980134013.5, dated Feb. 16, 2015, 10 pages.
Examination Report for European Patent Application No. 09789091.7, dated May 8, 2015, 3 pages.
Examination Report for European Patent Application No. 10778368.0, dated May 13, 2015, 4 pages.
Summons to Attend Oral Proceedings for European Patent Application No. 10790017.7, dated Dec. 3, 2015, 7 pages.
Extended European Search Report for European Patent Application No. 15189567.9, dated Jan. 28, 2016, 9 pages.
Office Action for Canadian Patent Application No. 2734718, dated Oct. 7, 2015, 7 pages.
English Translation of Notification for Reexamination for Chinese Patent Application No. 201080031413.6, dated Feb. 24, 2016, 8 pages.
English Translation of Notification of Reexamination for Chinese Patent Application No. 200980134013.5, dated Mar. 14, 2016, 9 pages.
Office Action for Canadian Patent Application No. 2760818, dated Apr. 19, 2016, 3 pages.
Patent Examination Report No. 1 for Australian Patent Application No. 2015210380, dated May 3, 2016, 2 pages.
Office Action for Canadian Patent Application No. 2765837, dated May 17, 2016, 3 pages.
English Translation of Notification of Reexamination for Chinese Patent Application No. 200980135014.X, dated Feb. 29, 2016, 8 pages.
Extended European Search Report for European Patent Application No. 15184772.0, dated Jun. 14, 2016, 14 pages.
Patent Examination Report No. 1 for Australian Patent Application No. 2015203580, dated Jul. 4, 2016, 2 pages.
Extended European Patent Application No. 16176271.1, dated Sep. 29, 2016, 12 pages.
Partial European Search Report for European Patent Application No. 16173431.4, dated Oct. 20, 2016, 8 pages.
Decision for Reexamination for Chinese Patent Application No. 200980134014.X, dated Oct. 10, 2016, 15 pages.
Extended European Search Report for European Patent Application No. 16173431.4, dated Feb. 22, 2017, 12 pages.
Office Action for Canadian Patent Application No. 2765912, dated Apr. 5, 2017, 4 pages.
Office Action for Canadian Patent Application No. 2765837, dated Apr. 26, 2017, 3 pages.
Examination Report No. 1 for Australian Patent Application No. 2017221853, dated Mar. 16, 2018, 4 pages.
Decision on Appeal for Japanese Patent Application No. 2012-516347, dated Jul. 15, 2017, 8 pages.
Office Action for Canadian Patent Application No. 2765912, dated Mar. 9, 2018, 3 pages.
Notification of Grant for Japanese Patent Application No. 2012512020, dated Oct. 27, 2015, 4 pages.
Notice of Acceptance for Australian Patent Application No. 2009208086, dated Apr. 24, 2015, 2 pages.
Patent Examination Report No. 1 for Australian Patent Application No. 2009208086, dated Jul. 12, 2014, 3 pages.
Author Unknown, "Fibre Frame Solutions," Fibre Connectivity Solutions, 6356_au, Jun. 2007, ADC Krone, 123 pages.
Bulow, Knut, "ADC licenses Lx.5 SFF connector to Amphenol," Cabling, Install, Aug. 10, 2001, 1 page.
Author Unkown, "ADC Features New Fiber Optic Products at ECOC 2004," Business Wire, Sep. 6, 2004, 3 pages.
Author Unknown, "ADC FasTerm Multimode LX.5 Connector," Installation Instructions, ADCP-90-422, Issue 2, Apr. 2001, ADC Telecommunications, Inc., 25 pages.
Author Unknown, "FDM Series Fiber Distribution and Splice Modules," User Manual, ADCP-90-138, Issue 3, Oct. 2002, ADC Telecommunications, Inc., 34 pages.
Author Unkown, "ADC Next Generation Frame 96 & 144 Position Fiber Termination Block," User Manual, ADCP-90-287, Issue 2, May 2009, ADC Telecommunications, Inc., 42 pages.
Author Unknown, "Small-Form-Factor Connector," Product Data Sheet, 100082PR, Sep. 2001, ADC Telecommunications, Inc., 4 pages.
Author Unknown, "AFD Outside Plant Connector Modules," User Manual, ADCP-93-303, Issue 1, Jun. 2000, ADC Telecommunications, Inc., 14 pages.
Author Unknown, "Suhner Fiberoptic LX.5 Connector Family," Product Data Sheet, Jan. 3, 2000, Huber and Suhner, 4 pages.
Author Unknown, "OmniReach FTTP Solutions," Product Data Sheet 1276559, Apr. 2004, ADC Telecommunications, Inc., 12 pages.
Author Unknown, "Fiber Optic Cassettes," Product Search Results, Apr. 25, 2018, Panduit, 17 pages.
Author Unknown, "Pro Patch: Fiber Optical Normal Through Panel," Product Data Page, www.clarkwire.com/Propatchopticalnormalthroughpanel.htm, accessed Apr. 25, 2018, 2 pages.
Non-Final Office Action for U.S. Appl. No. 15/413,883, dated May 9, 2018, 6 pages.
Non-Final Office Action for U.S. Appl. No. 15/413,962, dated May 2, 2018, 6 pages.
Non-Final Office Action for U.S. Appl. No. 13/663,975, dated Aug. 1, 2018, 24 pages.
Notice of Allowance for U.S. Appl. No. 15/412,839, dated Aug. 14, 2018, 7 pages.
Non-Final Office Action for U.S. Appl. No. 15/412,839, dated Jun. 14, 2018, 7 pages.

* cited by examiner

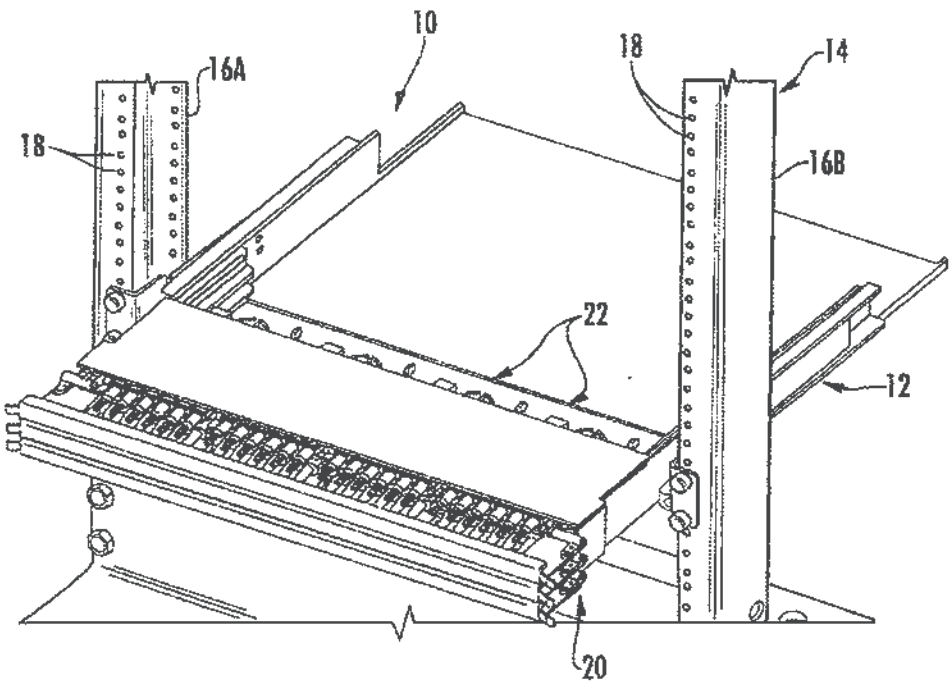

FIG. 1

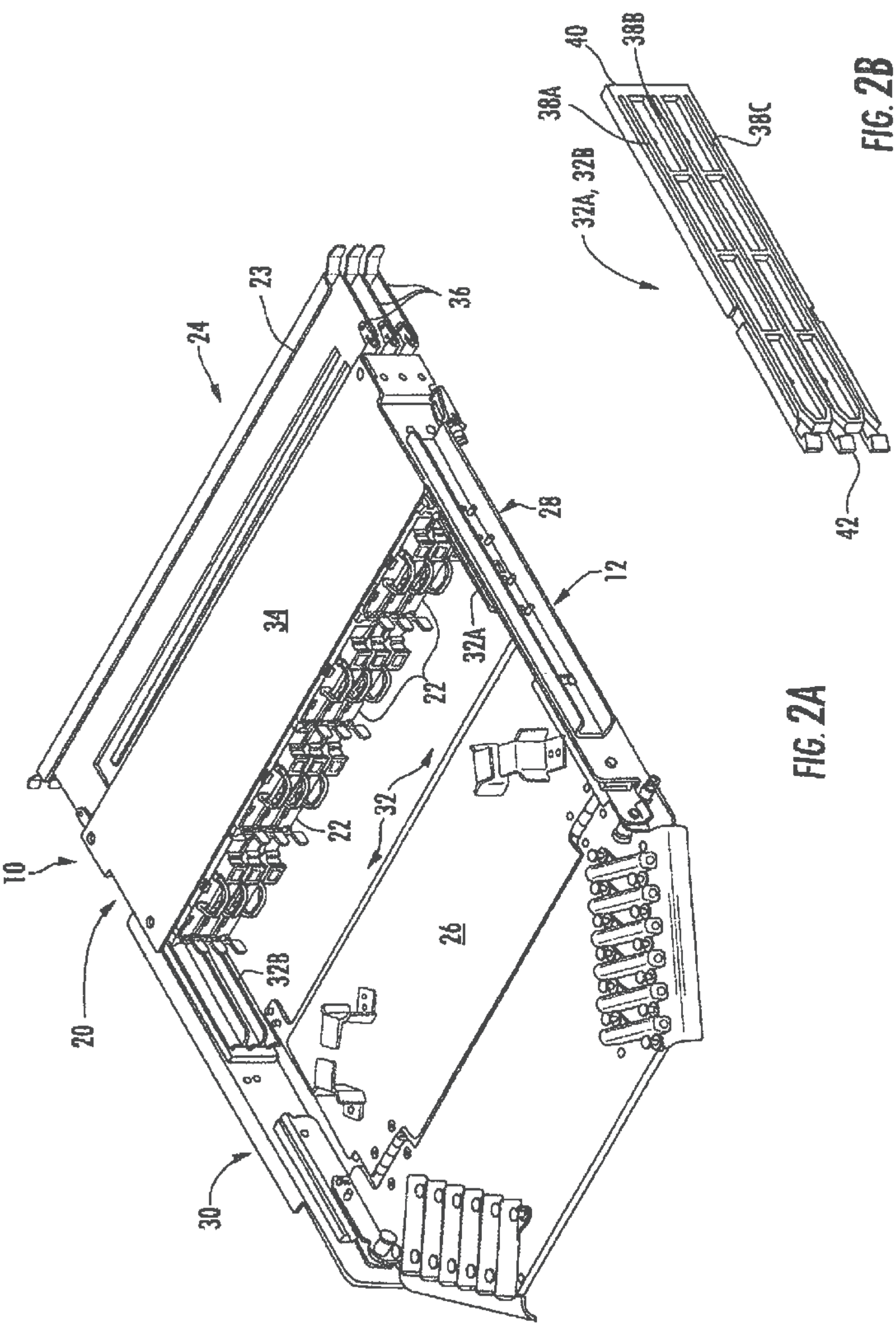

FIG. 2B

FIG. 2A

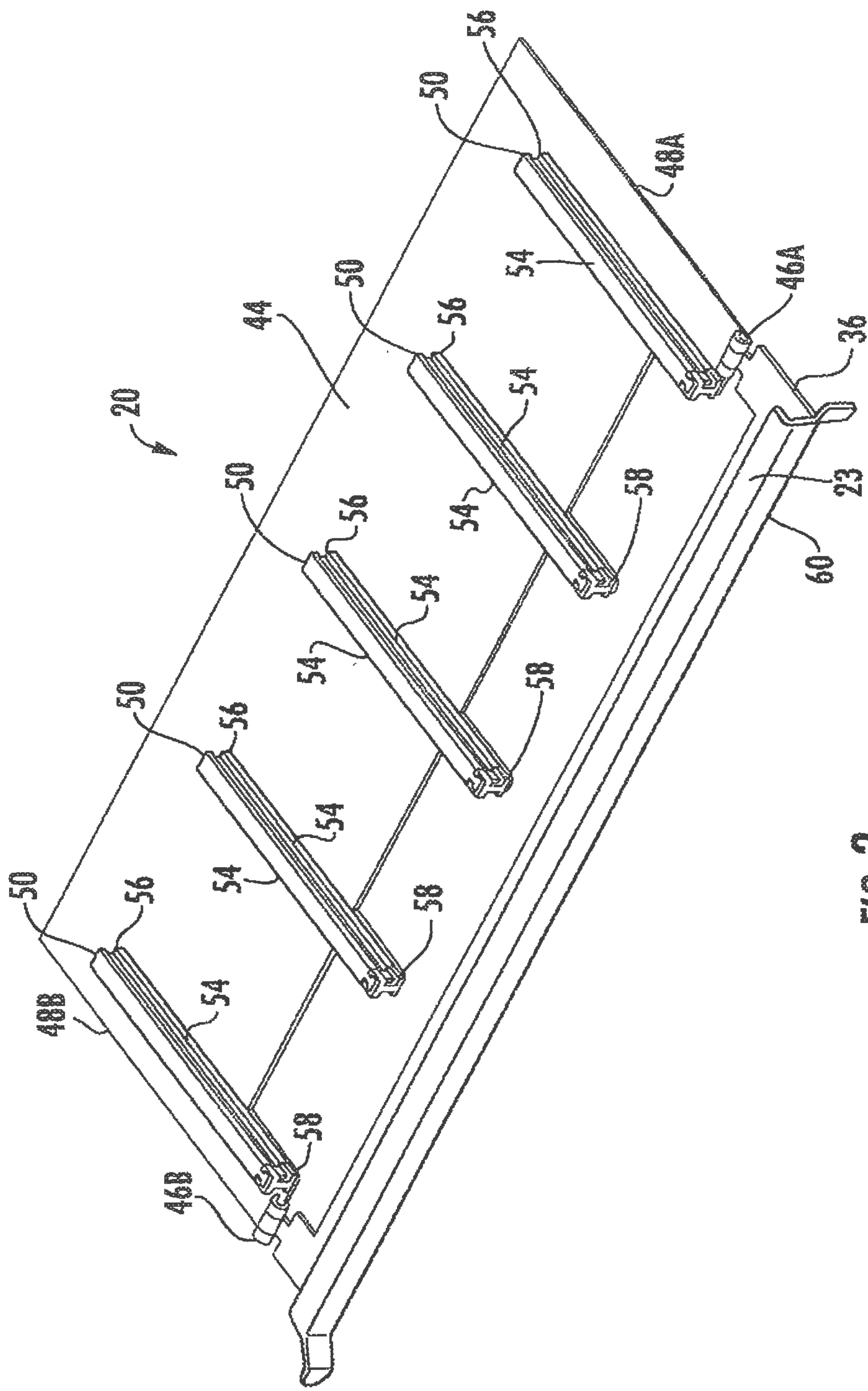

FIG. 3

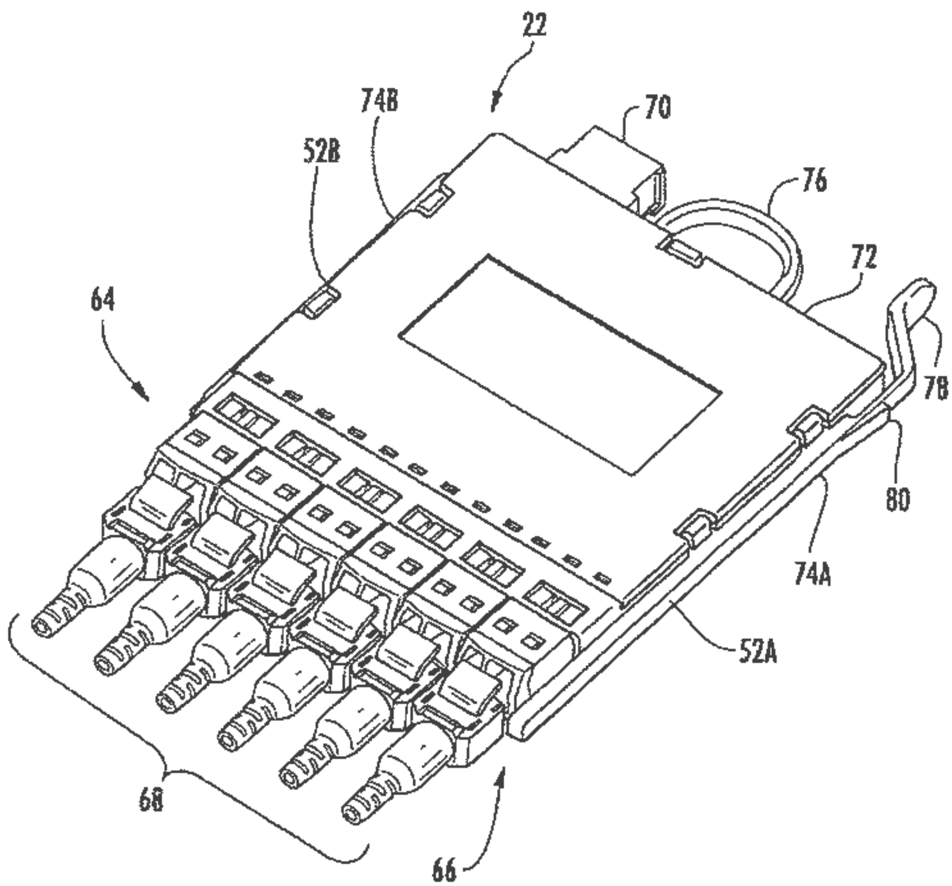

FIG. 4

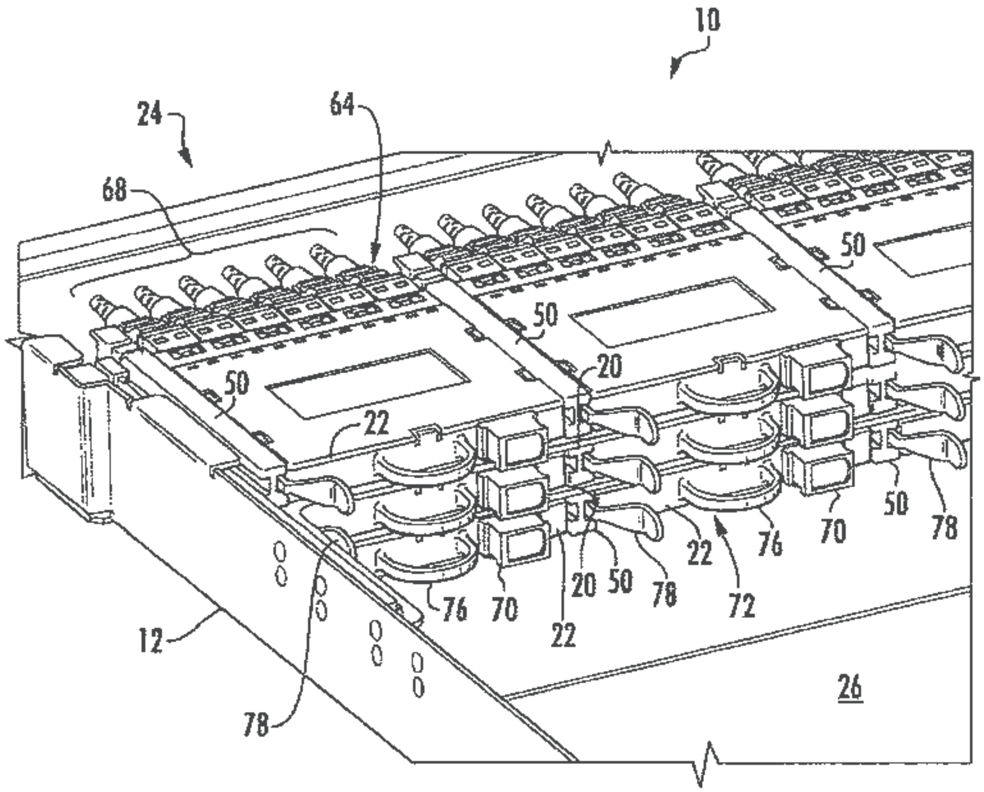
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FIG. 5

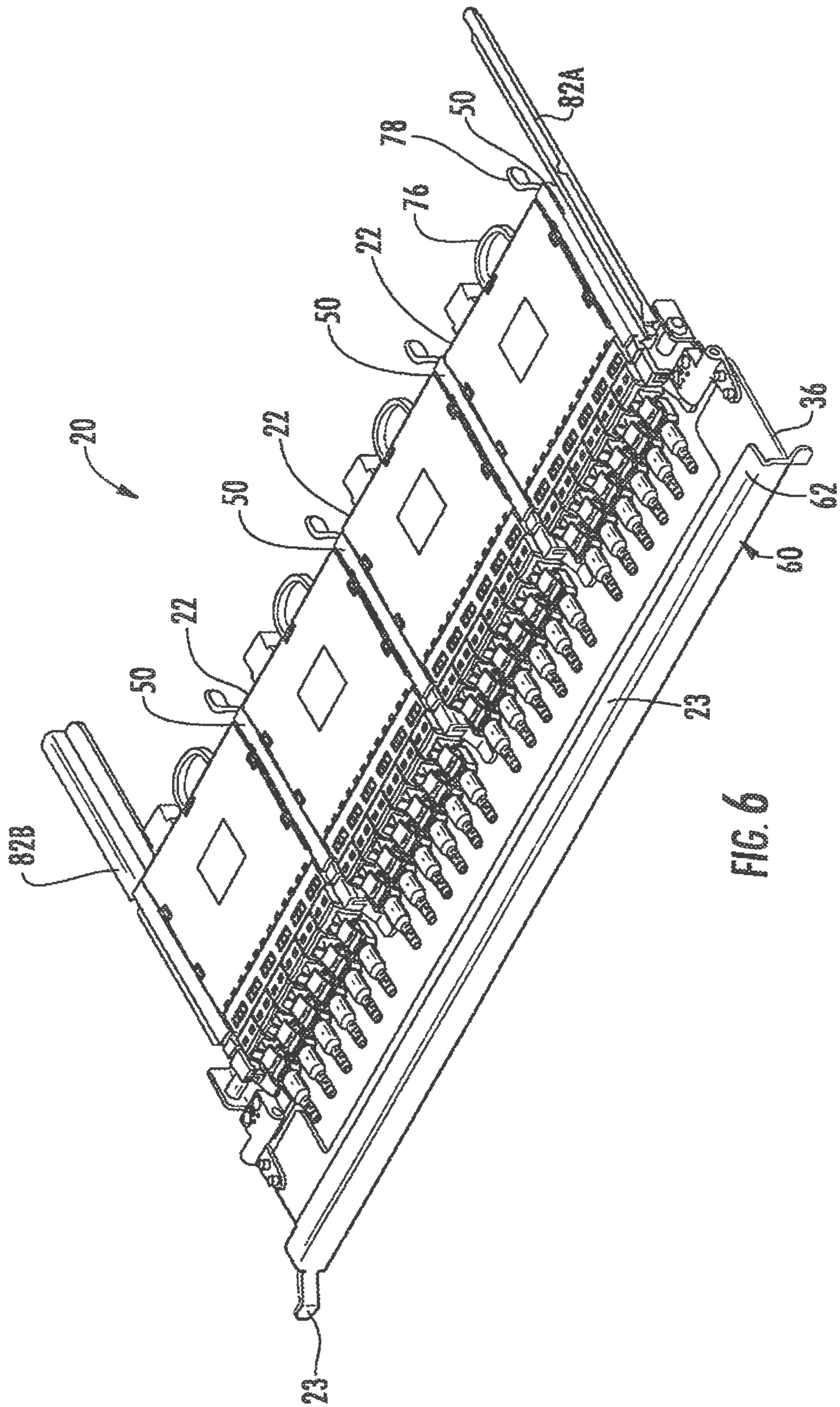

FIG. 6

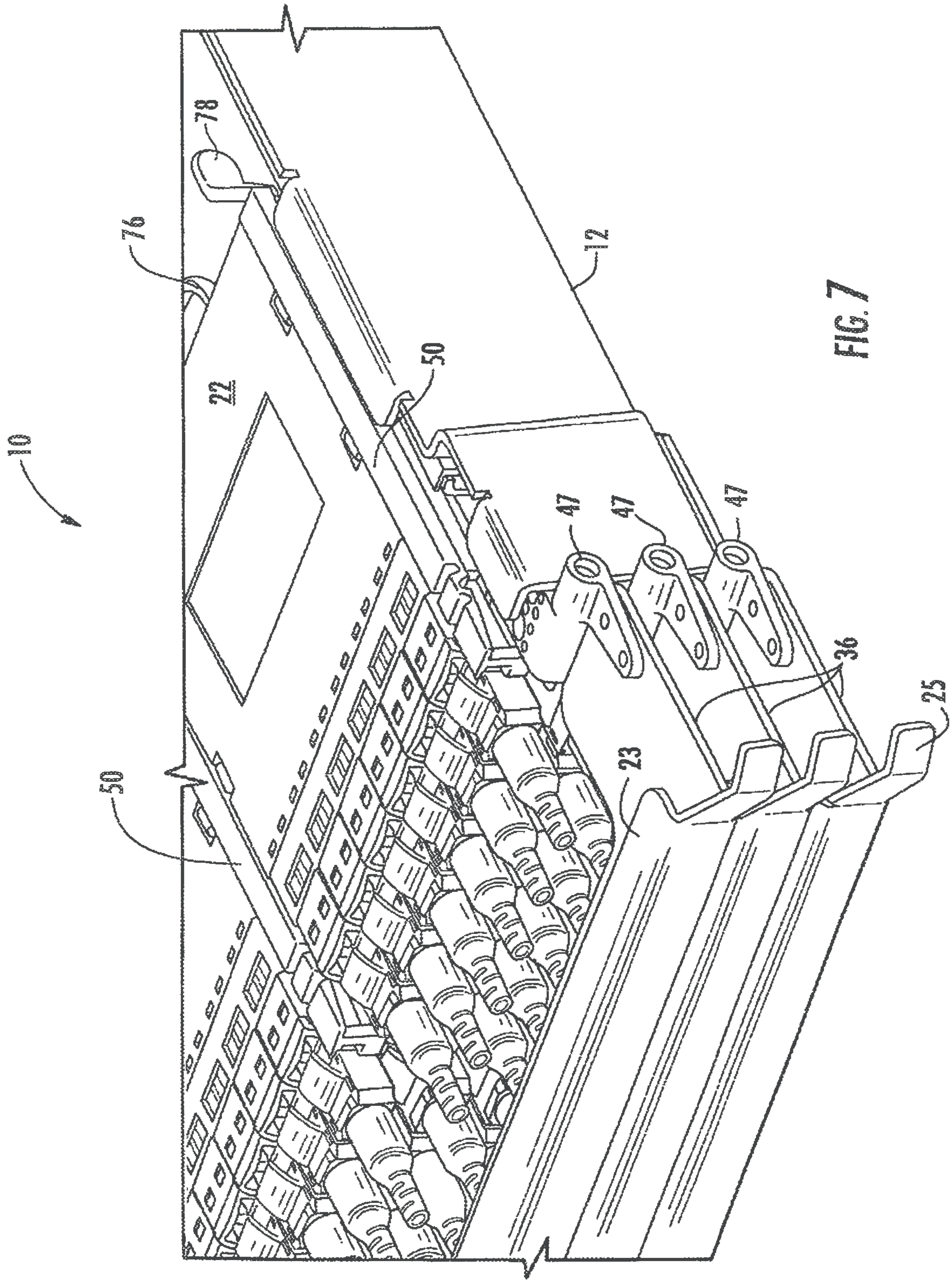

FIG. 7

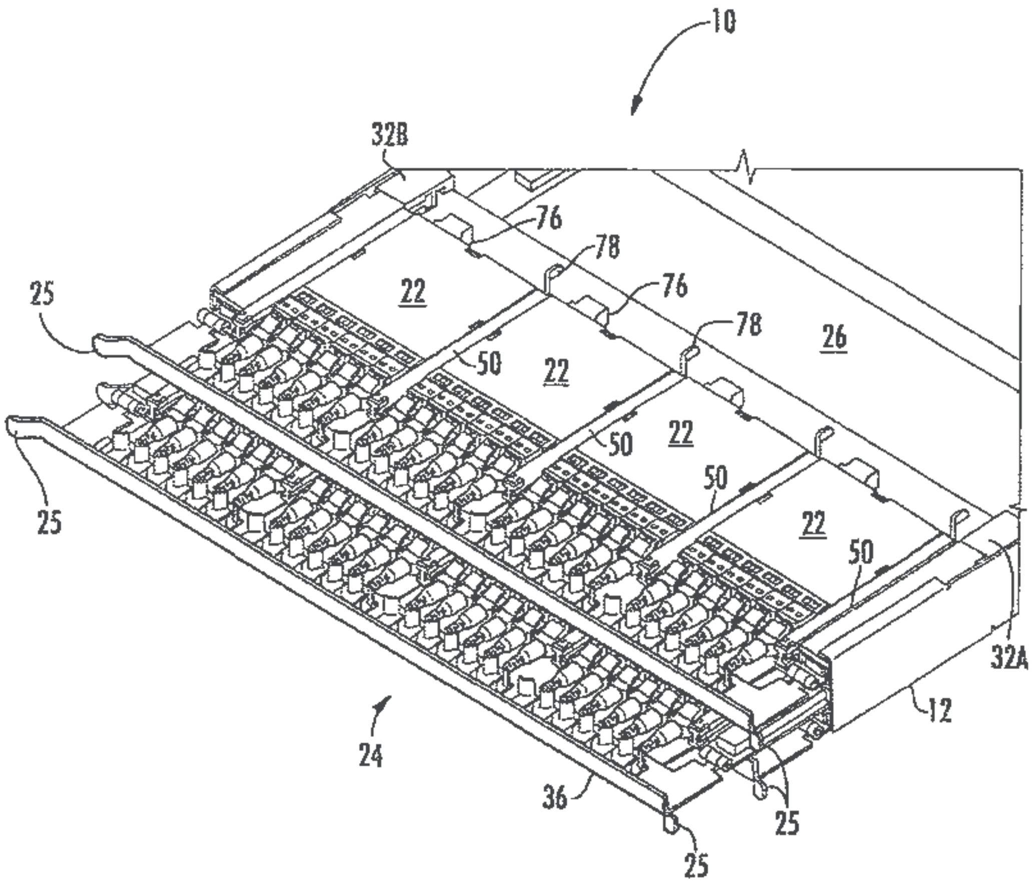

FIG. 8

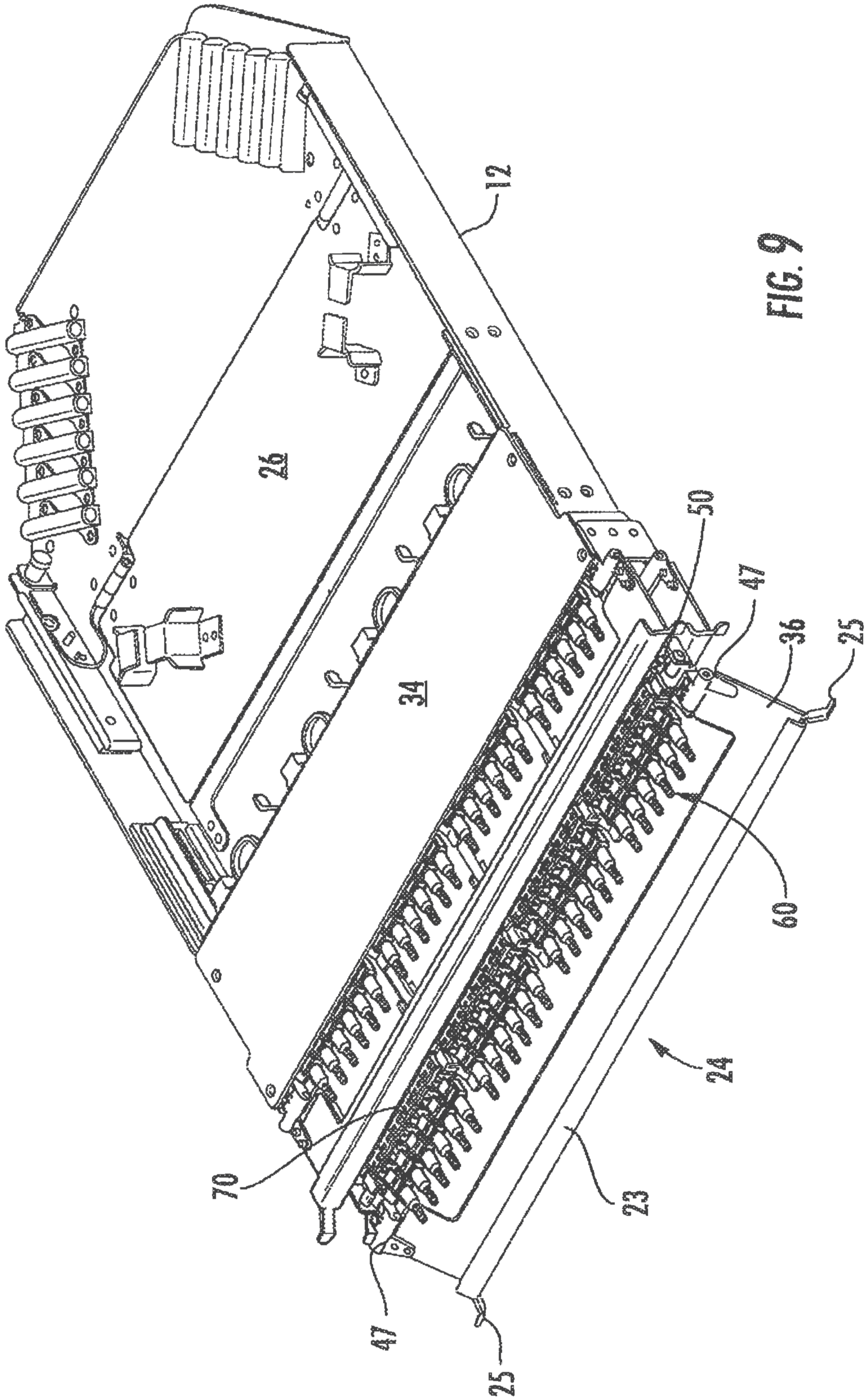

FIG. 9

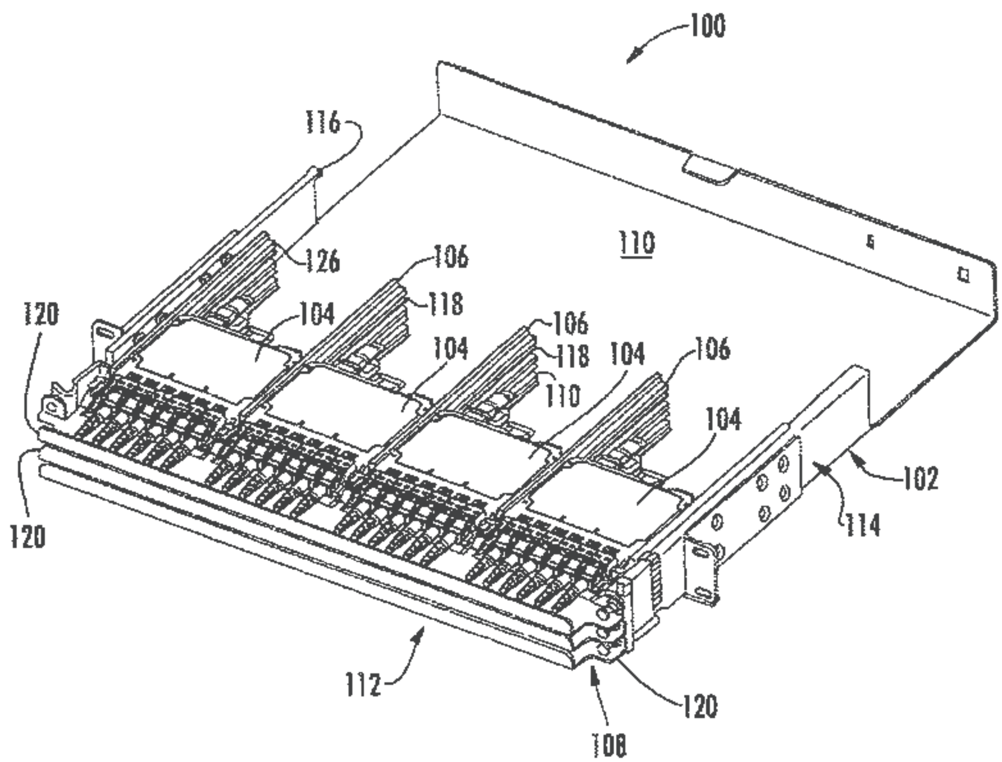
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FIG. 10

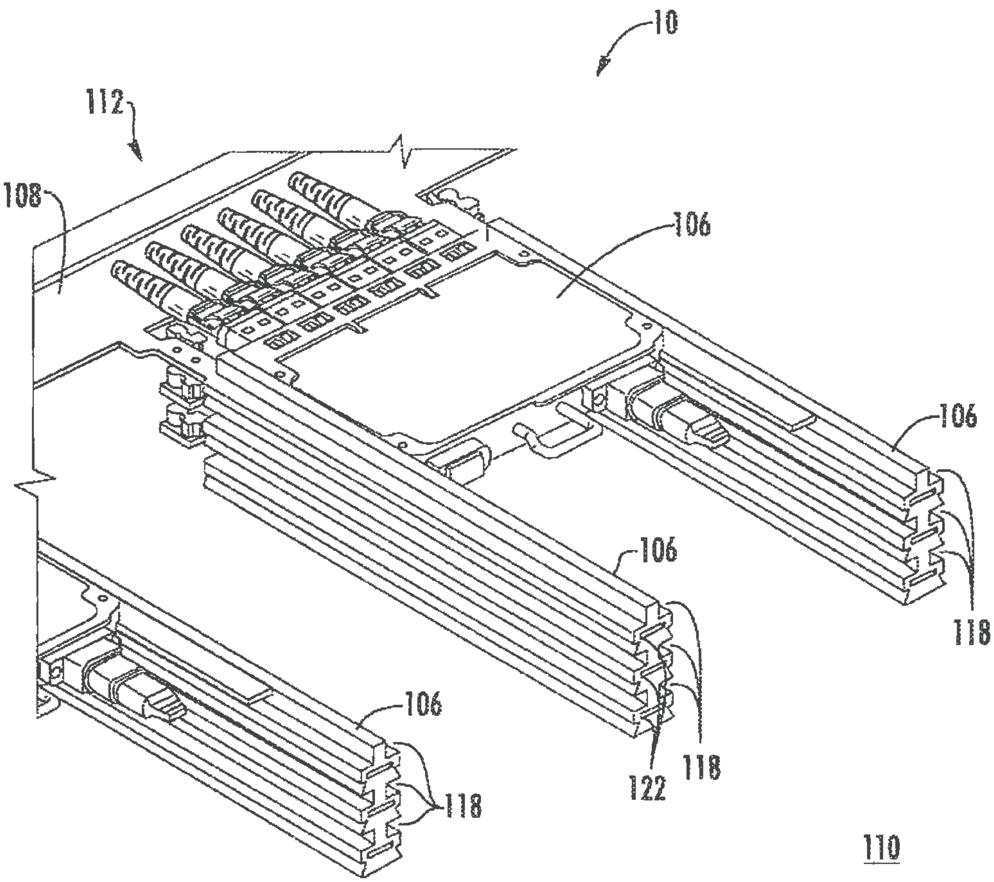

FIG. 11

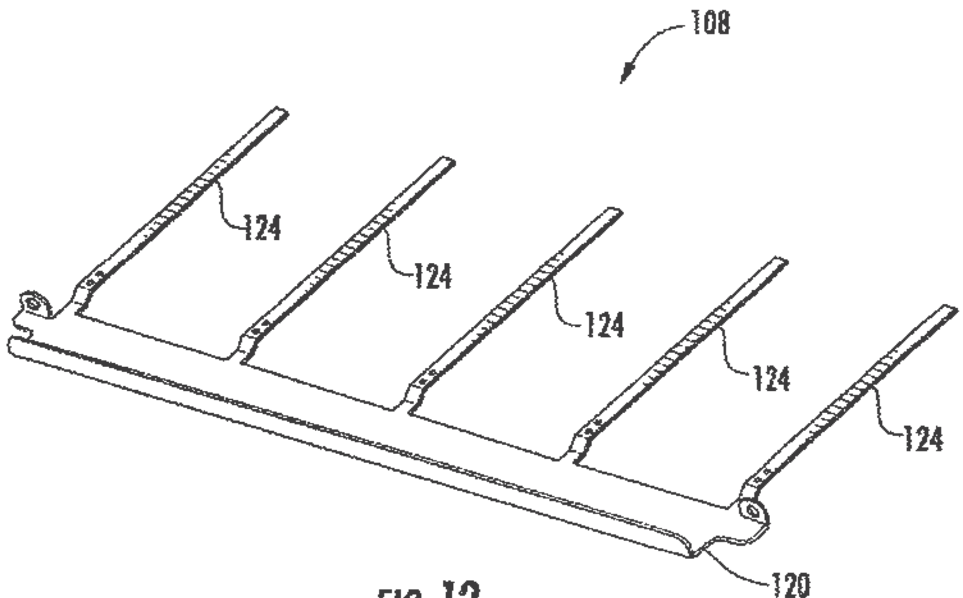

FIG. 12

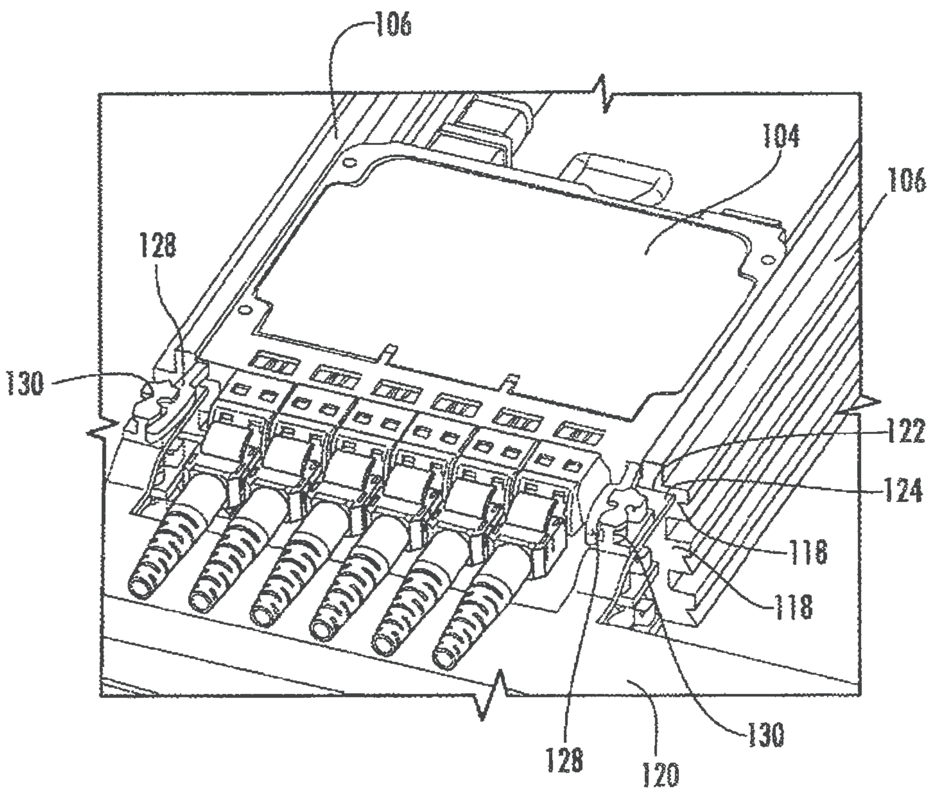

FIG. 13

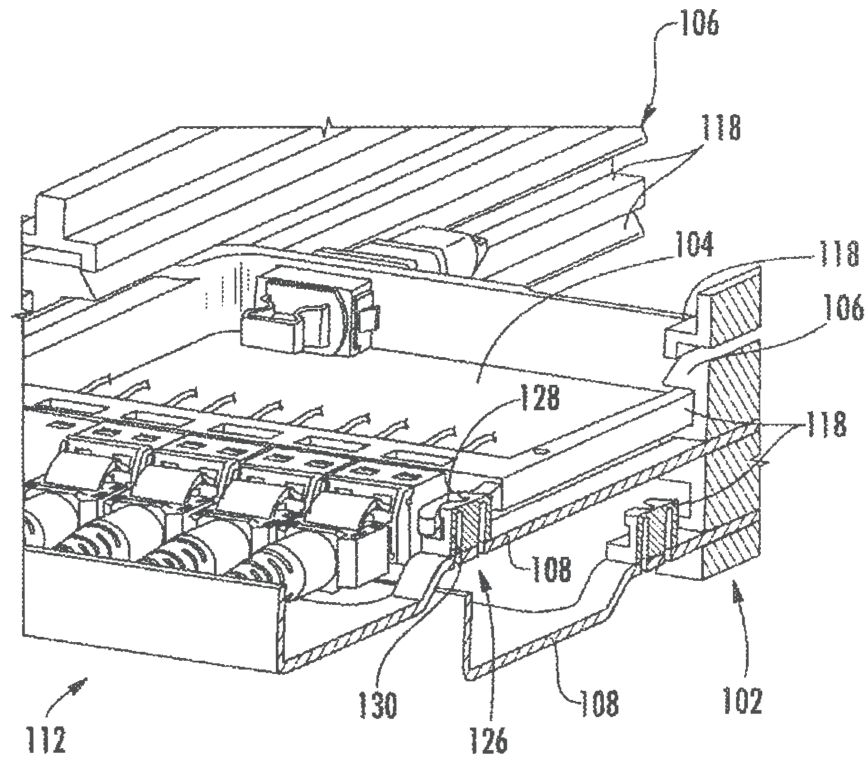

FIG. 14

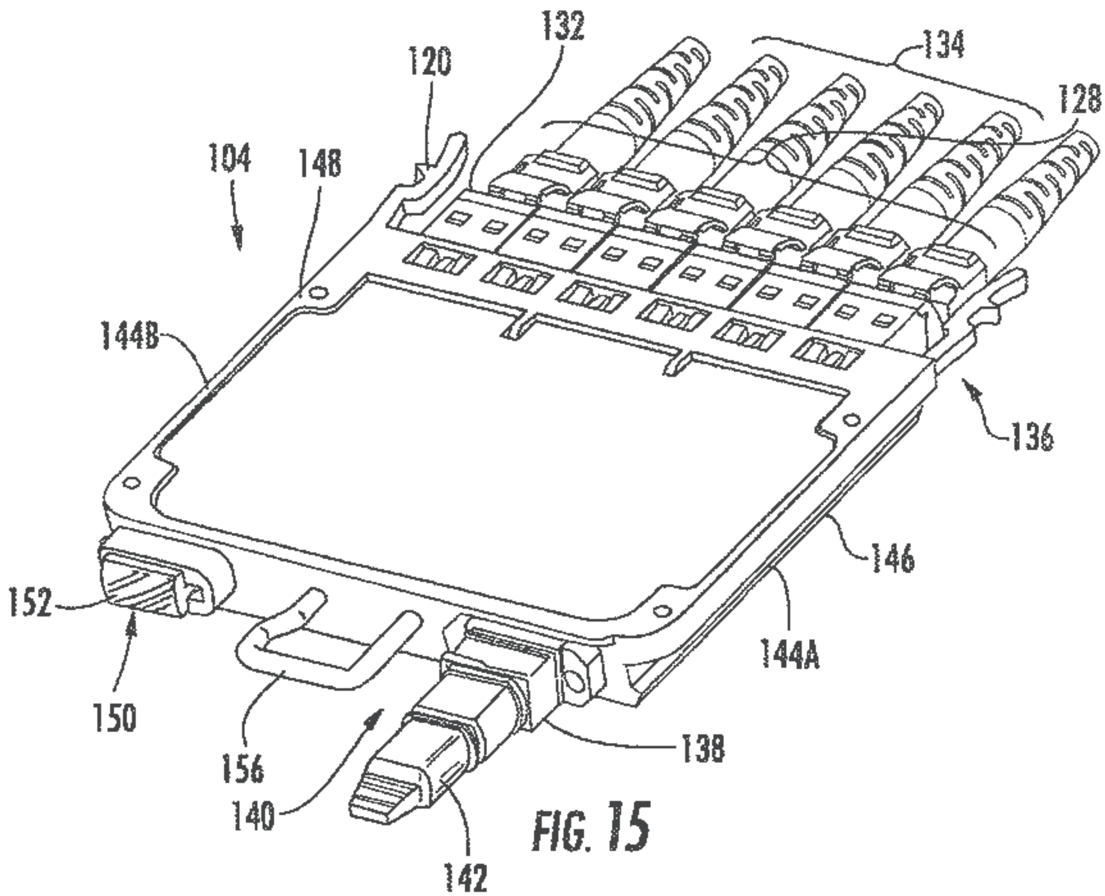

FIG. 15

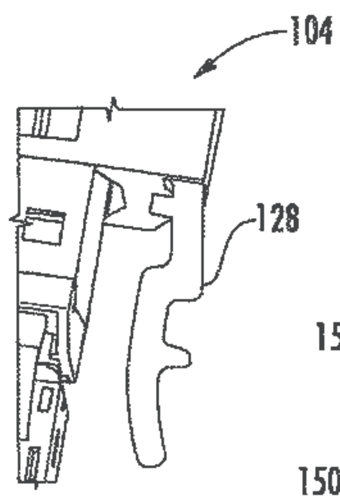

FIG. 16A

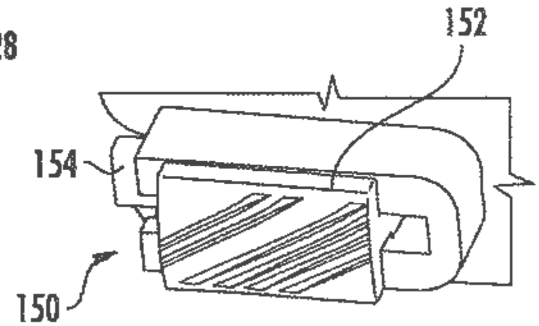

FIG. 16B

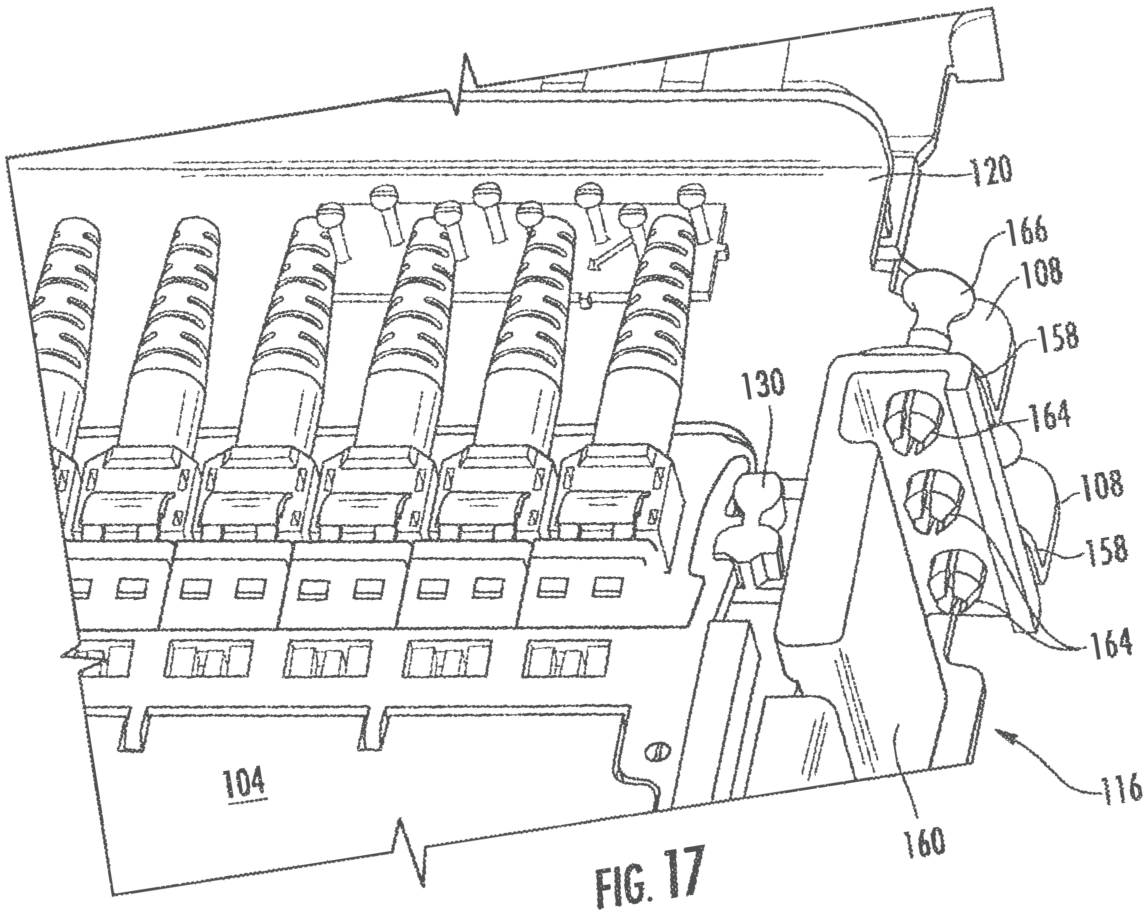

FIG. 17

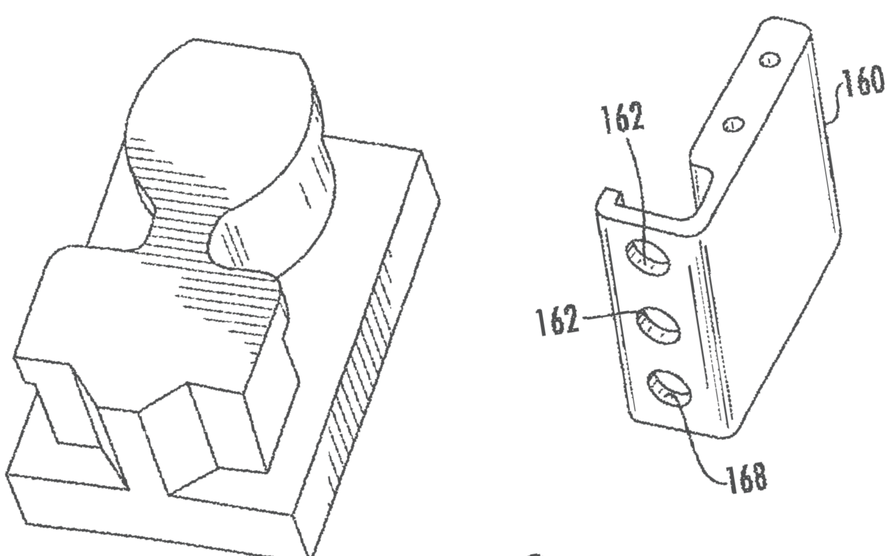

FIG. 18

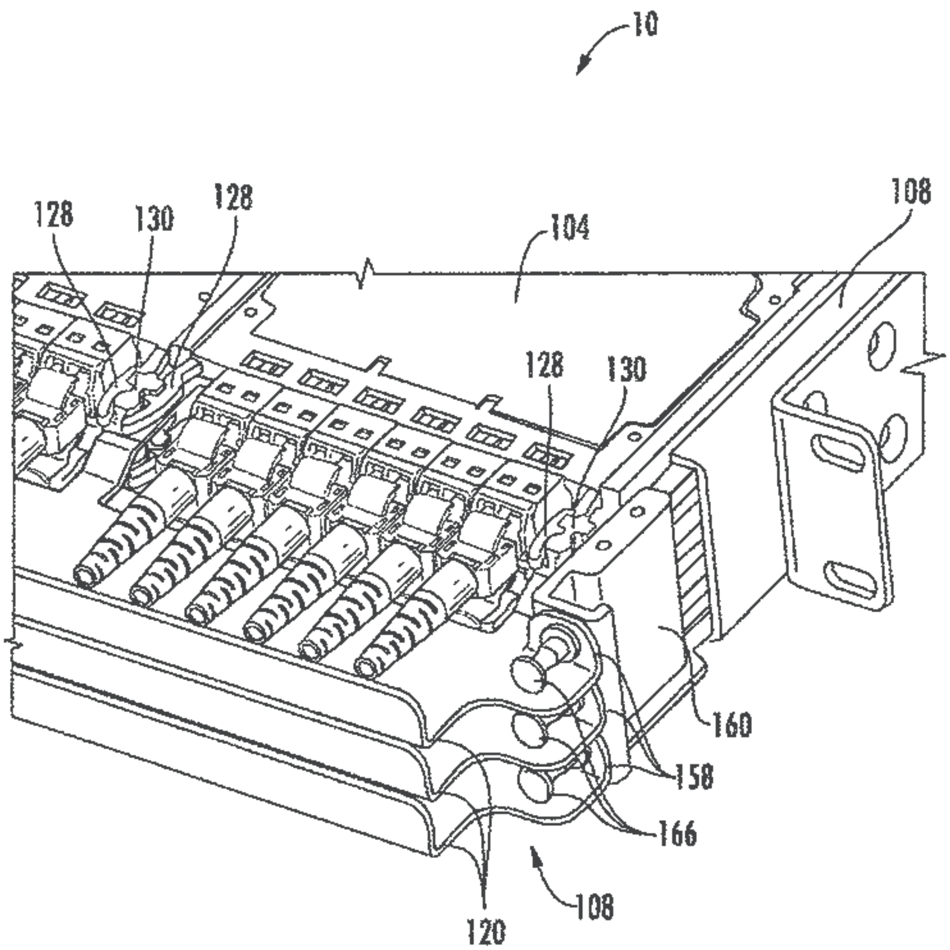

FIG. 19

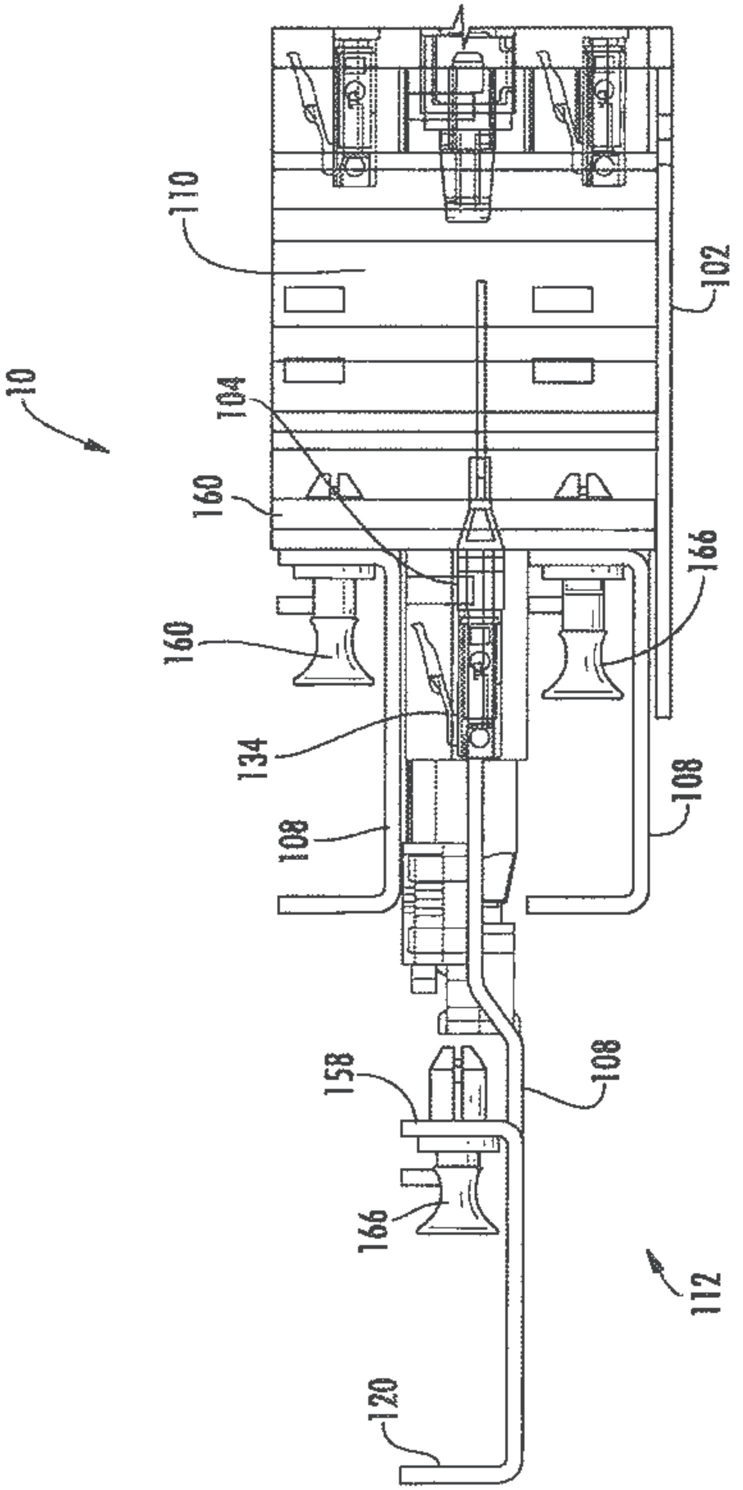

FIG. 20

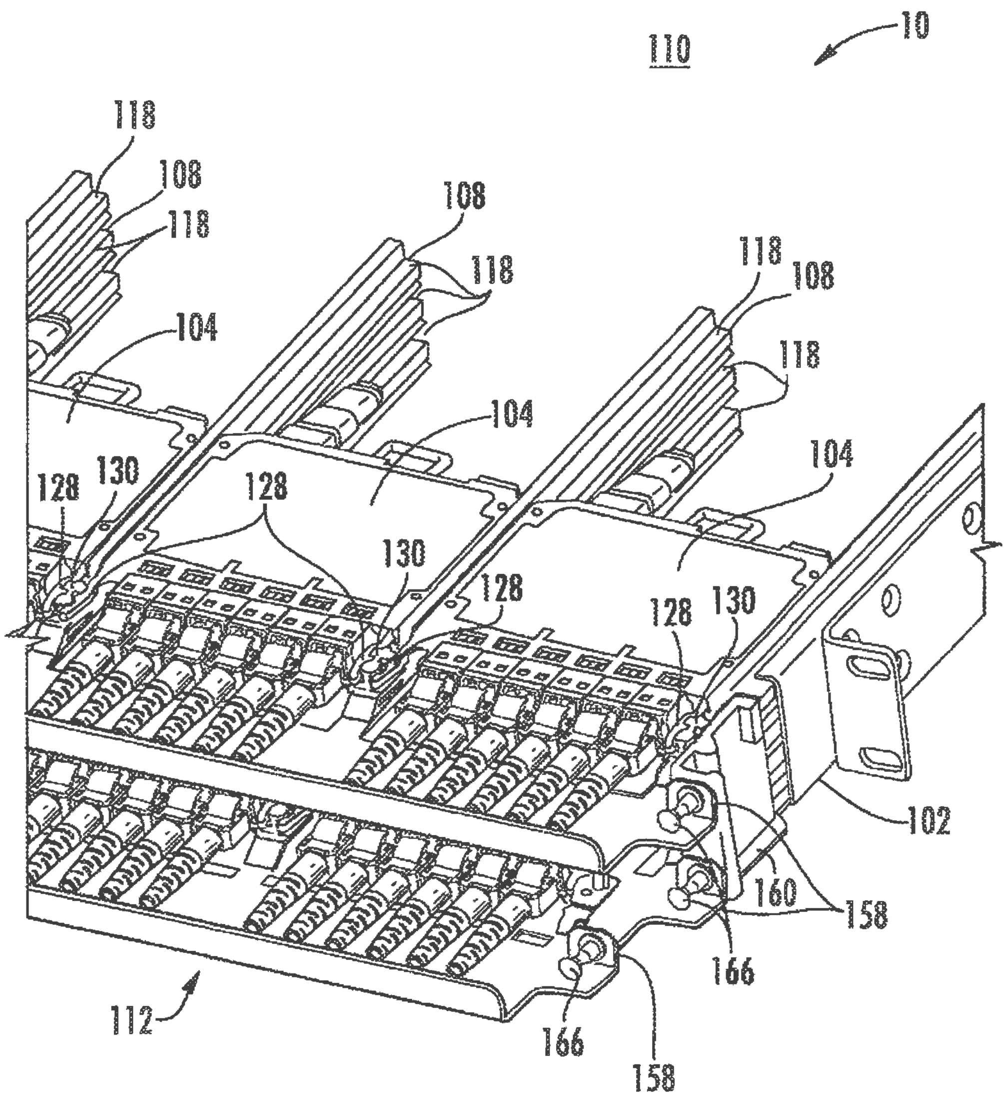
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FIG. 21

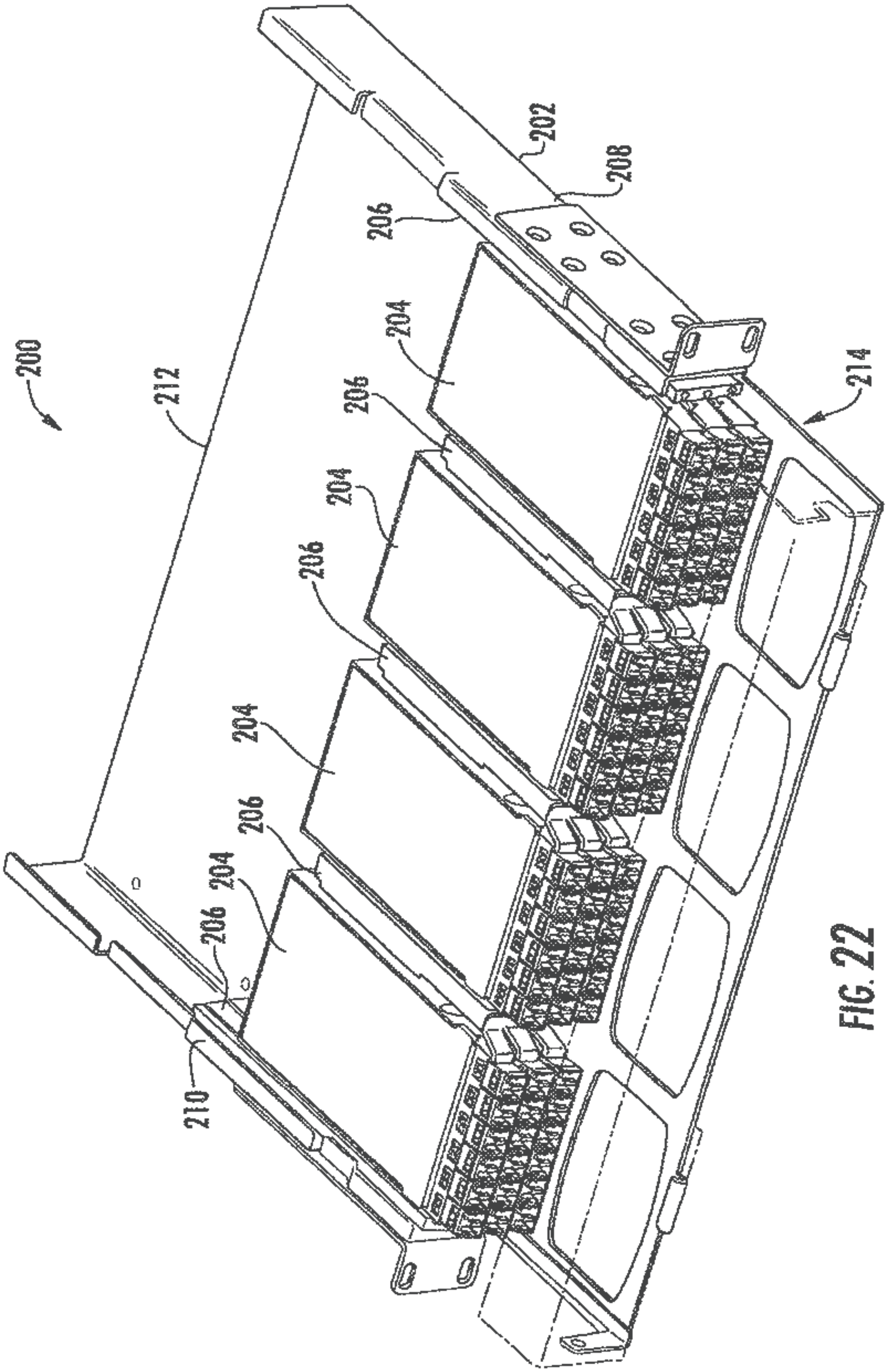

FIG. 22

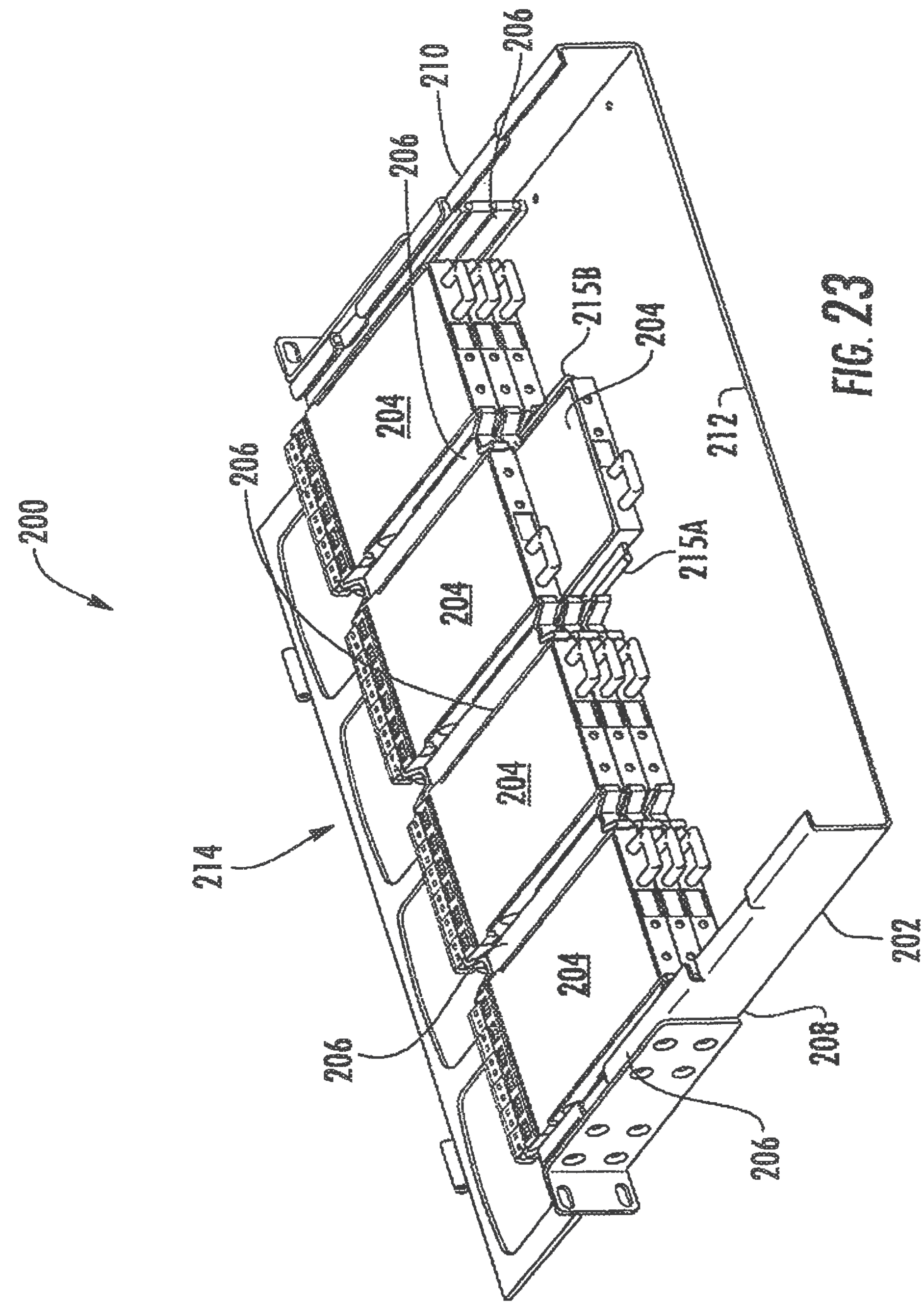
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FIG. 23

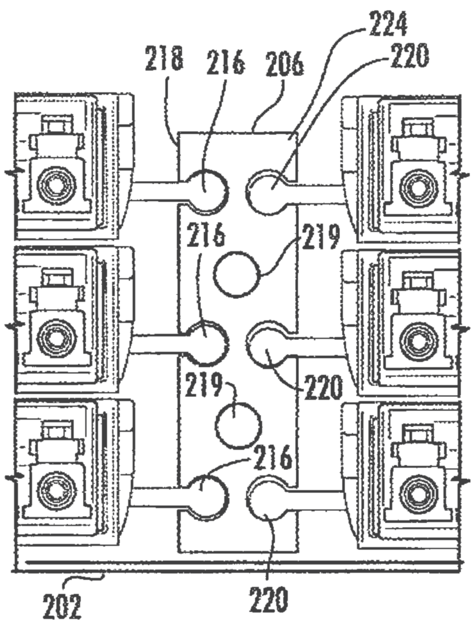

FIG. 24A

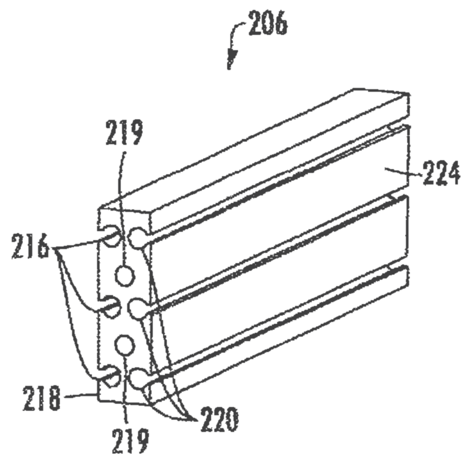

FIG. 24B

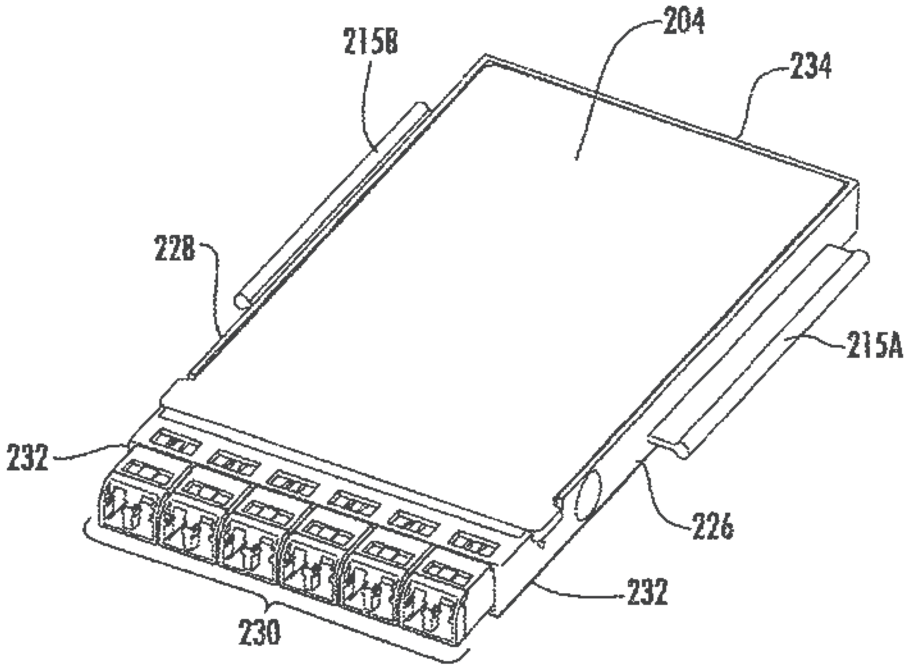

FIG. 25

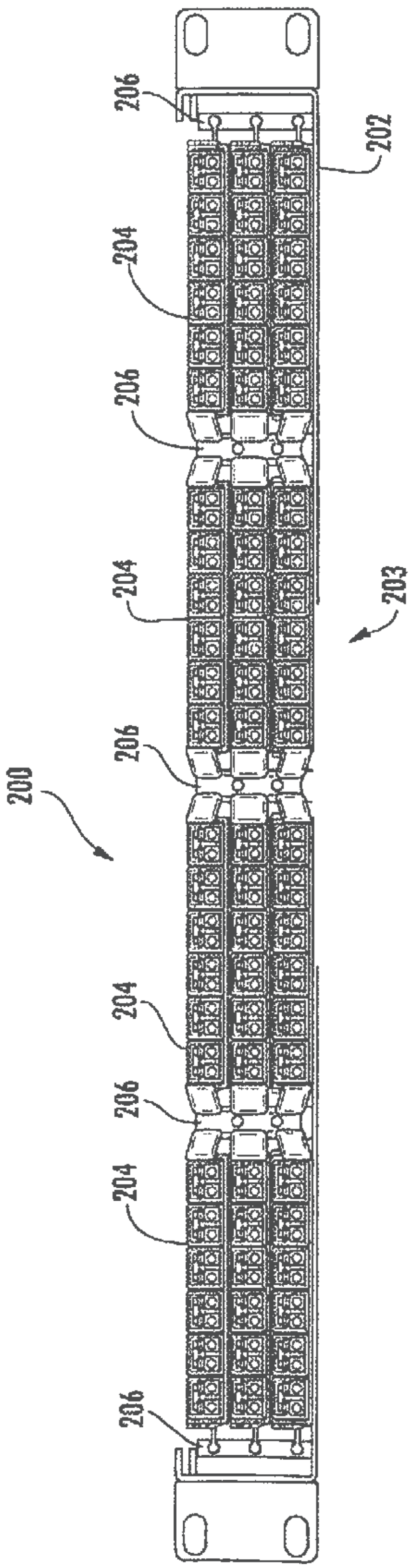

FIG. 26A

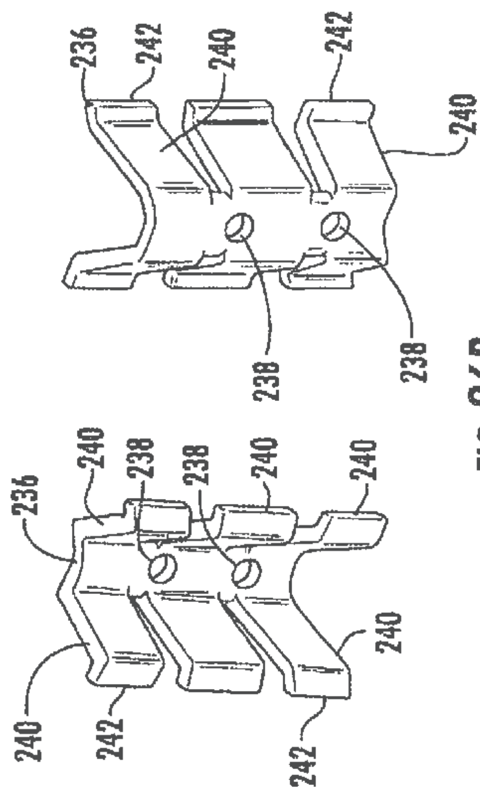

FIG. 26B

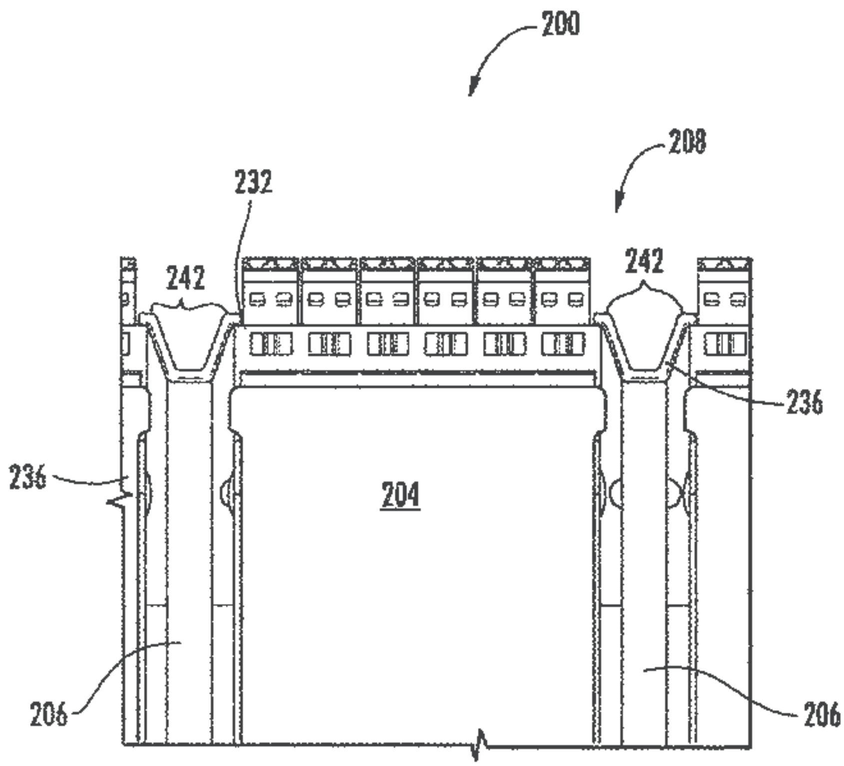

FIG. 27

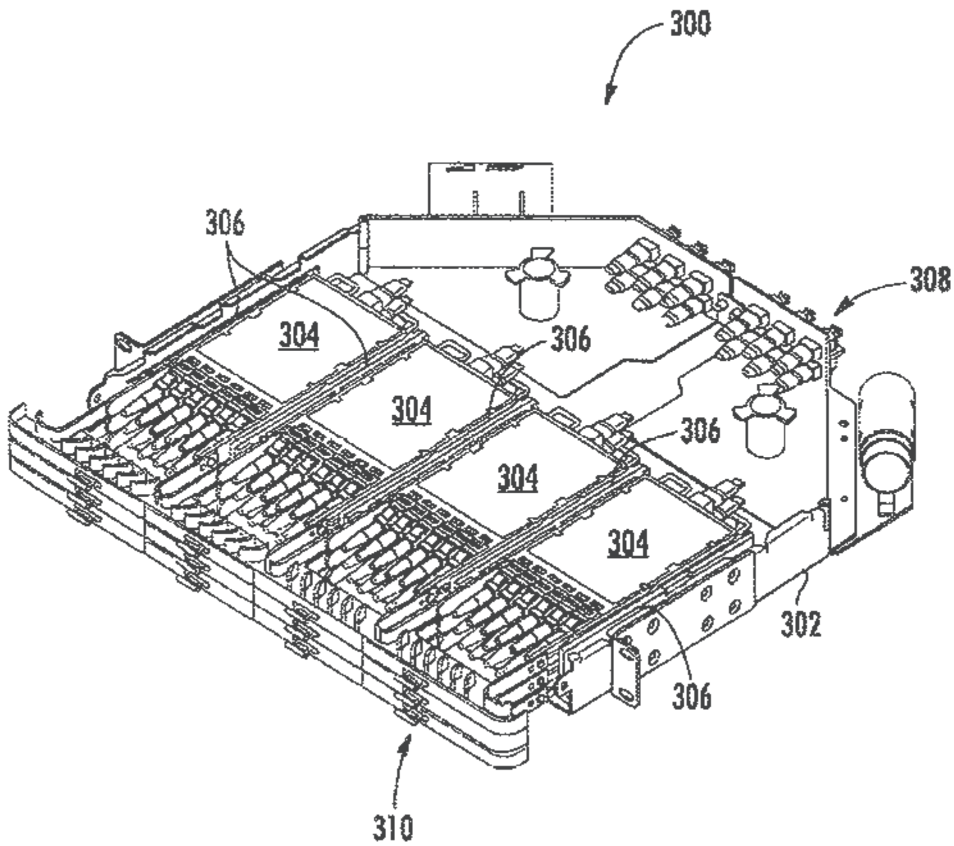

FIG. 28

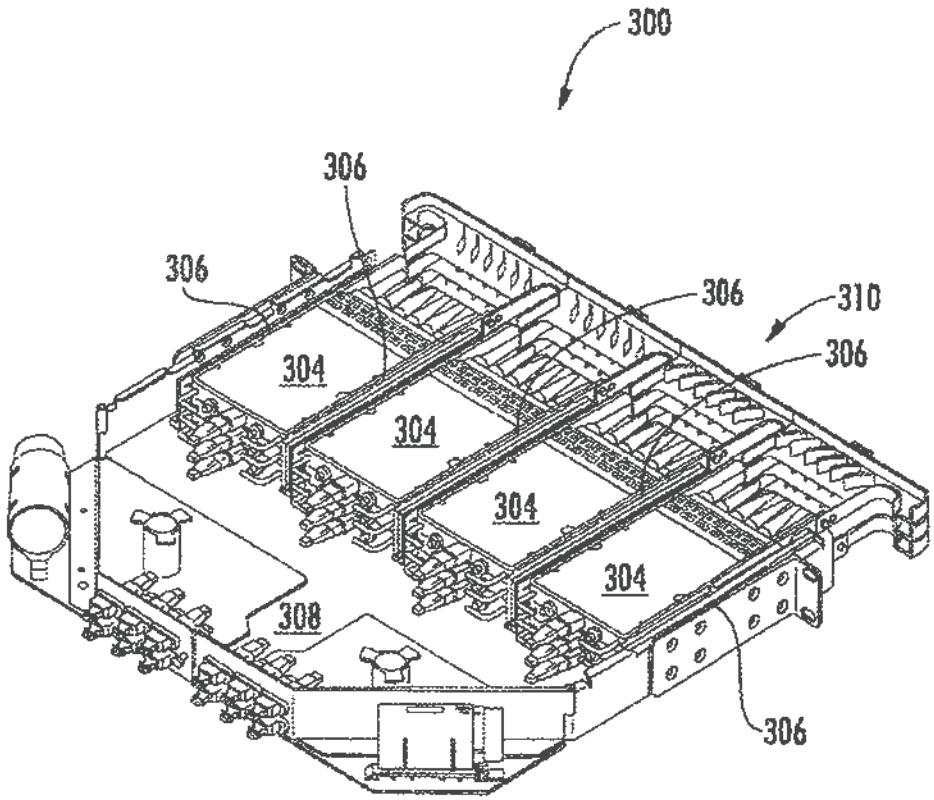

FIG. 29

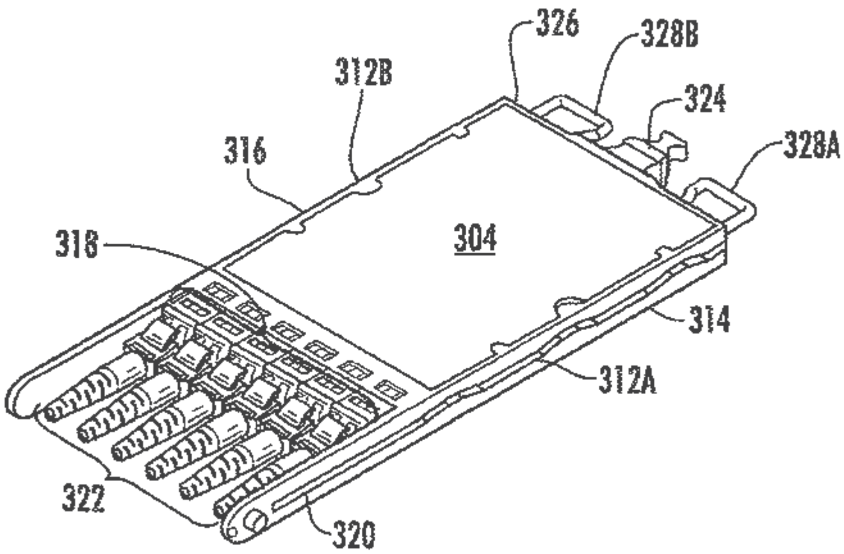

FIG. 30

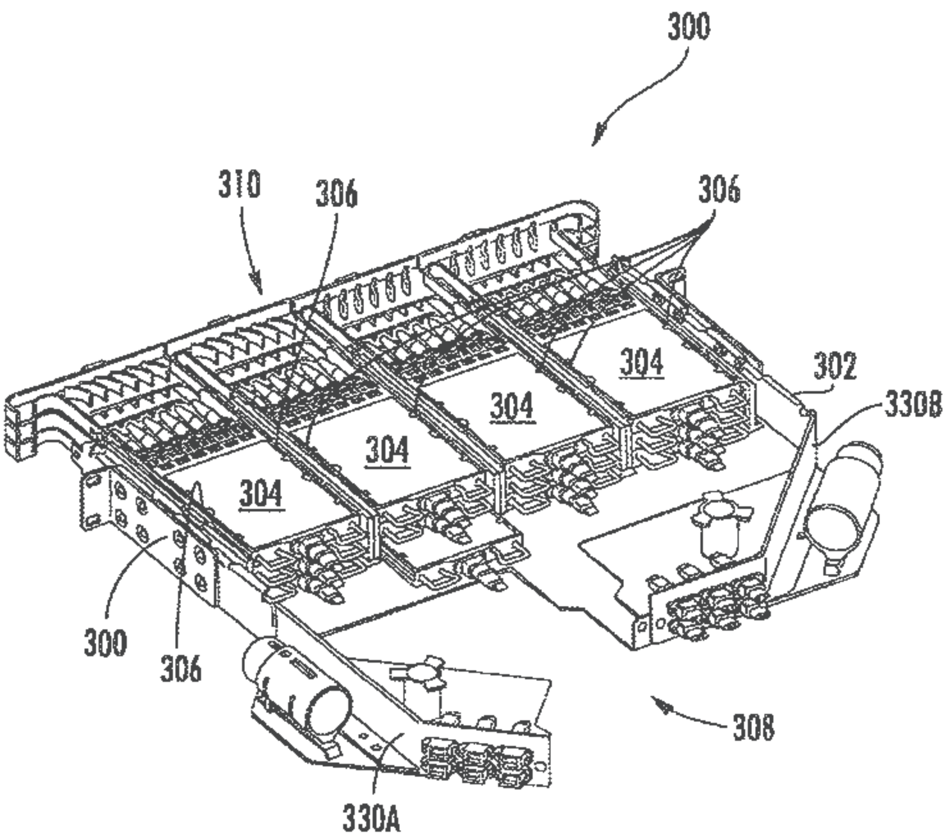

FIG. 31

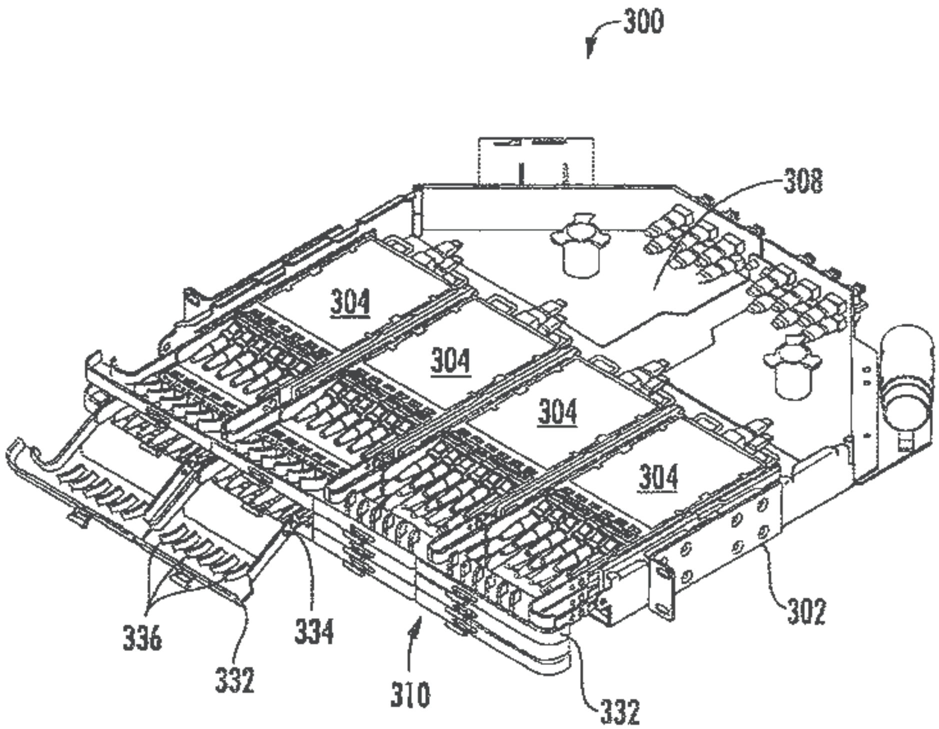

FIG. 32

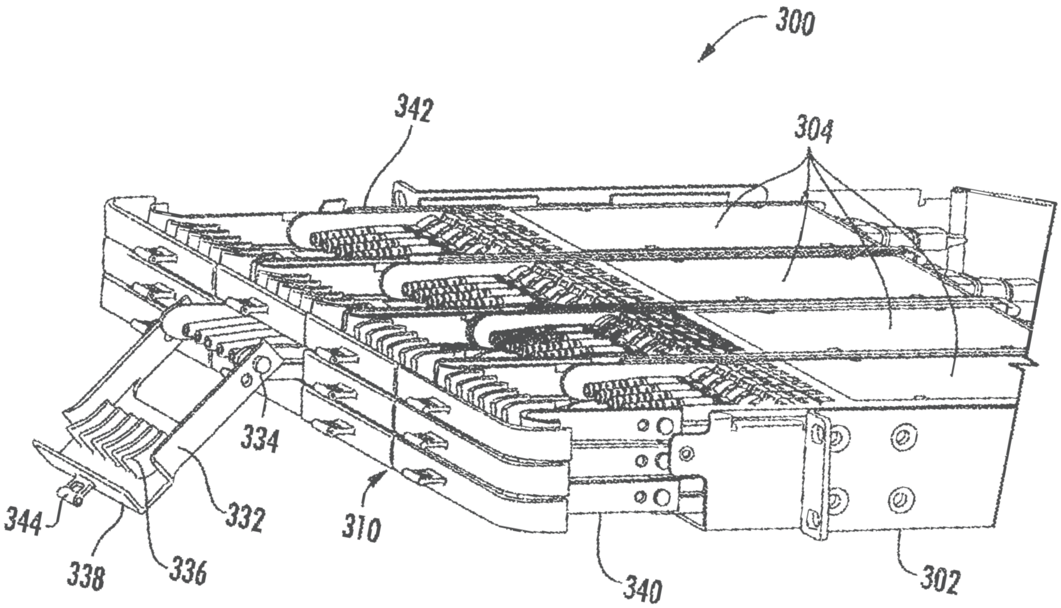

FIG. 33

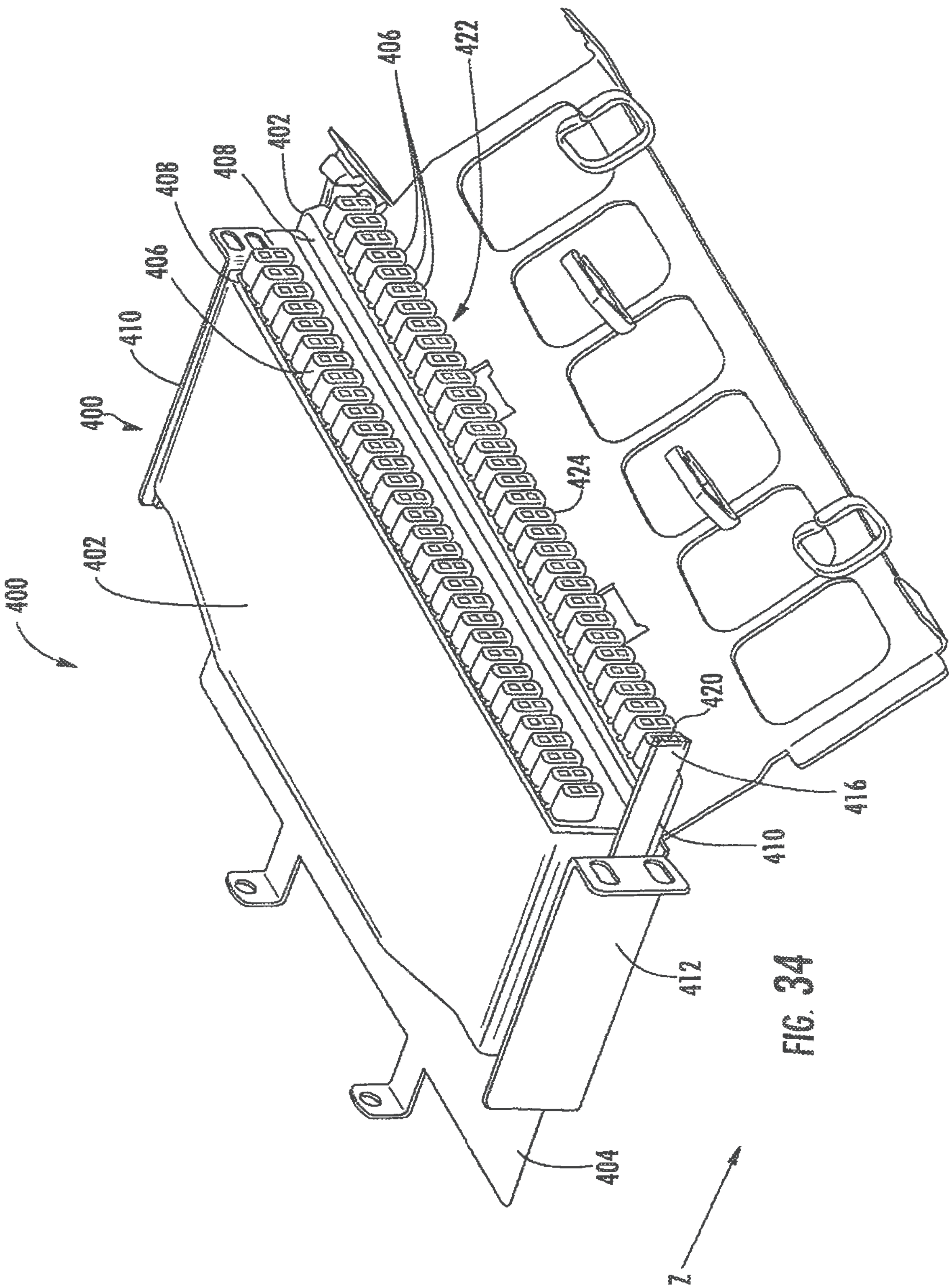

FIG. 34

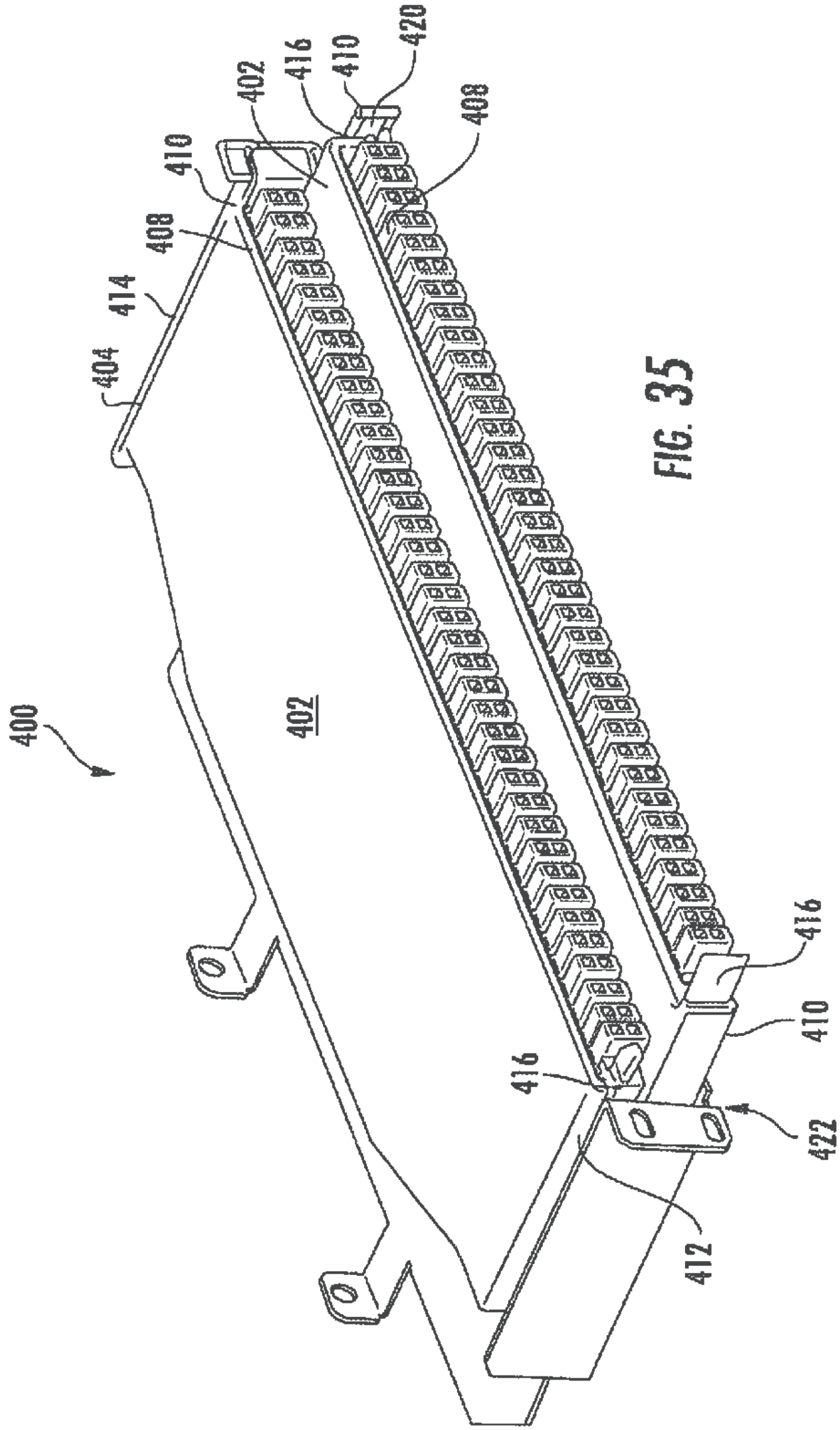

FIG. 35

INDEPENDENTLY TRANSLATABLE MODULES AND FIBER OPTIC EQUIPMENT TRAYS IN FIBER OPTIC EQUIPMENT

PRIORITY APPLICATIONS

The present application is a continuation application of U.S. patent application Ser. No. 13/901,074, filed May 23, 2013, entitled "Independently Translatable Modules and Fiber Optic Equipment Trays in Fiber Optic Equipment," published as U.S. Patent Application Publication No. 2013/0251326 A1 on Sep. 26, 2013, which is a continuation application of U.S. patent application Ser. No. 12/323,415, filed Nov. 25, 2008, entitled "Independently Translatable Modules and Fiber Optic Equipment Trays in Fiber Optic Equipment," issued as U.S. Pat. No. 8,452,148, which claims priority to U.S. Provisional Patent Application Ser. No. 61/197,068 filed Oct. 23, 2008, entitled "High Density Data Center Hardware, Assemblies and Components," and which also claims priority to U.S. Provisional Patent Application Ser. No. 61/190,538 filed Aug. 29, 2008, entitled "High Density Data Center Hardware, Assemblies and Components," all of which are incorporated by reference herein in their entireties.

RELATED APPLICATIONS

The present application is related to U.S. patent application Ser. No. 12/323,423, filed on Nov. 25, 2008 entitled "Rear-Installable Fiber Optic Modules and Equipment," issued as U.S. Pat. No. 8,184,938, which is incorporated herein by reference in its entirety.

The present application is also related to U.S. patent application Ser. No. 12/394,483, entitled "Rear Slidable Extension in Fiber Optic Tray," issued as U.S. Pat. No. 8,326,107, which is incorporated herein by reference in its entirety.

The present application is also related to U.S. patent application Ser. No. 15/412,839, filed on Jan. 23, 2017 entitled "Independently Translatable Modules and Fiber Optic Equipment Trays in Fiber Optic Equipment," published as U.S. Patent Application Publication No. 2018/0113266 on Apr. 26, 2018, with the foregoing application and publication being incorporated by reference herein.

The present application is also related to U.S. patent application Ser. No. 15/413,883, filed on Jan. 24, 2017 entitled "Independently Translatable Modules and Fiber Optic Equipment Trays in Fiber Optic Equipment," published as U.S. Patent Application Publication No. 2018/0113263 on Apr. 26, 2018, with the foregoing application and publication being incorporated by reference herein.

The present application is also related to U.S. patent application Ser. No. 15/413,919, filed on Jan. 24, 2017 entitled "Independently Translatable Modules and Fiber Optic Equipment Trays in Fiber Optic Equipment," published as U.S. Patent Application Publication No. 2018/0113263 on Apr. 26, 2018, with the foregoing application and publication being incorporated by reference herein.

The present application is also related to U.S. Patent Application Serial No. 15/413,962, filed on Jan. 24, 2017 entitled "Independently Translatable Modules and Fiber Optic Equipment Trays in Fiber Optic Equipment," published as U.S. Patent Application Publication No. 2018/0113263 on Apr. 26, 2018, with the foregoing application and publication being incorporated by reference herein.

BACKGROUND

Field of the Disclosure

The technology of the disclosure relates to fiber optic modules for fiber optic equipment. The fiber optic modules can be included in fiber optic equipment rack and/or trays.

Technical Background

Benefits of optical fiber use include extremely wide bandwidth and low noise operation. Because of these advantages, optical fiber is increasingly being used for a variety of applications, including but not limited to broadband voice, video, and data transmission. Fiber optic networks employing optical fiber are being developed and used to deliver voice, video, and data transmissions to subscribers over both private and public networks. These fiber optic networks often include separated connection points at which it is necessary to link optical fibers in order to provide "live fiber" from one connection point to another connection point. In this regard, fiber optic equipment is located in data distribution centers or central offices to support interconnections.

The fiber optic equipment is customized based on the application need. The fiber optic equipment is typically included in housings that are mounted in equipment racks to maximize space. One example of such fiber optic equipment is a fiber optic module. A fiber optic module is designed to provide cable-to-cable fiber optic connections and manage the polarity of fiber optic cable connections. The fiber optic module is typically mounted to a chassis which is then mounted inside an equipment rack or housing. The chassis may be provided in the form of a tray that is extendable from the equipment rack like a drawer. This allows a technician access to fiber optic adapters disposed in the fiber optic module and any fiber optic cables connected to the fiber optic adapters without removing the fiber optic module from the equipment rack.

Due to increasing bandwidth needs and the need to provide high connectivity density in data centers for increased revenue generating opportunities, fiber optic networks are migrating to higher cable fiber counts. Multi-fiber cables are used to provide higher cable fiber counts and are used for trunk connections in a fiber optic network. In general, higher density connections make it more difficult to access optical components and connections. The same is true for fiber optic modules because of the increased number of fiber optic adapters disposed in the fiber optic modules to handle the higher connectivity density. Increased density makes hand access to optical components and connectors as well as the routing and organizing jumper connections more difficult. Even with fiber optic equipment tray pull out capabilities, a need still exists to improve access to optical components in a fiber optic equipment tray as well as provide neat routing and organization of jumper connections.

SUMMARY OF THE DETAILED DESCRIPTION

Embodiments disclosed in the detailed description include fiber optic equipment and apparatuses that support independently translatable fiber optic modules and/or fiber optic equipment trays containing one or more fiber optic modules. In some embodiments, one or more fiber optic modules are disposed in a plurality of independently translatable fiber optic equipment trays. The fiber optic equipment trays are received in a tray guide system disposed in the fiber optic equipment. In this manner, each fiber optic equipment tray is independently translatable within the guide system. The one or more fiber optic modules disposed in each fiber optic equipment tray translate with their respective fiber optic equipment tray when translated.

One or more module guides may also be disposed in each of the fiber optic equipment trays. The fiber optic modules can be disposed in one or more module guides. The fiber optic modules translate within the module guides. In this manner, each fiber optic module disposed in a given fiber optic equipment tray may translate independently of other fiber optic modules in the same fiber optic equipment tray as well as each fiber optic equipment tray being independently translatable to other fiber optic equipment trays within the tray guide system.

In other embodiments, a plurality of fiber optic modules is disposed in a module guide system in the fiber optic equipment without need or requirement for an intermediate fiber optic equipment tray. Each of the fiber optic modules translates independently of other fiber optic modules disposed within the module guide system. One or more fiber optic equipment trays may also be provided. The fiber optic equipment trays may contain a locking feature adjacent the front end of the fiber optic equipment that releasably retains one or more fiber optic modules when moved forward within the guide system towards the front end of the fiber optic equipment. In this manner, a fiber optic equipment tray may be pulled to translate a fiber optic module forward from the fiber optic equipment.

Additional features and advantages of the invention will be set forth in the detailed description which follows, and in part will be readily apparent to those skilled in the art from that description or recognized by practicing the invention as described herein, including the detailed description that follows, the claims, as well as the appended drawings.

It is to be understood that both the foregoing general description and the following detailed description present embodiments of the invention, and are intended to provide an overview or framework for understanding the nature and character of the invention as it is claimed. The accompanying drawings are included to provide a further understanding of the invention, and are incorporated into and constitute a part of this specification. The drawings illustrate various embodiments of the invention, and together with the description serve to explain the principles and operation of the invention.

BRIEF DESCRIPTION OF THE FIGURES

FIG. **1** is a front perspective view of an exemplary fiber optic equipment rack with exemplary fiber optic equipment supporting rear-installable fiber optic modules according to one embodiment;

FIG. **2**A is a rear perspective view of the fiber optic equipment supporting the rear-installable fiber optic modules of FIG. **1**;

FIG. **2**B is a perspective view of fiber optic equipment tray guides disposed in the fiber optic equipment of FIG. **1**;

FIG. **3** is a front perspective view of an individual fiber optic equipment tray in the fiber optic equipment of FIG. **1** without rear-installable fiber optic modules installed in module guides disposed in the fiber optic equipment tray;

FIG. **4** is a front perspective view of a fiber optic module that is rear-installable in the fiber optic equipment tray of FIG. **3**;

FIG. **5** is a rear perspective close-up view of the rear-installable fiber optic module of FIG. **4** installed in the fiber optic equipment tray of FIG. **3**;

FIG. **6** is a front perspective view of the fiber optic equipment tray of FIG. **3** with rear-installable fiber optic modules installed in the module guides;

FIG. **7** is a front perspective close-up view of the fiber optic equipment tray of FIG. **3** with rear-installable fiber optic modules installed in the module guides;

FIG. **8** is a front perspective view of a fiber optic equipment tray extended from the fiber optic equipment;

FIG. **9** is a front perspective view of a fiber routing guide tray of a fiber optic equipment tray lowered to obtain front access to the fiber optic modules supported in the fiber optic equipment tray;

FIG. **10** is a front perspective view of another exemplary fiber optic equipment supporting rear-installable fiber optic modules disposed in module guides;

FIG. **11** is a rear perspective view of the fiber optic equipment supporting the rear-installable fiber optic modules of FIG. **10**;

FIG. **12** is a front perspective view of an individual fiber optic equipment tray in the fiber optic equipment of FIG. **10**;

FIG. **13** is a rear perspective view of the rear-installable fiber optic module installed in the module guides disposed in the fiber optic equipment of FIG. **10**;

FIG. **14** is a rear perspective close-up view of the rear-installable fiber optic module disposed within module guides in the fiber optic equipment of FIG. **10** and locked into the fiber optic equipment tray of FIG. **12** when the fiber optic module is pulled forward;

FIG. **15** is a rear perspective view of the fiber optic module in FIG. **14**;

FIG. **16**A is a perspective close-up view of a front locking latch in the fiber optic module of FIG. **15**;

FIG. **16**B is a perspective close-up view of a rear lock in the fiber optic module of FIG. **15**;

FIG. **17** is a rear perspective close-up view of the rear-installable fiber optic modules installed in module guides;

FIG. **18** is a perspective view of the locking features to lock fiber optic modules to fiber optic equipment tray and the fiber optic equipment trays to the chassis of the fiber optic equipment of FIG. **10**;

FIG. **19** is a front perspective view of the fiber optic equipment of FIG. **10** with rear-installable fiber optic modules disposed in the module guides;

FIG. **20** is a side cross-sectional view of the fiber optic equipment of FIG. **10** with rear-installable fiber optic modules disposed in the module guides and interlocked with the fiber optic equipment trays, with one fiber optic equipment tray extended forward;

FIG. **21** is a front perspective view of the fiber optic equipment of FIG. **20**;

FIG. **22** is a front perspective view of another exemplary fiber optic equipment supporting rear-installable fiber optic modules;

FIG. **23** is a rear perspective view of the fiber optic equipment supporting the rear-installable fiber optic modules of FIG. **22**;

FIG. **24**A is a front view of a module guide supporting rear-installable fiber optic modules in the fiber optic equipment of FIG. **22**;

FIG. **24**B is a perspective view of the module guide illustrated in FIG. **24**A;

FIG. **25** is a front perspective view of the fiber optic modules disposed in the module guides provided in the fiber optic equipment of FIG. **22**;

FIGS. **26**A and **26**B are a front view of the fiber optic equipment of FIG. **22** with fiber optic modules installed in all module guides and a locking feature to prevent the fiber optic modules from being pulled forward beyond a front end of the fiber optic equipment;

FIG. **27** is a top view of a fiber optic module supported by module guides disposed in the fiber optic equipment of FIG. **22**;

FIG. **28** is a front perspective view of another exemplary fiber optic equipment supporting rear-installable fiber optic modules;

FIG. **29** is a rear perspective view of the fiber optic equipment supporting the rear-installable fiber optic modules of FIG. **28**;

FIG. **30** is a front perspective view of the fiber optic modules provided in the fiber optic equipment of FIG. **22**;

FIG. **31** is another rear perspective view of the fiber optic equipment supporting the rear-installable fiber optic modules of FIG. **28**;

FIG. **32** is another front perspective view of the fiber optic equipment supporting the rear-installable fiber optic modules of FIG. **28** with a fiber routing tray extended and tilted downward to provide access to certain fiber optic modules;

FIG. **33** is another front perspective view of the fiber optic equipment supporting the rear-installable fiber optic modules of FIG. **28** with the fiber routing tray extended and tilted downward;

FIG. **34** is a front perspective view of another exemplary fiber optic equipment supporting rear-installable fiber optic modules; and

FIG. **35** is another front perspective view of another exemplary fiber optic equipment supporting rear-installable fiber optic modules.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings, in which some, but not all embodiments of the invention are shown. Indeed, the invention may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will satisfy applicable legal requirements. Whenever possible, like reference numbers will be used to refer to like components or parts.

Embodiments disclosed in the detailed description include fiber optic equipment and apparatuses that support independently translatable fiber optic modules and/or fiber optic equipment trays containing one or more fiber optic modules. In some embodiments, one or more fiber optic modules are disposed in a plurality of independently translatable fiber optic equipment trays. The fiber optic equipment trays are received in a tray guide system disposed in the fiber optic equipment. In this manner, each fiber optic equipment tray is independently translatable within the guide system. The one or more fiber optic modules disposed in each fiber optic equipment tray translate with their respective fiber optic equipment tray when translated.

One or more module guides may also be disposed in each of the fiber optic equipment trays. The fiber optic modules can be disposed in one or more module guides. The fiber optic modules translate within the module guides. In this manner, each fiber optic module disposed in a given fiber optic equipment tray may translate independently of other fiber optic modules in the same fiber optic equipment tray as well as each fiber optic equipment tray being independently translatable to other fiber optic equipment trays within the tray guide system.

In this regard, FIG. **1** illustrates exemplary fiber optic equipment **10**. The fiber optic equipment **10** may be provided at a data distribution center or central office to support cable-to-cable fiber optic connections and to manage a plurality of fiber optic cable connections. As will be described in greater detail below, the fiber optic equipment **10** has one or more fiber optic equipment trays that each support one or more rear-installable fiber optic modules. The fiber optic modules can be fiber optic adapter modules or any other type of fiber optic modules or fiber optic apparatuses, including those that support fiber optic connections. Both the fiber optic modules and the fiber optic equipment trays are rear-installable, meaning they can be installed from a rear section of the fiber optic equipment **10**. Further, both the fiber optic equipment trays and the fiber optic modules supported therein are independently translatable about the chassis for installation, access, and/or removal.

In this regard and as illustrated in FIG. **1**, the fiber optic equipment **10** includes a fiber optic equipment chassis **12** ("chassis **12**"). The chassis **12** is shown as being installed in a fiber optic equipment rack **14**. The fiber optic equipment rack **14** contains two vertical rails **16**A, **16**B that extend vertically and include a series of apertures **18** for facilitating attachment of the fiber optic equipment **10** inside the fiber optic equipment rack **14**. The fiber optic equipment **10** is attached and supported by the fiber optic equipment rack **14** in the form of shelves that are stacked on top of each other within the vertical rails **16**A, **16**B. As illustrated, the fiber optic equipment **10** is attached to the vertical rails **16**A, **16**B. The fiber optic equipment rack **14** may support 1U-sized shelves, with "U" equal a standard 1.75 inches in height. As will be discussed in greater detail later in this application, the fiber optic equipment **10** includes a plurality of extendable fiber optic equipment trays **20** that each carries one or more rear-installable fiber optic modules **22**. In this example, the fiber optic equipment **10** provides a density of 144 fibers, although it is not limited to this density. Further, as will also be described in more detail below, each fiber optic equipment tray **20** is independently translatable and accessible to access the fiber optic modules supported therein.

FIG. **2**A illustrates a rear perspective view of the fiber optic equipment **10** illustrated in FIG. **1**. The fiber optic equipment **10** is provided in the chassis **12** that defines a front end **24**, a rear section **26**, a first end **28**, and a second end **30**. The first end **28** of the chassis **12** is disposed on the opposite side of the second end **30** of the chassis **12**. A guide system in the form of a rail guide system **32** is provided to support the rear-installable fiber optic modules **22**. The rail guide system **32** comprises two tray rail guides **32**A, **32**B attached to the chassis **12** on the first end **28** and the second end **30**, respectively. The tray rail guides **32**A, **32**B are configured to support one or more fiber optic equipment trays that support the fiber optic modules **22**, which will be illustrated in FIG. **3** and described below. The tray rail guides **32**A, **32**B allow each fiber optic equipment tray **20** installed therein to be translated about the chassis **12**. In this example, the chassis **12** supports three (3) fiber optic equipment trays **20** with each one stacked on top of each other. A tray cover **34** is disposed on top of the top fiber optic equipment tray **20** disposed in the chassis **12** and within the tray rail guides **32**A, **32**B. As will be discussed later in this application, each fiber optic equipment tray **20** contains a fiber routing tray **36** attached thereto to support routing of optical fibers connected to the fiber optic modules **22**. The fiber routing tray **36** can be extended and lowered as desired to obtain access to the fiber optic modules **22** from the front end **24** of the fiber optic equipment **10**.

FIG. 2B illustrates the tray rail guides 32A, 32B in more detail. As illustrated therein, the tray rail guides 32A, 32B form a series of channels 38A-38C, wherein each channel 38A-38C is configured to receive a fiber optic equipment tray 20. The tray rail guides 32A, 32B allow a plurality of fiber optic trays 20 arranged in a column format. The tray rail guides 32A, 32B comprise an end portion 40 by which the channels 38A-38C stop and the fiber optic equipment trays 20 cannot extend beyond. This end portion 40 is disposed in an orientation such that it is adjacent the rear section 26 of the fiber optic equipment 10. The tray rail guides 32A, 32B also contain an entry portion 42 through which the fiber optic equipment trays 20 can be inserted into the channels 38A-38C. Note that the entry portion 42 does not close off the channels 38A-38C such that the fiber optic equipment trays 20 can be extended beyond the entry portion 42 back towards the rear section 26 of the chassis 12. In this manner, the tray rail guides 32A, 32B support rear installation of fiber optic equipment trays 20 into the chassis 12 from the rear section 26.

FIG. 3 illustrates an individual fiber optic equipment tray 20 not disposed in the chassis 12 or contained within the tray rail guides 32A, 32B for further discussion and illustration. As illustrated therein, the fiber optic equipment tray 20 contains a main tray portion 44 and the fiber routing tray 36 attached thereto. The fiber routing tray 36 is attached to the main tray portion 44 via hinge mechanisms in the form of hinges 46A, 46B disposed on each end 48A, 48B of the main tray portion 44. The main tray portion 44 contains a plurality of module guides in the form of module rail guides 50 that support the fiber optic modules 22. More specifically, the fiber optic modules 22 contain rails (elements 52A, 52B in FIG. 4) that couple to tray channels 54 disposed within the module rail guides 50. The fiber optic modules 22 are disposed in a row arrangement if at least one intermediate module rail guide 50 is disposed in the fiber optic equipment tray 20. Providing a plurality of tray channels 54 in each module rail guide 50 allows a plurality of fiber optic modules 22 to be stacked on top of each other in a column arrangement. The fiber optic modules 22 can be moved within the module rail guides 50 in the fiber optic equipment tray 20 either towards the front end 24 of the chassis 12 or the rear section 26 or the chassis 12. The fiber optic equipment trays 20 can also be moved about the tray rail guides 32A, 32B. In this manner, the fiber optic equipment trays 20 can be translated independently of each other about the tray rail guides 32A, 32B, and each of the fiber optic modules 22 within a given fiber optic equipment tray 20 can be independently translated within their respective module rail guides 50.

Note that in FIG. 3, the fiber optic equipment tray 20 contains five (5) module rail guides 50, which means that the fiber optic equipment tray 20 can support four (4) individual fiber optic modules 22. Four (4) fiber optic modules 22 can be installed in the fiber optic equipment tray 20 of FIG. 3, or less than four as desired or as required according to installation requirements. Also as shown in FIG. 3 and as illustrated in more detail in FIG. 4, the module rail guides 50 are configured such that the tray channels 54 are open on a rear end 56 of the module rail guides 50. This allows the fiber optic modules 22 to be rear-installable into the fiber optic equipment trays 20 from the rear section 26 of the chassis 12. More specifically, the fiber optic equipment tray 20 is disposed in the chassis 12 such that the rear ends 56 of the module rail guides 50 are oriented towards the rear section 26 of the chassis 12. Thus, as will be discussed in more detail below, the fiber optic modules 22 can be inserted into the rear ends 56 of the module rail guides 50 and pushed forward within the module rail guides 50 until the fiber optic modules 22 reach a front end 58 of each module rail guide 50. A locking feature not illustrated in FIG. 3, but described later below in this application, can be provided to prevent the fiber optic module 22 from extending beyond the front end 58 of the module rail guides 50 unless a release is engaged. In this manner, the fiber optic modules 22 can be installed from the rear of the chassis 12, but can also be extended and removed from the front end 24 of the chassis 12 as well.

Also as illustrated in FIG. 3, the fiber routing tray 36 is formed from sheet metal or other material that is bent on top of itself in a U-shape on a front end 60 of the fiber routing tray 36. In this manner, optic fibers extending from the fiber optic modules 22 installed in the fiber optic equipment tray 20, and in particular the module rail guides 50 disposed therein, can be routed underneath a lip section 23 contained in the fiber routing tray 36 and disposed to either end 48A, 48B of the fiber optic equipment tray 20 to be routed for connection to other fiber optic equipment.

FIG. 4 illustrates an example of a fiber optic module 22 that is supported in the fiber optic equipment tray 20 in FIGS. 1-3. As illustrated therein, the fiber optic module 22 is comprised of a number of fiber optic adapters 64 disposed on a front end 66 of the fiber optic module 22. In this example, the fiber optic adapters 64 accept duplex LC fiber optic connectors 68. However, any fiber optic connection type desired can be provided in the fiber optic modules 22. Fiber optic cables (not shown) extend from the fiber optic connectors 68 to establish fiber optic connections with other equipment. Another fiber optic adapter 70 is disposed on a rear end 72 of the fiber optic module 22. In this example, the fiber optic adapter 70 is an MTP fiber optic adapter equipped to establish connections to up to twelve (12) optical fibers. The fiber optic module 22 may also manage polarity between the fiber optic connectors 68 and the fiber optic adapters 64 disposed on the front end 66 of the fiber optic module 22 and the fiber optic adapter 70 disposed on the rear end 72 of the fiber optic module 22.

Module rails 52A, 52B are disposed on each side 74A, 74B of the fiber optic module 22. The module rails 52A, 52B are configured to be inserted within the tray channels 54 of the module rail guides 50 in the fiber optic equipment tray 20 as illustrated in FIG. 3. In this manner, when it is desired to install the fiber optic module 22 in the fiber optic equipment tray 20, the front end 66 of the fiber optic module 22 can be inserted from the rear section 26 of the chassis 12. More specifically, the front end 66 of the fiber optic module 22 is inserted into the tray channels 54 of the module rail guides 50 at their rear ends 56. In this manner, the fiber optic module 22 is rear-installable in the fiber optic equipment tray 20 and the chassis 12. The fiber optic module 22 can then be pushed forward within the tray channels 54 until the fiber optic module 22 reaches the front end 58 of the module rail guides 50. In this manner, a technician can install a fiber optic connection to the fiber optic adapter 70 disposed on the rear end 72 of the fiber optic module 22 and can then install the fiber optic module 22 from the rear section 26 of the chassis 12 into the fiber optic equipment tray 20.

In this regard, FIG. 5 illustrates a rear perspective view of the fiber optic modules 22 installed in the fiber optic equipment trays 20 and the module rail guides 50 disposed therein. As illustrated therein, when the fiber optic module 22 is installed in the tray channels 54 of the module rail guides 50 from the rear section 26 of the chassis 12, the module rails 52A, 52B of the fiber optic module 22 move towards the front end 24 within the tray channels 54. The fiber optic module 22 can be moved towards the front end 24 until the fiber optic modules 22 reach a stop or locking feature disposed in the front end 24 as will described later in this application. A locking feature in the form of a locking latch 78 and a protrusion 80 (FIG. 4) engage a complementary protrusion disposed in the tray channel 54 such that the fiber optic module 22. The locking latch 78 is inwardly biased such that the fiber optic module 22 can be installed in the tray rail guides 32, but cannot be pulled back towards the rear section 26 of the chassis 12 until the locking latch 78 is disengaged to prevent the protrusion 80 from engaging with the module rail guides 50. The locking latch 78 is disengaged by pushing it inward towards the fiber optic module 22 to release the protrusion 80 from the tray channel 54.

If it is desired to remove the fiber optic module 22 from the fiber optic equipment tray 20, the fiber optic module 22 can be removed from either the rear section 26 of the chassis 12 or from the front end 24 of the chassis 12. To remove the fiber optic module 22 from the rear section 26 of the chassis 12, a pulling loop 76 disposed in the rear end 72 of the fiber optic module 22 can be pulled once the locking latch 78 is disengaged inward. The locking latch 78 controls the position of the protrusion 80 extending outward from the module rail 52A such that when the fiber optic module 22 is extended along a certain portion of the module rail guides 50, the protrusion 80 prevents the fiber optic module 22 from moving backwards along the tray channels 54 towards the rear section 26 of the chassis 12.

FIG. 6 illustrates the fiber optic equipment tray 20 of FIG. 3; however, with the rear-installable fiber optic modules 22 installed therein. The fiber optic modules 22 are installed in the module rail guides 50 disposed in the fiber optic equipment tray rails 82A, 82B. These fiber optic equipment tray rails 82A, 82B are configured to be disposed in the module rail guides 32A, 32B attached to the chassis 12 as illustrated in FIG. 2A such that the fiber optic equipment tray 20 is translatable with respect to the chassis 12.

FIG. 7 illustrates a front perspective view of the fiber optic equipment tray 20 in FIG. 6 in more detail. As illustrated therein, three (3) fiber optiu equipment trays 20 are disposed within the tray rail guides 32A, 32B of the chassis 12. As illustrated therein, the hinges 46A, 46B that hingedly attach the fiber routing tray 36 to the fiber optic equipment trays 20 are provided in the form of position hinges 47. The position hinges 47 are configured to engage with the module rail guides 50 such that the fiber optic module 22 cannot be extended forward when the position hinges 47 are engaged. If it is desired to access the fiber optic module 22, the pulling tab 25 attached to the fiber routing tray 36 can be pulled forward to cause the fiber optic equipment tray 20 to extend forward from the front end 24 of the chassis 12 as illustrated in FIG. 8. Thereafter, the fiber routing tray 36 can be tilted downward as illustrated in FIG. 9. When the fiber optic equipment tray 20 and its fiber routing tray 36 are tilted downward, the position hinges 47 on each side of the fiber optic equipment tray 20 are disengaged with the module rail guides 50 for that particular fiber optic equipment tray 20 such that the fiber optic modules 22 supported by that fiber optic equipment tray 20 can be removed from the front end 24 of the chassis 12. Also, by allowing the fiber routing tray 36 to be tilted downward, unobstructed access can be obtained to the fiber optic module adapter 70 and fiber optic connectors 68 for establishing or disconnecting fiber optic connections.

A plurality of fiber optic modules can also be disposed in a module guide system in the fiber optic equipment without

need or requirement for an intermediate fiber optic equipment tray. In this manner, each of the fiber optic modules translate independently of other fiber optic modules disposed within the module guide system. In this regard, FIG. 10 illustrates another embodiment of fiber optic equipment 100. Fiber optic equipment 100 includes a module guide system disposed in a chassis 102 that supports rear-installable fiber optic modules. As will be described later in this application, the fiber optic equipment 100 provides an alternative guide system for rear-installable fiber optic modules. In FIG. 10, fiber optic modules 104 are supported within module rail guides 106 disposed in a chassis 102 of the fiber optic equipment 100. This is opposed to the fiber optic equipment 10 in FIGS. 1-9, wherein fiber optic modules are disposed in intermediate fiber optic equipment trays attached to a chassis. In this manner and as illustrated in FIG. 10, the fiber optic equipment 100 allows fiber optic modules 104 to be inserted into module rail guides 106 disposed in the chassis 102 and independently translated about the module rail guides 106.

Turning to FIG. 10, a plurality of rear installable fiber optic modules 104 are installed in the fiber optic equipment 100. The fiber optic modules 104 are supported by a plurality of module rail guides 106. Unlike the fiber optic equipment 10 of FIG. 1, the module rail guides 106 are attached directly to the chassis 102. Fiber optic equipment trays 108 are still provided to support the forward translation of the fiber optic modules 104 from the fiber optic equipment 100. As will be described later in this application, when the fiber optic modules 104 are installed from a rear section 110 of the chassis 102 iuto the module rail guides 106. The fiber optic modules 104 can then be moved forward within the module rail guides 106 to a front end 112 of the chassis 102. The fiber optic modules 104 will then engage with a latch (not shown) that will then attach the fiber optic modules 104 to fiber optic equipment trays 108. In this manner, when the fiber optic equipment tray 108 is pulled forward from the chassis 102, the fiber optic module 104 will also move outward with the fiber optic equipment tray 108 due to the interlock between the fiber optic modules 104 and the fiber optic equipment tray 108, although is still supported by the module rail guides 106. Thus, in the fiber optic equipment 100 in FIG. 10, the fiber optic equipment trays 108 are independently movable with respect to the chassis 102; however, the fiber optic modules 104 are not independently movable within the fiber optic equipment tray 108 like provided in the fiber optic equipment 10 of FIG. 1.

The chassis 102 also comprises a first end 114 and a second end 116, wherein the second end 116 is disposed on the opposite side from the first end 114. A plurality of module rail guides 106 are disposed within the chassis 102 between the first end 114 and the second end 116. A minimum of two (2) module rail guides 106 are required to support at least one (1) fiber optic module 104. However, as illustrated in FIG. 10, five (5) module rail guides 106 are provided to support four (4) fiber optic modules 104 per level. As will be described later in this application in more detail, the module rail guides 106 can contain a plurality of channels 118 to support more than one level or plane of fiber optic modules 104. In the example of the fiber optic equipment 100 in FIG. 10, three (3) levels of fiber optic modules 104 are provided; thus, three (3) channels 118 are provided in each module rail guide 106. The fiber optic equipment trays 108 each contain a routing tray 120 that can be pulled in order to remove a fiber optic equipment tray 108 from the chassis 102.

FIG. **11** illustrates a rear perspective view of the module rail guides **106** disposed within the chassis **102** and how the fiber optic module **104** is installed from the rear section **110** of the chassis **102**. Further, FIG. **11** illustrates how the fiber optic equipment trays **108** are also supported by the module rail guides **106** and how the fiber optic modules **104** attach to the fiber optic equipment trays **108** when pulled forward. As illustrated in FIG. **11**, the module rail guides **106** are provided wherein a fiber optic module **104** can be inserted from the rear section **110** into the channels **118**. The fiber optic module **104** can then be pushed forward with the module rail guides **106** towards the front end **112** of the chassis **102**. The module rail guides **106** also contain a series of tray guides **122** disposed in the plane substantially orthogonal to the channels **118** to receive fiber optic equipment trays **108**, although any orientation is possible.

As illustrated in FIG. **12**, the fiber optic equipment tray **108** contains a series of elongated sections **124**. The elongated sections **124** are configured to be inserted into the tray guides **122** disposed inside the module rail guides **106** along the longitudinal axis of the channels **118**. Thus, as illustrated in FIGS. **13** and **14**, when the fiber optic module **104** is pulled all the way forward along the module rail guide **106** to a front portion **126** of the fiber optic equipment tray **108**, a locking feature in the form of a front module latch **128** interlocks with a detent feature **130** disposed adjacent the front end **112** of the chassis **102**. The detent feature **130** is secured to the fiber optic equipment tray **108**. In this manner, the fiber optic module **104** becomes interlocked with the fiber optic equipment tray **108** such that when the fiber optic equipment tray **108** is translated forward on the first end **114** of the chassis **102**, the fiber optic module **104** travels forward with the fiber optic equipment tray **108**. The elongated sections **124** and the fiber optic modules **104** interlocked with the fiber optic equipment tray **108** translate together about the tray guides **122** even though the fiber optic module **104** is still supported by the module rail guides **106**. FIG. **15** illustrates the fiber optic module **104** and more detail regarding the front module latch **128** in particular.

As illustrated in FIG. **15**, the fiber optic module **104** is comprised of a plurality of fiber optic adapters **132** configured to support fiber optic connectors **134** on a front end **136** of the fiber optic module **104**. A fiber optic adapter **138** is disposed on a rear end **140** of the fiber optic module **104**. In this example of the fiber optic module **104** of FIG. **15**, the fiber optic adapters **132** are duplex LC fiber optic adapters, and the fiber optic adapter **138** disposed in the rear end **140** of the fiber optic module **104** is an MTP fiber optic adapter, although any fiber connection type is possible. Fiber optic connections are established between the fiber optic connectors **134** and an MTP fiber optic connector **142** connected to the MTP fiber optic adapter **138**. Optical fibers establishing connections between the fiber optic adapters **132**, **138** are provided inside the fiber optic module **104**.

The fiber optic module **104** also contains two (2) module rails **144**A, **144**B on a first side **146** and a second side **148**, respectively, of the fiber optic module **104**. The module rails **144**A, **144**B are configured to be inserted into the channels **118** of the module rail guides **106** such that the fiber optic module **104** can be translated within the module rail guides **106**. In this regard, because the channels **118** in the module rail guides **106** are open in the rear section **110**, as illustrated in FIG. **11**, the fiber optic modules **104** are rear-installable into the fiber optic equipment **100**. The fiber optic module **104** can then be translated forward within the channels **118** until the front module latch **128** reaches the detent feature **130**. The front module latch **128** is biased inward such that

when it reaches the detent feature **130**, the front module latch **128** flexes inward and is retained in the detent feature **130**. Once the front module latch **128** is retained in the detent feature **130**, the fiber optic module **104** cannot be pulled back towards the rear section **110** or towards the front end **112** independent of the fiber optic equipment tray **108** unless the front module latch **128** is released from the detent features **130**. In this manner, the front module latch **128** releasably retains the fiber optic module **104**.

FIG. **16**A illustrates the front module latch **128** for the fiber optic module **104** in more detail. FIG. **16**B illustrates a locking feature in the form of a rear module lock **150** that may be provided in the rear end **140** of the fiber optic module **104** to lock the fiber optic module **104** within the module rail guides **106**. In this manner, the fiber optic module **104** cannot be removed towards the rear section **110** of the fiber optic equipment **100** unless the rear module lock **150** is unlocked by pushing a rear module lock button **152** to the right as illustrated. When the rear module lock button **152** is moved to the right as illustrated, a latch **154** is disengaged from the channel **118** of the module rail guide **106** such that the fiber optic module **104** can be removed from the rear section **110**. The fiber optic module **104** may be removed from the rear section **110** by pulling on a pulling loop **156** (as shown in FIG. **15**) attached to the rear end **140** of the fiber optic module **104**.

FIGS. **17** and **18** illustrate the detent feature **130** and how the fiber optic equipment trays **108** are interlocked into the chassis **102**. As illustrated therein, the fiber optic equipment tray **108** contains an upwardly extending tab **158** that is secured to a bracket **160** wherein the bracket **160** is attached to the chassis **102**. The bracket **160** contains a series of apertures **162** that are adapted to receive flanges **164** from plungers **166**. Each fiber optic equipment tray **108** contains a plunger **166** disposed through the upwardly extending tab **158** that is adapted to engage with the aperture **162**. When it is desired to lock the fiber optic equipment tray **108** to the chassis **102**, the plunger **166** is engaged in the aperture **162**. As illustrated in FIGS. **17** and **18**, three (3) apertures **162** are provided in the bracket **160** because three (3) fiber optic equipment trays **108** are provided. Each aperture **162** is designed to retain the upwardly extending tab **158** from a particular fiber optic equipment tray **108**. FIG. **17** illustrates the bracket **160** disposed on the second end **116** of the chassis **102**. Although not shown, the bracket **160** is also disposed on the first end **114** of the chassis **102** as illustrated in FIG. **10**. When it is desired to release the fiber optic equipment tray **108** from the chassis **102**, such as to pull it forward for access, the plunger **166** is pulled and disengaged from the corresponding aperture **162** in the bracket **160**. In this manner, each fiber optic equipment tray **108** is free to independently translate outwardly towards the front end **112** wherein the elongated sections **124** are moved forward about the tray guides **122** within the module rail guides **106**.

FIG. **19** illustrates a front perspective view of the fiber optic equipment **100** and the fiber optic modules **104** locked into the fiber optic equipment trays **108** via the front module latch **128** engaging with the detent feature **130**. As illustrated therein, each of the fiber optic equipment trays **108** are secured to the chassis **102** via their plungers **166** being engaged with the bracket **160**. In order to disengage the fiber optic equipment tray **108** from the chassis **102**, the plunger **166** is pulled to disengage the plunger **166** from the aperture **162** in the bracket **160**. In this manner, the pulling force applied towards the front end **112** will translate the fiber optic equipment tray **108** forward. This is illustrated in FIGS. **20** and **21**. FIG. **20** is a side cross-sectional view of the fiber optic equipment **100** shown in perspective view in FIG. **21** with a middle fiber optic equipment tray **108** extended. As illustrated therein, the middle fiber optic equipment tray **108** is extended from the chassis **102**. The plunger **166** for the middle fiber optic equipment tray **108** is disengaged from the bracket **160** and the aperture **162** therein.

FIG. **22** illustrates yet another example of fiber optic equipment **200** that also provides for rear-installable fiber optic modules. Like the fiber optic equipment **100** in FIGS. **10-21**, each fiber optic module supported in the fiber optic equipment **200** of FIG. **22** is supported in module rails disposed in the chassis. The fiber optic modules are also independently translatable within the module rails.

As illustrated in FIG. **22**, the fiber optic equipment **200** is provided, which includes a chassis **202** configured to hold one or more fiber optic modules **204**. The fiber optic modules **204** are supported on a guide system in the form of module rail guides **206** that are disposed within and attached to the chassis **202** similar to the fiber optic equipment **100** in FIGS. **10-21**. The module rail guides **206** are attached to the chassis **202**. Only two module rail guides **206** are required to be provided on a first end **208** of the chassis **202** and a second end **210** of the chassis **202** such that a fiber optic module **204** can be installed in a rear section **212** of the chassis **202** and moved along the module rail guides **206** to a front end **214** of the chassis **202**.

As will be described in further detail in this application, the module rail guides **206** contain one or more channels **216** (shown in FIGS. **24**A and **24**B) that are adapted to receive rails (element **215** in FIG. **25**) disposed on each side of the fiber optic modules **204**. The channels **216** are open in the rear section **212** such that the rails of the fiber optic module **204** can be inserted into the module rail guides **206** in the rear section **212** of the chassis **202** and moved forward within the module rail guides **206** until the fiber optic module **204** reaches the front end **214** of the chassis **202**. This is further illustrated in FIG. **23**. As illustrated therein, a fiber optic module **204** is shown as being inserted partially into the module rail guides **206**. Module rails **215**A, **215**B are disposed on each side of the fiber optic module **204** such that the module rails **215**A, **215**B mate with the channels **216** in the module rail guides **206** so that the fiber optic module **204** may be slid from the rear section **212** to the front end **214** of the chassis **202**.

FIGS. **24**A and **24**B illustrate more detail regarding the module rail guides **206** that are disposed in the fiber optic equipment **200** of FIGS. **22** and **23**. As illustrated therein, a module rail guide **206** is disclosed that is provided between the first end **208** and the second end **210**. For this type of module rail guide **206**, the channels **216** are disposed on a first side **218** of the module rail guides **206**. Channels **220** are also provided on a second side **224** of the module rail guides **206**. In this manner, the module rail guide **206** can support rails of fiber optic modules **204** on each side. The module rail guide **206** illustrated in FIG. **24**A would be provided as an intermediate module rail guide if more than one fiber optic module **204** in a given plane is supported by the fiber optic equipment **200**. In this case, at least one intermediate module rail guide **206** is provided with channels **216**, **220** disposed on each side **218**, **224**. As illustrated in FIG. **24**A, the module rail guide **206** is attached to the chassis **202** such that when the module rails **215**A, **215**B of the fiber optic modules **204** are disposed within the channels **216**, **220**, the fiber optic modules **204** are supported by the chassis **202**. Also, as will be described in greater detail below with regard to FIGS. **26**A and **26**B, the module rail guides **206** also contain a series of internal apertures **219** that support attaching module locks or stops to the chassis **202**. The module locks or stops prevent the fiber optic modules **204** from translating beyond the front end **214** of the chassis **202**.

FIG. **25** illustrates the rear-installable fiber optic module **204** that is adapted to be supported by the module rail guides **206** of the fiber optic equipment **200**. As illustrated therein, module rails **215**A, **215**B are disposed on sides **226**, **228**, respectively, of the fiber optic module **204**. These module rails **215**A, **215**B can be inserted into the module rail guides **206** to insert the fiber optic module **204** into the fiber optic equipment **200**. Because the channels **220** in the module rail guides **206** are open in the rear section **212** of the chassis **202**, the fiber optic modules **204** are rear-installable, meaning they can be installed from the rear section **212** of the chassis **202**. The fiber optic module **204** contains a series of fiber optic adapters **230** disposed on a front end **232** of the fiber optic module **204**. One or more fiber optic adapters **230** optically connected to the fiber optic adapters **230** are disposed on a rear end **234** of the fiber optic module **204**. In this manner, connectorized fiber optic cables (not shown) connected to the fiber optic adapters **230** establish a fiber optic connection with fiber optic cables (not shown) installed in the fiber optic adapters **230** in the rear end **234** of the fiber optic module **204**.

FIG. **26**A illustrates a front view of the fiber optic equipment **200** with fiber optic modules **204** installed in the module rail guides **206** as previously described. To prevent the fiber optic modules **204** from extending beyond the first end **208** of the chassis **202**, stop or lock features **236** are disposed between the rows of fiber optic modules **204** on the intermediate module rail guides **206**. FIG. **26**B illustrates the stop or lock features **236** in more detail wherein front and rear perspective views are illustrated. The stop or lock features **236** contain a series of apertures **238** that align with the apertures **219** disposed in the module rail guides **206** as illustrated previously in FIG. **24**B. A fastener (not shown) can be inserted into the apertures **238** to fasten the stop or lock features **236** to the module rail guides **206**. The stop features **236** contain opposing flared portions **240** on each side of the stop or lock feature **236** which contain platforms **242** of which the front end **232** of the fiber optic modules **204** abut against to prevent the fiber optic modules **204** from extending forward from the first end **208** of the chassis **202**.

FIG. **27** illustrates a top view of the fiber optic equipment **200** with the fiber optic module **204** installed therein between two module rail guides **206**. As illustrated therein, the fiber optic module **204** is extended forward to the front end **214** of the chassis **202** wherein the front end **232** of the fiber optic module **204** abut against the platforms **242** in the stop or lock features **236** to prevent the fiber optic modules **204** from being extended beyond the front end **214** of the fiber optic equipment **200**.

FIG. **28** illustrates yet another embodiment of fiber optic equipment that is configured to allow and support rear-installable fiber optic modules. As illustrated in FIG. **28**, the fiber optic equipment **300** contains a chassis **302** that supports one or more fiber optic modules **304**. The fiber optic modules **304** are supported by a guide system in the form of module rail guides **306** that are attached to the chassis **302** such that each of the fiber optic modules **304** can translate about the module rail guides **306**. More specifically, the fiber optic modules **304** can be rear-installable from a rear section **308** of the chassis **302** into the module rail guides **306** and extended forward within the module rail guides **306** to a front end **310** of the chassis **302**.

FIG. 29 illustrates a rear perspective view of the fiber optic equipment **300** illustrated in FIG. **28** showing a series of rear-installable fiber optic modules **304** installed therein. It is noted that the module rail guides **306** can be provided that support more than one plane or row of fiber optic modules **304**. In such a case, a plurality of channels will be provided in the module rail guides **306** to support more than one row of fiber optic modules **304**.

FIG. **30** illustrates the fiber optic module **304** illustrated in FIGS. **28** and **29** in more detail. As illustrated therein, the fiber optic module **304** contains module rails **312A**, **312B** disposed on each side **314**, **316** of the fiber optic module **304**. The module rails **312A**, **312B** are adapted to be received into channels of the module rail guides **306** to support the fiber optic modules **304**. Each fiber optic module **304** is independently movable about the module rail guides **306**. Intermediate fiber optic equipment trays are not provided. The fiber optic module **304** contains a series of fiber optic adapters **318** disposed on a front end **320** of the fiber optic module **304**. A series of fiber optic connectors **322** may be connected to the fiber optic adapters **318** to establish fiber optic connections. A fiber optic adapter **324** is disposed in a rear end **326** of the fiber optic module **304** such that a fiber optic connector **322** connected to the fiber optic adapter **324** will establish an optical connection with optical fibers connected to the fiber optic connectors **322**. The fiber optic module **304** also contains a series of pulling loops **328A**, **328B** disposed on each side of the fiber optic adapter **324** that may assist in removing the fiber optic module **304** from the rear section **308** of the fiber optic equipment **300**.

In order to install a fiber optic module **304** from the rear section **308** of the fiber optic equipment **300**, as illustrated in FIG. **31**, hinged portions **330A**, **330B** of the rear section **308** of the chassis **302** are pulled outward such that the module rail guides **306** are accessible to a technician. Thereafter, the fiber optic module **304** and its module rails **312A**, **312B** are inserted into channels in the module rail guides **306** as illustrated in FIG. **31**. The fiber optic module **304** is then pushed forward within the module rail guides **306** until the fiber optic module **304** reaches the front end **310** of the chassis **302**. Once the fiber optic modules **304** are installed as desired, the hinged portions **330A**, **330B** are closed.

In order to access the fiber optic connectors **322** of the fiber optic modules **304**, a module guide tray **332**, which is hingedly attached via hinges to the module rail guides **306**, can be pulled forward and tilted downward as illustrated in FIG. **32**. Each fiber optic module **304** has its own module guide tray **332** such that each fiber optic module **304** is individually accessible and independently movable about the module rail guides **306**. The module guide tray **332** may contain a series of fiber routing guides **336** that support routing of connectorized fiber optic cables (not shown) connected to the fiber optic adapters **318** of the fiber optic module **304**. FIG. **33** illustrates a side perspective view illustrating more detail regarding the module guide tray **332**. The module guide tray **332** is pulled forward and hingably tilted via hinge **334** downward to access the fiber optic adapters **318** of the fiber optic modules **304**. The module guide tray **332** may contain a U-shaped flange **338** to allow optical fibers to be routed therein to either the left or right of the tray to the sides **340**, **342** of the chassis **302**. Further, a handle **344** may be provided and attached to the module guide tray **332** to allow for pulling and pushing for easy translation of the fiber optic module **304**.

FIGS. **34** and **35** illustrate yet another embodiment of fiber optic equipment **400**. In this embodiment, a module

guide system is provided to allow fiber optic modules **402** to translate independently of each other about a chassis **404** outward in the Z-axis direction. As illustrated herein, two (2) fiber optic modules **402** are provided. Each fiber optic module **402** contains a series of fiber optic adapters **406** disposed in a front end **408** of the fiber optic module **402**. A module rail guide **410** is disposed in the fiber optic equipment **400** for each fiber optic module **402**. As illustrated in FIGS. **34** and **35**, two fiber optic modules **402** are provided that expand the entire width of the chassis **404**. Thus, no intermediate module rail guides **410** are necessary or provided in the fiber optic equipment **400**. Only two (2) module rail guides **410** are disposed on a first end **412** and a second end **414** of the chassis **404**, although intermediate module rail guides can be provided if the fiber optic equipment **400** is designed to support multiple fiber optic modules in a single level or plane. Each fiber optic module **402** comprises a module rail **416** that is configured to be disposed within a channel **420** of the module rail guides **410**. In this manner, the fiber optic modules **402** may be rear-installable and may be independently movable from each other along their dedicated module rail **416** so they can be pulled out towards a front end **422** of the fiber optic equipment **400** and chassis **404**. This is illustrated in FIGS. **34** and **35** wherein the bottom fiber optic module **402** is pulled forward along its module rail **416** to provide access. After any access desired is completed, the bottom fiber optic module **402** can be pushed back in along its module rail **216** into the chassis **404** such that the front end **422** of the fiber optic module **402** will be disposed within the front end **408** of the chassis **404**.

Many modifications and other embodiments of the invention set forth herein will come to mind to one skilled in the art to which the invention pertains having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. These modifications include, but are not limited to, number or type of fiber optic modules, use of a fiber optic equipment tray, fiber optic connection type, number of fiber optic adapters, density, etc.

Therefore, it is to be understood that the invention is not to be limited to the specific embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of the appended claims. It is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.

What is claimed is:

1. A fiber optic apparatus, comprising:

a chassis configured to be disposed in an equipment rack, the chassis comprising opposite front and rear ends that are spaced apart from one another in a longitudinal direction, and comprising opposite first and second ends that are spaced apart from one another in a lateral direction that extends crosswise to the longitudinal direction;

a guide system configured to be disposed within the chassis;

at least one fiber optic equipment tray configured to slidably engage within the guide system, the at least one fiber optic equipment tray comprising a front end with at least one fiber optic routing element that comprises successive material sections extending frontward, upward, and rearward, respectively, to permit optical fibers to be routed to either left or right portions of the at least one fiber optic equipment tray toward the first and second ends of the chassis; and

a plurality of fiber optic modules configured to be received by the at least one fiber optic equipment tray, wherein each fiber optic module of the plurality of fiber optic modules is independently movable in the longitudinal direction relative to the at least one fiber optic equipment tray, and wherein each fiber optic module of the plurality of fiber optic modules comprises a front end, a rear end, an interior, a plurality of first fiber optic adapters disposed through the front end, at least one second fiber optic adapter disposed through the rear end, and at least one optical fiber disposed within the interior and establishing at least one optical connection between the at least one second fiber optic adapter and at least one first fiber optic adapter of the plurality of first fiber optic adapters.

2. The fiber optic apparatus of claim 1, wherein the at least one fiber optic routing element comprises a substantially U-shaped fiber optic routing element.

3. The fiber optic apparatus of claim 1, wherein the at least one fiber optic routing element comprises a fiber optic routing tray comprising an upper lip section.

4. The fiber optic apparatus of claim 1, wherein a number of adapters of the plurality of first fiber optic adapters exceeds a number of adapters of the at least one second fiber optic adapter.

5. The fiber optic apparatus of claim 1, wherein each fiber optic module of the plurality of fiber optic modules is configured to move by translation in the longitudinal direction.

6. The fiber optic apparatus of claim 1, wherein the at least one fiber optic equipment tray comprises a plurality of fiber optic equipment trays.

7. The fiber optic apparatus of claim 6, wherein the plurality of fiber optic equipment trays comprises fiber optic equipment trays arranged in a stacked configuration.

8. The fiber optic apparatus of claim 6, wherein each fiber optic equipment tray of the plurality of fiber optic equipment trays is configured to receive multiple fiber optic modules of the plurality of fiber optic modules.

9. The fiber optic apparatus of claim 6, wherein:

each fiber optic equipment tray of the plurality of fiber optic equipment trays is configured to receive multiple fiber optic modules of the plurality of fiber optic modules; and

the plurality of fiber optic equipment trays and the plurality of fiber optic modules are configured to permit each fiber optic module of the plurality of fiber optic modules to be removable from a front of the plurality of fiber optic equipment trays, and releasably removable from a rear of the plurality of fiber optic equipment trays.

10. The fiber optic apparatus of claim 1, wherein the at least one fiber optic equipment tray comprises a plurality of module guides, and each fiber optic module of the plurality of fiber optic modules is configured to move and be guided between a different pair of laterally spaced module guides of the plurality of module guides.

11. The fiber optic apparatus of claim 10, wherein at least one module guide of the plurality of module guides comprises a stop feature arranged to limit forward translation in the longitudinal direction of a fiber optic module of the plurality of fiber optic modules.

12. The fiber optic apparatus of claim 10, wherein the chassis comprises a rear section, and a rear portion of each module guide of the plurality of module guides defines at least one guide channel that is open on a rear end thereof to permit the plurality of fiber optic modules to be inserted into the plurality of module guides from the rear section of the chassis and to be guided toward the front end of the chassis.

13. The fiber optic apparatus of claim 10, wherein the at least one fiber optic equipment tray comprises at least one module locking feature disposed adjacent to a forward portion of the at least one fiber optic equipment tray, and the at least one module locking feature is configured to retain a fiber optic module of the plurality of fiber optic modules in the at least one fiber optic equipment tray when the fiber optic module is disposed adjacent to the forward portion of the at least one fiber optic equipment tray.

14. The fiber optic apparatus of claim 10, wherein each fiber optic module of the plurality of fiber optic modules comprises at least one laterally extending protrusion configured to cooperate with at least one module guide of the plurality of module guides.

15. The fiber optic apparatus of claim 10, wherein each fiber optic module of the plurality of fiber optic modules comprises a locking latch that is actuatable by a user from a rear of the fiber optic module, and the locking latch is configured to be actuated by the user pulling the locking latch inward toward a medial portion of the fiber optic module to permit disengagement of a lateral protrusion associated with the locking latch from at least one module guide of the plurality of module guides, thereby permitting release of the fiber optic module from the at least one fiber optic equipment tray.

16. The fiber optic apparatus of claim 1, wherein at least one fiber optic module of the plurality of fiber optic modules comprises a locking latch comprising a lateral protrusion configured to prevent the at least one fiber optic module from moving rearward relative to the at least one fiber optic equipment tray, the locking latch being actuatable by a user from a rear of the at least one fiber optic module to enable removal of the at least one fiber optic module from a rear of the at least one fiber optic equipment tray.

17. The fiber optic apparatus of claim 16, wherein the locking latch for the at least one fiber optic module of the plurality of fiber optic modules extends rearward beyond the rear end of the at least one fiber optic module.

18. The fiber optic apparatus of claim 16, wherein the locking latch for the at least one fiber optic module extends rearward from a lateral edge of the at least one fiber optic module.

19. The fiber optic apparatus of claim 16, wherein:

the at least one fiber optic equipment tray comprises a plurality of module guides, and each fiber optic module of the plurality of fiber optic modules is configured to move and be guided between a different pair of laterally spaced module guides of the plurality of module guides; and

the locking latch for the at least one fiber optic module is configured to be pulled inward toward a medial portion of the at least one fiber optic module to permit disengagement of the lateral protrusion from at least one module guide of the plurality of module guides.

20. The fiber optic apparatus of claim 1, wherein for at least one fiber optic module of the plurality of fiber optic modules, the at least one second fiber optic adapter comprises a higher connection density than each first fiber optic adapter of the plurality of first fiber optic adapters.

21. The fiber optic apparatus of claim 20, wherein for the at least one fiber optic module of the plurality of fiber optic modules, the plurality of first fiber optic adapters is config-

ured to accept LC fiber optic connectors, and the at least one second fiber optic adapter comprises an MTP fiber optic adapter.

22. The fiber optic apparatus of claim **1**, wherein each fiber optic module of the plurality of fiber optic modules comprises first and second lateral walls extending in the longitudinal direction and bounding the interior.

23. A fiber optic apparatus, comprising:

a chassis configured to be disposed in an equipment rack, the chassis comprising opposite front and rear ends that are spaced apart from one another in a longitudinal direction, and comprising opposite first and second ends that are spaced apart from one another in a lateral direction that extends crosswise to the longitudinal direction;

a guide system configured to be disposed within the chassis;

a plurality of fiber optic equipment trays arranged in a stacked configuration and configured to slidably engage within the guide system, wherein each fiber optic equipment tray of the plurality of fiber optic equipment trays comprises a front end with at least one fiber optic routing element that comprises successive material sections extending frontward, upward, and rearward, respectively, to permit optical fibers to be routed to either left or right portions of the plurality of fiber optic equipment trays toward the first and second ends of the chassis; and

a plurality of fiber optic modules configured to be received by the plurality of fiber optic equipment trays, wherein each fiber optic module of the plurality of fiber optic modules is independently movable in the longitudinal direction relative to each fiber optic equipment tray of the plurality of fiber optic equipment trays;

wherein each fiber optic module of the plurality of fiber optic modules comprises a front end, a rear end, an interior, a plurality of first fiber optic adapters disposed through the front end, at least one second fiber optic adapter disposed through the rear end, and at least one optical fiber disposed within the interior and establishing at least one optical connection between the at least one second fiber optic adapter and at least one first fiber optic adapter of the plurality of first fiber optic adapters;

wherein for at least one fiber optic module of the plurality of fiber optic modules, the at least one second fiber optic adapter comprises a higher connection density than each first fiber optic adapter of the plurality of first fiber optic adapters;

wherein each fiber optic equipment tray of the plurality of fiber optic equipment trays is configured to receive multiple fiber optic modules of the plurality of fiber optic modules; and

wherein the plurality of fiber optic equipment trays and the plurality of fiber optic modules are configured to permit the plurality of fiber optic modules to be removable from a front of the plurality of fiber optic equipment trays, and releasably removable from a rear of the plurality of fiber optic equipment trays.

24. The fiber optic apparatus of claim **23**, wherein the at least one fiber optic routing element comprises a substantially U-shaped fiber optic routing element.

25. The fiber optic apparatus of claim **23**, further comprising a plurality of module guides associated with the plurality of fiber optic equipment trays, wherein the chassis comprises a rear section, and a rear portion of each module guide of the plurality of module guides defines at least one guide channel that is open on a rear end thereof to permit the plurality of fiber optic modules to be inserted into the plurality of module guides from the rear section of the chassis and to be guided toward the front end of the chassis.

26. The fiber optic apparatus of claim **25**, wherein each fiber optic module of the plurality of fiber optic modules comprises a locking latch that is configured to prevent the fiber optic module from moving rearward relative to a fiber optic equipment tray of the plurality of fiber optic equipment trays, and that is actuatable by a user from a rear of the fiber optic module to enable removal of the fiber optic module from the fiber optic equipment tray.

27. The fiber optic apparatus of claim **26**, wherein the locking latch is configured to be actuated by the user pulling the locking latch inward toward a medial portion of the fiber optic module to permit disengagement of a lateral protrusion associated with the locking latch from at least one module guide of the plurality of module guides, thereby permitting release of the fiber optic module from the fiber optic equipment tray.

28. The fiber optic apparatus of claim **27**, wherein each fiber optic module of the plurality of fiber optic modules comprises first and second lateral walls extending in the longitudinal direction and bounding the interior.

29. The fiber optic apparatus of claim **28**, wherein for at least one fiber optic module of the plurality of fiber optic modules, the plurality of first fiber optic adapters is configured to accept LC fiber optic connectors, and the at least one second fiber optic adapter comprises an MTP fiber optic adapter.

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U.S. PATENT: ***10,444,456***
ISSUE DATE: ***October 15, 2019***

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(12) **United States Patent**
Cooke et al.

(10) **Patent No.:** **US 10,444,456 B2**
(45) **Date of Patent:** **Oct. 15, 2019**

(54) **HIGH DENSITY AND BANDWIDTH FIBER OPTIC APPARATUSES AND RELATED EQUIPMENT AND METHODS**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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Related U.S. Application Data

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G02B 6/44 (2006.01)

(52) **U.S. Cl.**
CPC ***G02B 6/4452*** (2013.01); *G02B 6/4453* (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

620,013	A	2/1899	Barnes
864,761	A	8/1907	Erickson

(Continued)

FOREIGN PATENT DOCUMENTS

AU	2010270959	A1	2/2012
CA	2029592	A1	5/1992

(Continued)

OTHER PUBLICATIONS

Non-Final Rejection dated Sep. 7, 2010, for U.S. Appl. No. 12/323,423, 18 pages.

(Continued)

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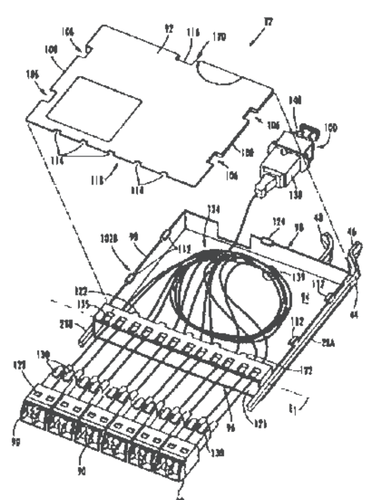
(57) **ABSTRACT**

High-connection density and bandwidth fiber optic apparatuses and related equipment and methods are disclosed. In certain embodiments, fiber optic apparatuses are provided and comprise a chassis defining one or more U space fiber optic equipment units. At least one of the one or more U space fiber optic equipment units may be configured to support particular fiber optic connection densities and bandwidths in a given 1-U space. The fiber optic connection densities and bandwidths may be supported by one or more fiber optic components, including but not limited to fiber optic adapters and fiber optic connectors, including but not limited to simplex, duplex, and other multi-fiber fiber optic components. The fiber optic components may also be disposed in fiber optic modules, fiber optic patch panels, or other types of fiber optic equipment.

30 Claims, 25 Drawing Sheets



Related U.S. Application Data

No. 14/660,074, filed on Mar. 17, 2015, now Pat. No. 9,910,236, which is a division of application No. 13/746,938, filed on Jan. 22, 2013, now Pat. No. 9,020,320, which is a continuation of application No. 12/819,081, filed on Jun. 18, 2010, now abandoned, and a continuation-in-part of application No. 12/323,415, filed on Nov. 25, 2008, now Pat. No. 8,452,148.

(60) Provisional application No. 61/218,880, filed on Jun. 19, 2009, provisional application No. 61/197,068, filed on Oct. 23, 2008, provisional application No. 61/190,538, filed on Aug. 29, 2008.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,528,910	A	11/1950	Poe
2,614,685	A	10/1952	Miller
3,057,525	A	10/1962	Malachick
3,081,717	A	3/1963	Yurevich
3,175,873	A	3/1965	Blomquist et al.
3,212,192	A	10/1965	Bachmann et al.
3,433,886	A	3/1969	Myers
3,494,306	A	2/1970	Aguilar
3,545,712	A	12/1970	Ellis
3,568,263	A	3/1971	Meehan
3,646,244	A	2/1972	Cole
3,664,514	A	5/1972	Drake
3,683,238	A	8/1972	Olds et al.
3,701,835	A	10/1972	Eisele et al.
3,880,396	A	4/1975	Freiberger et al.
3,906,592	A	9/1975	Sakasegawa et al.
3,991,960	A	11/1976	Tanaka
4,047,797	A	9/1977	Arnold et al.
4,059,872	A	11/1977	Delesandri
4,119,285	A	10/1978	Bisping et al.
4,148,454	A	4/1979	Carlson et al.
4,239,316	A	12/1980	Spaulding
4,244,638	A	1/1981	Little et al.
4,266,853	A	5/1981	Hutchins et al.
4,285,486	A	8/1981	Von Osten et al.
4,303,296	A	12/1981	Spaulding
4,354,731	A	10/1982	Mouissie
4,457,482	A	7/1984	Kitagawa
4,525,012	A	6/1985	Dunner
4,540,222	A	9/1985	Burrell
4,561,615	A	12/1985	Medlin, Jr.
4,564,163	A	1/1986	Barnett
4,597,173	A	7/1986	Chino et al.
4,611,875	A	9/1986	Clarke et al.
4,634,214	A	1/1987	Cannon, Jr. et al.
4,635,886	A	1/1987	Santucci et al.
4,645,292	A	2/1987	Sammueller
4,657,340	A	4/1987	Tanaka et al.
4,681,288	A	7/1987	Nakamura
4,702,551	A	10/1987	Coulombe
4,711,518	A	12/1987	Shank et al.
4,736,100	A	4/1988	Vastagh
4,744,629	A	5/1988	Bertoglio et al.
4,747,020	A	5/1988	Brickley et al.
4,752,110	A	6/1988	Blanchet et al.
4,753,510	A	6/1988	Sezerman
4,787,706	A	11/1988	Cannon, Jr. et al.
4,792,203	A	12/1988	Nelson et al.
4,798,432	A	1/1989	Becker et al.
4,805,979	A	2/1989	Bossard et al.
4,808,774	A	2/1989	Crane
4,824,193	A	4/1989	Maeda et al.
4,824,196	A	4/1989	Bylander
4,826,277	A	5/1989	Weber et al.
4,838,643	A	6/1989	Hodges et al.
4,840,449	A	6/1989	Ghandeharizadeh
4,865,280	A	9/1989	Wollar
4,889,403	A	12/1989	Zucker et al.
4,898,448	A	2/1990	Cooper
4,900,123	A	2/1990	Barlow
4,911,662	A	3/1990	Debortoli et al.
4,913,514	A	4/1990	Then
4,948,220	A	8/1990	Violo et al.
4,949,376	A	8/1990	Nieves et al.
4,971,421	A	11/1990	Ori
4,986,625	A	1/1991	Yamada et al.
4,988,831	A	1/1991	Wilson et al.
4,991,928	A	2/1991	Zimmer
4,995,688	A	2/1991	Anton et al.
5,001,602	A	3/1991	Suffi et al.
5,005,941	A	4/1991	Barlow et al.
5,011,257	A	4/1991	Wettengel et al.
5,017,211	A	5/1991	Wenger et al.
5,023,646	A	6/1991	Ishida et al.
5,024,498	A	6/1991	Becker et al.
5,028,114	A	7/1991	Krausse et al.
5,037,175	A	8/1991	Weber
5,048,918	A	9/1991	Daems et al.
5,060,897	A	10/1991	Thalenfeld
5,066,149	A	11/1991	Wheeler et al.
5,067,784	A	11/1991	Debortoli et al.
5,071,211	A	12/1991	Debortoli et al.
5,071,220	A	12/1991	Ruello et al.
5,073,042	A	12/1991	Mulholland et al.
5,074,635	A	12/1991	Justice et al.
5,076,688	A	12/1991	Bowen et al.
5,080,459	A	1/1992	Wettengel et al.
5,100,221	A	3/1992	Carney et al.
5,104,336	A	4/1992	Hatanaka et al.
5,125,060	A	6/1992	Edmundson
5,127,082	A	6/1992	Below et al.
5,127,851	A	7/1992	Hilbert et al.
5,129,030	A	7/1992	Petunia
5,129,607	A	7/1992	Satoh
5,129,842	A	7/1992	Morgan et al.
5,133,039	A	7/1992	Dixit
5,138,678	A	8/1992	Briggs et al.
5,138,688	A	8/1992	Debortoli
5,142,598	A	8/1992	Tabone
5,142,607	A	8/1992	Petrotta et al.
5,150,277	A	9/1992	Bainbridge et al.
D330,368	S	10/1992	Bourgeois et al.
5,152,760	A	10/1992	Latina
5,153,910	A	10/1992	Mickelson et al.
5,157,749	A	10/1992	Briggs et al.
5,167,001	A	11/1992	Debortoli et al.
5,170,452	A	12/1992	Ott
5,189,723	A	2/1993	Johnson et al.
5,199,099	A	3/1993	Dalgoutte
5,204,929	A	4/1993	Machall et al.
5,209,572	A	5/1993	Jordan
5,214,735	A	5/1993	Henneberger et al.
5,224,186	A	6/1993	Kishimoto et al.
5,230,492	A	7/1993	Zwart et al.
5,231,687	A	7/1993	Handley
5,231,688	A	7/1993	Zimmer
5,233,674	A	8/1993	Vladic
5,239,609	A	8/1993	Auteri
5,243,679	A	9/1993	Sharrow et al.
5,253,320	A	10/1993	Takahashi et al.
5,260,957	A	11/1993	Hakimi et al.
5,261,633	A	11/1993	Mastro
5,265,187	A	11/1993	Morin et al.
5,274,729	A	12/1993	King et al.
5,274,731	A	12/1993	White
5,278,933	A	1/1994	Hunsinger et al.
5,280,138	A	1/1994	Preston et al.
5,285,515	A	2/1994	Milanowski et al.
5,291,570	A	3/1994	Filgas et al.
5,315,679	A	5/1994	Baldwin et al.
5,317,663	A	5/1994	Beard et al.
5,323,478	A	6/1994	Milanowski et al.
5,323,480	A	6/1994	Mullaney et al.
5,329,520	A	7/1994	Richardson
5,333,193	A	7/1994	Cote et al.
5,333,221	A	7/1994	Briggs et al.
5,333,222	A	7/1994	Belenkiy et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,337,400	A	8/1994	Morin et al.
5,339,379	A	8/1994	Kutsch et al.
5,347,603	A	9/1994	Belenkiy et al.
5,353,367	A	10/1994	Czosnowski et al.
5,359,688	A	10/1994	Underwood
5,363,466	A	11/1994	Milanowski et al.
5,363,467	A	11/1994	Keith
5,366,388	A	11/1994	Freeman et al.
5,367,598	A	11/1994	Devenish, III et al.
5,373,421	A	12/1994	Detsikas et al.
5,383,051	A	1/1995	Delrosso et al.
5,390,272	A	2/1995	Repta et al.
5,398,295	A	3/1995	Chang et al.
5,398,820	A	3/1995	Kiss
5,399,814	A	3/1995	Staber et al.
5,401,193	A	3/1995	Lo Cicero et al.
5,402,515	A	3/1995	Vidacovich et al.
5,408,557	A	4/1995	Hsu
5,408,570	A	4/1995	Cook et al.
RE34,955	E	5/1995	Anton et al.
5,412,751	A	5/1995	Siemon et al.
5,416,837	A	5/1995	Cote et al.
5,418,874	A	5/1995	Carlisle et al.
5,420,956	A	5/1995	Grugel et al.
5,420,958	A	5/1995	Henson et al.
5,421,532	A	6/1995	Richter
5,438,641	A	8/1995	Malacarne
5,442,725	A	8/1995	Peng
5,442,726	A	8/1995	Howard et al.
5,443,232	A	8/1995	Kesinger et al.
5,444,804	A	8/1995	Yui et al.
5,448,015	A	9/1995	Jamet et al.
5,450,518	A	9/1995	Burek et al.
5,458,019	A	10/1995	Trevino
5,471,555	A	11/1995	Braga et al.
5,479,505	A	12/1995	Butler et al.
5,481,634	A	1/1996	Anderson et al.
5,481,939	A	1/1996	Bernardini
5,490,229	A	2/1996	Ghandeharizadeh et al.
5,495,549	A	2/1996	Schneider et al.
5,497,416	A	3/1996	Butler, III et al.
5,497,444	A	3/1996	Wheeler
5,511,144	A	4/1996	Hawkins et al.
5,511,798	A	4/1996	Kawamoto et al.
5,519,804	A	5/1996	Burek et al.
5,530,786	A	6/1996	Radliff et al.
5,535,970	A	7/1996	Gobbi
5,538,213	A	7/1996	Brown
5,542,015	A	7/1996	Hultermans
5,546,495	A	8/1996	Bruckner et al.
5,548,641	A	8/1996	Butler et al.
5,553,183	A	9/1996	Bechamps
5,553,186	A	9/1996	Allen
5,563,971	A	10/1996	Abendschein
5,572,617	A	11/1996	Bernhardt et al.
5,575,680	A	11/1996	Suffi
5,577,151	A	11/1996	Hoffer
5,590,234	A	12/1996	Pulido
5,595,507	A	1/1997	Braun et al.
5,596,670	A	1/1997	Debortoli et al.
5,600,020	A	2/1997	Wehle et al.
5,602,954	A	2/1997	Nolf et al.
5,608,606	A	3/1997	Blaney
5,613,030	A	3/1997	Hoffer et al.
5,617,501	A	4/1997	Miller et al.
5,638,474	A	6/1997	Lampert et al.
5,640,476	A	6/1997	Womack et al.
5,640,482	A	6/1997	Barry et al.
5,647,043	A	7/1997	Anderson et al.
5,647,045	A	7/1997	Robinson et al.
5,650,334	A	7/1997	Zuk et al.
5,668,910	A	9/1997	Arnett
5,668,911	A	9/1997	Debortoli
5,671,273	A	9/1997	Lanquist
5,689,605	A	11/1997	Cobb et al.
5,689,607	A	11/1997	Vincent et al.
5,692,079	A	11/1997	Iso
5,694,511	A	12/1997	Pimpinella et al.
5,701,380	A	12/1997	Larson et al.
5,704,573	A	1/1998	de Beers et al.
5,708,742	A	1/1998	Beun et al.
5,708,751	A	1/1998	Mattei
5,710,851	A	1/1998	Walter et al.
5,717,810	A	2/1998	Wheeler
5,734,776	A	3/1998	Puetz
5,734,779	A	3/1998	Okino
5,740,300	A	4/1998	Hodge
5,742,982	A	4/1998	Dodd et al.
5,751,874	A	5/1998	Chudoba et al.
5,751,882	A	5/1998	Daems et al.
5,754,724	A	5/1998	Peterson et al.
5,758,003	A	5/1998	Wheeler et al.
5,758,004	A	5/1998	Alarcon et al.
5,761,026	A	6/1998	Robinson et al.
5,765,698	A	6/1998	Bullivant
5,769,908	A	6/1998	Koppelman
5,774,612	A	6/1998	Belenkiy et al.
5,778,122	A	7/1998	Giebel et al.
5,778,130	A	7/1998	Walters et al.
5,781,686	A	7/1998	Robinson et al.
5,788,087	A	8/1998	Orlando
5,790,741	A	8/1998	Vincent et al.
5,793,920	A	8/1998	Wilkins et al.
5,793,921	A	8/1998	Wilkins et al.
5,796,908	A	8/1998	Vicory
5,806,687	A	9/1998	Ballesteros et al.
5,823,646	A	10/1998	Arizpe et al.
5,825,955	A	10/1998	Ernst et al.
5,825,961	A	10/1998	Wilkins et al.
5,828,807	A	10/1998	Tucker et al.
5,832,162	A	11/1998	Sarbell
5,835,657	A	11/1998	Suarez et al.
5,835,658	A	11/1998	Smith
5,862,290	A	1/1999	Burek et al.
5,870,519	A	2/1999	Jenkins et al.
5,874,733	A	2/1999	Silver et al.
5,877,565	A	3/1999	Hollenbach et al.
5,880,864	A	3/1999	Williams et al.
5,881,200	A	3/1999	Burt
5,883,995	A	3/1999	Lu et al.
5,884,003	A	3/1999	Cloud et al.
5,887,095	A	3/1999	Nagase et al.
5,887,106	A	3/1999	Cheeseman et al.
5,892,877	A	4/1999	Meyerhoefer
5,894,540	A	4/1999	Drewing
5,901,220	A	5/1999	Garver et al.
5,903,693	A	5/1999	Brown
5,906,342	A	5/1999	Kraus
5,909,298	A	6/1999	Shimada et al.
5,913,006	A	6/1999	Summach
5,914,976	A	6/1999	Jayaraman et al.
5,915,055	A	6/1999	Bennett et al.
5,923,804	A	7/1999	Rosson
5,930,425	A	7/1999	Abel et al.
5,933,557	A	8/1999	Ott
5,940,563	A	8/1999	Kobayashi et al.
5,943,460	A	8/1999	Mead et al.
5,945,633	A	8/1999	Ott et al.
5,946,440	A	8/1999	Puetz
5,949,946	A	9/1999	Debortoli et al.
5,953,962	A	9/1999	Hewson
5,956,439	A	9/1999	Pimpinella
5,956,444	A	9/1999	Duda et al.
5,956,449	A	9/1999	Otani et al.
5,966,492	A	10/1999	Bechamps et al.
5,969,294	A	10/1999	Eberle et al.
5,975,769	A	11/1999	Larson et al.
5,978,540	A	11/1999	Bechamps et al.
5,980,303	A	11/1999	Lee et al.
5,984,531	A	11/1999	Lu
5,987,203	A	11/1999	Abel et al.
5,993,071	A	11/1999	Hultermans
5,995,700	A	11/1999	Burek et al.
5,999,393	A	12/1999	Brower

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,001,831 A	12/1999	Papenfuhs et al.
6,009,224 A	12/1999	Allen
6,009,225 A	12/1999	Ray et al.
6,011,831 A	1/2000	Nieves et al.
6,027,252 A	2/2000	Erdman et al.
6,027,352 A	2/2000	Byrne
6,041,042 A	3/2000	Bussiere
6,044,193 A	3/2000	Szentesi et al.
6,044,194 A	3/2000	Meyerhoefer
6,049,963 A	4/2000	Boe
6,058,235 A	5/2000	Hiramatsu et al.
6,061,492 A	5/2000	Strause et al.
6,078,661 A	6/2000	Arnett et al.
6,079,881 A	6/2000	Roth
6,088,497 A	7/2000	Phillips et al.
6,118,075 A	9/2000	Baker et al.
6,118,868 A	9/2000	Daoud
6,127,627 A	10/2000	Daoud
6,130,983 A	10/2000	Cheng
6,134,370 A	10/2000	Childers et al.
6,141,222 A	10/2000	Toor et al.
6,142,676 A	11/2000	Lu
6,149,313 A	11/2000	Giebel et al.
6,149,315 A	11/2000	Stephenson
6,151,432 A	11/2000	Nakajima et al.
6,160,946 A	12/2000	Thompson et al.
6,170,784 B1	1/2001	MacDonald et al.
6,172,782 B1	1/2001	Kobayashi
6,175,079 B1	1/2001	Johnston et al.
6,181,861 B1	1/2001	Wenski et al.
6,188,687 B1	2/2001	Mussman et al.
6,188,825 B1	2/2001	Bandy et al.
6,192,180 B1	2/2001	Kim et al.
6,200,170 B1	3/2001	Amberg et al.
6,201,919 B1	3/2001	Puetz et al.
6,201,920 B1	3/2001	Noble et al.
6,208,796 B1	3/2001	Williams Vigliaturo
6,212,324 B1	4/2001	Lin et al.
6,215,938 B1	4/2001	Reitmeier et al.
6,216,987 B1	4/2001	Fukuo
6,227,717 B1	5/2001	Ott et al.
6,229,948 B1	5/2001	Blee et al.
6,234,683 B1	5/2001	Waldron et al.
6,234,685 B1	5/2001	Carlisle et al.
6,236,795 B1	5/2001	Rodgers
6,240,229 B1	5/2001	Roth
6,243,522 B1	6/2001	Allan et al.
6,245,998 B1	6/2001	Curry et al.
6,247,851 B1	6/2001	Ichihara
6,250,816 B1	6/2001	Johnston et al.
6,256,210 B1	7/2001	Strijker et al.
6,259,850 B1	7/2001	Crosby, Jr. et al.
6,259,856 B1	7/2001	Shahid
6,263,141 B1	7/2001	Smith
6,265,680 B1	7/2001	Robertson
6,269,212 B1	7/2001	Schiattone
6,273,532 B1	8/2001	Chen et al.
6,275,641 B1	8/2001	Daoud
6,278,829 B1	8/2001	BuAbbud et al.
6,278,831 B1	8/2001	Henderson et al.
D448,005 S	9/2001	Klein, Jr. et al.
6,289,618 B1	9/2001	Kump et al.
6,292,614 B1	9/2001	Smith et al.
6,301,424 B1	10/2001	Hwang
6,305,848 B1	10/2001	Gregory
6,307,997 B1	10/2001	Walters et al.
6,318,824 B1	11/2001	LaGrotta et al.
6,321,017 B1	11/2001	Janus et al.
6,322,279 B1	11/2001	Yamamoto et al.
6,324,575 B1	11/2001	Jain et al.
6,325,549 B1	12/2001	Shevchuk
6,327,059 B1	12/2001	Bhalla et al.
RE37,489 E	1/2002	Anton et al.
6,343,313 B1	1/2002	Salesky et al.
6,344,615 B1	2/2002	Nolf et al.
6,347,888 B1	2/2002	Puetz
6,351,587 B1	2/2002	Holland
6,353,696 B1	3/2002	Gordon et al.
6,353,697 B1	3/2002	Daoud
6,357,712 B1	3/2002	Lu
6,359,228 B1	3/2002	Strause et al.
6,362,422 B1	3/2002	Vavrik et al.
6,363,198 B1	3/2002	Braga et al.
6,363,200 B1	3/2002	Thompson et al.
6,366,724 B1	4/2002	Jennings et al.
6,370,309 B1	4/2002	Daoud
6,371,419 B1	4/2002	Ohnuki
6,375,129 B2	4/2002	Koziol
6,377,218 B1	4/2002	Nelson et al.
6,379,052 B1	4/2002	De Jong et al.
6,381,642 B1	4/2002	O'Donnell et al.
6,385,374 B2	5/2002	Kropp
6,385,381 B1	5/2002	Janus et al.
6,389,214 B1	5/2002	Smith et al.
6,392,140 B1	5/2002	Yee et al.
6,397,166 B1	5/2002	Leung et al.
6,398,149 B1	6/2002	Hines et al.
6,406,314 B1	6/2002	Byrne
6,410,850 B1	6/2002	Abel et al.
6,411,767 B1	6/2002	Burrous et al.
6,412,986 B1	7/2002	Ngo et al.
6,418,262 B1	7/2002	Puetz et al.
6,419,519 B1	7/2002	Young
6,424,781 B1	7/2002	Puetz et al.
6,425,694 B1	7/2002	Szilagyi et al.
6,427,045 B1	7/2002	Matthes et al.
6,431,762 B1	8/2002	Taira et al.
6,434,313 B1	8/2002	Clapp, Jr. et al.
6,438,310 B1	8/2002	Lance et al.
6,452,925 B1	9/2002	Sistanizadeh et al.
6,456,773 B1	9/2002	Keys
6,464,402 B1	10/2002	Andrews et al.
6,466,724 B1	10/2002	Glover et al.
6,469,905 B1	10/2002	Hwang
D466,087 S	11/2002	Cuny et al.
6,478,472 B1	11/2002	Anderson et al.
6,480,487 B1	11/2002	Wegleitner et al.
6,480,660 B1	11/2002	Reitmeier et al.
6,483,977 B2	11/2002	Battey et al.
6,484,958 B1	11/2002	Xue et al.
6,494,550 B1	12/2002	Chen et al.
6,496,640 B1	12/2002	Harvey et al.
6,504,988 B1	1/2003	Trebesch et al.
6,507,980 B2	1/2003	Bremicker
6,510,274 B1	1/2003	Wu et al.
6,532,332 B2	3/2003	Solheid et al.
6,533,472 B1	3/2003	Dinh et al.
6,535,397 B2	3/2003	Clark et al.
6,537,106 B1	3/2003	Follingstad
6,539,147 B1	3/2003	Mahony
6,539,160 B2	3/2003	Battey et al.
6,542,688 B1	4/2003	Battey et al.
6,544,075 B1	4/2003	Liao
6,545,611 B2	4/2003	Hayashi et al.
6,550,977 B2	4/2003	Hizuka
6,554,485 B1	4/2003	Beatty et al.
6,560,334 B1	5/2003	Mullaney et al.
6,567,601 B2	5/2003	Daoud et al.
6,568,542 B1	5/2003	Chen
6,571,048 B1	5/2003	Bechamps et al.
6,577,595 B1	6/2003	Counterman
6,577,801 B2	6/2003	Broderick et al.
6,579,014 B2	6/2003	Melton et al.
6,584,267 B1	6/2003	Caveney et al.
6,585,423 B1	7/2003	Vergeest
6,587,630 B2	7/2003	Spence et al.
6,588,938 B1	7/2003	Lampert et al.
6,591,051 B2	7/2003	Solheid et al.
6,591,053 B2	7/2003	Fritz
6,592,266 B1	7/2003	Hankins et al.
6,597,670 B1	7/2003	Tweedy et al.
6,600,106 B2	7/2003	Standish et al.
6,600,866 B2	7/2003	Gatica et al.
6,601,997 B2	8/2003	Ngo

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,612,515	B1	9/2003	Tinucci et al.
6,612,874	B1	9/2003	Stout et al.
6,614,978	B1	9/2003	Caveney
6,614,980	B1	9/2003	Mahony
6,621,975	B2	9/2003	Laporte et al.
6,622,873	B2	9/2003	Hegrenes et al.
6,624,389	B1	9/2003	Cox
6,625,374	B2	9/2003	Holman et al.
6,625,375	B1	9/2003	Mahony
6,631,237	B2	10/2003	Knudsen et al.
6,640,042	B2	10/2003	Araki et al.
RE38,311	E	11/2003	Wheeler
6,644,863	B1	11/2003	Azami et al.
6,647,197	B1	11/2003	Marrs et al.
6,648,520	B2	11/2003	McDonald et al.
6,654,536	B2	11/2003	Battey et al.
6,668,127	B1	12/2003	Mahony
6,669,149	B2	12/2003	Akizuki
6,677,520	B1	1/2004	Kim et al.
6,679,604	B1	1/2004	Bove et al.
6,687,450	B1	2/2004	Kempeneers et al.
6,693,552	B1	2/2004	Herzig et al.
6,695,620	B1	2/2004	Huang
6,700,654	B2	3/2004	Gerrish et al.
6,701,056	B2	3/2004	Burek et al.
6,710,366	B1	3/2004	Lee et al.
6,714,698	B2	3/2004	Pfeiffer et al.
6,715,619	B2	4/2004	Kim et al.
6,719,149	B2	4/2004	Tomino
6,721,482	B1	4/2004	Glynn
6,728,462	B2	4/2004	Wu et al.
6,736,670	B2	5/2004	Clark et al.
6,741,784	B1	5/2004	Guan
6,741,785	B2	5/2004	Barthel et al.
6,746,037	B1	6/2004	Kaplenski et al.
6,748,154	B2	6/2004	O'Leary et al.
6,748,155	B2	6/2004	Kim et al.
6,758,600	B2	7/2004	Del Grosso et al.
6,761,585	B2	7/2004	Clark et al.
6,768,860	B2	7/2004	Liberty
6,771,861	B2	8/2004	Wagner et al.
6,773,297	B2	8/2004	Komiya
6,778,525	B1	8/2004	Baum et al.
6,778,752	B2	8/2004	Laporte et al.
6,786,647	B1	9/2004	Hinds et al.
6,786,743	B2	9/2004	Huang
6,786,896	B1	9/2004	Madhani et al.
6,788,871	B2	9/2004	Taylor
6,792,190	B2	9/2004	Xin et al.
6,792,191	B1	9/2004	Clapp, Jr. et al.
6,798,751	B1	9/2004	Voit et al.
6,804,447	B2	10/2004	Smith et al.
6,810,194	B2	10/2004	Griffiths et al.
6,813,412	B2	11/2004	Lin
6,816,660	B2	11/2004	Nashimoto
6,818,834	B1	11/2004	Lin
6,819,856	B2	11/2004	Dagley et al.
6,819,857	B2	11/2004	Douglas et al.
6,822,874	B1	11/2004	Marler
6,826,174	B1	11/2004	Erekson et al.
6,826,346	B2	11/2004	Sloan et al.
6,826,631	B2	11/2004	Webb
6,830,489	B2	12/2004	Aoyama
6,839,428	B2	1/2005	Brower et al.
6,839,438	B1	1/2005	Riegelsberger et al.
6,840,815	B2	1/2005	Musolf et al.
6,845,207	B2	1/2005	Schray
6,847,614	B2	1/2005	Banker et al.
6,848,862	B1	2/2005	Schlig
6,850,685	B2	2/2005	Tinucci et al.
6,853,637	B1	2/2005	Norrell et al.
6,854,894	B1	2/2005	Yunker et al.
6,856,334	B1	2/2005	Fukui
6,856,505	B1	2/2005	Venegas et al.
6,863,444	B2	3/2005	Anderson et al.
6,865,331	B2	3/2005	Mertesdorf
6,865,334	B2	3/2005	Cooke et al.
6,866,541	B2	3/2005	Barker et al.
6,868,216	B1	3/2005	Gehrke
6,869,227	B2	3/2005	Del Grosso et al.
6,870,734	B2	3/2005	Mertesdorf et al.
6,870,997	B2	3/2005	Cooke
6,879,545	B2	4/2005	Cooke et al.
6,909,833	B2	6/2005	Henschel et al.
6,915,058	B2	7/2005	Pons
6,916,199	B2	7/2005	Follingstad
6,918,786	B2	7/2005	Barker et al.
6,920,273	B2	7/2005	Knudsen
6,920,274	B2	7/2005	Rapp et al.
6,923,406	B2	8/2005	Akizuki
6,925,241	B2	8/2005	Bohle et al.
6,934,451	B2	8/2005	Cooke
6,934,456	B2	8/2005	Ferris et al.
6,935,598	B2	8/2005	Sono et al.
6,937,807	B2	8/2005	Franklin et al.
6,944,383	B1	9/2005	Herzog et al.
6,944,389	B2	9/2005	Giraud et al.
6,945,701	B2	9/2005	Trezza et al.
6,952,530	B2	10/2005	Helvajian et al.
6,963,690	B1	11/2005	Kassal et al.
6,968,107	B2	11/2005	Belardi et al.
6,968,111	B2	11/2005	Trebesch et al.
6,971,909	B2	12/2005	Levesque et al.
6,974,348	B2	12/2005	Bentley
6,980,725	B1	12/2005	Swieconek
6,981,893	B2	1/2006	Barker et al.
6,985,665	B2	1/2006	Baechtle
6,993,237	B2	1/2006	Cooke et al.
7,000,784	B2	2/2006	Canty et al.
7,005,582	B2	2/2006	Muller et al.
7,006,748	B2	2/2006	Dagley et al.
7,007,296	B2	2/2006	Rakib
7,025,275	B2	4/2006	Huang et al.
7,027,695	B2	4/2006	Cooke et al.
7,027,706	B2	4/2006	Diaz et al.
7,031,588	B2	4/2006	Cowley et al.
7,035,510	B2	4/2006	Zimmel et al.
7,038,137	B2	5/2006	Grubish et al.
7,048,447	B1	5/2006	Patel et al.
7,054,513	B2	5/2006	Herz et al.
7,059,887	B1	6/2006	Liu
7,066,748	B2	6/2006	Bricaud et al.
7,066,771	B2	6/2006	Clark et al.
7,068,907	B2	6/2006	Schray
7,070,459	B2	7/2006	Denovich et al.
7,077,710	B2	7/2006	Haggay et al.
7,079,744	B2	7/2006	Douglas et al.
7,090,406	B2	8/2006	Melton et al.
7,090,407	B2	8/2006	Melton et al.
7,094,095	B1	8/2006	Caveney
7,097,047	B2	8/2006	Lee et al.
7,101,093	B2	9/2006	Hsiao et al.
7,102,884	B2	9/2006	Mertesdorf et al.
7,103,255	B2	9/2006	Reagan et al.
7,110,654	B2	9/2006	Dillat
7,111,990	B2	9/2006	Melton et al.
7,113,679	B2	9/2006	Melton et al.
7,113,686	B2	9/2006	Bellekens et al.
7,113,687	B2	9/2006	Womack et al.
7,116,491	B1	10/2006	Willey et al.
7,116,883	B2	10/2006	Kline et al.
7,118,281	B2	10/2006	Chiu et al.
7,118,405	B2	10/2006	Peng
7,120,347	B2	10/2006	Blackwell, Jr. et al.
7,120,348	B2	10/2006	Trebesch et al.
7,120,349	B2	10/2006	Elliott
7,127,143	B2	10/2006	Elkins, II et al.
7,128,471	B2	10/2006	Wilson
7,136,555	B2	11/2006	Theuerkorn et al.
7,139,462	B1	11/2006	Richtman
7,140,903	B2	11/2006	Pulizzi et al.
7,147,383	B2	12/2006	Sullivan
7,170,466	B2	1/2007	Janoschka
7,171,099	B2	1/2007	Barnes et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,171,121	B1	1/2007	Skarica et al.
7,179,119	B2	2/2007	Follingstad
7,181,142	B1	2/2007	Xu et al.
7,186,134	B2	3/2007	Togami et al.
7,193,783	B2	3/2007	Willey et al.
7,194,181	B2	3/2007	Holmberg et al.
7,195,521	B2	3/2007	Musolf et al.
7,200,314	B2	4/2007	Womack et al.
7,200,316	B2	4/2007	Giraud et al.
7,201,595	B1	4/2007	Morello
7,207,835	B2	4/2007	Levesque et al.
7,217,040	B2	5/2007	Crews et al.
7,218,526	B2	5/2007	Mayer
7,220,065	B2	5/2007	Han et al.
7,221,832	B2	5/2007	Tinucci
7,228,036	B2	6/2007	Elkins, II et al.
7,228,047	B1	6/2007	Szilagyi et al.
7,231,125	B2	6/2007	Douglas et al.
7,234,878	B2	6/2007	Yamauchi et al.
7,236,677	B2	6/2007	Escoto et al.
7,239,789	B2	7/2007	Grubish et al.
7,241,182	B2	7/2007	Clark et al.
7,244,144	B2	7/2007	Follingstad
7,245,809	B1	7/2007	Gniadek et al.
7,259,325	B2	8/2007	Pincu et al.
7,266,283	B2	9/2007	Kline et al.
7,270,485	B1	9/2007	Robinson et al.
7,272,291	B2	9/2007	Bayazit et al.
7,274,852	B1	9/2007	Smrha et al.
7,284,785	B2	10/2007	Gotou et al.
7,287,913	B2	10/2007	Keenum et al.
7,289,731	B2	10/2007	Thinguldstad
7,292,769	B2	11/2007	Watanabe et al.
7,298,950	B2	11/2007	Frohlich
7,300,216	B2	11/2007	Morse et al.
7,300,308	B2	11/2007	Laursen et al.
7,302,149	B2	11/2007	Swam et al.
7,302,153	B2	11/2007	Thom
7,302,154	B2	11/2007	Trebesch et al.
7,308,184	B2	12/2007	Barnes et al.
7,310,471	B2	12/2007	Bayazit et al.
7,310,472	B2	12/2007	Haberman
7,315,681	B2	1/2008	Kewitsch
7,325,975	B2	2/2008	Yamada et al.
7,330,624	B2	2/2008	Isenhour et al.
7,330,625	B2	2/2008	Barth
7,330,626	B2	2/2008	Kowalczyk et al.
7,330,629	B2	2/2008	Cooke et al.
7,331,718	B2	2/2008	Yazaki et al.
D565,205	S	3/2008	Lo et al.
7,340,145	B2	3/2008	Allen
7,346,254	B2	3/2008	Kramer et al.
7,349,615	B2	3/2008	Frazier et al.
7,352,946	B2	4/2008	Heller et al.
7,352,947	B2	4/2008	Phung et al.
7,357,667	B2	4/2008	Clark et al.
7,373,071	B2	5/2008	Douglas et al.
7,376,321	B2	5/2008	Bolster et al.
7,376,322	B2	5/2008	Zimmel et al.
7,376,323	B2	5/2008	Zimmel
7,376,325	B1	5/2008	Cloud et al.
7,391,952	B1	6/2008	Ugolini et al.
7,397,996	B2	7/2008	Herzog et al.
7,400,813	B2	7/2008	Zimmel
7,404,736	B2	7/2008	Herbst et al.
7,409,137	B2	8/2008	Barnes
7,414,198	B2	8/2008	Stansbie et al.
7,417,188	B2	8/2008	McNutt et al.
7,418,181	B2	8/2008	Zimmel et al.
7,418,182	B2	8/2008	Krampotich
7,418,184	B1	8/2008	Gonzales et al.
7,421,182	B2	9/2008	Bayazit et al.
7,428,363	B2	9/2008	Leon et al.
7,435,090	B1	10/2008	Schriefer et al.
7,437,049	B2	10/2008	Krampotich
7,439,453	B2	10/2008	Murano et al.
7,454,113	B2	11/2008	Barnes
7,460,757	B2	12/2008	Hoehne et al.
7,460,758	B2	12/2008	Xin
7,461,981	B2	12/2008	Yow, Jr. et al.
7,462,779	B2	12/2008	Caveney et al.
7,463,810	B2	12/2008	Bayazit et al.
7,463,811	B2	12/2008	Trebesch et al.
7,469,090	B2	12/2008	Ferris et al.
7,471,867	B2	12/2008	Vogel et al.
7,474,828	B2	1/2009	Leon et al.
7,477,824	B2	1/2009	Reagan et al.
7,477,826	B2	1/2009	Mullaney et al.
7,480,438	B2	1/2009	Douglas et al.
7,488,205	B2	2/2009	Spisany et al.
7,493,002	B2	2/2009	Coburn et al.
7,496,269	B1	2/2009	Lee
7,499,622	B2	3/2009	Castonguay et al.
7,499,623	B2	3/2009	Barnes et al.
7,507,111	B2	3/2009	Togami et al.
7,509,015	B2	3/2009	Murano
7,509,016	B2	3/2009	Smith et al.
7,510,421	B2	3/2009	Fransen et al.
7,522,804	B2	4/2009	Araki et al.
7,523,898	B1	4/2009	Barry et al.
7,526,171	B2	4/2009	Caveney et al.
7,526,172	B2	4/2009	Gniadek et al.
7,526,174	B2	4/2009	Leon et al.
7,529,458	B2	5/2009	Spisany et al.
7,529,485	B2	5/2009	Farmer et al.
7,534,958	B2	5/2009	McNutt et al.
7,536,075	B2	5/2009	Zimmel
7,540,666	B2	6/2009	Luther et al.
7,542,645	B1	6/2009	Hua et al.
7,544,085	B2	6/2009	Baldwin et al.
7,552,899	B2	6/2009	Chen et al.
7,555,193	B2	6/2009	Rapp et al.
7,558,458	B2	7/2009	Gronvall et al.
7,565,051	B2	7/2009	Vongseng
7,567,744	B2	7/2009	Krampotich et al.
7,570,860	B2	8/2009	Smrha et al.
7,570,861	B2	8/2009	Smrha et al.
7,577,331	B2	8/2009	Laurisch et al.
7,593,614	B2	9/2009	Zimmel et al.
7,596,293	B2	9/2009	Isenhour et al.
7,603,020	B1	10/2009	Wakileh et al.
7,606,459	B2	10/2009	Zimmel et al.
7,607,938	B2	10/2009	Clark et al.
7,609,967	B2	10/2009	Hochbaum et al.
7,613,377	B2	11/2009	Gonzales et al.
7,614,903	B1	11/2009	Huang
7,620,287	B2	11/2009	Appenzeller et al.
7,641,398	B2	1/2010	O'Riorden et al.
7,668,430	B2	2/2010	McClellan et al.
7,668,433	B2	2/2010	Bayazit et al.
7,672,561	B1	3/2010	Keith et al.
7,676,135	B2	3/2010	Chen
7,689,079	B2	3/2010	Burnham et al.
7,689,089	B2	3/2010	Wagner et al.
7,694,926	B2	4/2010	Allen et al.
7,697,811	B2	4/2010	Murano et al.
7,706,294	B2	4/2010	Natarajan et al.
7,706,656	B2	4/2010	Zimmel
7,715,125	B2	5/2010	Willey
7,715,683	B2	5/2010	Kowalczyk et al.
7,734,138	B2	6/2010	Bloodworth et al.
7,740,409	B2	6/2010	Bolton et al.
7,743,495	B2	6/2010	Mori et al.
7,748,911	B2	7/2010	Keenum et al.
7,751,674	B2	7/2010	Hill
7,751,675	B2	7/2010	Holmberg et al.
7,756,371	B1	7/2010	Burnham et al.
7,756,382	B2	7/2010	Saravanos et al.
7,760,984	B2	7/2010	Solheid et al.
7,764,858	B2	7/2010	Bayazit et al.
7,764,859	B2	7/2010	Krampotich et al.
7,769,266	B2	8/2010	Morris
7,805,044	B2	9/2010	Reagan et al.
7,809,232	B2	10/2010	Reagan et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,809,235	B2	10/2010	Reagan et al.
7,811,136	B1	10/2010	Hsieh et al.
7,822,310	B2	10/2010	Castonguay et al.
7,822,340	B2	10/2010	Matityahu et al.
7,835,611	B2	11/2010	Zimmel
7,837,495	B2	11/2010	Baldwin et al.
7,850,372	B2	12/2010	Nishimura et al.
7,853,112	B2	12/2010	Zimmel et al.
7,856,166	B2	12/2010	Biribuze et al.
7,862,369	B2	1/2011	Gimenes et al.
7,869,685	B2	1/2011	Hendrickson et al.
7,876,580	B2	1/2011	Mayer
7,885,505	B2	2/2011	Zimmel
7,899,298	B2	3/2011	Cox et al.
7,912,336	B2	3/2011	Zimmel
7,914,332	B2	3/2011	Song et al.
7,941,053	B2	5/2011	Dallesasse
7,942,589	B2	5/2011	Yazaki et al.
7,945,135	B2	5/2011	Cooke et al.
7,945,136	B2	5/2011	Cooke et al.
7,945,138	B2	5/2011	Hill et al.
7,970,250	B2	6/2011	Morris
7,991,252	B2	8/2011	Cheng et al.
8,009,959	B2	8/2011	Barnes et al.
8,014,171	B2	9/2011	Kelly et al.
8,014,646	B2	9/2011	Keith et al.
8,020,813	B1	9/2011	Clark et al.
8,023,791	B2	9/2011	Zimmel et al.
8,059,932	B2	11/2011	Hill et al.
8,093,499	B2	1/2012	Hoffer et al.
8,107,785	B2	1/2012	Berglund et al.
8,121,457	B2	2/2012	Zimmel
8,131,126	B2	3/2012	Kowalczyk et al.
8,180,192	B2	5/2012	Zimmel
8,184,938	B2	5/2012	Cooke et al.
8,206,043	B2	6/2012	Thirugnanam et al.
8,206,058	B2	6/2012	Vrondran et al.
8,220,881	B2	7/2012	Keith
8,226,305	B2	7/2012	Thirugnanam et al.
8,249,410	B2	8/2012	Andrus et al.
8,251,591	B2	8/2012	Barnes et al.
8,270,798	B2	9/2012	Dagley et al.
8,280,216	B2	10/2012	Cooke et al.
8,285,104	B2	10/2012	Davis et al.
8,301,004	B2	10/2012	Cooke et al.
8,331,752	B2	12/2012	Biribuze
8,331,753	B2	12/2012	Zimmel et al.
8,340,491	B2	12/2012	Zimmel
8,346,045	B2	1/2013	Zimmel et al.
8,353,494	B2	1/2013	Peng et al.
8,369,679	B2	2/2013	Wakileh et al.
8,391,666	B2	3/2013	Hertzer et al.
8,452,148	B2	5/2013	Cooke et al.
8,472,773	B2	6/2013	de Jong
8,491,331	B2	7/2013	Follingstad
8,528,872	B2	9/2013	Mattlin et al.
8,537,477	B2	9/2013	Shioda
8,538,226	B2	9/2013	Makrides-Saravanos et al.
8,542,972	B2	9/2013	Zimmel
8,559,783	B2	10/2013	Campos et al.
8,634,689	B2	1/2014	Zimmel
8,705,928	B2	4/2014	Zimmel et al.
8,712,206	B2	4/2014	Cooke et al.
8,798,428	B2	8/2014	Zimmel et al.
8,824,850	B2	9/2014	Garcia et al.
8,861,918	B2	10/2014	Vazquez et al.
8,879,991	B2	11/2014	Kim
9,020,320	B2	4/2015	Cooke et al.
9,146,371	B2	9/2015	Zimmel
9,213,159	B2	12/2015	Zimmel et al.
9,563,017	B2	2/2017	Zimmel et al.
9,568,700	B2	2/2017	Zimmel
9,891,398	B2	2/2018	Zimmel
9,964,726	B2	5/2018	Zimmel et al.
2001/0010741	A1	8/2001	Hizuka
2001/0029125	A1	10/2001	Morita et al.
2002/0010818	A1	1/2002	Wei et al.
2002/0012353	A1	1/2002	Gerszberg et al.
2002/0014571	A1	2/2002	Thompson
2002/0034290	A1	3/2002	Pershan
2002/0037139	A1	3/2002	Asao et al.
2002/0064364	A1	5/2002	Battey et al.
2002/0117942	A1	8/2002	Audibert et al.
2002/0131730	A1	9/2002	Keeble et al.
2002/0136519	A1	9/2002	Tinucci et al.
2002/0141724	A1	10/2002	Ogawa et al.
2002/0145858	A1	10/2002	Hayashi et al.
2002/0150370	A1	10/2002	Battey et al.
2002/0150372	A1	10/2002	Schray
2002/0172467	A1	11/2002	Anderson et al.
2002/0180163	A1	12/2002	Muller et al.
2002/0181918	A1	12/2002	Spence et al.
2002/0181922	A1	12/2002	Xin et al.
2002/0191939	A1	12/2002	Daoud et al.
2002/0194596	A1	12/2002	Srivastava
2003/0002802	A1	1/2003	Trezza et al.
2003/0007743	A1	1/2003	Asada
2003/0007767	A1	1/2003	Douglas et al.
2003/0011855	A1	1/2003	Fujiwara
2003/0021539	A1	1/2003	Kwon et al.
2003/0022552	A1	1/2003	Barker et al.
2003/0036748	A1	2/2003	Cooper et al.
2003/0047524	A1	3/2003	Sato et al.
2003/0051026	A1	3/2003	Carter et al.
2003/0066998	A1	4/2003	Lee
2003/0086675	A1	5/2003	Wu et al.
2003/0095753	A1	5/2003	Wada et al.
2003/0096536	A1	5/2003	Clark et al.
2003/0123834	A1	7/2003	Burek et al.
2003/0129871	A1	7/2003	Follingstad
2003/0133642	A1	7/2003	Pfeiffer et al.
2003/0134541	A1	7/2003	Johnsen et al.
2003/0147604	A1	8/2003	Tapia et al.
2003/0156552	A1	8/2003	Banker et al.
2003/0174996	A1	9/2003	Henschel et al.
2003/0180004	A1	9/2003	Cox et al.
2003/0180012	A1	9/2003	Deane et al.
2003/0183413	A1	10/2003	Kato
2003/0199201	A1	10/2003	Mullaney et al.
2003/0210882	A1	11/2003	Barthel et al.
2003/0223723	A1	12/2003	Massey et al.
2003/0223725	A1	12/2003	Laporte et al.
2003/0235387	A1	12/2003	Dufour
2004/0001717	A1	1/2004	Bennett et al.
2004/0008984	A1	1/2004	Gerrish et al.
2004/0013389	A1	1/2004	Taylor
2004/0013390	A1	1/2004	Kim et al.
2004/0022494	A1	2/2004	Liddle et al.
2004/0024934	A1	2/2004	Webb
2004/0038594	A1	2/2004	Clark et al.
2004/0067036	A1	4/2004	Clark et al.
2004/0074852	A1	4/2004	Knudsen et al.
2004/0086238	A1	5/2004	Finona et al.
2004/0086252	A1	5/2004	Smith et al.
2004/0120259	A1	6/2004	Jones et al.
2004/0120679	A1	6/2004	Vincent et al.
2004/0120681	A1	6/2004	Bohle et al.
2004/0147159	A1	7/2004	Urban et al.
2004/0151465	A1	8/2004	Krampotich et al.
2004/0175090	A1	9/2004	Vastmans et al.
2004/0192115	A1	9/2004	Bugg
2004/0196841	A1	10/2004	Tudor et al.
2004/0208459	A1	10/2004	Mizue et al.
2004/0219829	A1	11/2004	Clark et al.
2004/0228598	A1	11/2004	Allen et al.
2004/0240827	A1	12/2004	Daoud et al.
2004/0240882	A1	12/2004	Lipski et al.
2004/0256138	A1	12/2004	Grubish et al.
2004/0264873	A1	12/2004	Smith et al.
2005/0002633	A1	1/2005	Solheid et al.
2005/0008131	A1	1/2005	Cook
2005/0025444	A1	2/2005	Barnes et al.
2005/0026497	A1	2/2005	Holliday
2005/0036749	A1	2/2005	Vogel et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2005/0041947 A1 2/2005 Barker et al.
2005/0067358 A1 3/2005 Lee et al
2005/0069248 A1 3/2005 Jasti et al.
2005/0074990 A1 4/2005 Shearman et al.
2005/0076149 A1 4/2005 McKown et al.
2005/0083959 A1 4/2005 Binder
2005/0103515 A1 5/2005 Fuller et al.
2005/0107086 A1 5/2005 Tell et al.
2005/0111809 A1 5/2005 Giraud et al.
2005/0123261 A1 6/2005 Bellekens et al.
2005/0129379 A1 6/2005 Reagan et al.
2005/0142910 A1 6/2005 Levesque et al.
2005/0142932 A1 6/2005 Levesque et al.
2005/0178573 A1 8/2005 James
2005/0185912 A1 8/2005 Levesque et al.
2005/0191901 A1 9/2005 Follingstad
2005/0201073 A1 9/2005 Pincu et al.
2005/0215112 A1 9/2005 Barker et al.
2005/0232566 A1 10/2005 Rapp et al.
2005/0233647 A1 10/2005 Denovich et al.
2005/0237721 A1 10/2005 Cowley et al
2005/0254757 A1 11/2005 Ferretti, III et al.
2005/0265013 A1 12/2005 Keith et al.
2005/0281526 A1 12/2005 Vongseng et al.
2005/0285493 A1 12/2005 Hu et al.
2006/0007562 A1 1/2006 Willey et al.
2006/0018448 A1 1/2006 Stevens et al.
2006/0018622 A1 1/2006 Caveney
2006/0025011 A1 2/2006 Follingstad
2006/0029353 A1 2/2006 Bolster et al.
2006/0034048 A1 2/2006 Xu
2006/0039290 A1 2/2006 Roden et al.
2006/0044774 A1 3/2006 Vasavda et al.
2006/0045458 A1 3/2006 Sasaki et al.
2006/0062538 A1 3/2006 Araki et al.
2006/0063421 A1 3/2006 Barker et al.
2006/0072606 A1 4/2006 Posthuma
2006/0077968 A1 4/2006 Pitsoulakis et al.
2006/0093303 A1 5/2006 Reagan et al.
2006/0103270 A1 5/2006 Bergesch et al.
2006/0127026 A1 6/2006 Beck
2006/0133736 A1 6/2006 Sullivan
2006/0133759 A1 6/2006 Mullaney et al.
2006/0134972 A1 6/2006 Barker et al.
2006/0147171 A1 7/2006 Dofher
2006/0147172 A1 7/2006 Luther et al.
2006/0153517 A1 7/2006 Reagan et al.
2006/0154513 A1 7/2006 Barker et al.
2006/0160377 A1 7/2006 Huang
2006/0165365 A1 7/2006 Feustel et al.
2006/0165366 A1 7/2006 Feustel et al.
2006/0191700 A1 8/2006 Herzog et al.
2006/0193590 A1 8/2006 Puetz et al.
2006/0193591 A1 8/2006 Rapp et al.
2006/0194470 A1 8/2006 Caveney
2006/0194471 A1 8/2006 Clark et al.
2006/0198098 A1 9/2006 Clark et al.
2006/0204179 A1 9/2006 Patel et al.
2006/0215980 A1 9/2006 Bayazit et al.
2006/0225912 A1 10/2006 Clark et al.
2006/0228087 A1 10/2006 Bayazit et al.
2006/0228940 A1 10/2006 Follingstad
2006/0269194 A1 11/2006 Luther et al.
2006/0269205 A1 11/2006 Zimmel
2006/0269206 A1 11/2006 Zimmel
2006/0269208 A1 11/2006 Allen et al.
2006/0275008 A1 12/2006 Xin
2006/0275009 A1 12/2006 Ellison et al.
2006/0285812 A1 12/2006 Ferris et al.
2007/0003204 A1 1/2007 Makrides-Saravanos et al.
2007/0020991 A1 1/2007 Murano
2007/0025070 A1 2/2007 Jiang et al.
2007/0031099 A1 2/2007 Herzog et al.
2007/0033629 A1 2/2007 McGranahan et al.
2007/0047891 A1 3/2007 Bayazit et al.
2007/0047893 A1 3/2007 Kramer et al.
2007/0047894 A1 3/2007 Holmberg et al.
2007/0047896 A1 3/2007 Kowalczyk et al.
2007/0053385 A1 3/2007 Tollbom
2007/0058641 A1 3/2007 Cicchetti et al.
2007/0086723 A1 4/2007 Sasaki et al.
2007/0104447 A1 5/2007 Allen
2007/0110373 A1 5/2007 Dudek et al.
2007/0131628 A1 6/2007 Mimlitch, III et al.
2007/0183732 A1 8/2007 Wittmeier et al.
2007/0189692 A1 8/2007 Zimmel et al.
2007/0190853 A1 8/2007 Caveney
2007/0196071 A1 8/2007 Laursen et al.
2007/0221793 A1 9/2007 Kusuda et al.
2007/0237484 A1 10/2007 Reagan et al.
2007/0257159 A1 11/2007 Nelson et al.
2007/0266192 A1 11/2007 Campini et al.
2007/0274718 A1 11/2007 Bridges et al.
2007/0298652 A1 12/2007 Clark et al.
2008/0009182 A1 1/2008 Follingstad
2008/0011514 A1 1/2008 Zheng et al.
2008/0025683 A1 1/2008 Murano
2008/0031585 A1 2/2008 Solheid et al.
2008/0037209 A1 2/2008 Niazi et al.
2008/0063350 A1 3/2008 Trebesch et al.
2008/0068788 A1 3/2008 Ozawa et al.
2008/0069511 A1 3/2008 Blackwell, Jr. et al.
2008/0069512 A1 3/2008 Barnes et al.
2008/0078899 A1 4/2008 Chen et al.
2008/0080826 A1 4/2008 Leon et al.
2008/0080827 A1 4/2008 Leon et al.
2008/0080828 A1 4/2008 Leon et al.
2008/0085092 A1 4/2008 Barnes
2008/0085094 A1 4/2008 Krampotich
2008/0089656 A1 4/2008 Wagner et al.
2008/0095502 A1 4/2008 McColloch
2008/0095541 A1 4/2008 Dallesasse
2008/0100440 A1 5/2008 Downie et al.
2008/0106871 A1 5/2008 James
2008/0108253 A1 5/2008 Clark et al.
2008/0112681 A1 5/2008 Battey et al.
2008/0115956 A1 5/2008 Fransen et al.
2008/0118207 A1 5/2008 Yamamoto et al.
2008/0121423 A1 5/2008 Vogel et al.
2008/0124039 A1 5/2008 Gniadek et al.
2008/0131068 A1 6/2008 Mertesdorf et al.
2008/0145011 A1 6/2008 Register
2008/0145013 A1 6/2008 Escoto et al.
2008/0146079 A1 6/2008 Spisany et al.
2008/0152294 A1 6/2008 Hirano et al.
2008/0166094 A1 7/2008 Bookbinder et al.
2008/0166131 A1 7/2008 Hudgins et al.
2008/0175541 A1 7/2008 Lu et al.
2008/0175550 A1 7/2008 Coburn et al.
2008/0175551 A1 7/2008 Smrha et al.
2008/0175552 A1 7/2008 Smrha et al.
2008/0193091 A1 8/2008 Herbst
2008/0205823 A1 8/2008 Luther et al.
2008/0205843 A1 8/2008 Castonguay et al.
2008/0205844 A1 8/2008 Castonguay et al.
2008/0212928 A1 9/2008 Kowalczyk et al.
2008/0219632 A1 9/2008 Smith et al.
2008/0219634 A1 9/2008 Rapp et al.
2008/0236858 A1 10/2008 Quijano
2008/0240653 A1 10/2008 King et al.
2008/0247723 A1 10/2008 Herzog et al.
2008/0267573 A1 10/2008 Douglas et al.
2008/0285934 A1 11/2008 Standish et al.
2008/0292261 A1 11/2008 Kowalczyk et al.
2008/0296060 A1 12/2008 Hawley et al.
2008/0298763 A1 12/2008 Appenzeller et al.
2008/0310810 A1 12/2008 Gallagher
2009/0010607 A1 1/2009 Elisson et al.
2009/0016685 A1 1/2009 Hudgins et al.
2009/0022470 A1 1/2009 Krampotich
2009/0034912 A1 2/2009 Sepe, Jr.
2009/0038845 A1 2/2009 Fransen et al.
2009/0060439 A1 3/2009 Cox et al.
2009/0060440 A1 3/2009 Wright et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2009/0067800	A1	3/2009	Vazquez et al.
2009/0074371	A1	3/2009	Bayazit et al.
2009/0080849	A1	3/2009	Hankins et al.
2009/0097813	A1	4/2009	Hill
2009/0110347	A1	4/2009	Jacobsson
2009/0110391	A1	4/2009	Matityahu et al.
2009/0121092	A1	5/2009	Keith
2009/0129033	A1	5/2009	Smrha et al.
2009/0136194	A1	5/2009	Barnes
2009/0136195	A1	5/2009	Smrha et al.
2009/0136196	A1	5/2009	Trebesch et al.
2009/0146342	A1	6/2009	Haney et al.
2009/0148117	A1	6/2009	Laurisch
2009/0166404	A1	7/2009	German et al.
2009/0169163	A1	7/2009	Abbott, III et al.
2009/0175588	A1	7/2009	Brandt et al.
2009/0180737	A1	7/2009	Burnham et al.
2009/0180749	A1	7/2009	Douglas et al.
2009/0184221	A1	7/2009	Sculler
2009/0185782	A1	7/2009	Parikh et al.
2009/0191891	A1	7/2009	Ma et al.
2009/0194647	A1	8/2009	Keith
2009/0196563	A1	8/2009	Mullsteff et al.
2009/0202214	A1	8/2009	Holmberg et al.
2009/0207577	A1	8/2009	Fransen et al.
2009/0208178	A1	8/2009	Kowalczyk et al.
2009/0208210	A1	8/2009	Trojer et al.
2009/0212679	A1	8/2009	Frousiakis et al.
2009/0214171	A1	8/2009	Coburn et al.
2009/0220200	A1	9/2009	Wong et al.
2009/0220204	A1	9/2009	Ruiz
2009/0226142	A1	9/2009	Barnes et al.
2009/0238531	A1	9/2009	Holmberg et al.
2009/0245743	A1	10/2009	Cote et al.
2009/0252472	A1	10/2009	Solheid et al.
2009/0257718	A1	10/2009	Nishimura et al.
2009/0257726	A1	10/2009	Redmann et al.
2009/0257727	A1	10/2009	Laurisch et al.
2009/0257754	A1	10/2009	Theodoras, II et al.
2009/0263096	A1	10/2009	Solheid et al.
2009/0263122	A1	10/2009	Helkey et al.
2009/0267865	A1	10/2009	Miller et al.
2009/0269016	A1	10/2009	Korampally et al.
2009/0269018	A1	10/2009	Frohlich et al.
2009/0269019	A1	10/2009	Andrus et al.
2009/0274429	A1	11/2009	Krampotich et al.
2009/0274430	A1	11/2009	Krampotich et al.
2009/0274432	A1	11/2009	Iwaya
2009/0290842	A1	11/2009	Bran de Leon et al.
2009/0290843	A1	11/2009	Reagan et al.
2009/0297099	A1	12/2009	Benjamin et al.
2009/0297111	A1	12/2009	Reagan et al.
2009/0304342	A1	12/2009	Adomeit et al.
2009/0324189	A1	12/2009	Hill et al.
2010/0003000	A1	1/2010	Rapp et al.
2010/0012671	A1	1/2010	Vrondran et al.
2010/0027953	A1	2/2010	Russell
2010/0054681	A1	3/2010	Biribuze et al.
2010/0054682	A1	3/2010	Cooke et al.
2010/0054683	A1	3/2010	Cooke et al.
2010/0054684	A1	3/2010	Cooke et al.
2010/0054685	A1	3/2010	Cooke et al.
2010/0054686	A1	3/2010	Cooke et al.
2010/0054687	A1	3/2010	Ye et al.
2010/0061693	A1	3/2010	Bran de Leon et al.
2010/0074587	A1	3/2010	Loeffelholz et al.
2010/0080517	A1	4/2010	Cline et al.
2010/0086267	A1	4/2010	Cooke et al.
2010/0086274	A1	4/2010	Keith
2010/0111483	A1	5/2010	Reinhardt et al.
2010/0119201	A1	5/2010	Smrha et al.
2010/0129035	A1	5/2010	Teo
2010/0142544	A1	6/2010	Chapel et al.
2010/0142910	A1	6/2010	Hill et al.
2010/0150518	A1	6/2010	Leon et al.
2010/0158467	A1	6/2010	Hou et al.
2010/0166377	A1	7/2010	Nair et al.
2010/0178022	A1	7/2010	Schroeder et al.
2010/0183270	A1	7/2010	Davis et al.
2010/0202740	A1	8/2010	Barlowe et al.
2010/0202745	A1	8/2010	Sokolowski et al.
2010/0202748	A1	8/2010	Pierce et al.
2010/0215330	A1	8/2010	Sokolowski et al.
2010/0220967	A1	9/2010	Cooke et al.
2010/0220968	A1	9/2010	Dagley et al.
2010/0239210	A1	9/2010	Wakileh et al.
2010/0247051	A1	9/2010	Kowalczyk et al.
2010/0266245	A1	10/2010	Sabo
2010/0278499	A1	11/2010	Mures et al.
2010/0296790	A1	11/2010	Cooke et al.
2010/0296791	A1	11/2010	Makrides-Saravanos et al.
2010/0310225	A1	12/2010	Anderson et al.
2010/0310226	A1	12/2010	Wakileh et al.
2010/0316334	A1	12/2010	Kewitsch
2010/0322554	A1	12/2010	Barnes et al.
2010/0322579	A1	12/2010	Cooke et al.
2010/0322580	A1	12/2010	Beamon et al.
2010/0322581	A1	12/2010	Cooke et al.
2010/0322582	A1	12/2010	Cooke et al.
2010/0322583	A1	12/2010	Cooke et al.
2010/0329624	A1	12/2010	Zhou et al.
2011/0008004	A1	1/2011	Liao et al.
2011/0058786	A1	3/2011	Zimmel
2011/0069931	A1	3/2011	Cote et al.
2011/0073730	A1	3/2011	Kitchen
2011/0085774	A1	4/2011	Murphy et al.
2011/0085776	A1	4/2011	Biribuze et al.
2011/0097053	A1	4/2011	Smith et al.
2011/0097977	A1	4/2011	Bubnick et al.
2011/0129185	A1	6/2011	Lewallen et al.
2011/0129186	A1	6/2011	Lewallen et al.
2011/0186532	A1	8/2011	Wu
2011/0192631	A1	8/2011	Burek et al.
2011/0211799	A1	9/2011	Conner et al.
2011/0217014	A1	9/2011	Dominique
2011/0217016	A1	9/2011	Mullsteff
2011/0222821	A1	9/2011	Pitwon et al.
2011/0235985	A1	9/2011	Cote et al.
2011/0249950	A1	10/2011	Chapa Ramirez et al.
2011/0262096	A1	10/2011	Fabrykowski et al.
2011/0268404	A1	11/2011	Cote et al.
2011/0268405	A1	11/2011	Cote et al.
2011/0268406	A1	11/2011	Giraud et al.
2011/0268407	A1	11/2011	Cowen et al.
2011/0268408	A1	11/2011	Giraud et al.
2011/0268409	A1	11/2011	Giraud et al.
2011/0268410	A1	11/2011	Giraud et al.
2011/0268411	A1	11/2011	Giraud et al.
2011/0268412	A1	11/2011	Giraud et al.
2011/0268413	A1	11/2011	Cote et al.
2011/0268414	A1	11/2011	Giraud et al.
2011/0274402	A1	11/2011	Giraud et al.
2011/0280535	A1	11/2011	Womack
2011/0280537	A1	11/2011	Cowen et al.
2012/0020629	A1	1/2012	Shiratori et al.
2012/0025683	A1	2/2012	Mattlin et al.
2012/0051707	A1	3/2012	Barnes et al.
2012/0057836	A1	3/2012	Andrzejewski et al.
2012/0057838	A1	3/2012	Hill et al.
2012/0106897	A1	5/2012	Cline et al.
2012/0106899	A1	5/2012	Choi
2012/0106911	A1	5/2012	Cooke et al.
2012/0134639	A1	5/2012	Giraud et al.
2012/0183263	A1	7/2012	Wu
2012/0183289	A1	7/2012	Lou et al.
2012/0219263	A1	8/2012	Beamon et al.
2012/0288244	A1	11/2012	Wu et al.
2012/0288248	A1	11/2012	Chapa Ramirez et al.
2012/0301083	A1	11/2012	Carter et al.
2013/0004136	A1	1/2013	Brower et al.
2013/0056599	A1	3/2013	Baker et al.
2013/0058616	A1	3/2013	Cote et al.
2013/0072053	A1	3/2013	Fabrykowski et al.
2013/0077927	A1	3/2013	O'Connor

(56) **References Cited**

U.S. PATENT DOCUMENTS

2013/0134115 A1	5/2013	Hernandez-Ariguznaga
2013/0214108 A1	8/2013	Irudayaraj et al
2013/0243386 A1	9/2013	Pimentel et al.
2013/0251326 A1	9/2013	Cooke et al.
2013/0266282 A1	10/2013	Cote et al.
2013/0308908 A1	11/2013	Isenhour et al.
2013/0308915 A1	11/2013	Buff et al.
2013/0308916 A1	11/2013	Buff et al.
2013/0328258 A1	12/2013	Mutsuno
2014/0003782 A1	1/2014	Blackwell, Jr. et al.
2014/0010510 A1	1/2014	Blackard
2014/0029907 A1	1/2014	Isenhour et al.
2014/0037251 A1	2/2014	Isenhour et al.
2014/0079366 A1	3/2014	Rodriguez et al.
2014/0112628 A1	4/2014	Keenum et al.
2014/0226946 A1	8/2014	Cooke et al.
2015/0027967 A1	1/2015	Vazquez et al.
2015/0185429 A1	7/2015	Cooke et al.
2017/0038549 A1	2/2017	Smrha et al.
2017/0131504 A1	5/2017	Cooke et al.
2017/0131505 A1	5/2017	Cooke et al.
2017/0131506 A1	5/2017	Cooke et al.
2017/0131508 A1	5/2017	Cooke et al.
2017/0160505 A1	6/2017	Cooke et al.

FOREIGN PATENT DOCUMENTS

CA	2186314 A1	4/1997
CA	2765835 A1	1/2011
CH	688705 A5	1/1998
CN	1471649 A	1/2004
CN	1690745 A	11/2005
CN	2849745 Y	12/2006
CN	102460258 A	5/2012
CN	202693880 U	1/2013
DE	8711970 U1	10/1987
DE	3726718 A1	2/1989
DE	3726719 A1	2/1989
DE	4030301 A1	3/1992
DE	4112871 A1	10/1992
DE	4231181 C1	8/1993
DE	4321815 A1	1/1995
DE	20115940 U1	1/2002
DE	10338848 A1	3/2005
DE	202005009932 U1	11/2005
DE	202007000556 U1	10/2007
DE	102007024476 A1	11/2008
DE	202010009385 U1	9/2010
EP	29512 A1	6/1981
EP	0105597 A2	4/1984
EP	0250900 A2	1/1988
EP	0349290 A1	1/1990
EP	0408266 A2	1/1991
EP	0474091 A1	8/1991
EP	0468671 A1	1/1992
EP	0490698 A1	6/1992
EP	0529830 A1	3/1993
EP	0544004 A1	6/1993
EP	0547778 A1	6/1993
EP	0581527 A1	2/1994
EP	0620462 A1	10/1994
EP	0693699 A1	1/1996
EP	0720322 A2	7/1996
EP	0730178 A2	9/1996
EP	0776557 B1	6/1997
EP	0940700 A2	9/1999
EP	0949522 A2	10/1999
EP	1041417 A2	10/2000
EP	1056177 A1	11/2000
EP	1065542 A1	1/2001
EP	1162485 A2	12/2001
EP	1203974 A2	5/2002
EP	1280363 A2	1/2003
EP	1289319 A2	3/2003
EP	1310816 A2	5/2003
EP	1316829 A2	6/2003
EP	1367308 A1	12/2003
EP	1621907 A1	2/2006
EP	1557061 B1	3/2006
EP	1777563 A1	4/2007
EP	2060942 A2	5/2009
EP	2159613 A2	3/2010
FR	1586331 A	2/1970
FR	2123728 A5	9/1972
FR	2378378 A1	8/1978
GB	2241591 A	9/1991
GB	2277812 A	11/1994
GB	2367379 A	4/2002
GB	2377839 A	1/2003
JP	3060994 A	3/1991
JP	3172806 A	7/1991
JP	3281378 A	12/1991
JP	5045541 A	2/1993
JP	06018749 A	1/1994
JP	7308011 A	11/1995
JP	7318761 A	12/1995
JP	8007308 A	1/1996
JP	8248235 A	9/1996
JP	8248237 A	9/1996
JP	3487946 A	10/1996
JP	8254620 A	10/1996
JP	H09178998 A	7/1997
JP	H09197139 A	7/1997
JP	3279474 A	10/1997
JP	9258033 A	10/1997
JP	9258055 A	10/1997
JP	2771870 B2	7/1998
JP	3448448 A	8/1998
JP	10227919 A	8/1998
JP	3478944 A	12/1998
JP	10332945 A	12/1998
JP	10339817 A	12/1998
JP	11023858 A	1/1999
JP	H11202146 A	7/1999
JP	2000098138 A	4/2000
JP	2000098139 A	4/2000
JP	2000241631 A	9/2000
JP	2001004849 A	1/2001
JP	3160322 B2	4/2001
JP	2001119177 A	4/2001
JP	2001133636 A	5/2001
JP	3173962 B2	6/2001
JP	3176906 B2	6/2001
JP	2001154030 A	6/2001
JP	2001159714 A	6/2001
JP	2002022974 A	1/2002
JP	2002032153 A	1/2002
JP	2002077236 A	3/2002
JP	2002116337 A	4/2002
JP	2002169035 A	6/2002
JP	3312893 B2	8/2002
JP	2002305389 A	10/2002
JP	3344701 B2	11/2002
JP	2003029054 A	1/2003
JP	3403573 B2	5/2003
JP	2003149458 A	5/2003
JP	2003169026 A	6/2003
JP	2003215353 A	7/2003
JP	2003344701 A	12/2003
JP	2004086060 A	3/2004
JP	3516765 B2	4/2004
JP	2004118091 A	4/2004
JP	2004144808 A	5/2004
JP	2004514931 A	5/2004
JP	3542939 B2	7/2004
JP	2004246147 A	9/2004
JP	2004361652 A	12/2004
JP	2004361890 A	12/2004
JP	2004361893 A	12/2004
JP	3107704 U	2/2005
JP	2005055748 A	3/2005
JP	2005062569 A	3/2005
JP	2005084241 A	3/2005
JP	2005148327 A	6/2005

(56) **References Cited**

FOREIGN PATENT DOCUMENTS

JP	2005165158 A	6/2005
JP	2005181600 A	7/2005
JP	2005257937 A	9/2005
JP	2005338618 A	12/2005
JP	2006507606 A	3/2006
JP	3763645 B2	4/2006
JP	3778021 B2	5/2006
JP	2006126513 A	5/2006
JP	2006126516 A	5/2006
JP	3794540 B2	7/2006
JP	2006227041 A1	8/2006
JP	3833638 B2	10/2006
JP	2006276782 A	10/2006
JP	2006292924 A	10/2006
JP	3841344 B2	11/2006
JP	3847533 B2	11/2006
JP	200747336 A	2/2007
JP	3896035 B2	3/2007
JP	2007067458 A1	3/2007
JP	2007093760 A	4/2007
JP	2007511959 A	5/2007
JP	3934052 B2	6/2007
JP	2007179046 A	7/2007
JP	3964191 B2	8/2007
JP	3989853 B2	10/2007
JP	4026244 B2	12/2007
JP	2007324441 A	12/2007
JP	4029494 B2	1/2008
JP	4065223 B2	3/2008
JP	4093475 B2	6/2008
JP	4105696 B2	6/2008
JP	4112437 B2	7/2008
JP	4118862 B2	7/2008
JP	2008176118 A1	7/2008
JP	2008180817 A1	8/2008
JP	2008533583 A	8/2008
JP	4184329 B2	11/2008
JP	2008271017 A	11/2008
JP	2008542822 T	11/2008
JP	2009503582 T	1/2009
JP	2009515242 A	4/2009
JP	2009115962 A	5/2009
JP	2009229506 A	10/2009
JP	2012065019 A	3/2012
KR	20110037404 A	4/2011
WO	9000261 A1	1/1990
WO	9105281 A1	4/1991
WO	9326070 A1	12/1993
WO	9520175 A1	7/1995
WO	9636896 A1	11/1996
WO	9638752 A1	12/1996
WO	9712268 A1	4/1997
WO	9722025 A1	6/1997
WO	9736197 A1	10/1997
WO	9744605 A1	11/1997
WO	9825416 A1	6/1998
WO	9927404 A1	6/1999
WO	9959295 A1	11/1999
WO	9963628 A1	12/1999
WO	0005611 A2	2/2000
WO	0127660 A2	4/2001
WO	0130007 A2	4/2001
WO	0180596 A1	10/2001
WO	0242818 A1	5/2002
WO	03009527 A2	1/2003
WO	2003014943 A1	2/2003
WO	03044902 A1	5/2003
WO	2004041525 A2	5/2004
WO	2004052066 A1	6/2004
WO	2005020400 A1	3/2005
WO	2005069448 A1	7/2005
WO	2005091030 A1	9/2005
WO	2005107275 A1	11/2005
WO	2006012389 A1	2/2006
WO	2006076062 A	7/2006
WO	2006091850 A1	8/2006
WO	2006108024 A1	10/2006
WO	2006127400 A2	11/2006
WO	2007050515 A1	5/2007
WO	2007079074 A2	7/2007
WO	2007089682 A2	8/2007
WO	2007149215 A2	12/2007
WO	2008027201 A2	3/2008
WO	2008063054 A2	5/2008
WO	2008074013 A2	6/2008
WO	2008113054 A2	9/2008
WO	2008157248 A1	12/2008
WO	2009026688 A1	3/2009
WO	2009029485 A1	3/2009
WO	2009030360 A1	3/2009
WO	2009032245 A1	3/2009
WO	2009091465 A2	7/2009
WO	2009120280 A2	10/2009
WO	2010024842 A1	3/2010
WO	2010024847 A2	3/2010
WO	2010036549 A1	4/2010
WO	2010080745 A1	7/2010
WO	2011005461 A1	1/2011

OTHER PUBLICATIONS

Notice of Allowance for U.S. Appl. No. 12/323,423 dated Jan. 24, 2012, 8 pages.

Examiner's Answer dated Mar. 4, 2011, for U.S. Appl. No. 12/323,415, 11 pages.

Final Rejection dated Jun. 25, 2010, for U.S. Appl. No. 12/323,415, 10 pages.

Non-Final Rejection dated Aug. 5, 2011, for U.S. Appl. No. 12/323,415, 41 pages.

Non-final Office Action for U.S. Appl. No. 12/323,415 dated Apr. 23, 2012, 11 pages.

Non-Final Rejection dated Dec. 10, 2009, for U.S. Appl. No. 12/323,415, 7 pages.

Examiner's Answer to Appeal Brief for U.S. Appl. No. 11/320,062 dated Dec. 8, 2011, 8 pages.

Final Office Action for U.S. Appl. No. 11/320,062 dated Mar. 8, 2011, 8 pages.

Non-final Office Action for U.S. Appl. No. 11/320,062 dated Jan. 15, 2010, 11 pages.

Non-final Office Action for U.S. Appl. No. 12/320,062 dated Sep. 30, 2010, 7 pages.

Final Office Action for U.S. Appl. No. 11/439,086 dated Feb. 4, 2010, 14 pages.

Non-final Office Action for U.S. Appl. No. 11/439,086 dated May 3, 2010, 11 pages.

Non-final Office Action for U.S. Appl. No. 11/439,086 dated Sep. 21, 2009, 10 pages.

Final Office Action for U.S. Appl. No. 12/079,481 dated Mar. 18, 2010, 10 pages.

Non-final Office Action for U.S. Appl. No. 12/079,481 dated Dec. 26, 2008, 9 pages.

Non-final Office Action for U.S. Appl. No. 12/079,481 dated Sep. 16, 2009, 10 pages.

Notice of Allowance for U.S. Appl. No. 12/079,481 dated Jun. 3, 2010, 6 pages.

Notice of Allowance for U.S. Appl. No. 12/079,481 dated Oct. 4, 2010, 4 pages.

Final Office Action for U.S. Appl. No. 12/394,114 dated Dec. 22, 2011, 8 pages.

Non-final Office Action for U.S. Appl. No. 12/394,114 dated Mar. 16, 2012, 8 pages.

Non-final Office Action for U.S. Appl. No. 12/394,114 dated Sep. 1, 2011, 7 pages.

Non-final Office Action for U.S. Appl. No. 12/323,373 dated May 3, 2012, 7 pages.

Non-final Office Action for U.S. Appl. No. 11/809,474 dated Apr. 8, 2008, 13 pages.

Non-final Office Action for U.S. Appl. No. 11/809,474 dated Nov. 13, 2008, 10 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Notice of Allowance for U.S. Appl. No. 11/809,474 dated Jul. 6, 2009, 6 pages.
Final Office Action for U.S. Appl. No. 11/320.031 dated Mar. 8, 2011, 8 pages.
Non-final Office Action for U.S. Appl. No. 11/320,031 dated Jan. 5, 2010, 16 pages.
Non-final Office Action for U.S. Appl. No. 11/320,031 dated Sep. 30, 2010, 7 pages.
Notice of Allowance for U.S. Appl. No. 11/320,031 dated Nov. 15, 2011, 7 pages.
Non-final Office Action for U.S. Appl. No. 12/157,622 dated Mar. 31, 2009, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/157,622 dated Oct. 15, 2009, 9 pages.
Notice of Allowance for U.S. Appl. No. 12/157,622 dated Apr. 22, 2010, 4 pages.
Non-final Office Action for U.S. Appl. No. 12/323,395 dated Dec. 8, 2011, 7 pages.
Non-final Office Action for U.S. Appl. No. 12/415,454 dated Mar. 2, 2012, 5 pages.
Non-final Office Action for U.S. Appl. No. 12/415,454 dated Sep. 6. 2011, 7 pages.
Notice of Allowance for U.S. Appl. No. 12/415,454 dated Jan. 13, 2012, 5 pages.
Non-final Office Action for U.S. Appl. No. 12/576,769 dated Feb. 2, 2012, 23 pages.
Notice of Allowance for U.S. Appl. No. 12/415,454 dated Jun. 19, 2012, 5 pages.
Non-final Office Action for U.S. Appl. No. 13/603.894 dated Oct. 3, 2013, 9 pages.
International Search Report for PCT/US2009/066779 dated Aug. 27, 2010, 3 pages.
"MPO Fiber Optic Rack Panels now available from L-com Connectivity Products," article dated Jun. 4, 2007, 16 pages, http://www.l-com.com/content/Article.aspx?Type=P&ID=438.
"19" Rack Panel with 16 MPO Fiber Optic Couplers—1U high," product page, accessed Oct. 23, 2012, 2 pages, http://www.l-com.com/item.aspx?id=9767#.UlbgG8XXay5.
"Drawing for L-com 1U Panel with 16 MTP couplers." May 15, 2007, 1 page, http://www.l-com.com/multimedia/eng_drawings/PR17516MTP.pdf.
"RapidNet Fibre MTP VHD Cassette," Brochure, Date Unknown, 1 page, http://www.hellermanntyton.se/documents/5000/576_fiber_1U.pdf.
"MPO for Gigabit Ethernet/FAS-NET MTP Solution," Brochure, Date Unknown, 11 pages, http://www.infinique.com/upload/13182286190.pdf.
"Hubbell OptiChannel High Density 144 Port 1U Fiber Enclosure," Brochure, Date Unknown, 2 pages, http://www.hubbell-premise.com/literature/PLDF010.pdf.
Non-final Office Action for U.S. Appl. No. 12/771,473 dated Oct. 4, 2012, 6 pages.
Non-final Office Action for U.S. Appl. No. 12/819,081 dated Aug. 21, 2012, 12 pages.
International Search Report for PCT/US2010/038986 dated Aug. 18, 2010, 1 page.
International Search Report for PCT/US2012/023622 dated Mar. 9, 2012, 4 pages.
International Search Report for PCT/US2012/023635 dated Sep. 14, 2012, 3 pages.
International Search Report for PCT/US2012/023626 dated May 22, 2012, 4 pages.
Notice of Allowance for U.S. Appl. No. 13/951,916 dated Dec. 16, 2013, 12 pages.
International Preliminary Report on Patentability for PCT/US2012/052958 dated Mar. 13, 2014, 14 pages.
Non-final Office Action for U.S. Appl. No. 12/947,883 dated Sep. 6, 2013, 9 pages.
Final Office Action for U.S. Appl. No. 12/947,883 dated Mar. 31, 2014, 13 pages.
International Search Report for PCT/US2011/030446 dated Jul. 14, 2011, 2 pages.
International Search Report for PCT/US2011/030448 dated Jul. 20, 2011, 2 pages.
International Search Report for PCT/US2011/030466 dated Aug. 5, 2011, 2 pages.
International Search Report for PCT/US2012/052958 dated Mar. 1, 2013, 7 pages
International Search Report for PCT/US2013/041266 dated Aug. 20, 2013, 4 pages.
Non-final Office Action for U.S. Appl. No. 13/621,958 dated Feb. 13, 2014, 10 pages.
Non-final Office Action for U.S. Appl. No. 13/649,417 dated Feb. 13, 2014, 10 pages.
Non-final Office Action for U.S. Appl. No. 13/663,949 dated Feb. 3, 2014, 19 pages.
Non-final Office Action for U.S. Appl. No. 12/953,003 dated Apr. 14, 2014, 13 pages.
Non-final Office Action for U.S. Appl. No. 12/953,039 dated Apr. 15, 2014, 8 pages.
Final Office Action for U.S. Appl. No. 12/946,139 dated Apr. 22, 2014, 18 pages.
Final Office Action for U.S. Appl. No. 13/597,549 dated Apr. 24, 2014, 10 pages.
Final Office Action for U.S. Appl. No. 13/901,074 dated May 9, 2014, 7 pages.
Notice of Panel Decision for Pre-Appeal Brief for U.S. Appl. No. 12/417,325 dated Aug. 8, 2012, 2 pages.
Advisory Action for U.S. Appl. No. 12/417,325 dated Jun. 29, 2012, 3 pages.
Advisory Action for U.S. Appl. No. 12/417,325 dated Jun. 12, 2012, 3 pages.
Final Office Action for U.S. Appl. No. 12/417,325 dated Apr. 16, 2012, 6 pages.
Final Office Action for U.S. Appl. No. 12/417,325 dated Feb. 7, 2012, 7 pages.
Non-final Office Action for U.S. Appl. No. 12/417,325 dated Jun. 15, 2011, 6 pages.
Notice of Allowance for U.S. Appl. No. 12/487,929 dated Sep. 12, 2012, 4 pages.
Notice of Allowance for U.S. Appl. No. 12/487,929 dated Jun. 13, 2012, 8 pages.
Advisory Action for U.S. Appl. No. 12/487,929 dated Apr. 17, 2012, 3 pages.
Final Office Action for U.S. Appl. No. 12/487,929 dated Feb. 14, 2012, 6 pages.
Final Office Action for U.S. Appl. No. 12/487,929 dated Dec. 5, 2011, 7 pages.
Non-final Office Action for U.S. Appl. No. 12/487,929 dated May 23, 2011, 7 pages.
Notice of Allowance for U S. Appl. No. 12/415,253 dated Mar. 11, 2011, 7 pages.
Non-final Office Action for U.S. Appl. No. 12/415,253 dated Jul. 12, 2010, 11 pages.
Final Office Action for U.S. Appl. No. 12/415,253 dated Apr. 16, 2010, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/415,253 dated Sep. 30. 2009, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/641,617 dated Oct. 5, 2012, 21 pages.
Final Office Action for U.S. Appl. No. 12/630,938 dated Jun. 1, 2012, 18 pages.
Non-final Office Action for U.S. Appl. No. 12/630,938 dated Dec. 19, 2011, 15 pages
Non-final Office Action for U.S. Appl. No. 12/751,884 dated Jul. 2, 2012, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/871,052 dated Aug. 13, 2012, 8 pages.
Decision on Appeal for U.S. Appl. No. 12/221,117 dated Jul. 1, 2014. 7 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Notice of Allowance for U.S. Appl. No. 12/221,117 dated Jul. 16, 2014, 7 pages.
Final Office Action for U.S. Appl. No. 13/081,856 dated Jul. 2, 2014, 8 pages.
Final Office Action for U.S. Appl. No. 12/818,986 dated Jul. 18, 2014, 27 pages.
Non-final Office Action for U.S. Appl. No. 12/819,065 dated Jul. 18, 2014, 10 pages.
Notice of Allowance for U.S. Appl. No. 13/455,646 dated Jun. 2, 2014, 9 pages.
Notice of Allowance for U.S. Appl. No. 13/597,549 dated Jul. 8, 2014, 8 pages.
Notice of Allowance for U.S. Appl. No. 13/533,093 dated Jul. 8, 2014, 9 pages.
Notice of Allowance for U.S. Appl. No. 13/688,675 dated Jan. 26, 2015, 7 pages.
Final Office Action for U.S. Appl. No. 13/649,417 dated Jun. 25, 2014, 9 pages.
Notice of Allowance for U.S. Appl. No. 13/649,417 dated Sep. 8, 2014, 7 pages.
Non-final Office Action for U.S. Appl. No. 12/956,446 dated Dec. 5, 2014, 12 pages.
Advisory Action for U.S. Appl. No. 13/663,975 dated Dec. 24, 2014, 7 pages.
Author Unknown, "Living Hinge—From Wikipedia, the free encyclopedia," Retrieved from the internet on Mar. 19, 2015. http://en.eikipedia.org/wiki/Living_Hinge, 3 pages.
Bigo, Sebastien, et al., "10.2Tbit/s (256x42.7Gbit/s PDM/WDM) transmission over 100km TeraLight fiber with 1.28 bit/s/Hz spectral efficiency," Optical Fiber Communication Conference, Mar. 17-22, 2001, 3 pages.
McEachern, "Gigabit Networking on the Public Transmission Network," IEEE Communications Magazine, Apr. 1992, IEEE, pp. 70-78.
Author Unknown, "U-Space System for Brocade 48000," Product Specifications, LAN-904-EN, Apr. 2008, Communications Supply Corporation, pp. 1-16.
Patent Examination Report No. 1 for Australian Patent Application No. 2015242945, dated Sep. 1, 2016, 5 pages.
Translation of the Notification of the Office Rejection for Chinese Patent Application No. 200980134014.X, dated Dec. 18, 2014, 8 pages.
Translation of the Second Office Action for Chinese Patent Application No. 200980134014.X, dated Jul. 17, 2013, 8 pages.
Translation of Notification of Reason for Rejection for Japanese Patent Application No. 2011-524963, dated Jul. 14, 2014, 3 pages.
Translation of Notification of Reason for Rejection for Japanese Patent Application No. 2011-524963, dated Sep. 17, 2013, 4 pages.
English Translation of Second Office Action for Chinese Patent Application No. 201080018761.X, dated Apr. 3, 2015, 5 pages.
English Translation of Second Office Action for Chinese Patent Application No. 201180022996.0, dated Jul. 28, 2015, 10 pages.
English Translation of Search Report for Chinese Patent Application No. 201280009252.X, dated Jun. 25, 2015, 2 pages.
English Translation of Search Report for Chinese Patent Application No. 201280010672.X, dated Dec. 15, 2014, 2 pages.
English Translation of Notification of Reason for Rejection for Japanese Patent Application No. 2012-516298, dated Jul. 6, 2015, 6 pages.
Examination Report for European Patent Application No. 10707153.2, dated Mar. 25, 2015, 6 pages.
Examination Report for European patent application 09789090.9-1562 dated Aug. 2, 2013, 4 pages.
Examination Report for European patent application 09789090.9-1562 dated Feb. 25, 2014, 5 pages.
Examination Report for European patent application 09789090.9-1562 dated Oct. 2, 2014, 6 pages.
Examination Report for European patent application 09789090.9-1562 dated May 5, 2015, 5 pages.
Examination Report for European patent application 09789090.9-1562 dated Dec. 18, 2015, 4 pages.
Partial European Search Report for European Patent Application 15184772.0, dated Jan. 22, 2016, 7 pages.
Patent Examination Report No. 1 for Australian patent application 2011245168 dated Sep. 9, 2014, 3 pages.
English Translation of Notice on the First Office Action for Chinese patent application 201180021566.7 dated Jul. 3, 2014, 7 pages
English Translation of Notice on the Second Office Action for Chinese patent application 201180021566.7 dated May 26, 2015, 7 pages.
International Search Report for PCT/US2011/057582 dated Jan. 27, 2012, 3 pages.
International Search Report and Written Opinion for PCT/US2011/034581 dated Jul. 13, 2011, 13 pages.
Advisory Action for U.S. Appl. No. 12/394,114 dated Jan. 16, 2015, 3 pages.
Notice of Allowance and Examiner-Initiated Interview Summary for U.S. Appl. No. 12/947,883 dated Jan. 13, 2015, 11 pages.
Non-final Office Action for U.S. Appl. No. 12/818,986 dated Jan. 5, 2015, 21 pages.
Notice of Allowance for U.S. Appl. No. 13/649,417 dated Jan. 8, 2015, 7 pages
Non-final Office Action for U.S. Appl. No. 12/946,217 dated Dec. 29, 2014, 50 pages.
Notice of Allowance and Examiner-Initiated Interview Summary for U.S. Appl. No. 12/940,585 dated Feb. 27, 2015, 16 pages.
Notice of Allowance for U.S. Appl. No. 12/953,101 dated Feb. 20, 2015, 9 pages
Final Office Action for U.S. Appl. No. 12/819,065 dated Mar. 12, 2015, 13 pages.
Examiner's Answer to the Appeal Brief for U.S. Appl. No. 12/946,139 dated Feb. 5, 2015, 12 pages.
Notice of Allowance for U.S. Appl. No. 12/707,889 dated Feb. 17, 2015, 7 pages
Non-final Office Action for U.S. Appl. No. 13/902,012 dated Feb. 17, 2015, 9 pages.
Non-final Office Action for U.S. Appl. No. 13/081,856 dated Feb. 9, 2015, 8 pages.
Non-final Office Action for U.S. Appl. No. 13/901,074 dated May 30, 2015, 8 pages.
Notice of Allowance for U.S. Appl. No. 12/947,883 dated May 21, 2015, 11 pages.
Final Office Action for U.S. Appl. No. 12/940,699 dated Jun. 1, 2015, 10 pages.
Non-final Office Action for U.S. Appl. No. 13/663,949 dated May 5, 2015, 19 pages.
Non-final Office Action for U.S. Appl. No. 13/952,014 dated Jul. 30, 2015, 9 pages.
Final Office Action for U.S. Appl. No. 12/818,986 dated Jul. 23, 2015, 24 pages.
Non-final Office Action for U.S. Appl. No. 12/956,446 dated Jul. 31, 2015, 14 pages.
Notice of Allowance for U.S. Appl. No. 13/902,012 dated Aug. 5, 2015, 8 pages
Final Office Action for U.S. Appl. No. 12/946,217, dated Jul. 16, 2015, 50 pages.
Non-final Office Action for U.S. Appl. No. 12/394,114 dated Aug. 12, 2015, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/953,039 dated Sep. 3, 2015, 8 pages.
Final Office Action for U.S. Appl. No. 13/081,856 dated Sep. 8, 2015, 10 pages.
Examiner's Answer to the Appeal Brief for U.S. Appl. No. 13/663,975 dated Oct. 5, 2015, 14 pages.
Non-final Office Action for U.S. Appl. No. 12/819,065 dated Aug. 26, 2015, 13 pages.
Final Office Action for U.S. Appl. No. 13/567,288 dated May 8, 2015, 13 pages.
Non-final Office Action for U.S. Appl. No. 14/263,751 dated Oct. 30, 2015, 6 pages.
Decision on Appeal for U.S. Appl. No. 12/953,118, dated Apr. 5, 2016, 11 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Notice of Allowance for U.S. Appl. No. 12/953,118, dated Apr. 8, 2016, 8 pages.
Final Office Action for U.S. Appl. No. 13/663,949 dated Dec. 23, 2015, 24 pages.
Final Office Action for U.S. Appl. No. 14/263,751 dated Jun. 8, 2016, 6 pages.
Decision on Appeal for U.S. Appl. No. 12/953,134 dated Jun. 24, 2016, 6 page.
Decision on Appeal for U.S. Appl. No. 12/952,912 dated Jun. 28, 2016, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/940,699 dated Jul. 1, 2016, 10 pages.
Non-final Office Action for U.S. Appl. No. 13/901,074 dated Jun. 22, 2016, 8 pages.
Decision on Appeal for U.S. Appl. No. 12/946,139, dated Oct. 13, 2016, 8 pages.
Notice of Allowance for U.S. Appl. No. 12/953,118, dated Aug. 1, 2016, 7 pages.
Non-Final Office Action for U.S. Appl. No. 14/660,074, dated Sep. 15, 2016, 13 pages.
Notice of Allowance for U.S. Appl. No. 14/512,899, dated Mar. 1, 2017, 9 pages.
Non-Final Office Action for U.S. Appl. No. 14/512,899, dated Aug. 16, 2016, 8 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC*, Declaration of Casimer Decusatis in Support of Petition for Inter Partes Review of U.S. Pat. No. 8,452,148, dated Aug. 31, 2016, 62 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC*, Patent Owner's Preliminary Response, Case IPR2016-01703, U.S. Pat. No. 8,452,148 B2, dated Dec. 6, 2016, 42 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC* (Patent Owner), Decision for Institution of Inter Partes Review, Case IPR2016-01703, U.S. Pat. No. 8,452,148, Paper No. 7, dated Mar. 2, 2017, 30 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC* (Patent Owner), Petition for Inter Partes Review of U.S. Pat. No. 8,452,148, dated Aug. 31, 2016, 83 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC* (Patent Owner), Declaration of Casimer Decusatis in Support of Petition for Inter Partes Review of U.S. Pat. No. 8,184,938, dated Aug. 31, 2016, 56 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC* (Patent Owner), Petition for Inter Partes Review of U.S. Pat. No. 8,184,938, dated Aug. 31, 2016, 73 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC* (Patent Owner), Patent Owner's Preliminary Response, Case IPR2016-01709, U.S. Pat. No. 8,184,938, B2, dated Dec. 6, 2016, 36 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC* (Patent Owner), Decision for Institution of Inter Partes Review, Case IPR2016-01709, U.S. Pat. No. 8,184,938 B2, Paper No. 7, dated Mar. 1, 2017, 30 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC* (Patent Owner), Patent Owner's Preliminary Response, Case IPR2017-00009, U.S. Pat. No. 9,020,320 B2, dated Jan. 18, 2017, 33 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC* (Patent Owner), Petition for Inter Partes Review of U.S. Pat. No. 9,020,320, dated Oct. 4, 2016, 88 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC* (Patent Owner), Declaration of Casimer Decusatis in Support of Petition for Inter Partes Review of U.S. Pat. No. 9,020,320, dated Sep. 30, 2016, 113 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC* (Patent Owner), Declaration of Casimer Decusatis in Support of Petition for Inter Partes Review of U.S. Pat. No. 8,538,226, dated Oct. 6, 2016, 67 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC* (Patent Owner), Petition for Inter Partes Review of U.S. Pat. No. 8,538,226, dated Oct. 6, 2016, 87 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC* (Patent Owner), Patent Owner's Preliminary Response, Case IPR2017-00029, U.S. Pat. No. 8,538,226 B2, dated Jan. 13, 2017, 34 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC* (Patent Owner), Declaration of Casimer Decusatis in Support of, Petition for Inter Partes Review of U.S. Pat. No. 8,712,206, dated Dec. 22, 2016, 117 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC*, Petition for Inter Partes Review of U.S. Pat. No. 8,712,206, dated Dec. 22, 2016, 89 pages.
Author Unknown, "Cabinets, Racks, Panels, and Associated Equipment," EIA/ECA-310-E Standard, Dec. 2005, Electronic Industries Alliance, Arlington, Virginia, 26 pages.
Author Unknown, "Fiber Optic Connector Intermateability Standard—Type LC ," TIA/EIA-604-10A, FOCIS 10, Mar. 2002, Telecommunications Industry Association, Arlington, Virginia, 36 pages.
Author Unknown, "Fiber Optic Connector Intermateability Standard—Type MPO ," TIA/EIA-604-5-A, FOCIS-5, Sep. 2001, Telecommunications Industry Association, Arlington, Virginia, 24 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC* (Patent Owner), Decision Denying Institution of Inter Partes Review, Case IPR2017-00528, U.S. Pat. No. 8,712,206 B2, dated May 31, 2017, 28 pages.
Final Office Action for U.S. Appl. No. 14/660,074, dated May 18, 2017, 4 pages.
Notice of Allowance for U.S. Appl. No. 12/952,912, dated Mar. 29, 2017, 9 pages.
Non-Final Office Action for U.S. Appl. No. 15/412,900, dated Apr. 10, 2017, 10 pages.
Non-Final Office Action for U.S. Appl. No. 15/413,883, dated Mar. 17, 2017, 8 pages.
Non-Final Office Action for U.S. Appl. No. 15/413,919, dated Mar. 14, 2017, 9 pages.
Final Office Action for U.S. Appl. No. 12/394,114 dated Oct. 25, 2012, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/915,682 dated Oct. 24, 2012, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/818,986 dated Feb. 3, 2012, 12 pages.
Final Office Action for U.S. Appl. No. 12/818,986 dated Oct. 18, 2012, 13 pages.
Non-final Office Action for U.S. Appl. No. 12/952,960 dated Oct. 4, 2012, 11 pages.
Non-final Office Action for U S. Appl. No 12/953,134 dated Sep. 25, 2012, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/953,039 dated Jan. 11, 2013, 6 pages.
Non-final Office Action for U.S. Appl. No. 12/952,912 dated Dec. 28, 2012, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/953,118 dated Jan. 7, 2013, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/953,536 dated Jan. 2, 2013, 20 pages.
Non-final Office Action for U.S. Appl. No. 12/707,889 dated Jan. 2, 2013, 7 pages.
European Search Report for patent application 10790017.7 dated Nov. 8, 2012, 7 pages.
Examination Report for European patent application 09789090.9-2216 dated Aug. 29, 2011, 4 pages.
Examination Report for European patent application 09789090.9-2216 dated Mar. 30, 2012, 6 pages.
Written Opinion of the International Searching Authority for International patent application PCT/US2009004548, dated Apr. 5, 2011, 6 pages.
European Search Report for European patent application 09789090.9-2217 dated Jan. 24, 2013, 5 pages.
Non-final Office Action for U.S. Appl. No. 12/946,139 dated Jul. 26, 2012, 12 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Final Office Action for U.S. Appl. No. 12/946,139 dated Feb. 15, 2013, 17 pages.
Non-final Office Action for U.S. Appl. No. 12/751,884 dated Feb. 15, 2013, 5 pages.
Non-final Office Action for U.S. Appl. No. 12/394,114 dated Feb. 27, 2013, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/819,065 dated Mar. 4, 2013, 7 pages.
Final Office Action for U.S. Appl. No. 12/952,960 dated Mar. 7, 2013, 13 pages.
Notice of Allowance for U.S. Appl. No. 12/732,487 dated Mar. 19, 2013, 11 pages.
Non-final Office Action for U.S. Appl. No. 12/953,134 dated Mar. 21, 2013, 9 pages.
Final Office Action for U.S. Appl. No. 12/641,617 dated May 10, 2013, 21 pages.
Notice of Allowance for U.S. Appl. No. 13/090,621 dated Apr. 22, 2013, 8 pages.
Final Office Action for U.S. Appl. No. 12/953,039 dated May 1, 2013, 8 pages.
Final Office Action for U.S. Appl. No. 12/953,118 dated May 3, 2013, 11 pages.
Final Office Action for U.S. Appl. No. 12/915,682 dated Apr. 18, 2013, 9 pages.
Advisory Action for U.S. Appl. No. 12/952,960 dated May 15, 2013, 2 pages.
Non-final Office Action for U.S. Appl. No. 12/952,960 dated Jun. 20, 2013, 13 pages.
Non-final Office Action for U.S. Appl. No. 12/953,536 dated Jun. 6, 2013, 21 pages.
Non-final Office Action for U.S. Appl. No. 11/820,300 dated Apr. 25, 2012, 10 pages.
Final Office Action for U.S. Appl. No. 12/871,052 dated Jul. 1, 2013, 12 pages.
Non-final Office Action for U.S. Appl. No. 12/940,699 dated Jun. 26, 2013, 9 pages.
Notice of Allowance for U.S. Appl. No. 13/090,621 dated Jun. 25, 2013, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/956,475 dated Oct. 4, 2012, 7 pages.
Non-final Office Action for U.S. Appl. No. 13/302,067 dated Jun. 7, 2013, 13 pages.
Final Office Action for U.S. Appl. No. 12/771,473 dated Jul. 19, 2013, 7 pages.
Notice of Allowance for U.S. Appl. No. 12/751,884 dated Jul. 17, 2013, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/940,585 dated Aug. 16, 2013, 14 pages.
Final Office Action for U.S. Appl. No. 12/953,134 dated Aug. 23, 2013, 11 pages.
Ex parte Quayle Action for U.S. Appl. No. 12/953,164 dated Aug. 16, 2013, 5 pages.
Non-final Office Action for U.S. Appl. No. 12/732,487 dated Jul. 17, 2013, 22 pages.
Advisory Action for U.S. Appl. No. 12/953,039 dated Jul. 12, 2013, 3 pages.
Advisory Action for U.S. Appl. No. 12/953,118 dated Jul. 12, 2013, 3 pages.
Advisory Action for U.S. Appl. No. 12/641,617 dated Jul. 29, 2013, 3 pages.
Final Office Action for U.S. Appl. No. 12/952,912 dated Aug. 30, 2013, 15 pages.
Advisory Action for U.S. Appl. No. 12/771,473 dated Oct. 2, 2013, 3 pages.
Notice of Allowance for U.S. Appl. No. 12/641,617 dated Sep. 4, 2013, 9 pages.
International Search Report for PCT/US2010/023901 dated Jun. 11, 2010, 3 pages.
Notice of Allowance for U.S. Appl. No. 12/576,769 dated May 31, 2012, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/576,806 dated Dec. 13, 2011, 6 pages.
Notice of Allowance for U.S. Appl. No. 12/576,806 dated Apr. 18, 2012, 5 pages.
Non-final Office Action for U.S. Appl. No. 13/688,675 dated Jan. 31, 2014, 13 pages.
Non-final Office Action for U.S. Appl. No. 12/946,217 dated Jul. 26, 2012, 25 pages.
Final Office Action for U.S. Appl. No. 12/946,217 dated Mar. 18, 2013, 48 pages.
Non-final Office Action for U.S. Appl. No. 12/946,217 dated Oct. 3, 2013, 47 pages.
Final Office Action for U.S. Appl. No. 12/946,217 dated Apr. 25, 2014, 40 pages.
Non-final Office Action for U.S. Appl. No. 13/833,876 dated Apr. 24, 2014, 7 pages.
Notice of Allowance for U.S. Appl. No. 12/953,536 dated May 20, 2014, 9 pages.
Advisory Action for U.S. Appl. No. 12/707,889 dated Jun. 11, 2014, 4 pages.
Advisory Action for U.S. Appl. No. 12/940,585 dated Jun. 17, 2014, 3 pages.
Advisory Action for U.S. Appl. No. 12/947,883 dated Jun. 19, 2014, 3 pages.
Non-final Office Action for U.S. Appl. No. 12/732,487 dated Jun 20, 2014, 24 pages.
Non-final Office Action for U.S. Appl. No. 13/621,958 dated Jun. 20, 2014, 13 pages.
Non-final Office Action for U.S. Appl. No. 12/952,960 dated Jun. 26, 2014, 13 pages.
Non-final Office Action for U.S. Appl. No. 13/746,938 dated Jul. 11, 2014, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/751,895 dated May 20, 2014, 9 pages.
Final Office Action for U.S. Appl. No. 12/953,039 dated Jul 25, 2014, 10 pages.
Notice of Allowance for U.S. Appl. No. 12/953,536 dated Aug. 28, 2014, 9 pages.
Final Office Action for U.S. Appl. No. 13/901,074 dated Sep. 5, 2014, 7 pages.
Final Office Action for U.S. Appl. No. 13/663,975 dated Aug. 14, 2014, 42 pages.
Corrected Notice of Allowance for U.S. Appl. No. 13/533,093 dated Sep. 2, 2014, 7 pages.
Examiner's Answer to the Appeal for U.S. Appl. No. 12/952,912 dated Sep. 11, 2014, 15 pages.
Advisory Action and Examiner-Initiated Interview Summary for U.S. Appl. No. 13/081,856 dated Sep. 16, 2014, 4 pages.
Notice of Allowance for U.S. Appl. No. 13/455,646 dated Sep. 26, 2014, 9 pages.
Non-Final Office Action for U.S Appl. No. 13/663,949 dated Sep. 25, 2014, 21 pages.
Non-Final Office Action for U.S. Appl. No. 13/688,675 dated Sep. 30, 2014, 9 pages.
Advisory Action for U.S. Appl. No. 12/953,039 dated Oct. 3, 2014, 3 pages.
Notice of Allowance for U.S. Appl. No. 13/597,549 dated Oct. 3, 2014, 8 pages.
Decision on Appeal for U.S. Appl. No. 11/320,062 dated Aug. 14, 2014, 8 pages.
Final Office Action for U.S. Appl. No. 12/953,101 dated Oct. 20, 2014, 14 pages.
Notice of Allowance for U.S. Appl. No. 13/533,093 dated Oct. 17, 2014, 9 pages.
Notice of Allowance for U.S. Appl. No. 12/732,487 dated Oct. 7, 2014, 8 pages.
Non-Final Office Action for U.S. Appl. No. 13/567,288 dated Oct. 8, 2014, 7 pages.
Advisory Action for U.S. Appl. No. 12/818,986 dated Oct. 15, 2014, 5 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Examiner's Answer to the Appeal Brief for U.S. Appl. No. 12/953,134 dated Aug. 1, 2014, 7 pages.
Final Office Action for U.S. Appl. No. 12/394,114 dated Oct. 31, 2014, 10 pages.
Non-final Office Action for U.S. Appl. No. 12/940,699 dated Oct. 28, 2014, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/953,039 dated Nov. 12, 2014, 8 pages.
Notice of Allowance for U.S. Appl. No. 12/952,960 dated Nov. 10, 2014, 7 pages.
Notice of Allowance for U.S. Appl. No. 13/081,856 dated Oct. 29, 2014, 10 pages.
Notice of Allowance for U.S. Appl. No. 13/833,876 dated Nov. 7, 2014, 7 pages.
Advisory Action for U.S. Appl. No. 13/901,074 dated Nov. 24, 2014, 3 pages.
Notice of Allowance for U.S. Appl. No. 12/751,895 dated Nov. 19, 2014, 8 pages.
Final Office Action for U.S. Appl. No. 12/953,003 dated Feb. 12, 2015, 14 pages.
Final Office Action for U.S. Appl. No. 12/953,039 dated Feb. 23, 2015, 9 pages.
Unknown, Author, "QuickNet SFQ Series MTP Fiber Optic Cassettes," Panduit Specification Sheet, Jan. 2009, 2 pages.
Unknown Author, "Cellular Specialties introduces the first simulated in-building location-based tracking solution," smart-grid.tmenet.com/news, Sep. 14, 2009, 2 pages.
Unknown Author, "CDMA Co-Pilot Transmitter," Cellular Specialties, Inc., Aug. 2009, 2 pages.
Notice of Allowance for U.S. Appl. No. 12/871,052 dated Sep. 18, 2013, 9 pages.
Non-final Office Action for U.S. Appl. No. 12/953,039 dated Sep. 12, 2013, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/946,139 dated Oct. 2, 2013, 18 pages.
Final Office Action for U.S. Appl. No. 12/394,114 dated Oct. 4, 2013, 10 pages.
Non-final Office Action for U.S. Appl. No. 12/818,986 dated Oct. 4, 2013, 19 pages.
Non-final Office Action for U.S. Appl. No. 13/901,074 dated Oct. 9, 2013, 6 pages.
Advisory Action for U.S. Appl. No. 12/953,134 dated Nov. 4, 2013, 3 pages.
Final Office Action for U.S. Appl. No. 12/952,960 dated Oct. 29, 2013, 8 pages.
Notice of Allowance for U.S. Appl. No. 13/292,130 dated Oct. 18, 2013, 9 pages.
International Search Report and Written Opinion for PCT/US2011/035683 dated Sep. 8, 2011, 15 pages.
International Search Report and Written Opinion for PCT/US2010/039218 dated Oct. 27, 2010, 13 pages.
First Office Action for Chinese patent application 201080032453.2 dated Mar. 26, 2013, 6 pages.
Chinese Search Report for Chinese patent application 201080032453.2 dated May 15, 2013, 2 pages.
First Office Action for Chinese patent application 201080031621.6 dated Sep. 26, 2013, 9 pages.
Chinese Search Report for Chinese patent application 201080031621.6 dated Sep. 13, 2013, 2 pages.
RAMDAS, "Modern File Systems and Storage," Proceedings of the 2nd International SANE Conference, May 22-25, 2000, MECC, Maastricht, The Netherlands, Copyright Rodney R. Ramdas, 10 pages.
International Search Report and Written Opinion for PCT/US2011/035684 dated Jul. 1, 2011, 11 pages.
International Search Report and Written Opinion for PCT/US11/61754 dated Mar. 26, 2012, 9 pages.
Author Unknown, "144 Fiber Patch Panel 1U," Technical Data, ADTEK Group Limited, 2009, 2 pages.
Advisory Action for U.S. Appl. No. 12/394,114 dated Jan. 2, 2014, 3 pages.
Notice of Allowance for U.S. Appl. No. 12/871,052 dated Dec. 24, 2013, 9 pages.
Final Office Action for U.S. Appl. No. 12/953,039 dated Dec. 27, 2013, 10 pages.
Advisory Action for U.S. Appl. No. 12/952,960 dated Jan. 8, 2014, 3 pages.
Advisory Action for U.S. Appl. No. 12/952,912 dated Nov. 26, 2013, 3 pages.
Examiner's Answer to the Appeal Brief for U.S. Appl. No. 12/953,118 dated Dec. 3, 2013, 6 pages.
Non-final Office Action for U.S. Appl. No. 13/597,549 dated Jan. 14, 2014, 9 pages.
Final Office Action for U.S. Appl. No. 12/732,487 dated Dec. 6, 2013, 24 pages.
Final Office Action for U.S. Appl. No. 12/956,446 dated Dec. 23, 2013, 12 pages.
Non-final Office Action for U.S. Appl. No. 12/953,536 dated Dec. 17, 2013, 21 pages.
Non-final Office Action for U.S. Appl. No. 12/819,065 dated Dec. 3, 2013, 8 pages.
International Search Report and Written Opinion for PCT/US2011/062353 dated Apr. 10, 2012, 15 pages.
International Search Report for PCT/US2013/041268 dated Aug. 20, 2013, 5 pages.
Notice of Allowance for U.S. Appl. No. 13/292,130 dated Feb. 14, 2014, 7 pages.
Final Office Action for U.S. Appl. No. 12/707,889 dated Feb. 11, 2014, 17 pages.
Non-final Office Action for U.S. Appl. No. 12/940,699 dated Feb. 3, 2014, 10 pages.
Notice of Allowance for U.S. Appl. No. 12/952,960 dated Feb. 13, 2014, 7 pages.
Notice of Allowance and Applicant-Initiated Interview Summary for U.S. Appl. No. 12/771,473 dated Feb. 27, 2014, 8 pages.
Non-final Office Action for U.S. Appl. No. 13/081,856 dated Nov. 26, 2013, 11 pages.
Non-final Office Action for U.S. Appl. No. 13/663,975 dated Jan. 31, 2014, 18 pages.
Non-final Office Action for U.S. Appl. No. 12/394,114 dated Mar. 21, 2014, 9 pages.
Final Office Action for U.S. Appl. No. 12/940,585 dated Mar. 18, 2014, 15 pages.
Non-final Office Action for U.S. Appl. No. 12/953,101 dated Apr. 3, 2014, 9 pages.
Advisory Action for U.S. Appl. No. 12/953,039 dated Mar. 6, 2014, 3 pages.
Advisory Action for U.S. Appl. No. 12/956,446 dated Mar. 20, 2014, 3 pages.
Final Office Action for U.S. Appl. No. 13/603,894 dated Mar. 20, 2014, 15 pages.
Notice of Allowance for U.S. Appl. No. 12/417,325 dated Aug. 22, 2012, 7 pages.
Non-Final Office Action for U.S. Appl. No. 15/412,839, dated Mar. 9, 2017, 9 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC* (Patent Owner), Final Written Decision, Case IPR2016-01703, U.S. Pat. No. 8,452,148 B2, dated Feb. 27, 2018, 44 pages.
Panduit Corp. (Petitioner) V. *Corning Optical Communications LLC* (Patent Owner), Final Written Decision, Case IPR2016-01709, U.S. Pat. No. 8,184,938 B2, dated Feb. 27, 2018, 41 pages.
Notice of Allowance for U.S. Appl. No. 13/663,975, dated Oct. 4, 2017, 8 pages.
Final Office Action for U.S. Appl. No. 15/412,839, dated Nov. 3, 2017, 14 pages.
Final Office Action for U.S. Appl. No. 15/412,900, dated Oct. 6, 2017, 15 pages.
Final Office Action for U.S. Appl. No. 15/413,883, dated Oct. 6, 2017, 13 pages.
Final Office Action for U.S. Appl. No. 15/413,919, dated Oct. 6, 2017, 14 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Non-Final Office Action for U.S. Appl. No. 15/413,962, dated Mar. 24, 2017, 9 pages.
Final Office Action for U.S. Appl. No. 15/413,962, dated Oct. 10, 2017, 16 pages.
Notice of Allowance for U.S. Appl. No. 14/512,899, dated Jun. 28, 2017, 9 pages.
Decision on Appeal for U.S. Appl. No. 13/663,975, dated Aug. 24, 2017, 6 pages.
Easton et al., "High-density optical connectivity in the data center," Cabling: Installation & Maintenance, Feb. 1, 2010, www.cablinginstall.com/articles/print/volume-18/issue-2/features/-high-density-optical.htm, PennWell Corporation, Tusla, Oklahoma, 15 pages.
Extended European Search Report for European Patent Application No. 10790017.7, dated Oct. 22, 2012, 6 pages.
International Search Report and Written Opinion for PCT/US2009/004548, dated Mar. 19, 2010, 18 pages.
International Search Report and Written Opinion for PCT/US10/035529, dated Jul. 23, 2010, 10 pages.
International Search Report and Written Opinion for PCT/US2010/038580, dated Aug. 18, 2010, 8 pages.
International Search Report and Written Opinion for PCT/US2010/039225, dated Oct. 14, 2010, 17 pages.
International Preliminary Report on Patentability for PCT/US2009/004549, dated Mar. 1, 2011, 10 pages.
International Preliminary Report on Patentability for PCT/US2009/004548, dated Mar. 1, 2011, 8 pages.
International Preliminary Report on Patentability for PCT/US2010/035529, dated Dec. 1, 2011, 9 pages.
English Translation of the First Office Action for Chinese Patent Application No. 2009101715265, dated Jan. 31, 2012, 10 pages.
English Translation of the First Office Action for Chinese Patent Application No. 200980134014X, dated Oct. 16, 2012, 7 pages.
English Translation of the First Office Action for Chinese Patent Application No. 200980134013.5, dated Nov. 5, 2012, 3 pages.
English Translation of the First Office Action for Chinese Patent Application No. 201080022305.2, dated Feb. 25, 2013, 8 pages.
English Translation of the First Office Action for Chinese Patent Application No. 2010800314136, dated Feb. 27, 2013, 9 pages.
Notification of Reason for Rejection for Japanese Patent Application No. 2011-524964, dated Sep. 17, 2013, 8 pages.
English Translation of the Second Office Action for Chinese Patent Application No. 200980134013.5, dated Sep. 26, 2013, 9 pages.
English Translation of the Second Office Action for Chinese Patent Application No. 201080031413.6, dated Dec. 31, 2013, 10 pages.
English Translation of the Second Office Action for Chinese Patent Application No. 201080022305.2, dated Jan. 16, 2014, 5 pages.
Notification of Reason for Rejection for Japanese Patent Application No. 2012-516180, dated Feb. 24, 2014, 4 pages.
English Translation of the First Office Action for Chinese Patent Application No. 201080031967.6, dated Jan. 15, 2014, 6 pages.
Notification of Reason for Rejection for Japanese Patent Application No. 2012-512020, dated Mar. 3, 2014, 5 pages.
Examination Report for European Patent Application No. 10778368.0, dated Jan. 13, 2014, 4 pages.
Patent Examination Report No. 1 for Australian Patent Application No. 2010260251, dated Jun. 12, 2014, 3 pages.
English Translation of the Third Office Action for Chinese Patent Application No. 200980134013.5, dated Jun. 9, 2014, 5 pages.
Patent Examination Report No. 1 for Australian Patent Application No. 2009286118, dated Jun. 26, 2014, 3 pages.
Patent Examination Report No. 1 for Australian Patent Application No. 2010249538, dated Jun. 26, 2014, 4 pages.
Decision for Final Rejection for Japanese Patent Application No. 2011-524964, dated Jul. 14, 2014, 6 pages.
English Translation of the Third Office Action for Chinese Patent Application No. 201080022305.2, dated Oct. 8, 2014, 5 pages.
English Translation of Decision of Rejection for Chinese Patent Application No. 201080031413.6, dated Sep. 2, 2014, 10 pages.
Notification of Reason for Rejection for Japanese Patent Application No. 2012-516180, dated Sep. 22, 2014, 3 pages.
English Translation of the Second Office Action for Chinese Patent Application No. 201080031967.6, dated Oct. 17, 2014, 7 pages.
English Translation of the Notification of the Office Rejection for Chinese Patent Application No. 200980134013.5, dated Feb. 16, 2015, 10 pages.
Examination Report for European Patent Application No. 09789091.7, dated May 8, 2015, 3 pages.
Examination Report for European Patent Application No. 10778368.0, dated May 13, 2015, 4 pages.
Summons to Attend Oral Proceedings for European Patent Application No. 10790017.7, dated Dec. 3, 2015, 7 pages.
Extended European Search Report for European Patent Application No. 15189567.9, dated Jan. 28, 2016, 9 pages.
Office Action for Canadian Patent Application No. 2734718, dated Oct. 7, 2015, 7 pages.
English Translation of Notification for Reexamination for Chinese Patent Application No. 201080031413.6, dated Feb. 24, 2016, 8 pages.
English Translation of Notification of Reexamination for Chinese Patent Application No. 200980134013.5, dated Mar. 14, 2016, 9 pages.
Office Action for Canadian Patent Application No. 2760818, dated Apr. 19, 2016, 3 pages.
Patent Examination Report No. 1 for Australian Patent Application No. 2015210380, dated May 3, 2016, 2 pages.
Office Action for Canadian Patent Application No. 2765837, dated May 17, 2016, 3 pages.
English Translation of Notification of Reexamination for Chinese Patent Application No. 200980135014.X, dated Feb. 29, 2016, 8 pages.
Extended European Search Report for European Patent Application No. 15184772.0, dated Jun. 14, 2016, 14 pages.
Patent Examination Report No. 1 for Australian Patent Application No. 2015203580, dated Jul. 4, 2016, 2 pages.
Extended European Patent Application No. 16176271.1, dated Sep. 29, 2016, 12 pages.
Partial European Search Report for European Patent Application No. 16173431.4, dated Oct. 20, 2016, 8 pages.
Decision for Reexamination for Chinese Patent Application No. 200980134014.X, dated Oct. 10, 2016, 15 pages.
Extended European Search Report for European Patent Application No. 16173431.4, dated Feb. 22, 2017, 12 pages.
Office Action for Canadian Patent Application No. 2765912, dated Apr. 5, 2017, 4 pages.
Office Action for Canadian Patent Application No. 2765837, dated Apr. 26, 2017, 3 pages.
Examination Report No. 1 for Australian Patent Application No. 2017221853, dated Mar. 16, 2018, 4 pages.
Decision on Appeal for Japanese Patent Application No. 2012-516347, dated Jul. 15, 2017, 8 pages.
Office Action for Canadian Patent Application No. 2765912, dated Mar. 9, 2018, 3 pages.
Notification of Grant for Japanese Patent Application No. 2012512020, dated Oct. 27, 2015, 4 pages.
Notice of Acceptance for Australian Patent Application No. 2009208086, dated Apr. 24, 2015, 2 pages.
Patent Examination Report No. 1 for Australian Patent Application No. 2009208086, dated Jul. 12, 2014, 3 pages.
Author Unknown, "Fibre Frame Solutions," Fibre Connectivity Solutions, 6356_au, Jun. 2007, ADC Krone, 123 pages.
Bulow, Knut, "ADC licenses Lx.5 SFF connector to Amphenol," Cabling, Install, Aug. 10, 2001, 1 page.
Author Unkown, "ADC Features New Fiber Optic Products at ECOC 2004," Business Wire, Sep. 6, 2004, 3 pages.
Author Unknown, "ADC FasTerm Multimode LX.5 Connector," Installation Instructions, ADCP-90-422, Issue 2, Apr. 2001, ADC Telecommunications, Inc., 25 pages.
Author Unknown, "FDM Series Fiber Distribution and Splice Modules," User Manual, ADCP-90-138, Issue 3, Oct. 2002, ADC Telecommunications, Inc., 34 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Author Unkown, "ADC Next Generation Frame 96 & 144 Position Fiber Termination Block," User Manual, ADCP-90-287, Issue 2, May 2009, ADC Telecommunications, Inc., 42 pages.
Author Unknown, "Small-Form-Factor Connector," Product Data Sheet, 100082PR, Sep. 2001, ADC Telecommunications, Inc., 4 pages.
Author Unknown, "AFD Outside Plant Connector Modules," User Manual, ADCP-93-303, Issue 1, Jun. 2000, ADC Telecommunications, Inc., 14 pages.
Author Unknown, "Suhner Fiberoptic LX.5 Connector Family," Product Data Sheet, Jan. 3, 2000, Huber and Suhner, 4 pages.
Author Unknown, "OmniReach FTTP Solutions," Product Data Sheet 1276559, Apr. 2004, ADC Telecommunications, Inc., 12 pages.
Author Unknown, "Fiber Optic Cassettes," Product Search Results, Apr. 25, 2018, Panduit, 17 pages.
Author Unknown, "Pro Patch: Fiber Optical Normal Through Panel," Product Data Page, www.clarkwire.com/Propatchopticalnormalthroughpanel.htm, accessed Apr. 25, 2018, 2 pages.
Non-Final Office Action for U.S. Appl. No. 13/663,975, dated Aug. 1, 2018, 24 pages.
Final Office Action for U.S. Appl. No. 13/663,975, dated Jan. 10, 2019, 24 pages.
Non-Final Office Action for U.S. Appl. No. 15/886,402, dated Jan. 10, 2019, 17 pages.
Notice of Allowance for U.S. Appl. No. 15/412,839, dated Aug. 14, 2018, 7 pages.
Non-Final Office Action for U.S. Appl. No. 15/412,839, dated Jun. 14, 2018, 7 pages.
Non-Final Office Action for U.S. Appl. No. 15/412,900, dated May 10, 2018, 6 pages.
Notice of Allowance for U.S. Appl. No. 15/412,900, dated Aug. 14, 2018, 7 pages.
Non-Final Office Action for U.S. Appl. No. 15/413,883, dated May 9, 2018, 6 pages.
Notice of Allowance for U.S. Appl. No. 15/413,883, dated Sep. 14, 2018, 8 pages.
Notice of Allowance for U.S. Appl. No. 15/413,919, dated Feb. 21, 2019, 7 pages.
Non-Final Office Action for U.S. Appl. No. 15/886,342, dated Jan. 18, 2019, 15 pages.
Non-Final Office Action for U.S. Appl. No. 16/376,529, dated May 23, 2019, 5 pages.
Non-Final Office Action for U.S. Appl. No. 15/413,962, dated May 2, 2018, 6 pages.
Notice of Allowance for U.S. Appl. No. 15/413,962, dated Oct. 12, 2018, 8 pages.
Notice of Allowance for U.S. Appl. No. 15/413,919, dated Apr. 18, 2019, 7 pages.
Non-Final Office Action for U.S. Appl. No. 15/886,342, dated Jul. 12, 2019, 10 pages.
Notice of Allowance for U.S. Appl. No. 16/376,542, dated Jun. 13, 2019, 7 pages.
Annex to Form PCT/ISA/2006, Communication Relating to the Results of the Partial International Search, for PCT/US2009/004549 dated Feb. 10, 2010, 2 pages.
Annex to Form PCT/ISA/206, Communication Relating to the Results of the Partial International Search, for PCT/US2009/004548 dated Jan. 19, 2010, 2 pages.
Corning Cable Systems, "Corning Cable Systems Products for BellSouth High Density Shelves," Jun. 2000, 2 pages.
Corning Cable Systems, "Corning Cable Systems Quick Reference Guide for Verizon FTTP FDH Products," Jun. 2005, 4 pages.
Conner, M. "Passive Optical Design for RFOG and Beyond," Braodband Properties, Apr. 2009, pp. 78-81.
Corning Evolant, "Eclipse Hardware Family," Nov. 2009, 1 page.
Corning Evolant, "Enhanced Management Frame," Dec. 2009, 1 page.
Corning Evolant, "Enhanced Management Frame (EMF)," Specification Sheet, Nov. 2009, 24 pages.
Corning Cable Systems, "Evolant Solutions for Evolving Networks: Fiber Optic Hardware," Oct. 2002, 2 pages.
Corning Cable Systems, "Fiber Optic Hardware with Factory-Installed Pigtails: Features and Benefits," Nov. 2010, 12 pages.
Corning Cable Systems, "FiberManager System 1- and 3-Position Compact Shelves," Jan. 2003, 4 pages.
Corning Cable Systems, "FiberManager System Frame and Components," Jan. 2003, 12 pages.
Corning Cable Systems, "High Density Frame," Jul. 2001, 2 pages.
Corning Cable Systems, "High Density Frame (HDF) Connector-Splice Shelves and Housings," May 2003, 4 pages.
International Search Report for PCT/US10/35529 dated Jul. 23, 2010, 2 pages.
International Search Report for PCT/US10/35563 dated Jul. 23, 2012, 1 page.
International Search Report for PCT/US2008/002514 dated Aug. 8, 2008, 2 pages.
International Search Report for PCT/US2008/010317 dated Mar. 4, 2008, 2 pages.
International Search Report for PCT/US2009/001692 dated Nov. 24, 2009, 5 pages.
International Search Report for PCT/US2010/024888 dated Jun. 23, 2010, 5 pages.
International Search Report for PCT/US2010/027402 dated Jun. 16, 2010, 2 pages.
Corning Cable Systems, "MTX Frames and Accessories," Feb. 2006, 4 pages.
Panduit, "Lock-in LC Duplex Clip," Accessed Mar. 22, 2012, 1 page.
International Search Report for PCT/US06/49351 dated Apr. 25, 2008, 1 page.
International Search Report for PCT/US09/57069 dated Mar. 24, 2010, 2 pages.
International Search Report for PCT/US2009/057244 dated Nov. 9, 2009 3 pages.
International Search Report for PCTUS2009004548 dated Mar. 19, 2010, 5 pages.
International Search Report for PCTUS2009004549 dated Apr. 20, 2010, 6 pages.
Siecor, "Single Shelf HDF with Slack Storage and Heat Shield (HH1-CSH-1238-1V-BS)," Jan. 1998, 12 pages.
Corning Cable Systems, "Mass Termination Xchange (MTX) Frame System Equipment Office Planning and Application Guide," SRP003-664, Issue 1, Mar. 2005, 57 pages.
Corning Cable Systems, "Mass Termination Xchange (MTX) Equipment Patch Cord Interbay Vertical Channel," SRP003-684, Issue 1, Mar. 2005, 8 pages.
Corning Cable Systems, "High Density Frame (HDF) Installation," SRP003-355, Issue 4, Sep. 2002, 18 pages.
Written Opinion for PCT/US2010/023901 dated Aug. 25, 2011, 8 pages.
Advisory Action for U.S. Appl. No. 12/221,117 dated Aug. 24, 2011, 3 pages.
Examiner's Answer to Appeal Brief for U.S. Appl. No. 12/221,117 dated Mar. 29, 2012, 16 pages.
Final Office Action for U.S. Appl. No. 12/221,117 dated Feb. 19, 2010, 7 pages.
Final Office Action for U.S. Appl. No. 12/221,117 dated Jun. 10, 2011, 8 pages.
Non-final Office Action for U.S. Appl. No. 12/221,117 dated Jul. 14, 2010, 7 pages.
Non-final Office Action for U.S. Appl. No. 12/221,117 dated Jun. 9, 2009, 5 pages.
Non-final Office Action for U.S. Appl. No. 12/221,117 dated Dec. 21, 2010, 7 pages.
Advisory Action for U.S. Appl. No. 12/394,483 dated Feb. 16, 2012, 3 pages.
Final Office Action for U.S. Appl. No. 12/394,483 dated Dec. 6, 2011, 14 pages.
Non-final Office Action for U.S. Appl. No. 12/394,483 dated Jun. 17, 2011, 11 pages.

(56) **References Cited**

OTHER PUBLICATIONS

Advisory Action for U.S. Appl. No. 12/950,234 dated Dec. 21, 2011, 3 pages.
Non-final Office Action for U.S. Appl. No. 12/950,234 dated Jun. 17, 2011, 7 pages.
Non-final Office Action for U.S. Appl. No. 12/950,234 dated Mar. 12, 2012, 10 pages.
Final Office Action for U.S. Appl. No. 12/950,234 dated Oct. 14, 2011, 10 pages.
Advisory Action dated May 12, 2011, for U.S. Appl. No. 12/323,423, 3 pages.
Final Rejection dated Mar. 3, 2011, for U.S. Appl. No. 12/323,423, 17 pages.
Non-Final Rejection dated Aug. 5, 2011, for U.S. Appl. No. 12/323,423, 13 pages.
Final Office Action for U.S. Appl. No. 15/886,402, dated Jul. 25, 2019, 18 pages.
Advisory Action for U.S. Appl. No. 13/663,975, dated Jun. 13, 2019, 5 pages.

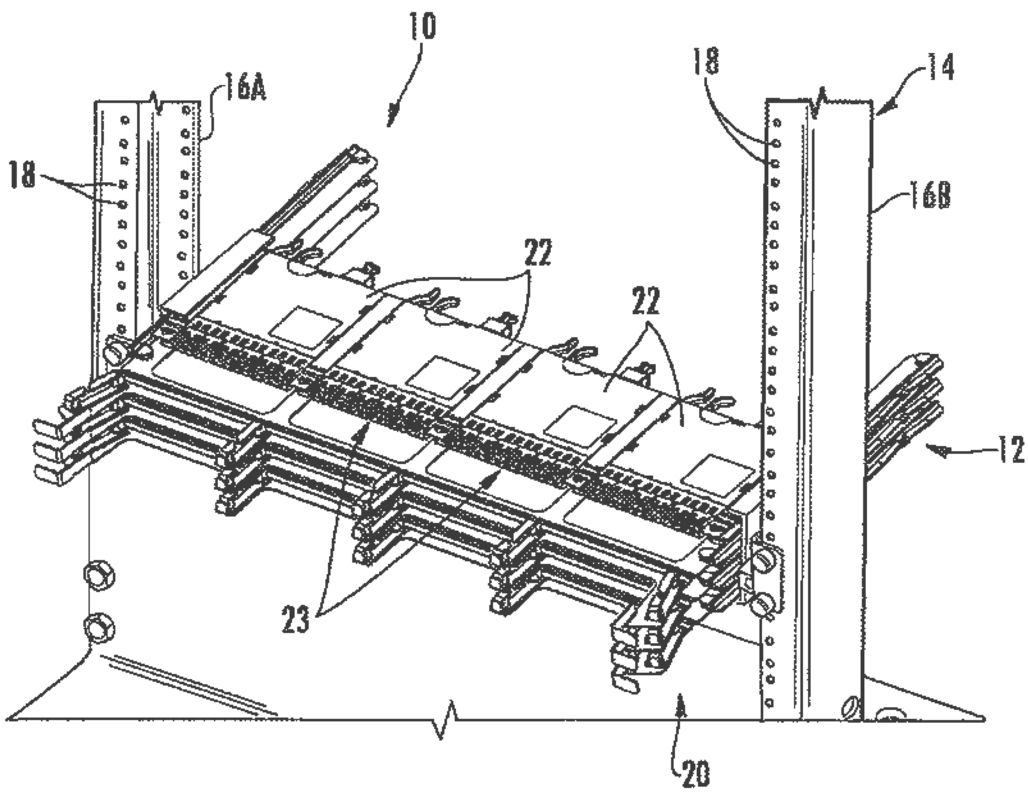


FIG. 1

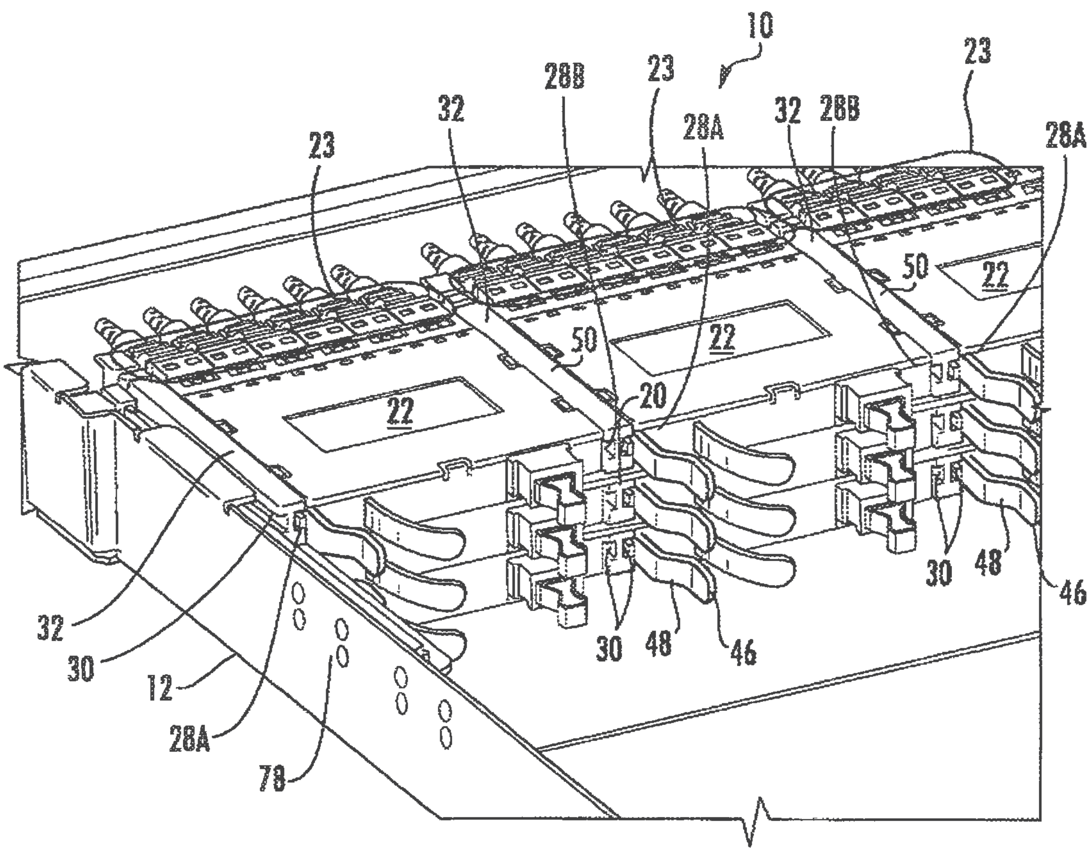

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FIG. 2

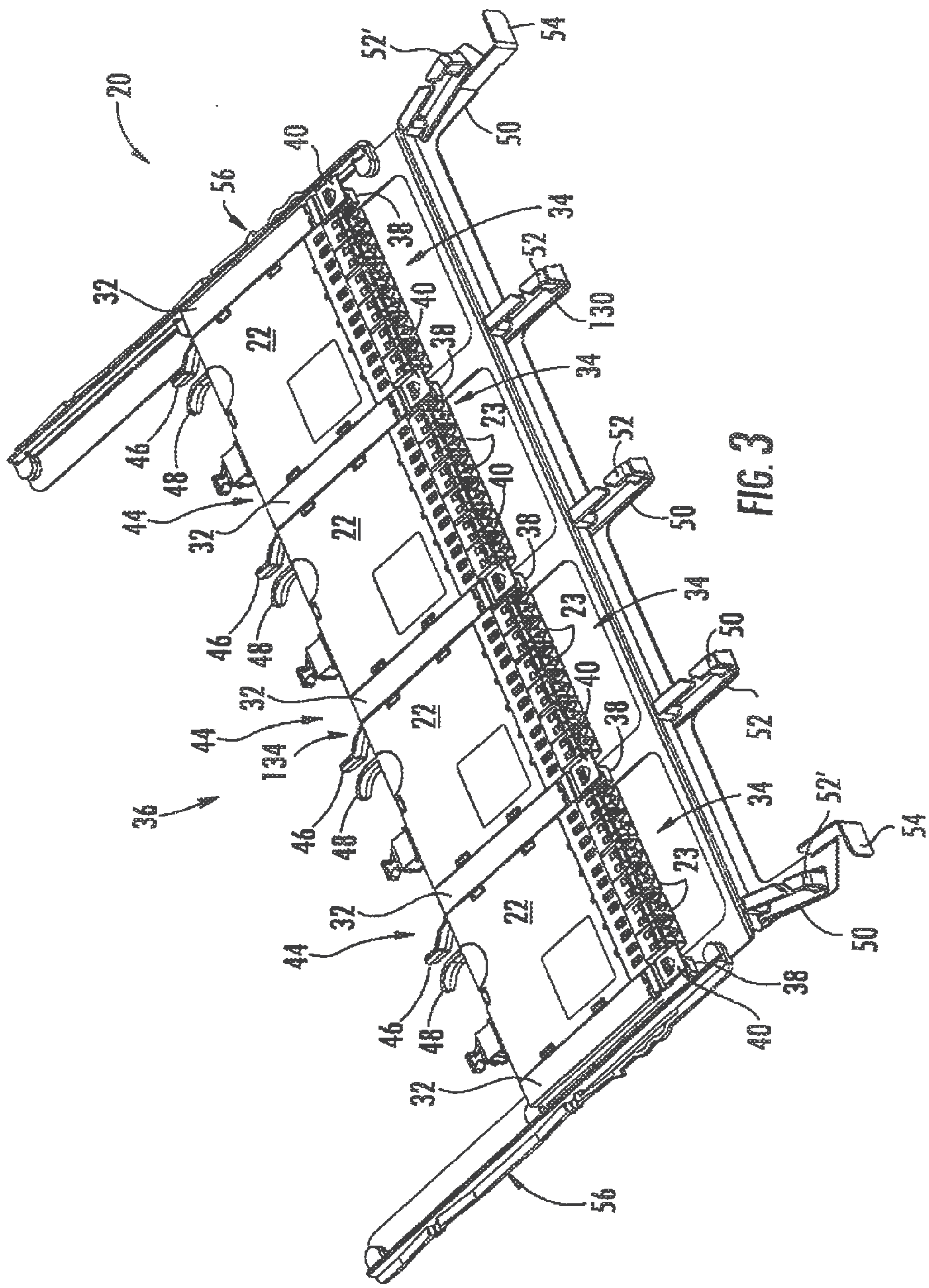


FIG. 3

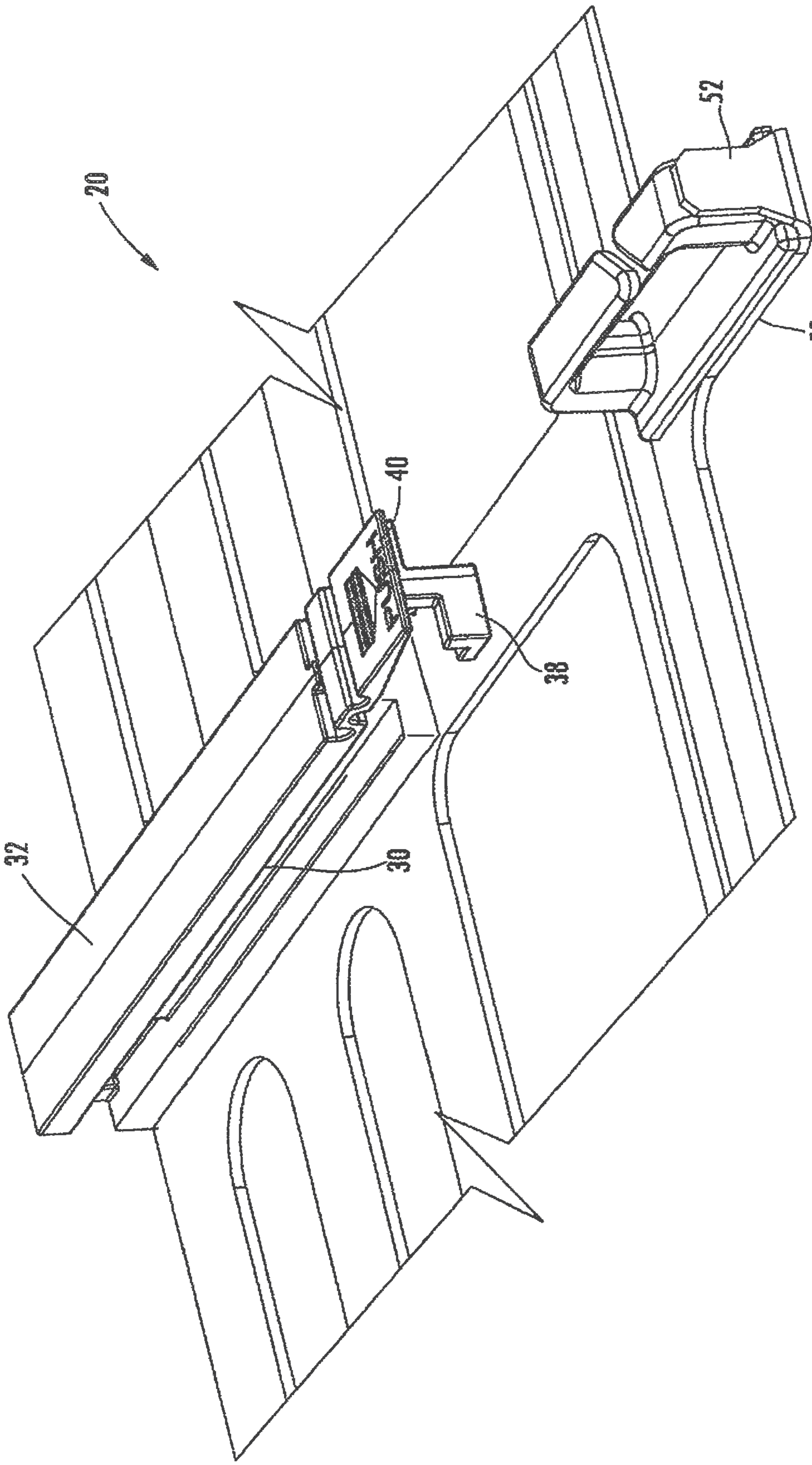
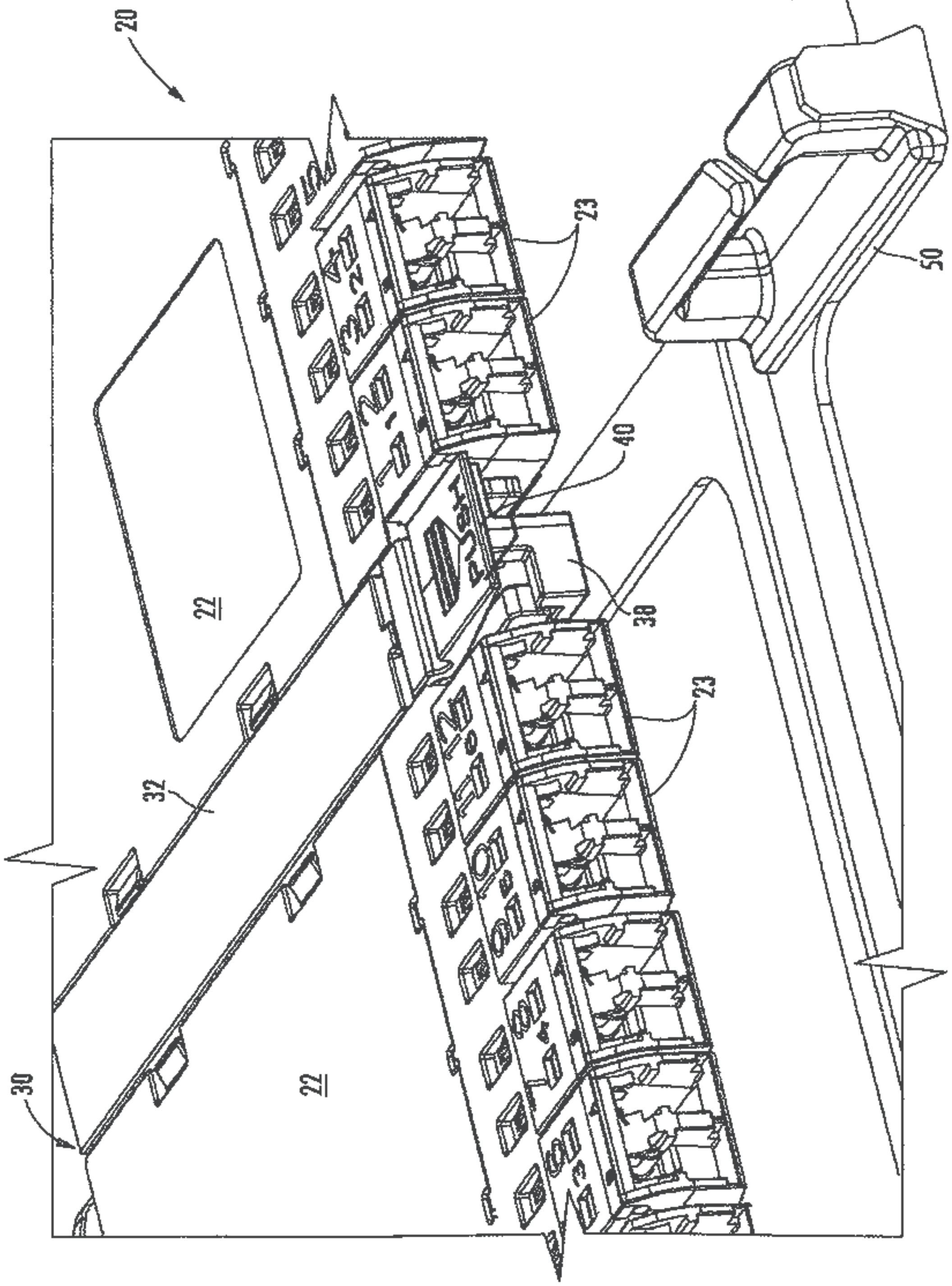


FIG. 4

FIG. 5



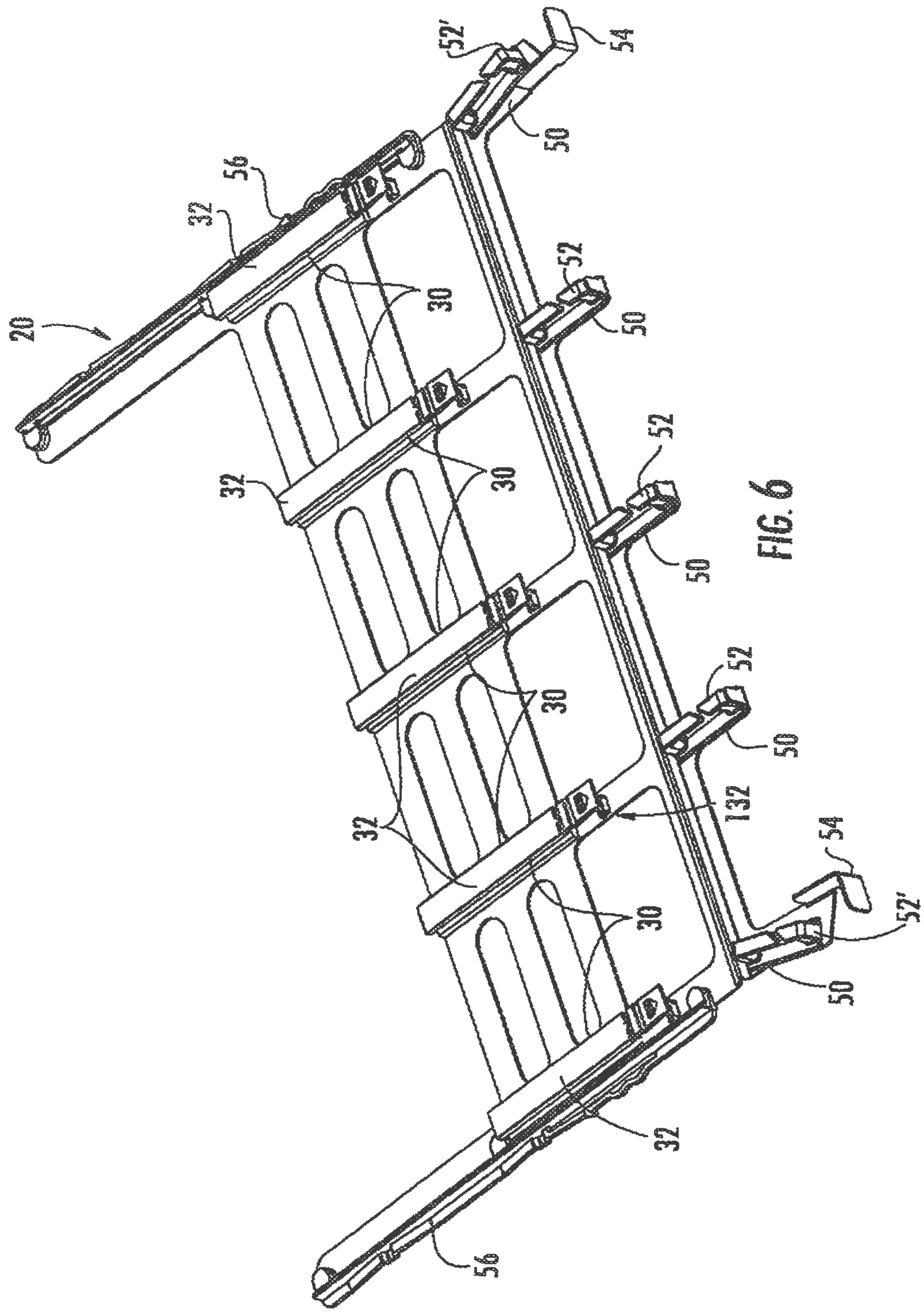


FIG. 6

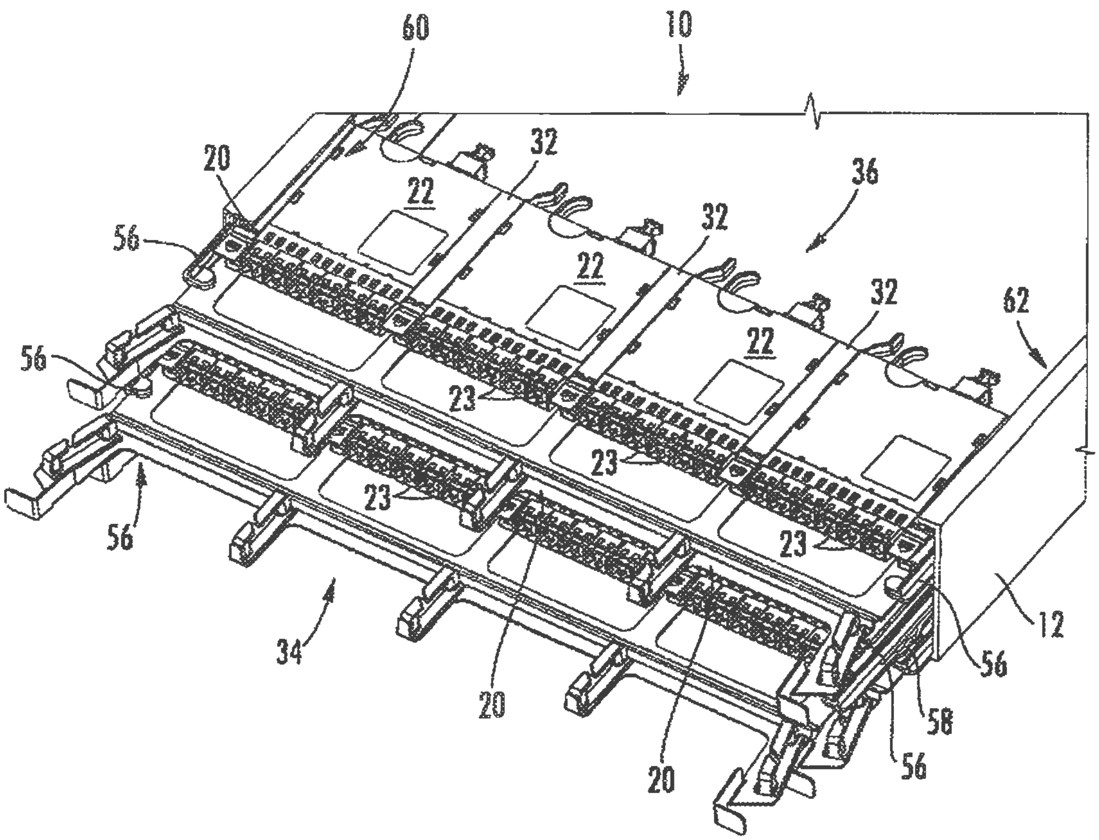

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FIG. 7

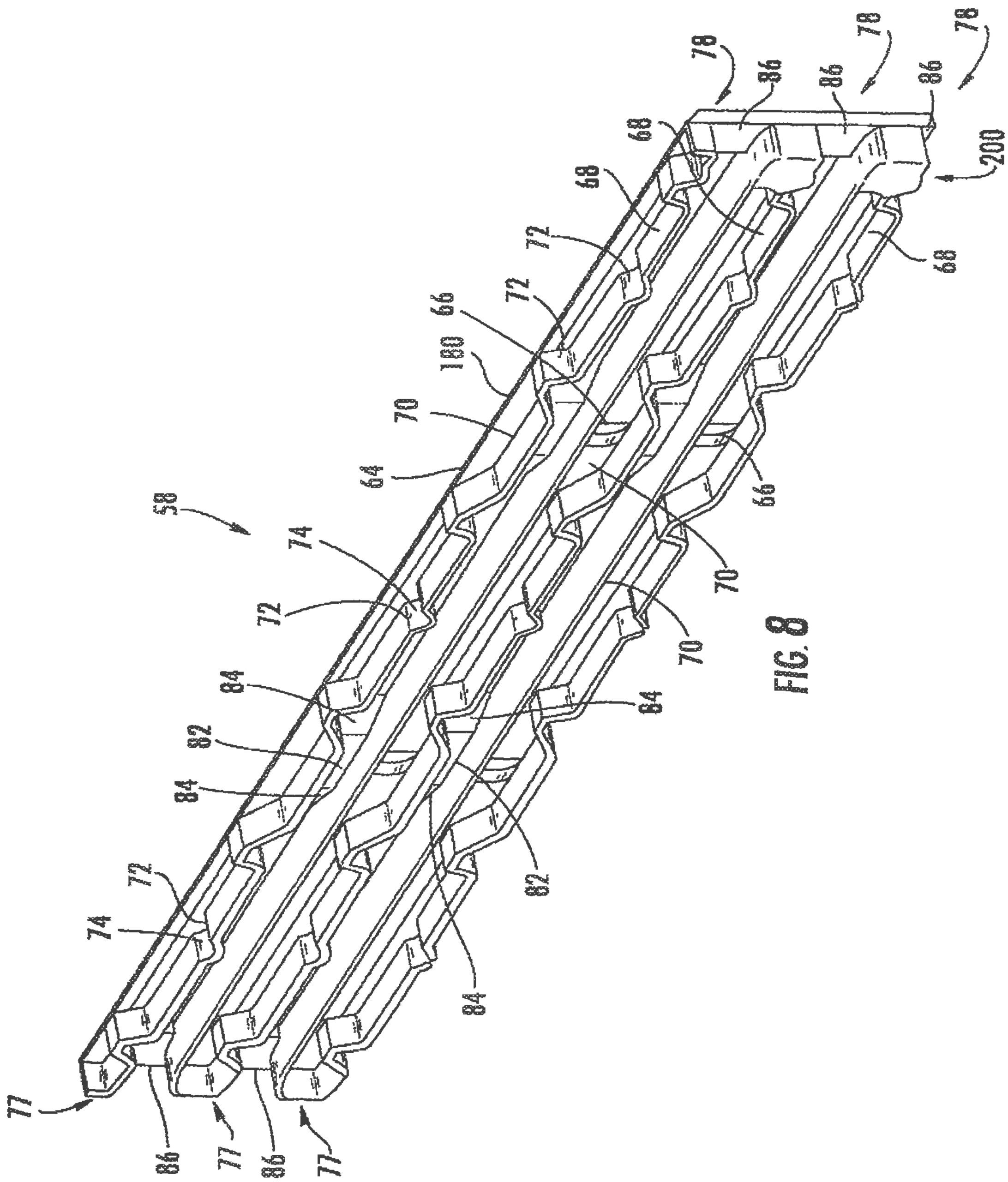
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FIG. 8

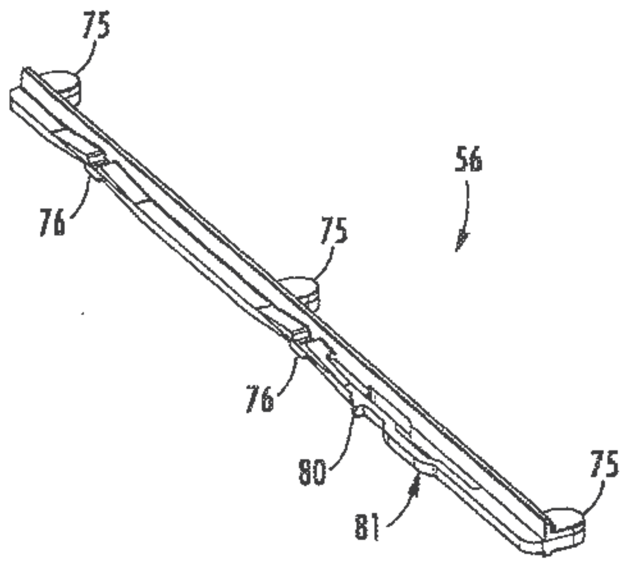


FIG. 9A

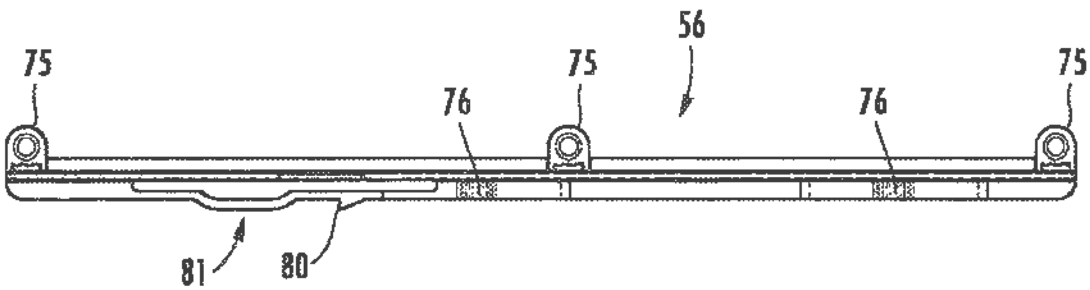


FIG. 9B

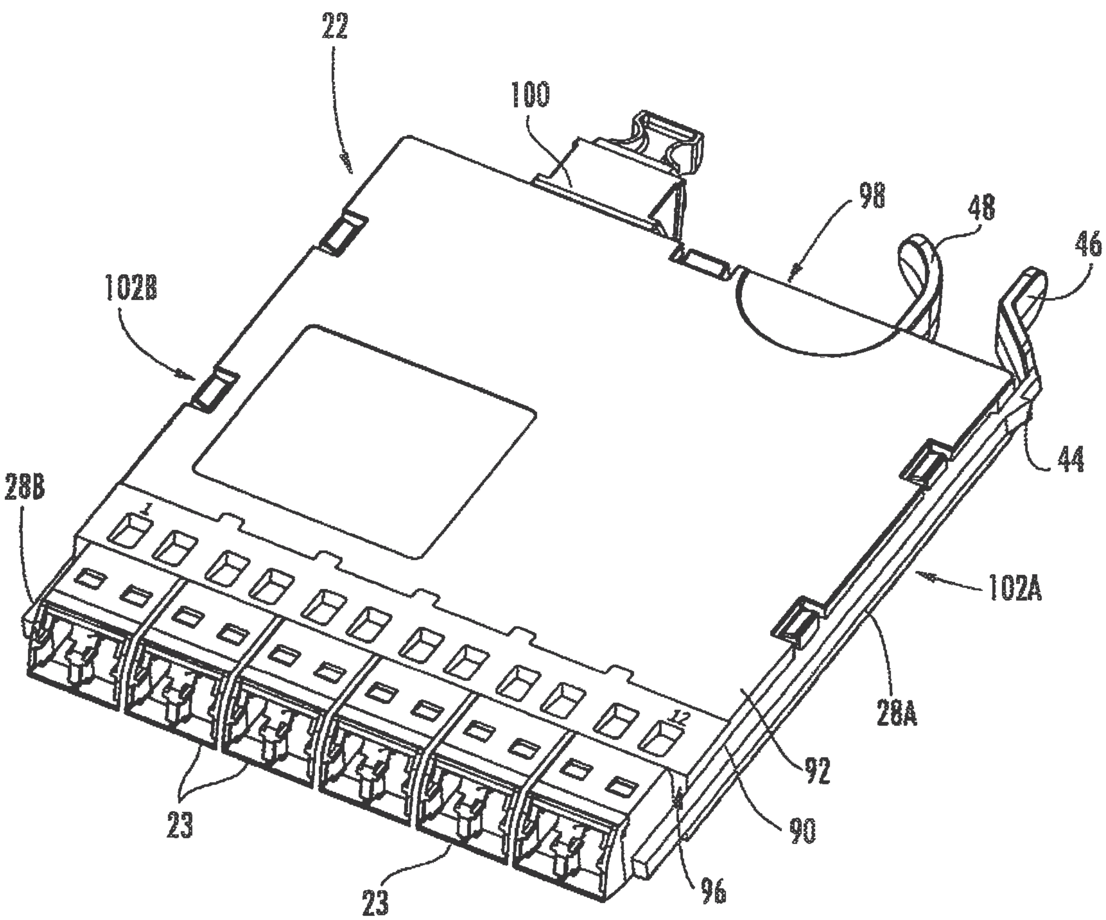


FIG. 10A

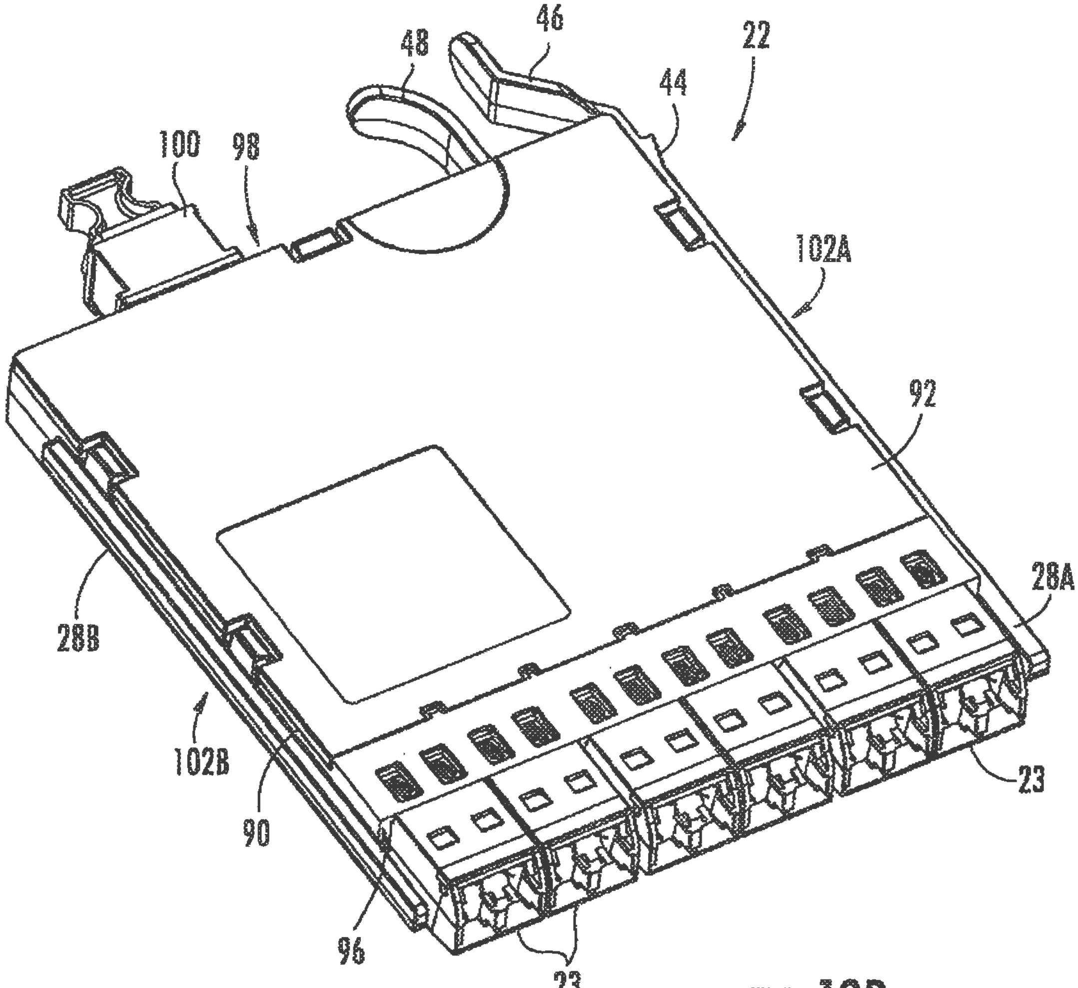
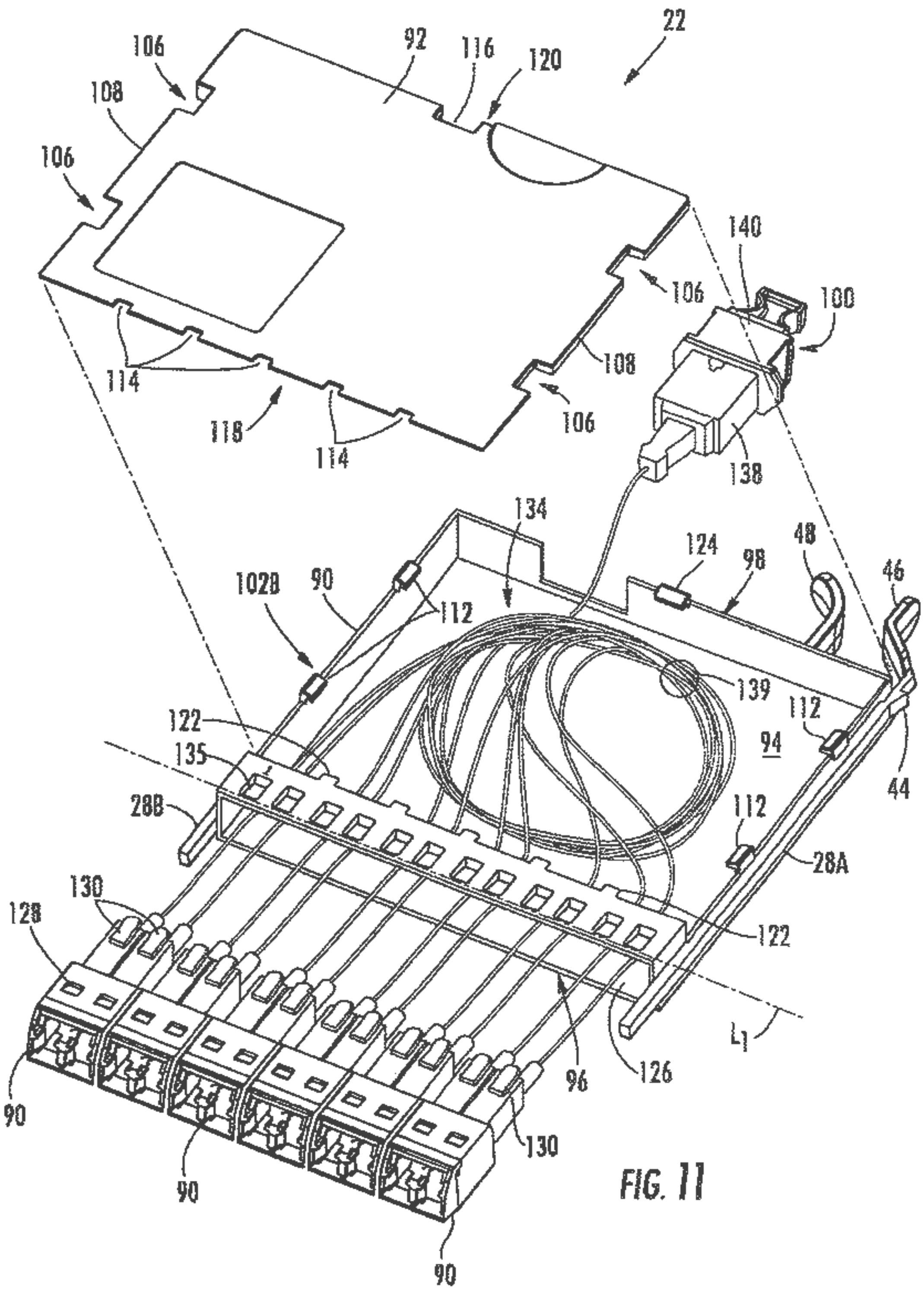


FIG. 10B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28B
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28A
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128
126
96
L1

FIG. 11

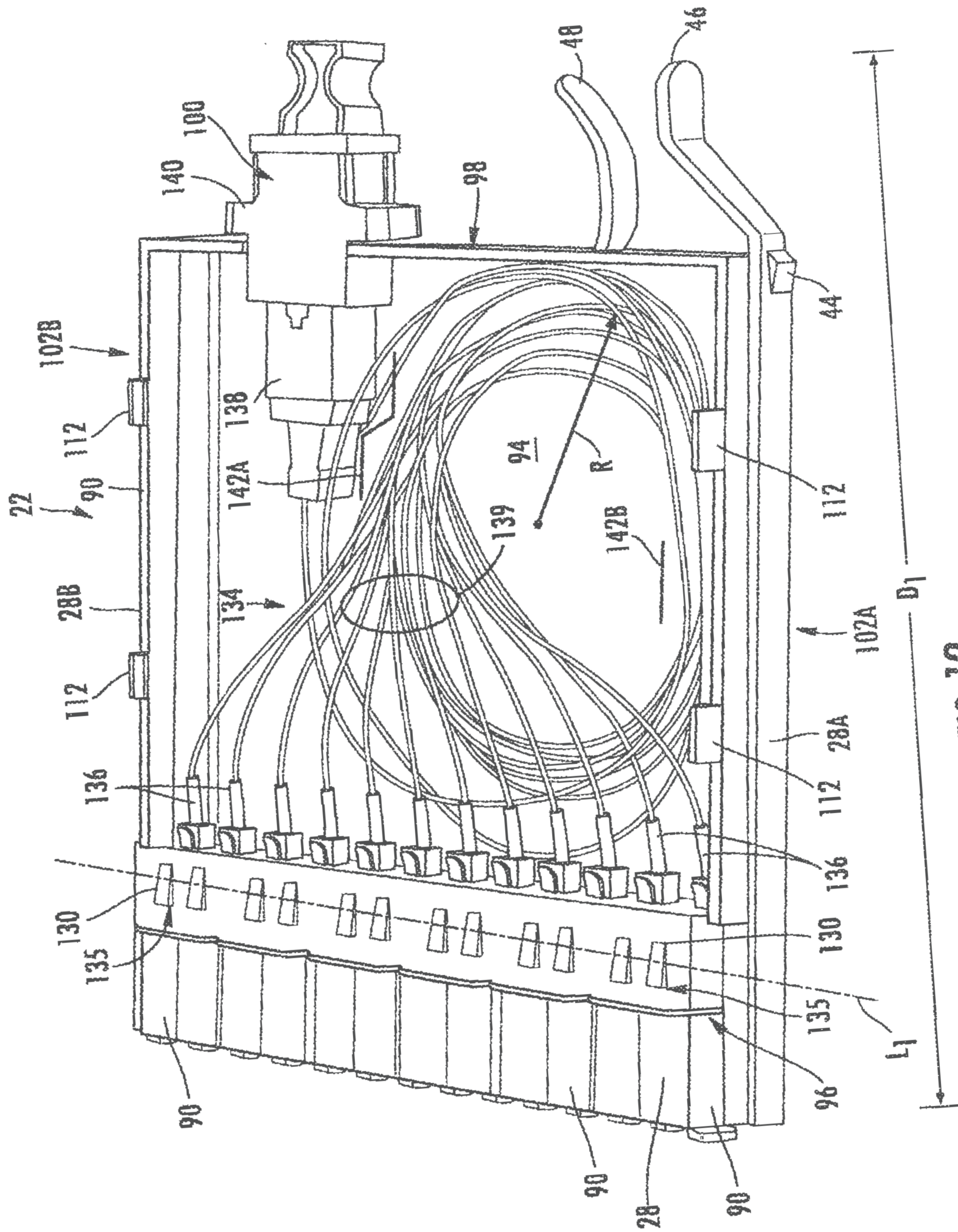
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FIG. 12

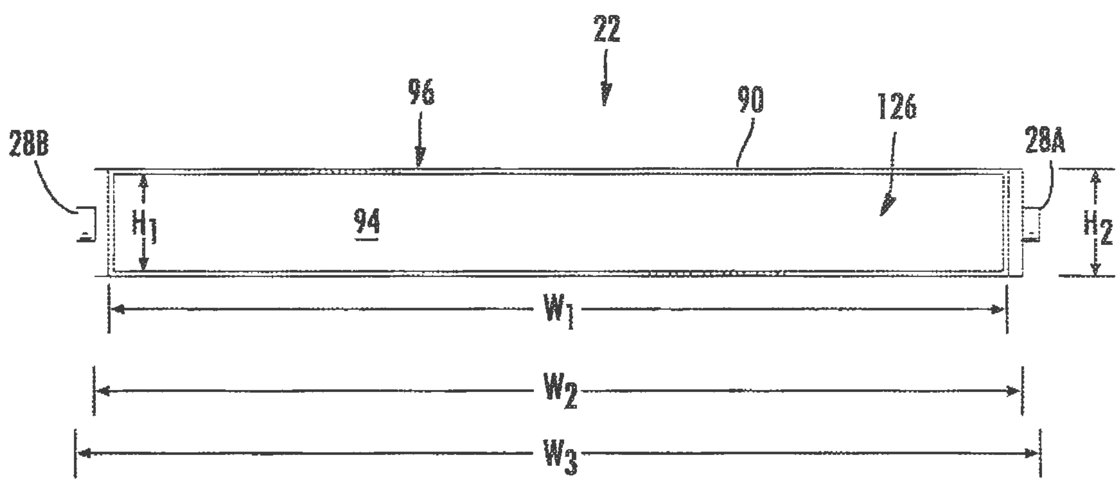

FIG. 13

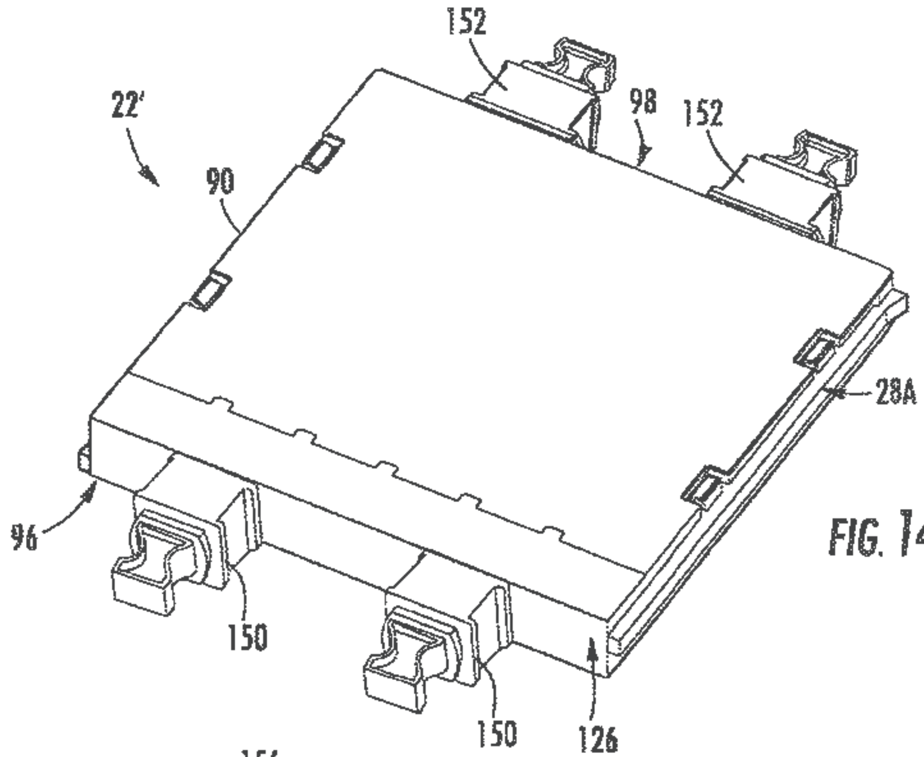
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FIG. 14

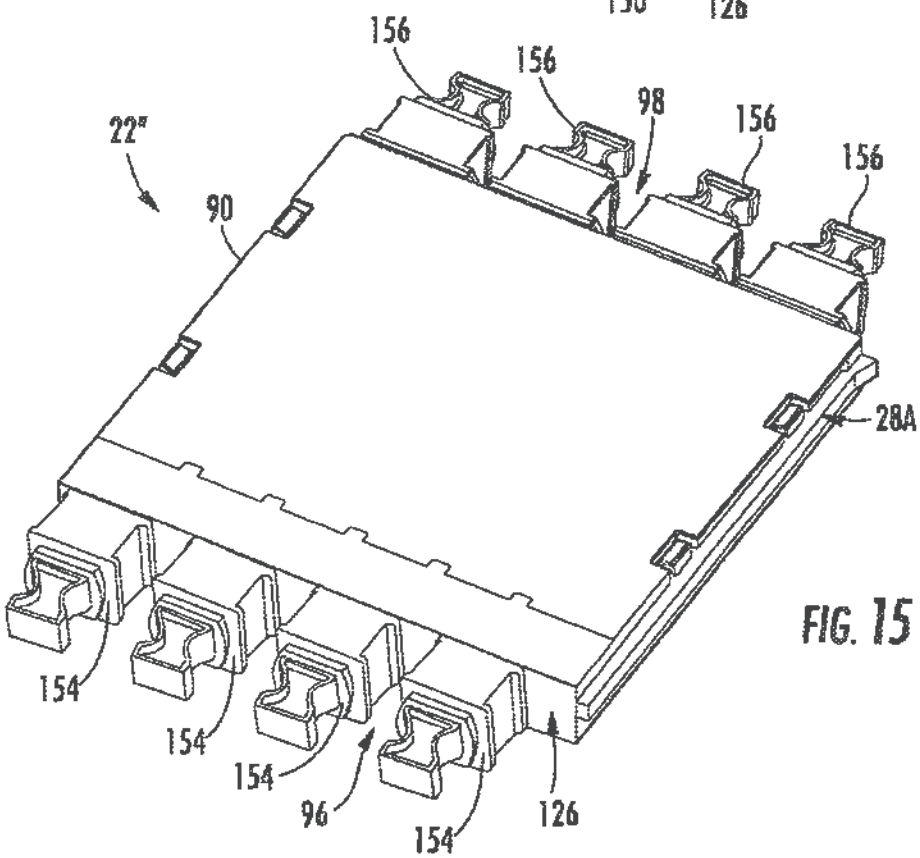
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FIG. 15

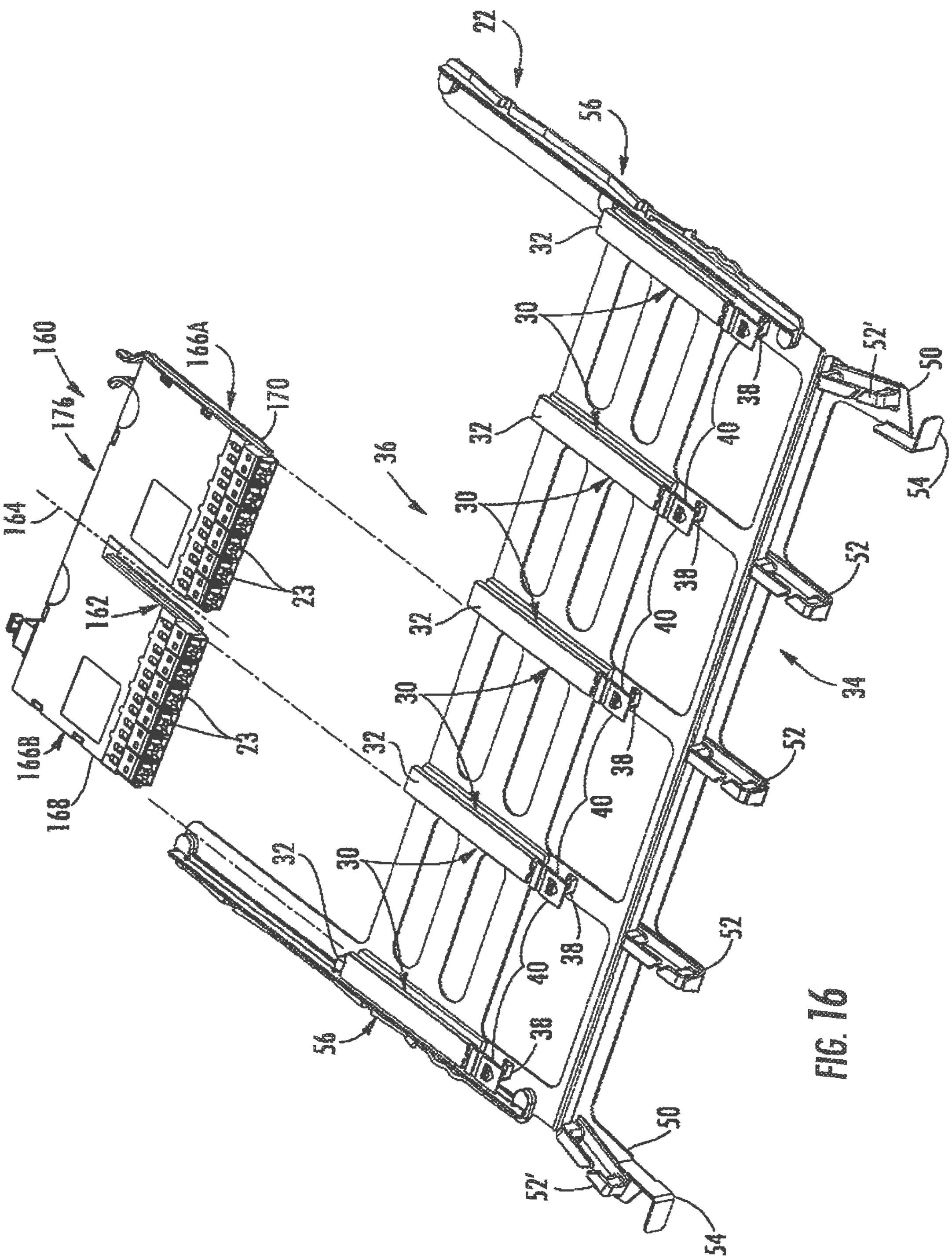
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FIG. 16

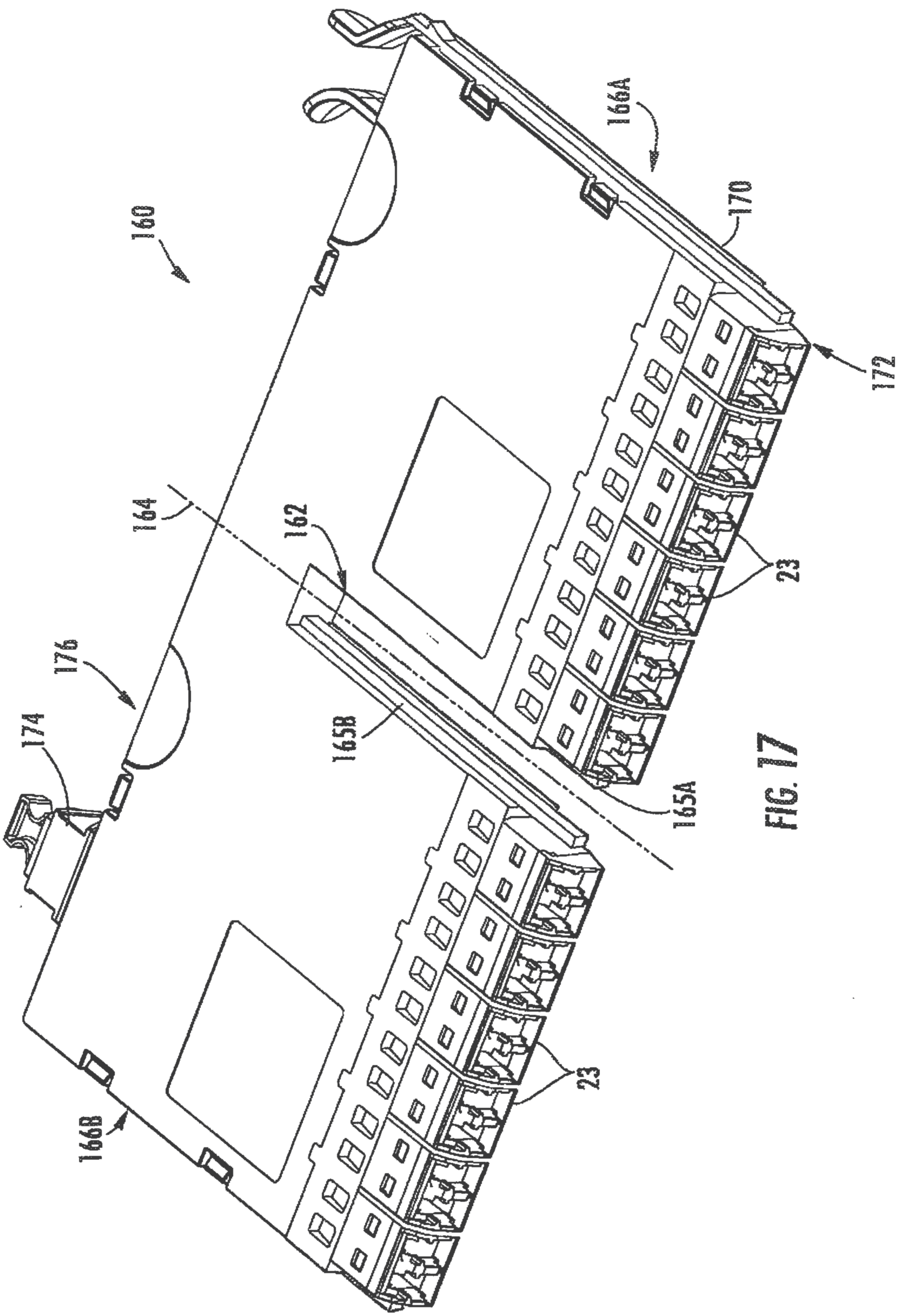

FIG. 17

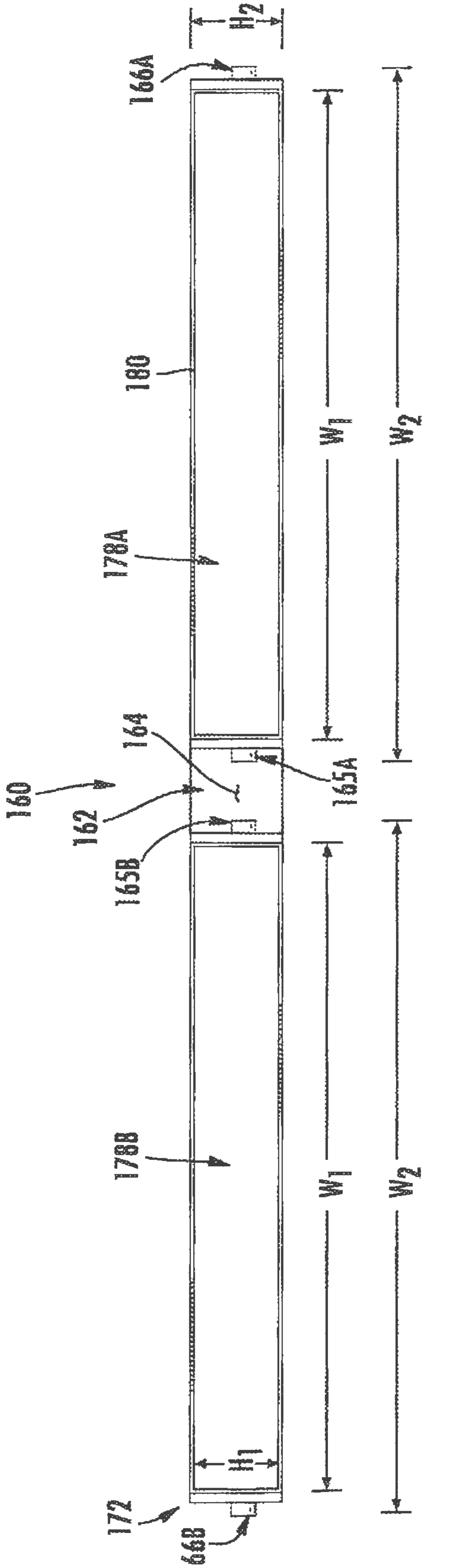
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FIG. 18

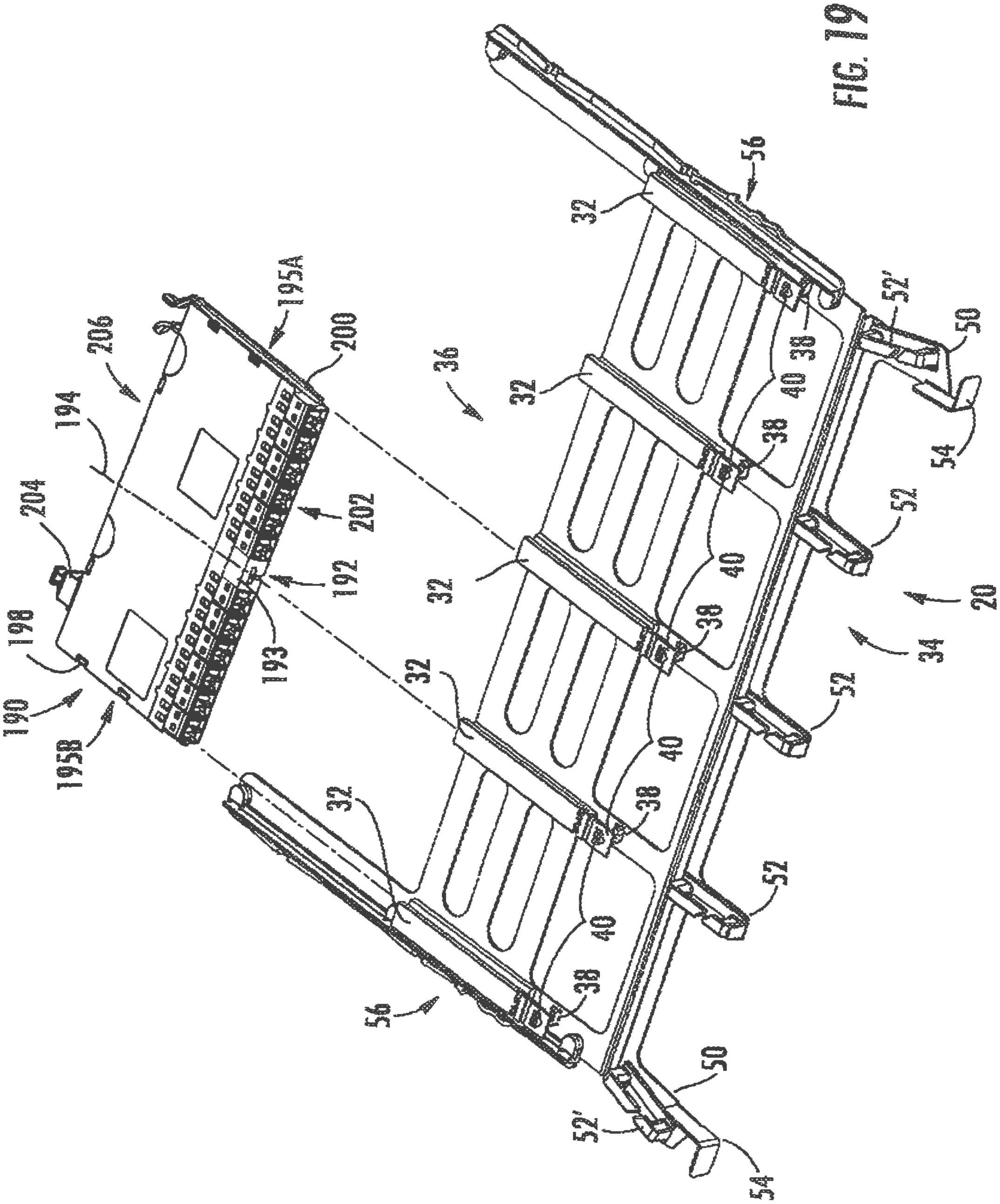
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FIG. 19

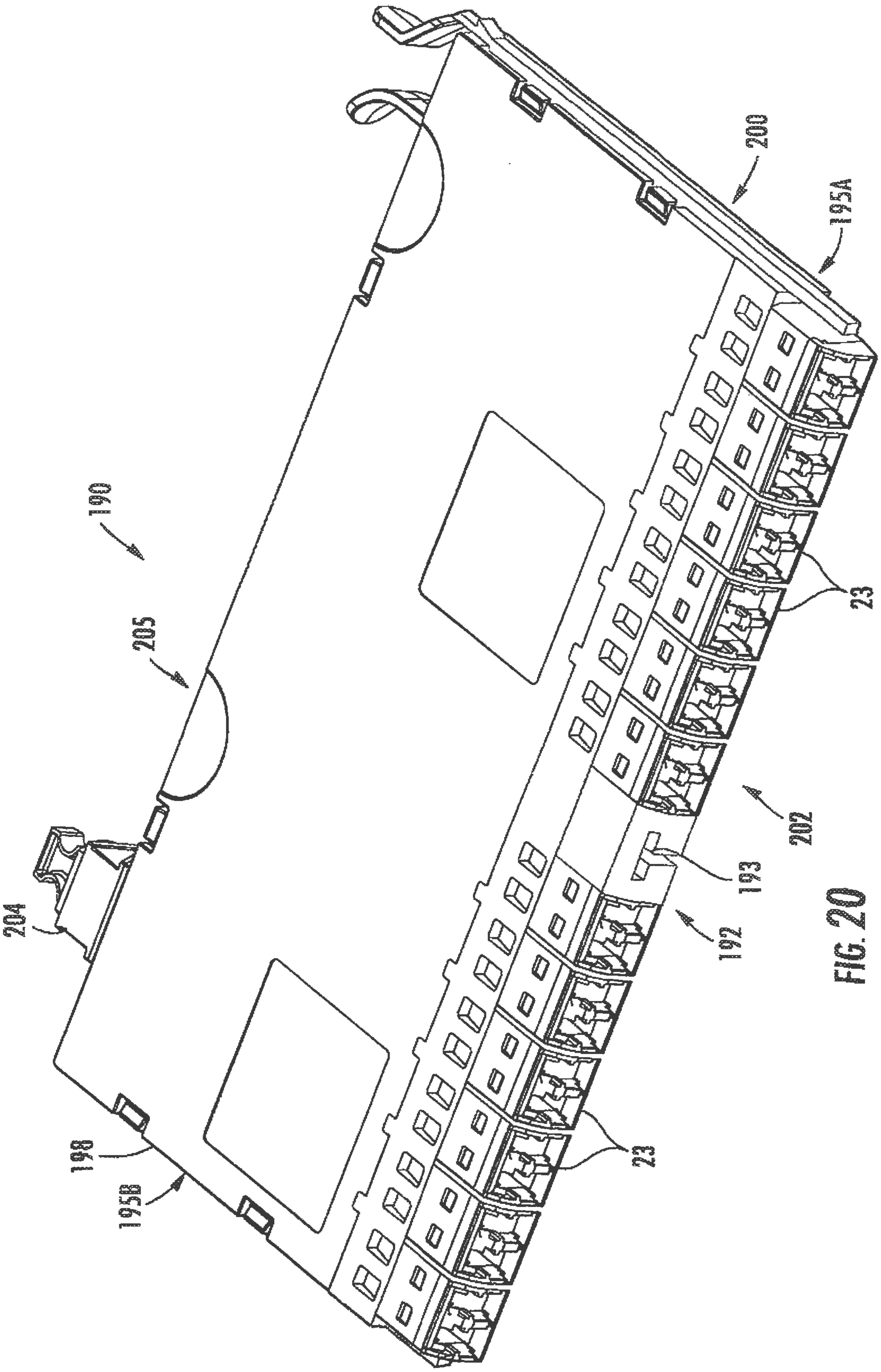

FIG. 20

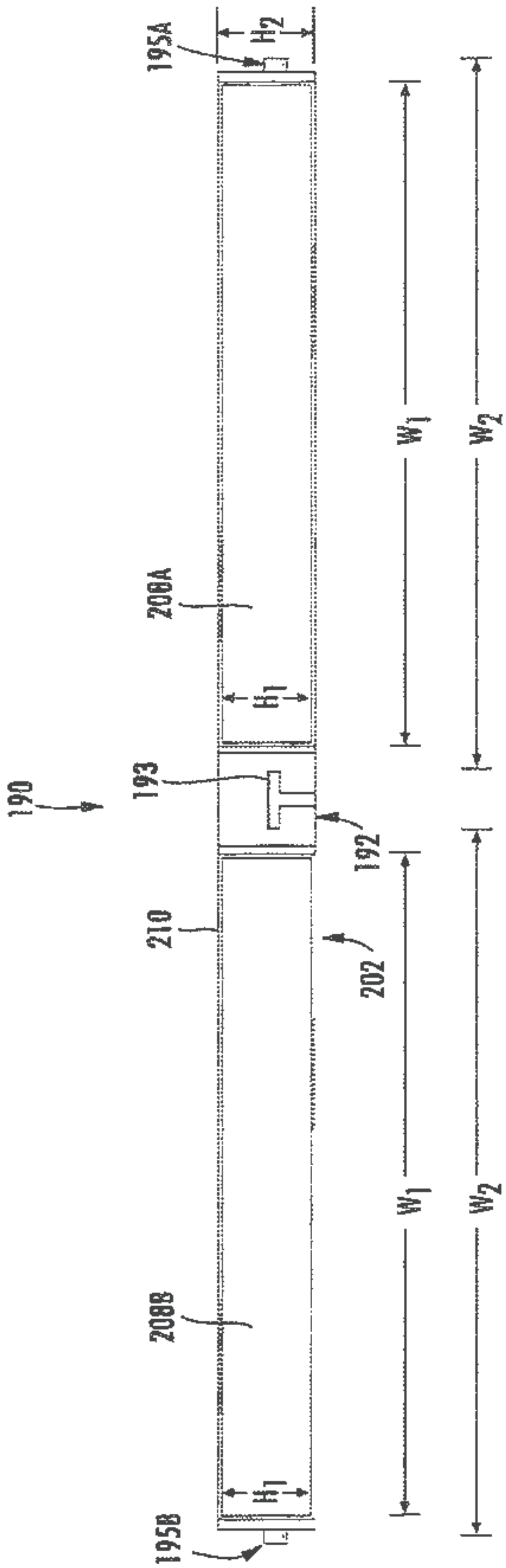

FIG. 21

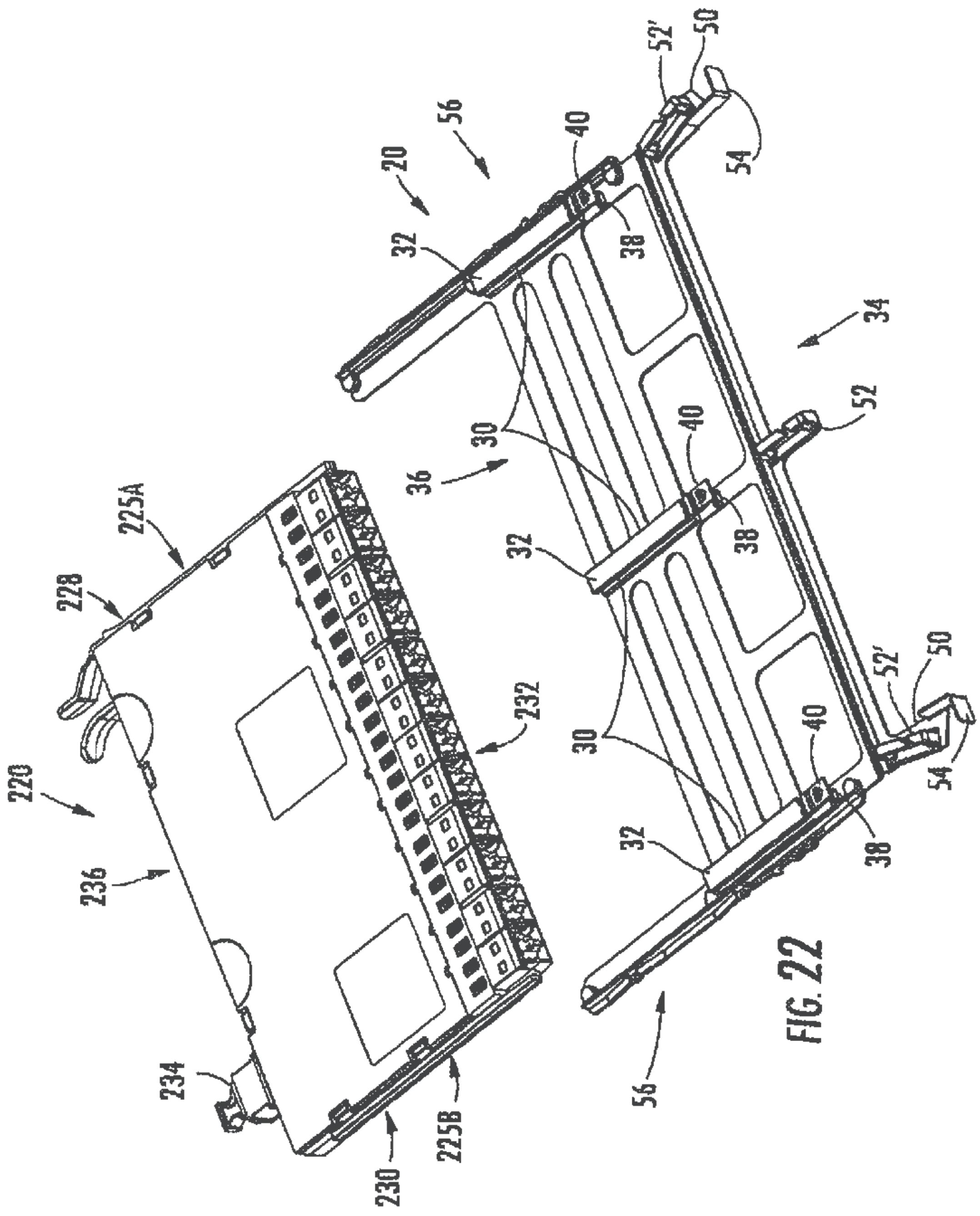
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FIG. 22

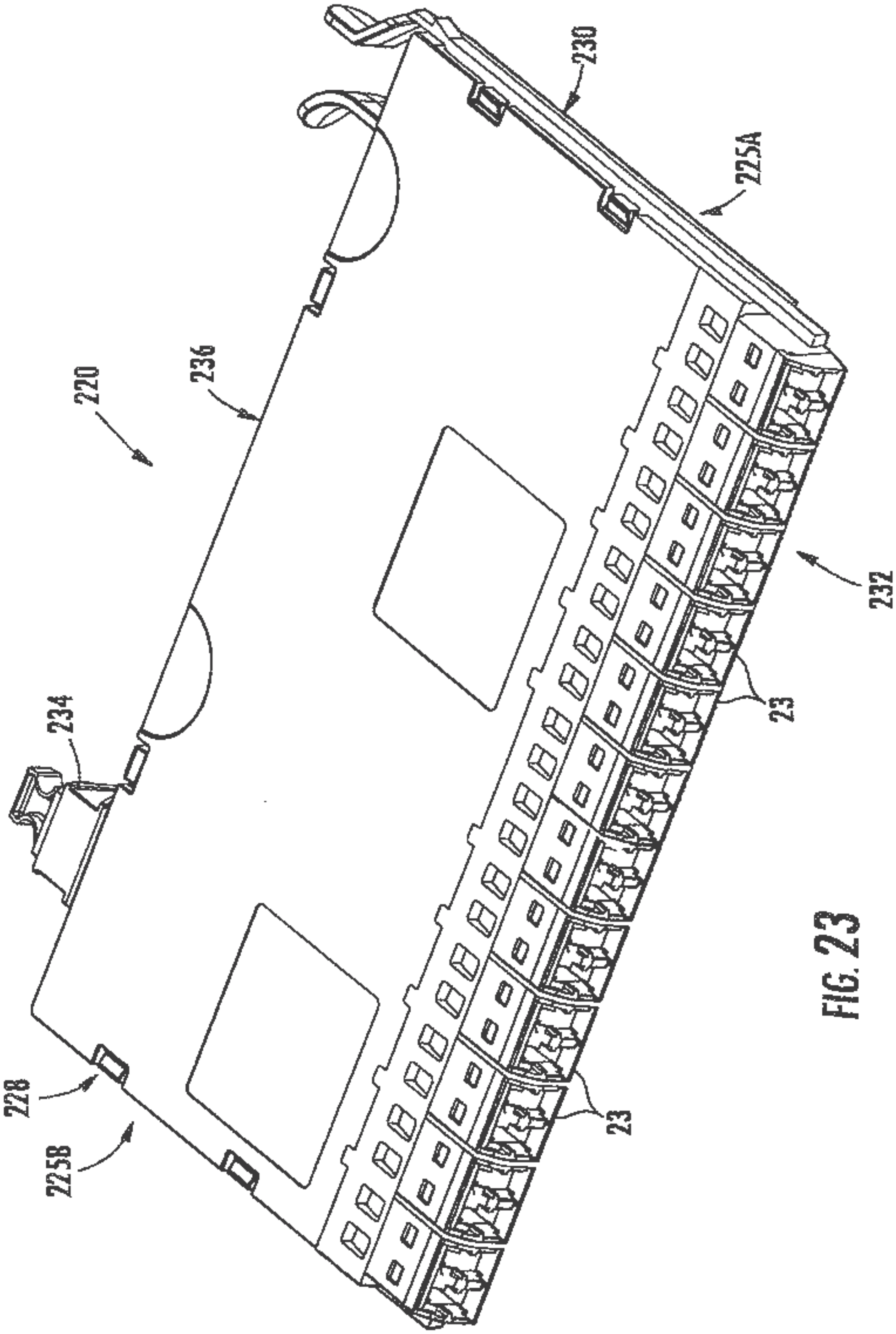

FIG. 23

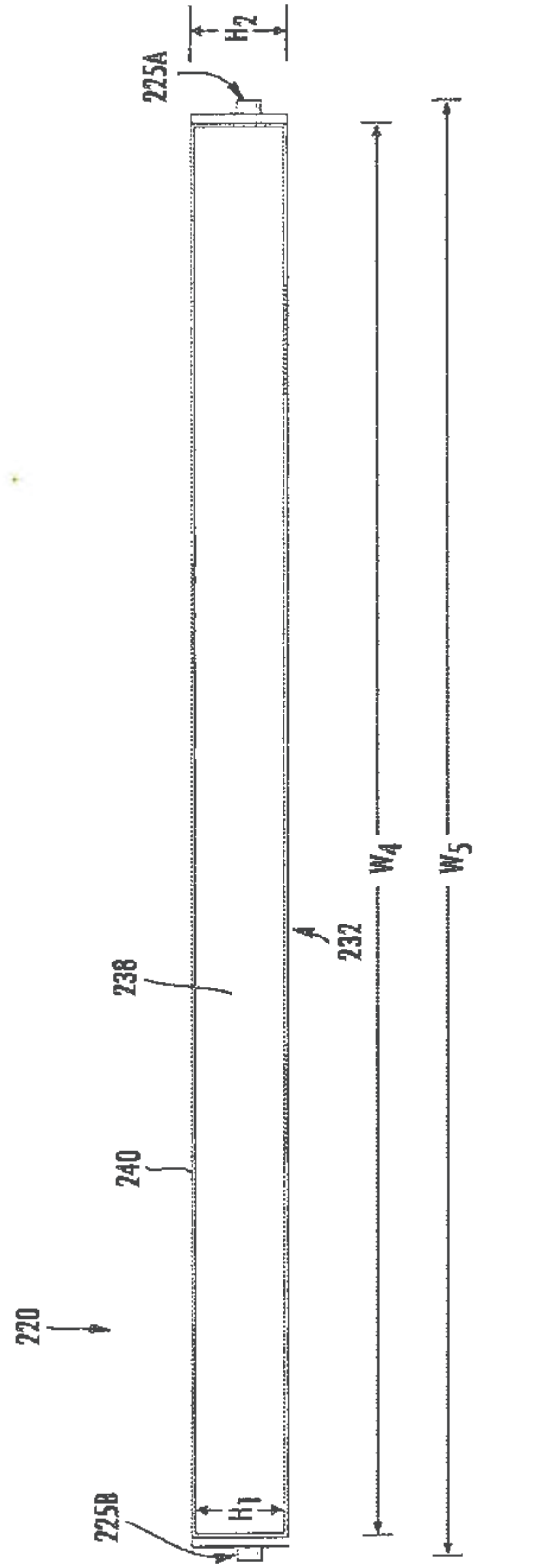

FIG. 24

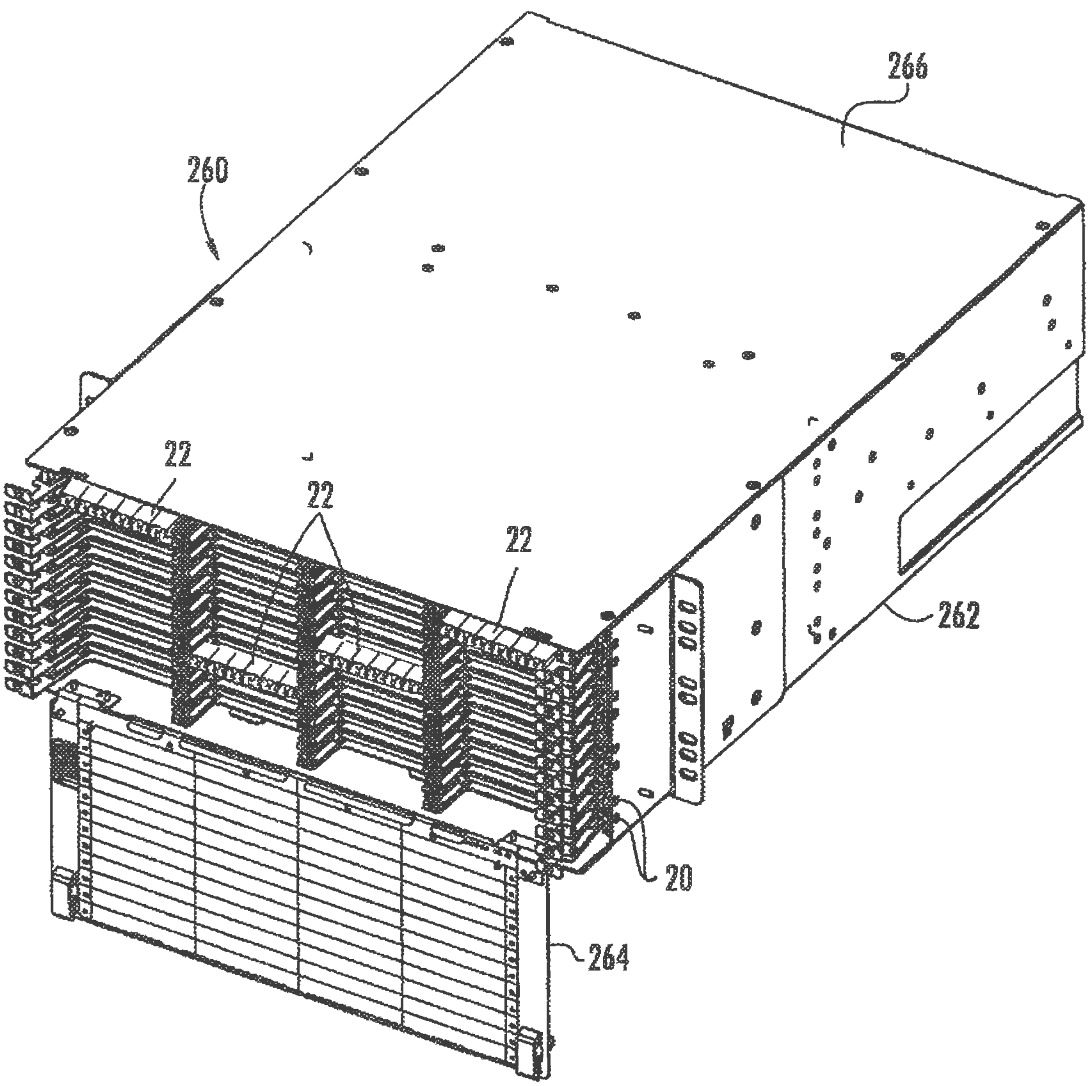

FIG. 25

HIGH DENSITY AND BANDWIDTH FIBER OPTIC APPARATUSES AND RELATED EQUIPMENT AND METHODS

PRIORITY APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 15/886,342 filed Feb. 1, 2018 and subsequently published as U.S. Patent Application Publication No. 2018/0156698 on Jun. 7, 2018, which is a continuation of U.S. patent application Ser. No. 14/660,074 filed on Mar. 17, 2015 and subsequently issued as U.S. Pat. No. 9,910,236, which is a divisional of U.S. patent application Ser. No. 13/746,938 filed Jan. 22, 2013 and subsequently issued as U.S. Pat. No. 9,020,320, which is a continuation of U.S. patent application Ser. No. 12/819,081 filed on Jun. 18, 2010 and subsequently abandoned, which claims priority to U.S. Provisional Patent Application No. 61/218,880 filed on Jun. 19, 2009, wherein said U.S. patent application Ser. No. 13/746,938 is a continuation-in-part of U.S. patent application Ser. No. 12/323,415 filed Nov. 25, 2008 and subsequently issued as U.S. Pat. No. 8,452,148, which claims priority to U.S. Provisional Patent Application No. 61/197,068 filed Oct. 23, 2008 and to U.S. Provisional Patent Application No. 61/190,538 filed Aug. 29, 2008; wherein the entire contents of all of the foregoing applications and patents are hereby incorporated by reference herein in their entireties.

BACKGROUND

Field of the Disclosure

The technology of the disclosure relates to fiber optic connection density and bandwidth provided in fiber optic apparatuses and equipment.

Technical Background

Benefits of optical fiber include extremely wide bandwidth and low noise operation. Because of these advantages, optical fiber is increasingly being used for a variety of applications, including but not limited to broadband voice, video, and data transmission. Fiber optic networks employing optical fiber are being developed and used to deliver voice, video, and data transmissions to subscribers over both private and public networks. These fiber optic networks often include separated connection points linking optical fibers to provide "live fiber" from one connection point to another connection point. In this regard, fiber optic equipment is located in data distribution centers or central offices to support interconnections. For example, the fiber optic equipment can support interconnections between servers, storage area networks (SANs), and other equipment at data centers. Interconnections may be supported by fiber optic patch panels or modules.

The fiber optic equipment is customized based on the application and connection bandwidth needs. The fiber optic equipment is typically included in housings that are mounted in equipment racks to optimize use of space. The data rates that can be provided by equipment in a data center are governed by the connection bandwidth supported by the fiber optic equipment. The bandwidth is governed by the number of optical fiber ports included in the fiber optic equipment and the data rate capabilities of a transceiver connected to the optical fiber ports. When additional bandwidth is needed or desired, additional fiber optic equipment can be employed or scaled in the data center to increase optical fiber port count. However, increasing the number of optical fiber ports can require more equipment rack space in a data center. Providing additional space for fiber optic equipment increases costs. A need exists to provide fiber optic equipment that provides a foundation in data centers for migration to high density patch fields and ports and greater connection bandwidth capacity to provide a migration path to higher data rates while minimizing the space needed for such fiber optic equipment.

SUMMARY OF THE DETAILED DESCRIPTION

Embodiments disclosed in the detailed description include high-density and connection bandwidth fiber optic apparatuses and related equipment and methods. In certain embodiments, fiber optic apparatuses comprising a chassis are provided. the chassis may be configured to support a fiber optic connection density of at least ninety-eight (98), at least one hundred twenty (120) per U space, or at least one hundred forty-four (144) fiber optic connections per U space based on using at least one simplex or duplex fiber optic component. In other disclosed embodiments, the chassis may be configured to support a fiber optic connection density of at least four hundred thirty-four (434) or at least five hundred seventy-six (576) fiber optic connections per U space based on using at least one twelve (12) fiber, fiber optic component. In other disclosed embodiments, the at least one of the chassis may be configured to support a fiber optic connection density of at least eight hundred sixty-six (866) per U space or at least one thousand one hundred fifty-two (1152) fiber optic connections per U space based on using at least one twenty-four (24) fiber, fiber optic component. Methods of providing and supporting the aforementioned fiber optic connections densities are also provided.

In other embodiments, fiber optic apparatuses comprising a chassis may be configured to support a full-duplex connection bandwidth of at least nine hundred sixty-two (962) Gigabits per second per U space, at least one thousand two hundred (1200) Gigabits per second, or at least one thousand four hundred forty (1440) Gigabits per second per U space based on using at least one simplex or duplex fiber optic component. In other disclosed embodiments, the chassis may be configured to support a full-duplex connection bandwidth of at least four thousand three hundred twenty-two (4322) Gigabits per second per U space, at least four thousand eight hundred (4800) Gigabits per second, or at least five thousand seven hundred sixty (5760) Gigabits per second per U space based on using at least one twelve (12) fiber, fiber optic component. In another disclosed embodiment, the chassis may be configured to support a full-duplex connection bandwidth of at least eight thousand six hundred forty-two (8642) Gigabits per second per U space. Methods of providing and supporting the aforementioned fiber optic connection bandwidths are also provided.

Additional features and advantages will be set forth in the detailed description which follows, and in part will be readily apparent to those skilled in the art from that description or recognized by practicing the invention as described herein, including the detailed description that follows, the claims, as well as the appended drawings.

It is to be understood that both the foregoing general description and the following detailed description present embodiments, and are intended to provide an overview or framework for understanding the nature and character of the disclosure. The accompanying drawings are included to provide a further understanding, and are incorporated into and constitute a part of this specification. The drawings illustrate various embodiments, and together with the description serve to explain the principles and operation of the concepts disclosed.

BRIEF DESCRIPTION OF THE FIGURES

FIG. **1** is a front perspective view of an exemplary fiber optic equipment rack with an installed exemplary 1-U size chassis supporting high-density fiber optic modules to provide a given fiber optic connection density and bandwidth capability, according to one embodiment;

FIG. **2** is a rear perspective close-up view of the chassis of FIG. **1** with fiber optic modules installed in fiber optic equipment trays installed in the fiber optic equipment;

FIG. **3** is a front perspective view of one fiber optic equipment tray with installed fiber optic modules configured to be installed in the chassis of FIG. **1**;

FIG. **4** is a close-up view of the fiber optic equipment tray of FIG. **3** without fiber optic modules installed;

FIG. **5** is a close-up view of the fiber optic equipment tray of FIG. **3** with fiber optic modules installed;

FIG. **6** is a front perspective view of the fiber optic equipment tray of FIG. **3** without fiber optic modules installed;

FIG. **7** is a front perspective view of fiber optic equipment trays supporting fiber optic modules with one fiber optic equipment tray extended out from the chassis of FIG. **1**;

FIG. **8** is a left perspective view of an exemplary tray guide disposed in the chassis of FIG. **1** configured to receive fiber optic equipment trays of FIG. **6** capable of supporting one or more fiber optic modules;

FIGS. **9**A and **9**B are perspective and top views, respectively, of an exemplary tray rail disposed on each side of the fiber optic equipment tray of FIG. **3** and configured to be received in the chassis of FIG. **1** by the tray guide of FIG. **8**;

FIGS. **10**A and **10**B are front right and left perspective views, respectively, of an exemplary fiber optic module that can be disposed in the fiber optic equipment trays of FIG. **3**;

FIG. **11** is a perspective, exploded view of the fiber optic module in FIGS. **10**A and **10**B;

FIG. **12** is a perspective top view of the fiber optic module of FIG. **11** with the cover removed and showing a fiber optic harness installed therein;

FIG. **13** is a front view of the fiber optic module of FIG. **11** without fiber optic components installed;

FIG. **14** is a front right perspective view of another alternate fiber optic module that supports twelve (12) fiber MPO fiber optic components and which can be installed in the fiber optic equipment tray of FIG. **3**;

FIG. **15** is front right perspective view of another alternate fiber optic module that supports twenty-four (24) fiber MPO fiber optic components and which can be installed in the fiber optic equipment tray of FIG. **3**;

FIG. **16** is a front perspective view of an alternate fiber optic module being installed in the fiber optic equipment tray of FIG. **3**;

FIG. **17** is front right perspective view of the fiber optic module of FIG. **16**;

FIG. **18** is a front view of the fiber optic module of FIGS. **16** and **17**;

FIG. **19** is a front perspective view of another alternate fiber optic module being installed in the fiber optic equipment tray of FIG. **3**;

FIG. **20** is front right perspective view of the fiber optic module of FIG. **19**;

FIG. **21** is a front view of the fiber optic module of FIGS. **19** and **20**;

FIG. **22** is a front perspective view of another alternate fiber optic module being installed in an alternate fiber optic equipment tray that can be installed in the chassis of FIG. **1**;

FIG. **23** is front right perspective view of the fiber optic module of FIG. **22**;

FIG. **24** is a front view of the fiber optic module of FIGS. **22** and **23**; and

FIG. **25** is a front perspective view of alternate exemplary 4-U size fiber optic chassis that can support the fiber optic equipment trays and fiber optic modules according to the fiber optic equipment tray and fiber optic modules disclosed.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Reference will now be made in detail to certain embodiments, examples of which are illustrated in the accompanying drawings, in which some, but not all features are shown. Indeed, embodiments disclosed herein may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will satisfy applicable legal requirements. Whenever possible, like reference numbers will be used to refer to like components or parts.

Embodiments disclosed in the detailed description include high-density fiber optic modules and fiber optic module housings and related equipment. In certain embodiments, the width and/or height of the front opening of fiber optic modules and/or fiber optic module housings can be provided according to a designed relationship to the width and/or height, respectively, of a front side of the main body of the fiber optic modules and fiber optic module housings to support fiber optic components or connections. In this manner, fiber optic components can be installed in a given percentage or area of the front side of the fiber optic module to provide a high density of fiber optic connections for a given fiber optic component type(s). In another embodiment, the front openings of the fiber optic modules and/or fiber optic module housings can be provided to support a designed connection density of fiber optic components or connections for a given width and/or height of the front opening of the fiber optic module and/or fiber optic module housing. Embodiments disclosed in the detailed description also include high connection density and bandwidth fiber optic apparatuses and related equipment. In certain embodiments, fiber optic apparatuses are provided and comprise a chassis defining one or more U space fiber optic equipment units, wherein at least one of the one or more U space fiber optic equipment units is configured to support a given fiber optic connection density or bandwidth in a 1-U space, and for a given fiber optic component type(s).

In this regard, FIG. **1** illustrates exemplary 1-U size fiber optic equipment **10** from a front perspective view. The fiber optic equipment **10** supports high-density fiber optic modules that support a high fiber optic connection density and bandwidth in a 1-U space, as will be described in greater detail below. The fiber optic equipment **10** may be provided at a data distribution center or central office to support cable-to-cable fiber optic connections and to manage a plurality of fiber optic cable connections. As will be described in greater detail below, the fiber optic equipment **10** has one or more fiber optic equipment trays that each support one or more fiber optic modules. However, the fiber optic equipment **10** could also be adapted to support one or more fiber optic patch panels or other fiber optic equipment that supports fiber optic components and connectivity.

The fiber optic equipment **10** includes a fiber optic equipment chassis **12** ("chassis **12**"). The chassis **12** is shown as being installed in a fiber optic equipment rack **14**. The fiber optic equipment rack **14** contains two vertical rails **16A**, **16B** that extend vertically and include a series of apertures **18** for facilitating attachment of the chassis **12** inside the fiber optic equipment rack **14**. The chassis **12** is attached and supported by the fiber optic equipment rack **14** in the form of shelves that are stacked on top of each other within the vertical rails **16A**, **16B**. As illustrated, the chassis **12** is attached to the vertical rails **16A**, **16B**. The fiber optic equipment rack **14** may support 1-U-sized shelves, with "U" equal to a standard 1.75 inches in height and nineteen (19) inches in width. In certain applications, the width of "U" may be twenty-three (23) inches. Also, the term fiber optic equipment rack **14** should be understood to include structures that are cabinets as well. In this embodiment, the chassis **12** is 1-U in size; however, the chassis **12** could be provided in a size greater than 1-U as well.

As will be discussed in greater detail later below, the fiber optic equipment **10** includes a plurality of extendable fiber optic equipment trays **20** that each carries one or more fiber optic modules **22**. The chassis **12** and fiber optic equipment trays **20** support fiber optic modules **22** that support high-density fiber optic modules and a fiber optic connection density and bandwidth connections in a given space, including in a 1-U space. FIG. **1** shows exemplary fiber optic components **23** disposed in the fiber optic modules **22** that support fiber optic connections. For example, the fiber optic components **23** may be fiber optic adapters or fiber optic connectors. As will also be discussed in greater detail later below, the fiber optic modules **22** in this embodiment can be provided such that the fiber optic components **23** can be disposed through at least eighty-five percent (85%) of the width of the front side or face of the fiber optic module **22**, as an example. This fiber optic module **22** configuration may provide a front opening of approximately 90 millimeters (mm) or less wherein fiber optic components can be disposed through the front opening and at a fiber optic connection density of at least one fiber optic connection per 7.0 mm of width of the front opening of the fiber optic modules **22** for simplex or duplex fiber optic components **23**. In this example, six (6) duplex or twelve (12) simplex fiber optic components may be installed in each fiber optic module **22**. The fiber optic equipment trays **20** in this embodiment support up to four (4) of the fiber optic modules **22** in approximately the width of a 1-U space, and three (3) fiber optic equipment trays **20** in the height of a 1-U space for a total of twelve (12) fiber optic modules **22** in a 1-U space. Thus, for example, if six (6) duplex fiber optic components were disposed in each of the twelve (12) fiber optic modules **22** installed in fiber optic equipment trays **20** of the chassis **12** as illustrated in FIG. **1**, a total of one hundred forty-four (144) fiber optic connections, or seventy-two (72) duplex channels (i.e., transmit and receive channels), would be supported by the chassis **12** in a 1-U space. If five (5) duplex fiber optic adapters are disposed in each of the twelve (12) fiber optic modules **22** installed in fiber optic equipment trays **20** of the chassis **12**, a total of one hundred twenty (120) fiber optic connections, or sixty (60) duplex channels, would be supported by the chassis **12** in a 1-U space. The chassis **12** also supports at least ninety-eight (98) fiber optic components in a 1-U space wherein at least one of the fiber optic components is a simplex or duplex fiber optic component.

If multi-fiber fiber optic components were installed in the fiber optic modules **22**, such as MPO components for example, higher fiber optic connection density and bandwidths would be possible over other chassis **12** that use similar fiber optic components. For example, if up to four (4) twelve (12) fiber MPO fiber optic components were disposed in each fiber optic module **22**, and twelve (12) of the fiber optic modules **22** were disposed in the chassis **12** in a 1-U space, the chassis **12** would support up to five hundred seventy-six (576) fiber optic connections in a 1-U space. If up to four (4) twenty-four (24) fiber MPO fiber optic components were disposed in each fiber optic module **22**, and twelve (12) of the fiber optic modules **22** were disposed in the chassis **12**, up to one thousand one hundred fifty-two (1152) fiber optic connections in a 1-U space.

FIG. **2** is a rear perspective close-up view of the chassis **12** of FIG. **1** with fiber optic modules **22** loaded with fiber optic components **23** and installed in fiber optic equipment trays **20** installed in the chassis **12**. Module rails **28A**, **28B** are disposed on each side of each fiber optic module **22**. The module rails **28A**, **28B** are configured to be inserted within tray channels **30** of module rail guides **32** disposed in the fiber optic equipment tray **20**, as illustrated in more detail in FIGS. **3-5**. Note that any number of module rail guides **32** can be provided. The fiber optic module **22** can be installed from both a front end **34** and a rear end **36** of the fiber optic equipment tray **20** in this embodiment. If it is desired to install the fiber optic module **22** in the fiber optic equipment tray **20** from the rear end **36**, a front end **33** of the fiber optic module **22** can be inserted from the rear end **36** of the fiber optic equipment tray **20**. More specifically, the front end **33** of the fiber optic module **22** is inserted into the tray channels **30** of the module rail guides **32**. The fiber optic module **22** can then be pushed forward within the tray channels **30** until the fiber optic module **22** reaches the front end **34** of the module rail guides **32**. The fiber optic modules **22** can be moved towards the front end **34** until the fiber optic modules **22** reach a stop or locking feature disposed in the front end **34** as will described later in this application. FIG. **6** also illustrates the fiber optic equipment tray **20** without installed fiber optic modules **22** to illustrate the tray channels **30** and other features of the fiber optic equipment tray **20**.

The fiber optic module **22** can be locked into place in the fiber optic equipment tray **20** by pushing the fiber optic module **22** forward to the front end **33** of the fiber optic equipment tray **20**. A locking feature in the form of a front stop **38** is disposed in the module rail guides **32**, as illustrated in FIG. **3** and in more detail in the close-up view in FIG. **4**. The front stop **38** prevents the fiber optic module **22** from extending beyond the front end **34**, as illustrated in the close-up view of the fiber optic equipment tray **20** with installed fiber optic modules **22** in FIG. **5**. When it is desired to remove a fiber optic module **22** from the fiber optic equipment tray **20**, a front module tab **40** also disposed in the module rail guides **32** and coupled to the front stop **38** can be pushed downward to engage the front stop **38**. As a result, the front stop **38** will move outward away from the fiber optic module **22** such that the fiber optic module **22** is not obstructed from being pulled forward. The fiber optic module **22**, and in particular its module rails **28A**, **28B** (FIG. **2**), can be pulled forward along the module rail guides **32** to remove the fiber optic module **22** from the fiber optic equipment tray **20**.

The fiber optic module **22** can also be removed from the rear end **36** of the fiber optic equipment tray **20**. To remove the fiber optic module **22** from the rear end **36** of the fiber optic equipment tray **20**, a latch **44** is disengaged by pushing a lever 46 (see FIGS. 2 and 3; see also, FIGS. 10A and 10B) inward towards the fiber optic module 22 to release the latch 44 from the module rail guide 32. To facilitate pushing the lever 46 inward towards the fiber optic module 22, a finger hook 48 is provided adjacent to the lever 46 so the lever 46 can easily be squeezed into the finger hook 48 by a thumb and index finger.

With continuing reference to FIG. 3-6, the fiber optic equipment tray 20 may also contain extension members 50. Routing guides 52 may be conveniently disposed on the extension members 50 to provide routing for optical fibers or fiber optic cables connected to fiber optic components 23 disposed in the fiber optic modules 22 (FIG. 3). The routing guides 52' on the ends of the fiber optic equipment tray 20 may be angled with respect to the module rail guides 32 to route optical fibers or fiber optic cables at an angle to the sides of the fiber optic equipment tray 20. Pull tabs 54 may also be connected to the extension members 50 to provide a means to allow the fiber optic equipment tray 20 to easily be pulled out from and pushed into the chassis 12.

As illustrated in FIGS. 3 and 6, the fiber optic equipment tray 20 also contains tray rails 56. The tray rails 56 are configured to be received in tray guides 58 disposed in the chassis 12 to retain and allow the fiber optic equipment trays 20 to move in and out of the chassis 12, as illustrated in FIG. 7. More detail regarding the tray rails 56 and their coupling to the tray guides 58 in the chassis 12 is discussed below with regard to FIGS. 8 and 9A-9B. The fiber optic equipment trays 20 can be moved in and out of the chassis 12 by their tray rails 56 moving within the tray guides 58. In this manner, the fiber optic equipment trays 20 can be independently movable about the tray guides 58 in the chassis 12. FIG. 7 illustrates a front perspective view of one fiber optic equipment tray 20 pulled out from the chassis 12 among three (3) fiber optic equipment trays 20 disposed within the tray guides 58 of the chassis 12. The tray guides 58 may be disposed on both a left side end 60 and a right side end 62 of the fiber optic equipment tray 20. The tray guides 58 are installed opposite and facing each other in the chassis 12 to provide complementary tray guides 58 for the tray rails 56 of the fiber optic equipment trays 20 received therein. If it is desired to access a particular fiber optic equipment tray 20 and/or a particular fiber optic module 22 in a fiber optic equipment tray 20, the pull tab 54 of the desired fiber optic equipment tray 20 can be pulled forward to cause the fiber optic equipment tray 20 to extend forward out from the chassis 12, as illustrated in FIG. 7. The fiber optic module 22 can be removed from the fiber optic equipment tray 20 as previously discussed. When access is completed, the fiber optic equipment tray 20 can be pushed back into the chassis 12 wherein the tray rails 56 move within the tray guides 58 disposed in the chassis 12.

FIG. 8 is a left perspective view of an exemplary tray guide 58 disposed in the chassis 12 of FIG. 1. As discussed above, the tray guides 58 are configured to receive fiber optic equipment trays 20 supporting one or more fiber optic modules 22 in the chassis 12. The tray guides 58 allow the fiber optic equipment trays 20 to be pulled out from the chassis 12, as illustrated in FIG. 7. The tray guide 58 in this embodiment is comprised of a guide panel 64. The guide panel 64 may be constructed out of any material desired, including but not limited to a polymer or metal. The guide panel 64 contains a series of apertures 66 to facilitate attachment of the guide panel 64 to the chassis 12, as illustrated in FIG. 8. Guide members 68 are disposed in the guide panel 64 and configured to receive the tray rail 56 of the fiber optic equipment tray 20. Three (3) guide members 68 are disposed in the guide panel 64 in the embodiment of FIG. 8 to be capable of receiving up to three (3) tray rails 56 of three (3) fiber optic equipment trays 20 in a 1-U space. However, any number of guide members 68 desired may be provided in the tray guide 58 to cover sizes less than or greater than a 1-U space. In this embodiment, the guide members 68 each include guide channels 70 configured to receive and allow tray rails 56 to move along the guide channels 70 for translation of the fiber optic equipment trays 20 about the chassis 12.

Leaf springs 72 are disposed in each of the guide members 68 of the tray guide 58 and are each configured to provide stopping positions for the tray rails 56 during movement of the fiber optic equipment tray 20 in the guide members 68. The leaf springs 72 each contain detents 74 that are configured to receive protrusions 76 (FIG. 9A-9D) disposed in the tray rails 56 to provide stopping or resting positions. The tray rails 56 contain mounting platforms 75 that are used to attach the tray rails 56 to the fiber optic equipment trays 20. It may be desirable to provide stopping positions in the tray guide 56 to allow the fiber optic equipment trays 20 to have stopping positions when moved in and out of the chassis 12. Two (2) protrusions 76 in the tray rail 56 are disposed in two (2) detents 74 in the tray guide 58 at any given time. When the fiber optic equipment tray 20 is fully retracted into the chassis 12 in a first stopping position, the two (2) protrusions 76 of the tray rail 56 are disposed in the one detent 74 adjacent a rear end 77 of the guide channel 70 and the middle detent 74 disposed between the rear end 77 and a front end 78 of the guide channel 70. When the fiber optic equipment tray 20 is pulled out from the chassis 12, the two (2) protrusions 76 of the tray rail 56 are disposed in the one detent 74 adjacent the front end 78 of the guide channel 70 and the middle detent 74 disposed between the rear end 77 and the front end 78 of the guide channel 70.

As the tray rail 56 is pulled within the guide channel 70, a protrusion 80 disposed in the tray rail 56 and illustrated in FIGS. 9A and 9B is biased to pass over transition members 82 disposed between the leaf springs 72, as illustrated in FIG. 8. The protrusion 80 is provided in a leaf spring 81 disposed in the tray rail 56, as illustrated in FIGS. 9A and 9B. The transition members 82 have inclined surfaces 84 that allow the protrusion 80 to pass over the transition members 82 as the fiber optic equipment tray 20 is being translated with the guide channel 70. As the protrusion 80 contains the transition members 82, the force imparted onto the protrusion 80 causes the leaf spring 81 to bend inward to allow the protrusion 80 to pass over the transition member 82. To prevent the tray rail 56 and thus the fiber optic equipment tray 20 from being extended beyond the front end 78 and rear end 77 of the guide channel 70, stopping members 86 are disposed at the front end 78 and rear end 77 of the guide channel 70. The stopping members 86 do not have an inclined surface; thus the protrusion 80 in the tray rail 56 abuts against the stopping member 86 and is prevented from extending over the stopping member 86 and outside of the front end 78 of the guide channel 70.

Against the background of the above disclosed embodiment of a 1-U chassis 12 and fiber optic equipment trays 20 and fiber optic modules 22 that can installed therein, the form factor of the fiber optic module 22 will now be described. The form factor of the fiber optic module 22 allows a high density of fiber optic components 23 to be disposed within a certain percentage area of the front of the fiber optic module 22 thus supporting a particular fiber optic connection density and bandwidth for a given type of fiber optic component 23. When this fiber optic module 22 form factor is combined with the ability to support up to twelve (12) fiber optic modules **22** in a 1-U space, as described by the exemplary chassis **12** example above, a higher fiber optic connection density and bandwidth is supported and possible.

In this regard, FIGS. **10**A and **10**B are right and left perspective views of the exemplary fiber optic module **22**. As discussed above, the fiber optic module **22** can be installed in the fiber optic equipment trays **20** to provide fiber optic connections in the chassis **12**. The fiber optic module **22** is comprised of a main body **90** receiving a cover **92**. An internal chamber **94** (FIG. **11**) disposed inside the main body **90** and the cover **92** and is configured to receive or retain optical fibers or a fiber optic cable harness, as will be described in more detail below. The main body **90** is disposed between a front side **96** and a rear side **98** of the main body **90**. Fiber optic components **23** can be disposed through the front side **96** of the main body **90** and configured to receive fiber optic connectors connected to fiber optic cables (not shown). In this example, the fiber optic components **23** are duplex LC fiber optic adapters that are configured to receive and support connections with duplex LC fiber optic connectors. However, any fiber optic connection type desired can be provided in the fiber optic module **22**. The fiber optic components **23** are connected to a fiber optic component **100** disposed through the rear side **98** of the main body **90**. In this manner, a connection to the fiber optic component **23** creates a fiber optic connection to the fiber optic component **100**. In this example, the fiber optic component **100** is a multi-fiber MPO fiber optic adapter equipped to establish connections to multiple optical fibers (e.g., either twelve (12) or twenty-four (24) optical fibers). The fiber optic module **22** may also manage polarity between the fiber optic components **23**, **100**.

The module rails **28**A, **28**B are disposed on each side **102**A, **102**B of the fiber optic module **22**. As previously discussed, the module rails **28**A, **28**B are configured to be inserted within the module rail guides **32** in the fiber optic equipment tray **20**, as illustrated in FIG. **3**. In this manner, when it is desired to install a fiber optic module **22** in the fiber optic equipment tray **20**, the front side **96** of the fiber optic module **22** can be inserted from either the front end **33** or the rear end **36** of the fiber optic equipment tray **20**, as previously discussed.

FIG. **11** illustrates the fiber optic module **22** in an exploded view with the cover **92** of the fiber optic module **22** removed to illustrate the internal chamber **94** and other internal components of the fiber optic module **22**. FIG. **12** illustrates the fiber optic module **22** assembled, but without the cover **92** installed on the main body **90**. The cover **92** includes notches **106** disposed in sides **108**, **110** that are configured to interlock with protrusions **112** disposed on the sides **102**A, **102**B of the main body **90** of the fiber optic modules **22** when the cover **92** is attached to the main body **90** to secure the cover **92** to the main body **90**. The cover **92** also contains notches **114**, **116** disposed on a front side **118** and rear side **120**, respectively, of the cover **92**. The notches **114**, **116** are configured to interlock with protrusions **122**, **124** disposed in the front side **96** and the rear end **98**, respectively, of the main body **90** when the cover **92** is attached to the main body **90** to also secure the cover **92** to the main body **90**. FIG. **12** does not show protrusions **122**, **124**.

With continuing reference to FIG. **11**, the fiber optic components **23** are disposed through a front opening **126** disposed along a longitudinal axis L_1 in the front side **96** of the main body **90**. In this embodiment, the fiber optic components **23** are duplex LC adapters **128**, which support

single or duplex fiber connections and connectors. The duplex LC adapters **128** in this embodiment contain protrusions **130** that are configured to engage with orifices **135** disposed on the main body **90** to secure the duplex LC adapters **128** in the main body **90** in this embodiment. A cable harness **134** is disposed in the internal chamber **94** with fiber optic connectors **136**, **138** disposed on each end of optical fibers **139** connected to the duplex LC adapters **128** and the fiber optic component **100** disposed in the rear side **98** of the main body **90**. The fiber optic component **100** in this embodiment is a twelve (12) fiber MPO fiber optic adapter **140** in this embodiment. Two vertical members **142**A, **142**B are disposed in the internal chamber **94** of the main body **90**, as illustrated in FIG. **12**, to retain the looping of the optical fibers **139** of the cable harness **134**. The vertical members **142**A, **142**B and the distance therebetween are designed to provide a bend radius R in the optical fibers **139** no greater than forty (40) mm and preferably twenty-five (25) mm or less in this embodiment.

FIG. **13** illustrates a front view of the fiber optic module **22** without loaded fiber optic components **23** in the front side **96** to further illustrate the form factor of the fiber optic module **22**. As previously discussed, the front opening **126** is disposed through the front side **96** of the main body **90** to receive the fiber optic components **23**. The greater the width W_1 of the front opening **126**, the greater the number of fiber optic components **23** that may be disposed in the fiber optic module **22**. Greater numbers of fiber optic components **23** equates to more fiber optic connections, which supports higher fiber optic connectivity and bandwidth. However, the larger the width W_1 of the front opening **126**, the greater the area required to be provided in the chassis **12** for the fiber optic module **22**. Thus, in this embodiment, the width W_1 of the front opening **126** is design to be at least eighty-five percent (85%) of the width W_2 of the front side **96** of the main body **90** of the fiber optic module **22**. The greater the percentage of the width W_1 to width W_2, the larger the area provided in the front opening **126** to receive fiber optic components **23** without increasing width W_2. Width W_3, the overall width of the fiber optic module **22**, may be 86.6 mm or 3.5 inches in this embodiment. The overall depth D_1 of the fiber optic module **22** is 113.9 mm or 4.5 inches in this embodiment (FIG. **12**). As previously discussed, the fiber optic module **22** is designed such that four (4) fiber optic modules **22** can be disposed in a 1-U width space in the fiber optic equipment tray **20** in the chassis **12**. The width of the chassis **12** is designed to accommodate a 1-U space width in this embodiment.

With three (3) fiber optic equipment trays **20** disposed in the 1-U height of the chassis **12**, a total of twelve (12) fiber optic modules **22** can be supported in a given 1-U space. Supporting up to twelve (12) fiber optic connections per fiber optic module **22** as illustrated in the chassis **12** in FIG. **1** equates to the chassis **12** supporting up to one hundred forty-four (144) fiber optic connections, or seventy-two (72) duplex channels, in a 1-U space in the chassis **12** (i.e., twelve (12) fiber optic connections X twelve (12) fiber optic modules **22** in a 1-U space). Thus, the chassis **12** is capable of supporting up to one hundred forty-four (144) fiber optic connections in a 1-U space by twelve (12) simplex or six (6) duplex fiber optic adapters being disposed in the fiber optic modules **22**. Supporting up to ten (10) fiber optic connections per fiber optic module **22** equates to the chassis **12** supporting one hundred twenty (120) fiber optic connections, or sixty (60) duplex channels, in a 1-U space in the chassis **12** (i.e., ten (10) fiber optic connections X twelve (12) fiber optic modules **22** in a 1-U space). Thus, the chassis

12 is also capable of supporting up to one hundred twenty (120) fiber optic connections in a 1-U space by ten (10) simplex or five (5) duplex fiber optic adapters being disposed in the fiber optic modules 22.

This embodiment of the chassis 12 and fiber optic module 22 disclosed herein can support a fiber optic connection density within a 1-U space wherein the area occupied by the fiber optic component 23 in twelve (12) fiber optic modules 22 in a 1-U space represents at least fifty percent (50%) of the total fiber optic equipment rack 14 area in a 1-U space (see FIG. 1). In the case of twelve (12) fiber optic modules 22 provided in a 1-U space in the chassis 12, the 1-U space is comprised of the fiber optic components 23 occupying at least seventy-five percent (75%) of the area of the front side 96 of the fiber optic module 22.

Two (2) duplexed optical fibers to provide one (1) transmission/reception pair can allow for a data rate of ten (10) Gigabits per second in half-duplex mode or twenty (20) Gigabits per second in full-duplex mode. Thus, with the above-described embodiment, providing at least seventy-two (72) duplex transmission and reception pairs in a 1-U space employing at least one duplex or simplex fiber optic component can support a data rate of at least seven hundred twenty (720) Gigabits per second in half-duplex mode in a 1-U space or at least one thousand four hundred forty (1440) Gigabits per second in a 1-U space in full-duplex mode if employing a ten (10) Gigabit transceiver. This configuration can also support at least six hundred (600) Gigabits per second in half-duplex mode in a 1-U space and at least one thousand two hundred (1200) Gigabits per second in full-duplex mode in a 1-U space, respectively, if employing a one hundred (100) Gigabit transceiver. This configuration can also support at least four hundred eighty (480) Gigabits per second in half-duplex mode in a 1-U space and nine hundred sixty (960) Gigabits per second in full duplex mode in a 1-U space, respectively, if employing a forty (40) Gigabit transceiver. At least sixty (60) duplex transmission and reception pairs in a 1-U space can allow for a data rate of at least six hundred (600) Gigabits per second in a 1-U space in half-duplex mode or at least one thousand two hundred (1200) Gigabits per second in a 1-U space in full-duplex mode when employing a ten (10) Gigabit transceiver. At least forty nine (49) duplex transmission and reception pairs in a 1-U space can allow for a data rate of at least four hundred eighty-one (481) Gigabits per second in half-duplex mode or at least nine hundred sixty-two (962) Gigabits per second in a 1-U space in full-duplex mode when employing a ten (10) Gigabit transceiver.

The width W_1 of front opening 126 could be designed to be greater than eighty-five percent (85%) of the width W_2 of the front side 96 of the main body 90 of the fiber optic module 22. For example, the width W_1 could be designed to be between ninety percent (90%) and ninety-nine percent (99%) of the width W_2. As an example, the width W_1 could be less than ninety (90) mm. As another example, the width W_1 could be less than eighty-five (85) mm or less than eighty (80) mm. For example, the width W_1 may be eighty-three (83) mm and width W_2 may be eighty-five (85) mm, for a ratio of width W_1 to width W_2 of 97.6%. In this example, the front opening 126 may support twelve (12) fiber optic connections in the width W_1 to support a fiber optic connection density of at least one fiber optic connection per 7.0 mm of width W_1 of the front opening 126. Further, the front opening 126 of the fiber optic module 22 may support twelve (12) fiber optic connections in the width W_1 to support a fiber optic connection density of at least one fiber optic connection per 6.9 mm of width W_1 of the front opening 126.

Further as illustrated in FIG. 13, height H_1 of front opening 126 could be designed to be at least ninety percent (90%) of height H_2 of the front side 96 of the main body 90 of the fiber optic module 22. In this manner, the front opening 126 has sufficient height to receive the fiber optic components 23, and such that three (3) fiber optic modules 22 can be disposed in a 1-U space height. As an example, height H_1 could be twelve (12) mm or less or ten (10) mm or less. As an example, height H_1 could be ten (10) mm and height H_2 could be eleven (11) mm (or 7⁄16 inches), for a ratio of height H_1 to width H_2 of 90.9%.

Alternate fiber optic modules with alternative fiber optic connection densities are possible. FIG. 14 is a front perspective view of an alternate fiber optic module 22' that can be installed in the fiber optic equipment tray 20 of FIG. 1. The form factor of the fiber optic module 22' is the same as the form factor of the fiber optic module 22 illustrated in FIGS. 1-13. However, in the fiber optic module 22' of FIG. 14, two (2) MPO fiber optic adapters 150 are disposed through the front opening 126 of the fiber optic module 22'. The MPO fiber optic adapters 150 are connected to two (2) MPO fiber optic adapters 152 disposed in the rear side 98 of the main body 90 of the fiber optic module 22'. Thus, if the MPO fiber optic adapters 150 each support twelve (12) fibers, the fiber optic module 22' can support up to twenty-four (24) fiber optic connections. Thus, in this example, if up to twelve (12) fiber optic modules 22' are provided in the fiber optic equipment trays 20 of the chassis 12, up to two hundred eighty-eight (288) fiber optic connections can be supported by the chassis 12 in a 1-U space. Further in this example, the front opening 126 of the fiber optic module 22' may support twenty-four (24) fiber optic connections in the width W_1 (FIG. 13) to support a fiber optic connection density of at least one fiber optic connection per 3.4-3.5 mm of width W_1 of the front opening 126. It should be understood that the discussion with regard to modules may also apply to a panel. For purposes of this disclosure, a panel may have one or more adapter on one side and no adapters on the opposite side.

Thus, with the above-described embodiment, providing at least two-hundred eighty-eight (288) duplex transmission and reception pairs in a 1-U space employing at least one twelve (12) fiber MPO fiber optic components can support a data rate of at least two thousand eight hundred eighty (2880) Gigabits per second in half-duplex mode in a 1-U space or at least five thousand seven hundred sixty (5760) Gigabits per second in a 1-U space in full-duplex mode if employing a ten (10) Gigabit transceiver. This configuration can also support at least four thousand eight hundred (4800) Gigabits per second in half-duplex mode in a 1-U space and nine thousand six hundred (9600) Gigabits per second in full-duplex mode in a 1-U space, respectively, if employing a one hundred (100) Gigabit transceiver. This configuration can also support at least one thousand nine hundred twenty (1920) Gigabits per second in half-duplex mode in a 1-U space and three thousand eight hundred forty (3840) Gigabits per second in full-duplex mode in a 1-U space, respectively, if employing a forty (40) Gigabit transceiver. This configuration also supports a data rate of at least four thousand three hundred twenty-two (4322) Gigabits per second in full-duplex mode in a 1-U space when employing a ten (10) Gigabit transceiver employing at least one twelve (12) fiber MPO fiber optic component, or two thousand one hundred sixty-one (2161) Gigabits per second in full-duplex mode in a 1-U space when employing a ten (10) Gigabit transceiver employing at least one twenty-four (24) fiber MPO fiber optic component.

If the MPO fiber optic adapters **150** in the fiber optic module **22'** support twenty-four (24) fibers, the fiber optic module **22'** can support up to forty-eight (48) fiber optic connections. Thus, in this example, if up to twelve (12) fiber optic modules **22'** are provided in the fiber optic equipment trays **20** of the chassis **12**, up to five hundred seventy-six (576) fiber optic connections can be supported by the chassis **12** in a 1-U space if the fiber optic modules **22'** are disposed in the fiber optic equipment trays **20**. Further, in this example, the front opening **126** of the fiber optic module **22'** may support up to forty-eight (48) fiber optic connections in the width W_1 to support a fiber optic connection density of at least one fiber optic connection per 1.7 mm of width W_1 of the front opening **126**.

FIG. **15** is a front perspective view of another alternate fiber optic module **22"** that can be installed in the fiber optic equipment tray **20** of FIG. **1**. The form factor of the fiber optic module **22"** is the same as the form factor of the fiber optic module **22** illustrated in FIGS. **1-13**. However, in the fiber optic module **22"**, four (4) MPO fiber optic adapters **154** are disposed through the front opening **126** of the fiber optic module **22"**. The MPO fiber optic adapters **154** are connected to four (4) MPO fiber optic adapters **156** disposed in the rear end **98** of the main body **90** of the fiber optic module **22'**. Thus, if the MPO fiber optic adapters **150** support twelve (12) fibers, the fiber optic module **22"** can support up to forty-eight (48) fiber optic connections. Thus, in this example, if up to twelve (12) fiber optic modules **22"** are provided in the fiber optic equipment trays **20** of the chassis **12**, up to five hundred seventy-six (756) fiber optic connections can be supported by the chassis **12** in a 1-U space. Further in this example, the front opening **126** of the fiber optic module **22"** may support twenty-four (24) fiber optic connections in the width W_1 to support a fiber optic connection density of at least one fiber optic connection per 1.7 mm of width W_1 of the front opening **126**.

If the four (4) MPO fiber optic adapters **154** disposed in the fiber optic module **22"** support twenty-four (24) fibers, the fiber optic module **22"** can support up to ninety-six (96) fiber optic connections. Thus, in this example, if up to twelve (12) fiber optic modules **22"** are provided in the fiber optic equipment trays **20** of the chassis **12**, up to one thousand one hundred fifty-two (1152) fiber optic connections can be supported by the chassis **12** in a 1-U space. Further, in this example, the front opening **126** of the fiber optic module **22"** may support up to ninety-six (96) fiber optic connections in the width W_1 to support a fiber optic connection density of at least one fiber optic connection per 0.85 mm of width W_1 of the front opening **126**.

Further, with the above-described embodiment, providing at least five hundred seventy-six (576) duplex transmission and reception pairs in a 1-U space employing at least one twenty-four (24) fiber MPO fiber optic component can support a data rate of at least five thousand seven hundred sixty (5760) Gigabits per second in half-duplex mode in a 1-U space or at least eleven thousand five hundred twenty (11520) Gigabits per second in a 1-U space in full-duplex mode if employing a ten (10) Gigabit transceiver. This configuration can also support at least four thousand eight hundred (4800) Gigabits per second in half-duplex mode in a 1-U space and at least nine thousand six hundred (9600) Gigabits per second in full-duplex mode in a 1-U space, respectively, if employing a one hundred (100) Gigabit transceiver. This configuration can also support at least three

thousand eight hundred forty (3840) Gigabits per second in half-duplex mode in a 1-U space and at least seven thousand six hundred eighty (7680) Gigabits per second in full-duplex mode in a 1-U space, respectively, if employing a forty (40) Gigabit transceiver. This configuration also supports a data rate of at least eight thousand six hundred forty two (8642) Gigabits per second in full-duplex mode in a 1-U space when employing a ten (10) Gigabit transceiver employing at least one twenty-four (24) fiber MPO fiber optic component, or four thousand three hundred twenty one (4321) Gigabits per second in full-duplex mode in a 1-U space when employing a ten (10) Gigabit transceiver employing at least one twenty-four (24) fiber MPO fiber optic component.

FIG. **16** illustrates an alternate fiber optic module **160** that may be provided in the fiber optic equipment trays **20** to support fiber optic connections and connection densities and bandwidths. FIG. **17** is a right front perspective view of the fiber optic module **160** of FIG. **16**. In this embodiment, the fiber optic module **160** is designed to fit across two sets of module rail guides **32**. A channel **162** is disposed through a center axis **164** of the fiber optic module **160** to receive a module rail guide **32** in the fiber optic equipment tray **20**. Module rails **165A**, **165B**, similar to the module rails **28A**, **28B** of the fiber optic module **22** of FIGS. **1-13**, are disposed on the inside the channel **162** of the fiber optic module **160** and configured to engage with tray channels **30** in the fiber optic equipment tray **20**. Module rails **166A**, **166B**, similar to the module rails **28A**, **28B** of the fiber optic module **22** of FIGS. **1-13**, are disposed on each side **168**, **170** of the fiber optic module **160** that are configured to engage with tray channels **30** in the fiber optic equipment tray **20**. The module rails **166A**, **166B** are configured to engage with tray channels **30** in a module rail guide **32** disposed between module rail guides **32** engaged with the module rail guides **32** disposed on the sides **168**, **170** of the fiber optic module **160**.

Up to twenty-four (24) fiber optic components **23** can be disposed in a front side **172** of the fiber optic module **160**. In this embodiment, the fiber optic components **23** are comprised of up to twelve (12) duplex LC fiber optic adapters, which are connected to one twenty-four (24) fiber MPO fiber optic connector **174** disposed in a rear end **176** of the fiber optic module **160**. Thus, with three (3) fiber optic equipment trays **20** disposed in the height of the chassis **12**, a total of six (6) fiber optic modules **160** can be supported in a given 1-U space. Supporting up to twenty-four (24) fiber optic connections per fiber optic module **160** equates to the chassis **12** supporting up to one hundred forty-four (144) fiber optic connections, or seventy-two (72) duplex channels, in a 1-U space in the chassis **12** (i.e., twenty-four (24) fiber optic connections X six (6) fiber optic modules **160** in a 1-U space). Thus, the chassis **12** is capable of supporting up to one hundred forty-four (144) fiber optic connections in a 1-U space by twenty-four (24) simplex or twelve (12) duplex fiber optic adapters being disposed in the fiber optic modules **160**. Supporting up to twenty (20) fiber optic connections per fiber optic module **160** equates to the chassis **12** supporting one hundred twenty (120) fiber optic connections, or sixty (60) duplex channels, in a 1-U space in the chassis **12** (i.e., twenty (20) fiber optic connections X six (6) fiber optic modules **160** in a 1-U space). Thus, the chassis **12** is also capable of supporting up to one hundred twenty (120) fiber optic connections in a 1-U space by twenty (20) simplex or ten (10) duplex fiber optic adapters being disposed in the fiber optic modules **160**.

FIG. **18** illustrates a front view of the fiber optic module **160** of FIGS. **16-17** without loaded fiber optic components **23** in the front side **172** to further illustrate the form factor of the fiber optic module **160** in this embodiment. Front openings **178**A, **178**B disposed on each side of the channel **162** are disposed through the front side **172** of a main body **180** of the fiber optic module **160** to receive the fiber optic components **23**. The widths W_1 and W_2 and the heights H_1 and H_2 are the same as in the fiber optic module **22** illustrated in FIG. **13**. Thus, in this embodiment, the widths W_1 of front openings **178**A, **178**B are designed to be at least eighty-five percent (85%) of the width W_2 of the front side **172** of the main body **180** of the fiber optic module **160**. The greater the percentage of the width W_1 to width W_2, the larger the area provided in the front openings **178**A, **178**B to receive fiber optic components **23** without increasing width W_2.

The width W_1 of the front openings **178**A, **178**B could each be designed to be greater than eighty-five percent (85%) of the width W_2 of the front side **172** of the main body **180** of the fiber optic module **160**. For example, the width W_1 could be designed to be between ninety percent (90%) and ninety-nine percent (99%) of the width W_2. As an example, the width W_1 could be less than ninety (90) mm. As another example, the width W_1 could be less than eighty-five (85) mm or less than eighty (80) mm. For example, width W_1 may be eighty-three (83) mm and width W_2 may be eighty-five (85) mm, for a ratio of width W_1 to width W_2 of 97.6%. In this example, the front openings **178**A, **178**B may support twelve (12) fiber optic connections in the widths W_1 to support a fiber optic connection density of at least one fiber optic connection per 7.0 mm of width W_1 of the front openings **178**A, **178**B. Further, each of the front openings **178**A, **178**B may support twelve (12) fiber optic connections in the widths W_1 to support a fiber optic connection density of at least one fiber optic connection per 6.9 mm of width W_1 of the front openings **178**A, **178**B.

Further as illustrated in FIG. **18**, the height H_1 of front openings **178**A, **178**B could be designed to be at least ninety percent (90%) of the height H_2 of the front side **172** of the main body **180** of the fiber optic module **160**. In this manner, the front openings **178**A, **178**B have sufficient height to receive the fiber optic components **23**, while three (3) fiber optic modules **160** can be disposed in the height of a 1-U space. As an example, the height H_1 could be twelve (12) mm or less or ten (10) mm or less. As an example, the height H_1 could be ten (10) mm and height H_2 could be eleven (11) mm, for a ratio of height H_1 to height H_2 of 90.9%.

FIG. **19** illustrates another alternate fiber optic module **190** that may be provided in the fiber optic equipment trays **20** to support fiber optic connections and connection densities and bandwidths. FIG. **20** is a right front perspective view of the fiber optic module **190** of FIG. **19**. In this embodiment, the fiber optic module **190** is designed to fit across two sets of module rail guides **32**. A longitudinal receiver **192** is disposed through a center axis **194** and is configured to receive a module rail guide **32** in the fiber optic equipment tray **20** through an opening **193** in the receiver **192**. Module rails **195**A, **195**B, similar to the module rails **28**A, **28**B of the fiber optic module **22** of FIGS. **1-13**, are disposed on each side **198**, **200** of the fiber optic module **190** that are configured to engage with tray channels **30** in the fiber optic equipment tray **20**.

Up to twenty-four (24) fiber optic components **23** can be disposed in a front side **202** of the fiber optic module **190**. In this embodiment, the fiber optic components **23** are comprised of up to twelve (12) duplex LC fiber optic adapters, which are connected to one twenty-four (24) fiber MPO fiber optic connector **204** disposed in a rear end **206** of the fiber optic module **190**. Thus, with three (3) fiber optic

equipment trays **20** disposed in the height of the chassis **12**, a total of six (6) fiber optic modules **190** can be supported in a given 1-U space. Supporting up to twenty-four (24) fiber optic connections per fiber optic module **190** equates to the chassis **12** supporting up to one hundred forty-four (144) fiber optic connections, or seventy-two (72) duplex channels, in a 1-U space in the chassis **12** (i.e., twenty-four (24) fiber optic connections X six (6) fiber optic modules **190** in a 1-U space). Thus, the chassis **12** is capable of supporting up to one hundred forty-four (144) fiber optic connections in a 1-U space by twenty (24) simplex or twelve (12) duplex fiber optic adapters being disposed in the fiber optic modules **190**. Supporting up to twenty-four (20) fiber optic connections per fiber optic module **190** equates to the chassis **12** supporting one hundred twenty (120) fiber optic connections, or sixty (60) duplex channels, in a 1-U space in the chassis **12** (i.e., twenty (20) fiber optic connections X six (6) fiber optic modules **190** in a 1-U space). Thus, the chassis **12** is also capable of supporting up to one hundred twenty (120) fiber optic connections in a 1-U space by twenty (20) simplex or ten (10) duplex fiber optic adapters being disposed in the fiber optic modules **190**.

FIG. **21** illustrates a front view of the fiber optic module **190** of FIGS. **19-20** without loaded fiber optic components **23** in the front side **202** to further illustrate the form factor of the fiber optic module **190**. Front openings **208**A, **208**B are disposed on each side of the receiver **192** and through the front side **202** of a main body **210** of the fiber optic module **190** to receive the fiber optic components **23**. The widths W_1 and W_2 and the heights H_1 and H_2 are the same as in the fiber optic module **22** as illustrated in FIG. **13**. Thus, in this embodiment, the width W_1 of front openings **208**A, **208**B is designed to be at least eighty-five percent (85%) of the width W_2 of the front side **202** of the main body **210** of the fiber optic module **190**. The greater the percentage of the width W_1 to width W_2, the larger the area provided in the front openings **208**A, **208**B to receive fiber optic components **23** without increasing the width W_2.

The width W_1 of front openings **208**A, **208**B could each be designed to be greater than eighty-five percent (85%) of the width W_2 of the front side **202** of the main body **210** of the fiber optic module **190**. For example, the width W_1 could be designed to be between ninety percent (90%) and ninety-nine percent (99%) of the width W_2. As an example, the width W_1 could be less than ninety (90) mm. As another example, the width W_1 could be less than eighty-five (85) mm or less than eighty (80) mm. For example, width W_1 may be eighty-three (83) mm and width W_2 may be eighty-five (85) mm, for a ratio of width W_1 to width W_2 of 97.6%. In this example, the front openings **208**A, **208**B may support twelve (12) fiber optic connections in the widths W_1 to support fiber optic connection density of at least one fiber optic connection per 7.0 mm of width W_1 of the front openings **208**A, **208**B. Further, each of the front openings **208**A, **208**B may support twelve (12) fiber optic connections in the widths W_1 to support a fiber optic connection density of at least one fiber optic connection per 6.9 mm of width W_1 of the front openings **208**A, **208**B.

Further as illustrated in FIG. **21**, the height H_1 of front openings **208**A, **208**B could be designed to be at least ninety percent (90%) of the height H_2 of the front side **202** of the main body **210** of the fiber optic module **190**. In this manner, the front openings **208**A, **208**B have sufficient height to receive the fiber optic components **23**, while three (3) fiber optic modules **190** can be disposed in the height of a 1-U space. As an example, the height H_1 could be twelve (12) mm or less or ten (10) mm or less. As an example, the height

H_1 could be ten (10) mm and the height H_2 could be eleven (11) mm, for a ratio of height H_1 to height H_2 of 90.9%.

FIG. **22** illustrates another alternate fiber optic module **220** that may be provided in a fiber optic equipment tray **20'** to support a higher number of fiber optic connections and connection densities and bandwidths in a 1-U space. The fiber optic equipment tray **20'** in this embodiment is similar to the fiber optic equipment tray **20** previously discussed above; however, the fiber optic equipment tray **20'** only contains three (3) module rail guides **32** instead of five (5) module rail guides **32**. Thus, the fiber optic equipment tray **20'** only supports two fiber optic modules **220** across a 1-U width space. Thus, the fiber optic module **220** does not have to provide the channel **162** or receiver **192** of the fiber optic modules **160**, **190**, respectively, to be disposed within the fiber optic equipment tray **20'**. FIG. **23** is a right front perspective view of the fiber optic module **220** of FIG. **22**. The fiber optic module **220** is designed to fit across one set of module rail guides **32** in the fiber optic equipment tray **20'**. Module rails **225A**, **225B**, similar to the module rails **28A**, **28B** of the fiber optic module **22** of FIGS. **1-13**, are disposed on each side **228**, **230** of the fiber optic module **220** that are configured to engage with tray channels **30** in the fiber optic equipment tray **20'**, as illustrated in FIG. **22**.

Up to twenty-four (24) fiber optic components **23** can be disposed in a front side **232** of the fiber optic module **220**. In this embodiment, the fiber optic components **23** are comprised of up to twelve (12) duplex LC fiber optic adapters, which are connected to one twenty-four (24) fiber MPO fiber optic connector **234** disposed in a rear end **236** of the fiber optic module **220**. Thus, with three (3) fiber optic equipment trays **20'** disposed in the height of the chassis **12**, a total of six (6) fiber optic modules **220** can be supported in a given 1-U space. Supporting up to twenty-four (24) fiber optic connections per fiber optic module **220** equates to the chassis **12** supporting up to one hundred forty-four (144) fiber optic connections, or seventy-two (72) duplex channels, in a 1-U space in the chassis 12 (i.e., twenty-four (24) fiber optic connections X six (6) fiber optic modules **220** in a 1-U space). Thus, the chassis **12** is capable of supporting up to one hundred forty-four (144) fiber optic connections in a 1-U space by twenty (24) simplex or twelve (12) duplex fiber optic adapters being disposed in the fiber optic modules **220**. Supporting up to twenty (20) fiber optic connections per fiber optic module **220** equates to the chassis **12** supporting one hundred twenty (120) fiber optic connections, or sixty (60) duplex channels, in a 1-U space in the chassis **12** (i.e., twenty (20) fiber optic connections X six (6) fiber optic modules **220** in a 1-U space). Thus, the chassis **12** is also capable of supporting up to one hundred twenty (120) fiber optic connections in a 1-U space by twenty (20) simplex or ten (10) duplex fiber optic adapters being disposed in the fiber optic modules **220**.

FIG. **24** illustrates a front view of the fiber optic module **220** of FIGS. **22-23** without loaded fiber optic components **23** in the front side **232** to further illustrate the form factor of the fiber optic module **220** in this embodiment. A front opening **238** is through the front side **232** of a main body **240** of the fiber optic module **220** to receive the fiber optic components **23**. Width W_4 of the front opening **238** is twice the width W_1 of the front opening **98** in the fiber optic module **22** illustrated in FIG. **13**. Width W_5 of the front side **232** is one hundred eighty-eight (188) mm. the width W_2 of the front side **96** in the fiber optic module **22** illustrated in FIG. **13**. The heights H_1 and H_2 are the same as in the fiber optic module **22** illustrated in FIG. **13**. Thus, in this embodiment, the width W_4 of the front opening **238** is designed to

be at least eighty-five percent (85%) of the width W_5 of the front side **232** of the main body **240** of the fiber optic module **220**. The greater the percentage of the width W_4 to the width W_5, the larger the area provided in the front opening **238** to receive fiber optic components **23** without increasing the width W_4.

Width W_4 of the front opening **238** could be designed to be greater than eighty-five percent (85%) of the width W_5 of the front side **232** of the main body **240** of the fiber optic module **220**. For example, the width W_4 could be designed to be between ninety percent (90%) and ninety-nine percent (99%) of the width of W_5. As an example, the width W_4 could be less than one hundred eighty (180) mm. As another example, the width W_4 could be less than one hundred seventy (170) mm or less than one hundred sixty (160) mm. For example, width W_4 may be one hundred sixty-six (166) mm and width W_5 may be 171 mm, for a ratio of width W_4 to width W_5 of 166/171=97%. In this example, the front opening **238** may support twenty-four (24) fiber optic connections in the width W_4 to support a fiber optic connection density of at least one fiber optic connection per 7.0 mm of width W_4 of the front opening **238**. Further, the front opening **238** may support twenty-four (24) fiber optic connections in the width W_4 to support a fiber optic connection density of at least one fiber optic connection per 6.9 mm of width W_4 of the front opening **238**.

Further, as illustrated in FIG. **24**, the height H_1 of the front opening **238** could be designed to be at least ninety percent (90%) of the height H_2 of the front side **232** of the main body **240** of the fiber optic module **220**. In this manner, the front opening **238** has sufficient height to receive the fiber optic components **23**, while three (3) fiber optic modules **220** can be disposed in the height of a 1-U space. As an example, the height H_1 could be twelve (12) mm or less or ten (10) mm or less. As an example, the height H_1 could be ten (10) mm and height H_2 could be eleven (11) mm, for a ratio of height H_1 to height H_2 of 90.9%.

FIG. **25** illustrates another embodiment of fiber optic equipment **260** that can include fiber optic equipment trays previously described above and illustrated to support fiber optic modules. The fiber optic equipment **260** in this embodiment includes a 4-U sized chassis **262** configured to hold fiber optic equipment trays each supporting one or more fiber optic modules. The supported fiber optic equipment trays may be any of the fiber optic equipment trays **20**, **20'** previously described above and thus will not be described again here. The supported fiber optic modules may be any of the fiber optic modules **22**, **22'**, **22"**, **160**, **190**, **220** previously described above and thus will not be described again here. In this example, the chassis **262** is illustrated as supporting twelve (12) fiber optic equipment trays **20** each capable of supporting fiber optic modules **22**.

The tray guides **58** previously described are used in the chassis **262** to support tray rails **56** of the fiber optic equipment trays **20** therein and to allow each fiber optic equipment tray **20** to be independently extended out from and retracted back into the chassis **262**. A front door **264** is attached to the chassis **262** and is configured to close about the chassis **262** to secure the fiber optic equipment trays **20** contained in the chassis **262**. A cover **266** is also attached to the chassis **262** to secure the fiber optic equipment trays **20**. However, in the chassis **262**, up to twelve (12) fiber optic equipment trays **20** can be provided. However, the fiber optic connection densities and connection bandwidths are still the same per 1-U space. The fiber optic connection densities and connection bandwidth capabilities have been previously described and equally applicable for the chassis **262** of FIG. **25**, and thus will not be described again here.

Thus, in summary, the table below summarizes some of the fiber optic connection densities and bandwidths that are possible to be provided in a 1-U and 4-U space employing the various embodiments of fiber optic modules, fiber optic equipment trays, and chassis described above. For example, two (2) optical fibers duplexed for one (1) transmission/reception pair can allow for a data rate of ten (10) Gigabits per second in half-duplex mode or twenty (20) Gigabits per second in full-duplex mode. As another example, eight (8) optical fibers in a twelve (12) fiber MPO fiber optic connector duplexed for four (4) transmission/reception pairs can allow for a data rate of forty (40) Gigabits per second in half-duplex mode or eighty (80) Gigabits per second in full-duplex mode. As another example, twenty optical fibers in a twenty-four (24) fiber MPO fiber optic connector duplexed for ten (10) transmission/reception pairs can allow for a data rate of one hundred (100) Gigabits per second in half-duplex mode or two hundred (200) Gigabits per second in full-duplex mode. Note that this table is exemplary and the embodiments disclosed herein are not limited to the fiber optic connection densities and bandwidths provided below.

Connector Type	Max Fibers per 1 RU	Max Fibers per 4 RU	Number of Connectors per 1 RU Space	Number of Connectors per 4 RU Space	Bandwidth per 1 U using 10 Gigabit Transceivers (duplex)	Bandwidth per 1 U using 40 Gigabit Transceivers (duplex)	Bandwidth per 1 U using 100 Gigabit Transceivers (duplex)
Duplexed LC	144	576	72	288	1,440 Gigabits/s.	960 Gigabits/s.	1,200 Gigabits/s.
12-F MPO	576	2,304	48	192	5,760 Gigabits/s.	3,840 Gigabits/s.	4,800 Gigabits/s.
24-F MPO	1,152	4,608	48	192	11,520 Gigabits/s.	7,680 Gigabits/s.	9,600 Gigabits/s.

Many modifications and other embodiments of the invention set forth herein will come to mind to one skilled in the art to which the invention pertains having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. These modifications include, but are not limited to, number or type of fiber optic equipment, fiber optic module, fiber optic equipment tray, features included in the fiber optic equipment tray. Any size equipment, including but not limited to 1-U, 2-U and 4-U sizes may include some or all of the aforementioned features and fiber optic modules disclosed herein and some or all of their features. Further, the modifications are not limited to the type of fiber optic equipment tray or the means or device to support fiber optic modules installed in the fiber optic equipment trays. The fiber optic modules can include any fiber optic connection type, including but not limited to fiber optic connectors and adapters, and number of fiber optic connections, density, etc.

Further, as used herein, the terms "fiber optic cables" and/or "optical fibers" include all types of single mode and multi-mode light waveguides, including one or more optical fibers that may be upcoated, colored, buffered, ribbonized and/or have other organizing or protective structure in a cable such as one or more tubes, strength members, jackets or the like. Likewise, other types of suitable optical fibers include bend-insensitive optical fibers, or any other expedient of a medium for transmitting light signals. An example of a bend-insensitive optical fiber is ClearCurve® Multimode fiber commercially available from Corning Incorporated.

Therefore, it is to be understood that the embodiments are not to be limited to the specific embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of the appended claims. It is intended that the embodiments cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.

What is claimed is:

1. A fiber optic apparatus, comprising:

a chassis configured to be disposed in an equipment rack, the chassis comprising front and rear ends that are spaced apart from one another in a longitudinal direction, and comprising opposite first and second ends that are spaced apart from one another in a lateral direction that extends crosswise to the longitudinal direction;

a plurality of fiber optic equipment trays supported by the chassis and extendable relative to the chassis in the longitudinal direction; and

a plurality of fiber optic modules configured to be installed in the plurality of fiber optic equipment trays, wherein each fiber optic module of the plurality of fiber optic modules comprises a front side configured to support a plurality of first fiber optic components, a rear side configured to support at least one second fiber optic component, an internal chamber, and a plurality of optical fibers disposed within the internal chamber and arranged to establish optical connections between the at least one second fiber optic component and the plurality of first fiber optic components;

wherein each fiber optic equipment tray of the plurality of fiber optic equipment trays is configured to receive multiple fiber optic modules of the plurality of fiber optic modules;

wherein the plurality of fiber optic equipment trays and the plurality of fiber optic modules are configured to support a fiber optic connection density of at least ninety-eight (98) fiber optic connections per U space of the chassis, based on using a simplex fiber optic component or a duplex fiber optic component as each fiber optic component of the plurality of first fiber optic components; and

wherein a U space comprises a height of 1.75 inches and comprises a width of 19 inches or 23 inches.

2. The fiber optic apparatus of claim **1**, wherein the front side of at least one fiber optic module of the plurality of fiber optic modules is configured to support twelve (12) duplex fiber optic components or twenty-four (24) simplex fiber optic components.

3. The fiber optic apparatus of claim **1**, wherein each fiber optic equipment tray of the plurality of fiber optic equipment trays is configured to receive a single row of multiple fiber optic modules of the plurality of fiber optic modules.

4. The fiber optic apparatus of claim **1**, wherein each fiber optic module of the plurality of fiber optic modules is

configured to be locked into place in a fiber optic equipment tray of the plurality of fiber optic equipment trays.

5. The fiber optic apparatus of claim 1, wherein the chassis is sized for more than one U space.

6. The fiber optic apparatus of claim 1, wherein the plurality of fiber optic equipment trays comprises three fiber optic equipment trays per U space of the chassis.

7. The fiber optic apparatus of claim 6, wherein the plurality of fiber optic equipment trays and the plurality of fiber optic modules are configured to support a fiber optic connection density of one hundred forty-four (144) fiber optic connections per U space of the chassis, based on using a simplex fiber optic component or a duplex fiber optic component as each fiber optic component of the plurality of first fiber optic components.

8. The fiber optic apparatus of claim 1, wherein:

each fiber optic equipment tray of the plurality of fiber optic equipment trays comprises first, second, and third module guide members extending upward from a bottom of the fiber optic equipment tray; and

each fiber optic equipment tray of the plurality of fiber optic equipment trays is configured to receive a first fiber optic module of the plurality of fiber optic modules between the first and second module guide members, and the fiber optic equipment tray is configured to receive a second fiber optic module of the plurality of fiber optic modules between the second and third module guide members.

9. The fiber optic apparatus of claim 8, wherein for each fiber optic equipment tray of the plurality of fiber optic equipment trays, each module guide member of the first, second, and third module guide members comprises a locking feature configured to cooperate with a fiber optic module of the first or second fiber optic modules to prevent movement of the fiber optic module relative to the fiber optic equipment tray.

10. The fiber optic apparatus of claim 1, wherein each fiber optic module of the plurality of fiber optic modules is installable on a fiber optic equipment tray of the plurality of fiber optic equipment trays from both a front end and a rear end of the fiber optic equipment tray.

11. A fiber optic apparatus, comprising:

a chassis configured to be disposed in an equipment rack, the chassis comprising front and rear ends that are spaced apart from one another in a longitudinal direction, and comprising opposite first and second ends that are spaced apart from one another in a lateral direction that extends crosswise to the longitudinal direction;

a plurality of fiber optic equipment trays supported by the chassis and extendable relative to the chassis in the longitudinal direction; and

a plurality of fiber optic modules configured to be installed in the plurality of fiber optic equipment trays, wherein each fiber optic module of the plurality of fiber optic modules comprises a front side, a rear side, an internal chamber, a plurality of first fiber optic adapters disposed through the front side, at least one second fiber optic adapter disposed through the rear side, and a plurality of optical fibers disposed within the internal chamber and extending from the at least one second fiber optic adapter to the plurality of first fiber optic adapters;

wherein each fiber optic equipment tray of the plurality of fiber optic equipment trays is configured to receive multiple fiber optic modules of the plurality of fiber optic modules;

wherein the plurality of fiber optic equipment trays and the plurality of fiber optic modules are configured to support a fiber optic connection density of at least ninety-eight (98) fiber optic connections per U space of the chassis, based on using a simplex fiber optic adapter or a duplex fiber optic adapter as each fiber optic adapter of the plurality of first fiber optic adapters; and

wherein a U space comprises a height of 1.75 inches and comprises a width of 19 inches or 23 inches.

12. The fiber optic apparatus of claim 11, wherein the plurality of first fiber optic adapters is disposed through at least eighty-five percent (85%) of a width of the front side of at least one fiber optic module of the plurality of fiber optic modules.

13. The fiber optic apparatus of claim 11, wherein for each fiber optic module of the plurality of fiber optic modules, the plurality of first fiber optic adapters is configured to support twelve (12) duplex fiber optic adapters or twenty-four (24) simplex fiber optic adapters.

14. The fiber optic apparatus of claim 11, wherein for each fiber optic module of the plurality of fiber optic modules, each fiber optic adapter of the plurality of first fiber optic adapters comprises a simplex LC fiber optic adapter or a duplex LC fiber optic adapter, and wherein the at least one second fiber optic adapter comprises at least one multi-fiber push-on (MPO) fiber optic adapter.

15. The fiber optic apparatus of claim 11, wherein each fiber optic equipment tray of the plurality of fiber optic equipment trays is configured to receive a single row of multiple fiber optic modules of the plurality of fiber optic modules.

16. The fiber optic apparatus of claim 11, wherein each fiber optic module of the plurality of fiber optic modules is configured to be locked into place in a fiber optic equipment tray of the plurality of fiber optic equipment trays.

17. The fiber optic apparatus of claim 11, wherein the chassis is sized for more than one U space.

18. The fiber optic apparatus of claim 11, wherein the plurality of fiber optic equipment trays comprises three fiber optic equipment trays per U space of the chassis.

19. The fiber optic apparatus of claim 18, wherein the plurality of fiber optic equipment trays and the plurality of fiber optic modules are configured to support a fiber optic connection density of one hundred forty-four (144) fiber optic connections per U space of the chassis, based on using a simplex fiber optic adapter or a duplex fiber optic adapter as each fiber optic adapter of the plurality of first fiber optic adapters.

20. The fiber optic apparatus of claim 11, wherein:

each fiber optic equipment tray of the plurality of fiber optic equipment trays comprises first, second, and third module guide members extending upward from a bottom of the fiber optic equipment tray; and

each fiber optic equipment tray of the plurality of fiber optic equipment trays is configured to receive a first fiber optic module of the plurality of fiber optic modules between the first and second module guide members, and the fiber optic equipment tray is configured to receive a second fiber optic module of the plurality of fiber optic modules between the second and third module guide members.

21. The fiber optic apparatus of claim 20, wherein for each fiber optic equipment tray of the plurality of fiber optic equipment trays, each module guide member of the first, second, and third module guide members comprises a locking feature configured to cooperate with a fiber optic module

of the first or second fiber optic modules to prevent movement of the fiber optic module relative to the fiber optic equipment tray.

22. A fiber optic apparatus, comprising:

a chassis configured to be disposed in an equipment rack, the chassis comprising front and rear ends that are spaced apart from one another in a longitudinal direction, and comprising opposite first and second ends that are spaced apart from one another in a lateral direction that extends crosswise to the longitudinal direction;

a plurality of fiber optic equipment trays supported by the chassis and extendable relative to the chassis in the longitudinal direction; and

a plurality of fiber optic modules configured to be installed in the plurality of fiber optic equipment trays, wherein each fiber optic module of the plurality of fiber optic modules comprises a front side configured to support a plurality of first fiber optic components, a rear side configured to support at least one second fiber optic component, an internal chamber, and a plurality of optical fibers disposed within the internal chamber and arranged to establish optical connections between the at least one second fiber optic component and the plurality of first fiber optic components;

wherein each fiber optic equipment tray of the plurality of fiber optic equipment trays is configured to receive multiple fiber optic modules of the plurality of fiber optic modules;

wherein the chassis defines a 4-U space, in which a U space comprises a height of 1.75 inches and comprises a width of 19 inches or 23 inches; and

wherein the plurality of fiber optic equipment trays and the plurality of fiber optic modules are configured to support a fiber optic connection density of five hundred seventy-six (576) fiber optic connections in the 4-U space of the chassis, based on using a simplex fiber optic component or a duplex fiber optic component as each fiber optic component of the plurality of first fiber optic components.

23. The fiber optic apparatus of claim 22, wherein the front side of at least one fiber optic module of the plurality of fiber optic modules is configured to support twelve (12) duplex fiber optic components or twenty-four (24) simplex fiber optic components.

24. The fiber optic apparatus of claim 22, wherein each fiber optic equipment tray of the plurality of fiber optic equipment trays is configured to receive a single row of multiple fiber optic modules of the plurality of fiber optic modules.

25. The fiber optic apparatus of claim 22, wherein each fiber optic module of the plurality of fiber optic modules is configured to be locked into place in a fiber optic equipment tray of the plurality of fiber optic equipment trays.

26. The fiber optic apparatus of claim 22, wherein:

each fiber optic equipment tray of the plurality of fiber optic equipment trays includes a plurality of module guides for receiving the plurality of fiber optic modules; and

each fiber optic module of the plurality of fiber optic modules is configured to be locked into place on each fiber optic equipment tray of the plurality of fiber optic equipment trays by pushing the fiber optic module forward to a stop feature disposed in each module guide of the plurality of module guides.

27. A fiber optic apparatus, comprising:

a chassis configured to be disposed in an equipment rack, the chassis comprising front and rear ends that are spaced apart from one another in a longitudinal direction, and comprising opposite first and second ends that are spaced apart from one another in a lateral direction that extends crosswise to the longitudinal direction;

a plurality of fiber optic equipment trays supported by the chassis and extendable relative to the chassis in the longitudinal direction; and

a plurality of fiber optic modules configured to be installed in the plurality of fiber optic equipment trays, wherein each fiber optic module of the plurality of fiber optic modules comprises a front side, a rear side, an internal chamber, a plurality of first fiber optic adapters disposed through the front side, at least one second fiber optic adapter disposed through the rear side, and a plurality of optical fibers disposed within the internal chamber and extending from the at least one second fiber optic adapter to the plurality of first fiber optic adapters;

wherein each fiber optic equipment tray of the plurality of fiber optic equipment trays is configured to receive multiple fiber optic modules of the plurality of fiber optic modules;

wherein the chassis defines a 4-U space, in which a U space comprises a height of 1.75 inches and comprises a width of 19 inches or 23 inches; and

wherein the plurality of fiber optic equipment trays and the plurality of fiber optic modules are configured to support a fiber optic connection density of five hundred seventy-six (576) fiber optic connections in the 4-U space of the chassis, based on using a simplex fiber optic adapter or a duplex fiber optic adapter as each fiber optic adapter of the plurality of first fiber optic adapters.

28. The fiber optic apparatus of claim 27, wherein the plurality of first fiber optic adapters is disposed through at least eighty-five percent (85%) of a width of the front side of at least one fiber optic module of the plurality of fiber optic modules.

29. The fiber optic apparatus of claim 27, wherein for each fiber optic module of the plurality of fiber optic modules, each fiber optic adapter of the plurality of first fiber optic adapters comprises a simplex LC fiber optic adapter or duplex LC fiber optic adapter, and wherein the plurality of first fiber optic adapters is configured to support twenty-four (24) fiber optic connections.

30. The fiber optic apparatus of claim 27, wherein:

each fiber optic equipment tray of the plurality of fiber optic equipment trays includes a plurality of module guides for receiving the plurality of fiber optic modules; and

each fiber optic module of the plurality of fiber optic modules is configured to be locked into place on each fiber optic equipment tray of the plurality of fiber optic equipment trays by pushing the fiber optic module forward to a stop feature disposed in each module guide of the plurality of module guides.

* * * * *

CERTIFICATE OF SERVICE

I, Kelly J. Eberspecher, counsel for Appellant and a member of the Bar of this Court, certify that, on April 25, 2022, a copy of the attached Corrected Non-Confidential Opening Brief of Appellants was filed electronically through the appellate CM/ECF system with the Clerk of the Court. I further certify that counsel for Appellees and Intervenors listed in the caption have been served via CM/ECF.

/s/*Kelly J. Eberspecher*
KELLY J. EBERSPECHER

APRIL 25, 2022

CERTIFICATE OF COMPLIANCE WITH TYPEFACE AND WORD COUNT LIMITATIONS

I, Kelly J. Eberspecher, counsel for Appellant and a member of the Bar of this Court, certify that the attached Corrected Non-Confidential Opening Brief of Appellants is proportionately spaced, has a typeface of 14 points or more, and contains 13,939 words.

/s/*Kelly J. Eberspecher*
KELLY J. EBERSPECHER

APRIL 25, 2022

CERTIFICATE OF CONFIDENTIAL MATERIAL

The foregoing Corrected Non-Confidential Opening Brief of Appellants contains 2 unique words (including numbers) marked confidential.

This number is below the 15-word maximum permitted by Federal Circuit Rule 25.1(d)(1).

/s/*Kelly J. Eberspecher*
KELLY J. EBERSPECHER

APRIL 25, 2022