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UNITED STATES DISTRICT COURT

NORTHERN DISTRICT OF CALIFORNIA

APPLIED OPTOELECTRONICS, INC., Plaintiff, vs. MOLEX, LLC, Defendant.	**Case No.:** **COMPLAINT FOR PATENT INFRINGEMENT** **DEMAND FOR JURY TRIAL**

For its complaint against Defendant Molex, LLC ("Molex" or "Defendant"), Plaintiff Applied Optoelectronics, Inc. ("AOI" or "Plaintiff") alleges on personal knowledge as to its own activities and on information and belief as to the activities of others as follows:

THE PARTIES

1. Plaintiff AOI is a Delaware Corporation with its principal place of business located at 13139 Jess Pirtle Blvd., Sugar Land, Texas 77478.

2. On information and belief, Defendant Molex, LLC is a Delaware Limited Liability Company with its principal place of business located at 2222 Wellington Ct, Lisle, Illinois 60532.

3. On information and belief, Molex is registered to do business in the State of California, has designated an agent for service of process in the State of California, and has a physical office located in the State of California and specifically in this district.

NATURE OF ACTION

4. This is an action alleging patent infringement by Defendant Molex of United States Patent No. 9,523,826 (the "'826 Patent"), entitled "Pluggable optical transceiver module" and issued on December 20, 2016, and of United States Patent No. 10,466,432 (the "'432 Patent", and collectively with the '826 Patent, the "Asserted Patents"), entitled "High speed optical transceiver module" and issued on November 5, 2019. A true and correct copy of the '826 Patent is attached hereto as Exhibit A, and a true and correct copy of the '432 patent is attached hereto as Exhibit B.

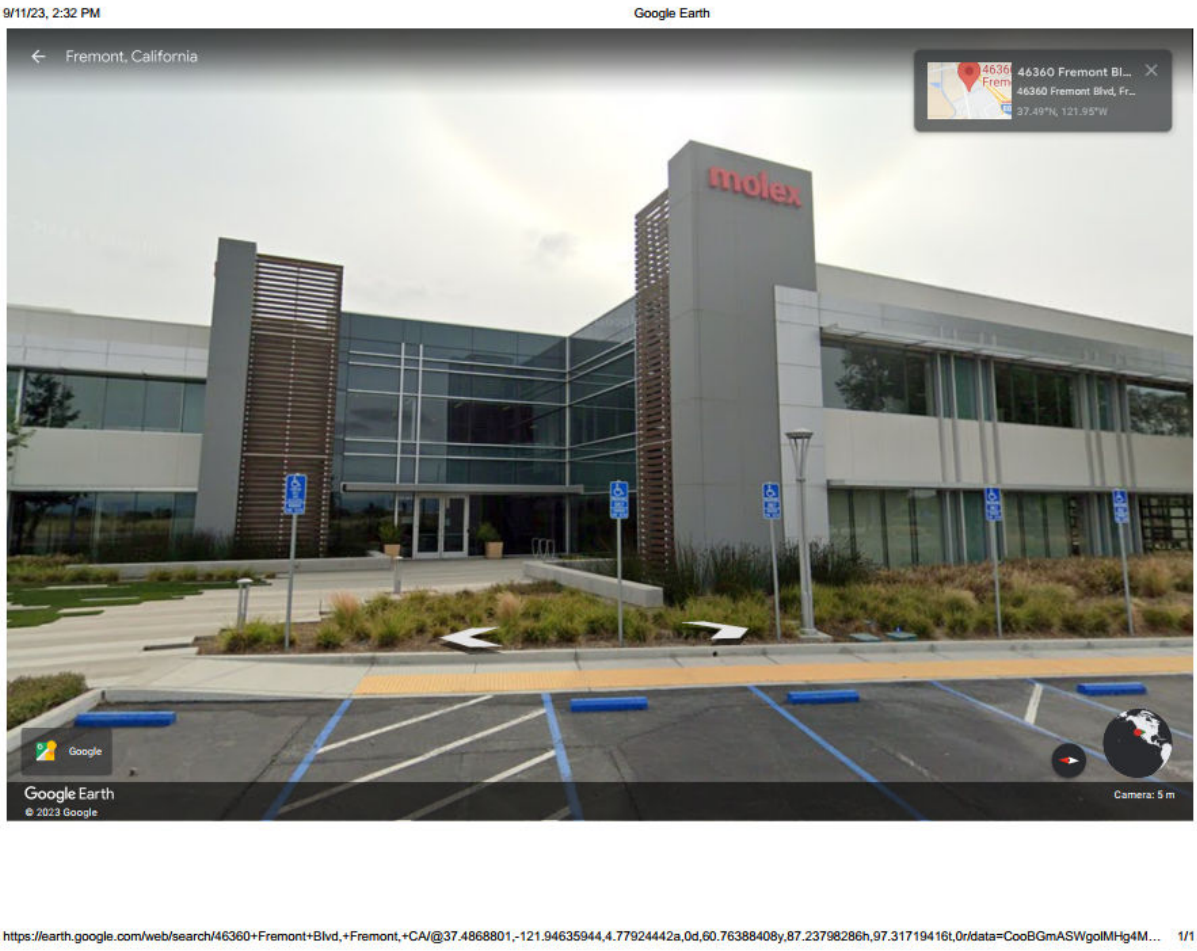
5. Plaintiff AOI is the assignee and owner of record of the '826 Patent, and all rights, title, and interest in and to the '826 Patent.

6. Plaintiff AOI is the assignee and owner of record of the '432 Patent, and all rights, title, and interest in and to the '432 Patent.

JURISDICATION AND VENUE

7. This is an action for patent infringement arising under the patent laws of the United States, Title 35 of the United States Code, including without limitation 35 U.S.C. §§ 271 *et seq.* This Court has subject matter jurisdiction over this case pursuant to 28 U.S.C. §§ 1331 and 1338(a), because this action arises under the patent laws of the United States, Title 35 of the United States Code, including but not limited to 35 U.S.C. §§ 271, 281, 284 and 285.

8. On information and belief, this Court has personal jurisdiction over Molex. On information and belief, Molex is a nationwide and international provider of interconnect solutions, for customers spanning industries, from automotive to telecommunications, mobile devices, data center, industrial, medtech, and more. On information and belief Molex designs products in this state and district and sells and offers for sale goods to customers in this state and district via its sales people and through its distributers. On information and belief, Molex is registered to do business in the State of California and has designated United Agent Group Inc., located at 5901 W Century Blvd., Los Angeles, CA 90045 as an agent for service of process in the State of California. On information and belief, Molex has at least one physical office located in the State of California and specifically in this district at 46360 Fremont Blvd, Fremont, CA 94538 as shown below in the image from Google Earth.



9. Venue is proper in the United States District Court for the Northern District of California under 28 U.S.C. §§ 1391(b)-(d) and/or 1400(b) because, on information and belief, Molex has committed acts of infringement in this district and has a regular and established place of business in this district. On information and belief, Molex designs products in this state and district at its physical office located in this district at 46360 Fremont Blvd, Fremont, CA 94538, and sells and offers for sale infringing goods to customers in this state and district via its sales people and through its distributers.

INTRADISTRICT ASSIGNMENT

10. This case is a patent infringement dispute that is appropriate for district-wide assignment.

AOI'S BUSINESS

11. AOI is a leading provider of fiber-optic networking products. It serves four

growing end-markets: internet data centers (Data Center), Cable Television Broadband (CATV), fiber-to-the-home (FTTH), and telecommunications. AOI designs and manufactures a range of optical communications products employing our vertical integration strategy from laser chips, components, subassemblies and modules to complete turn-key equipment. AOI designs, manufactures, and integrates its own analog and digital lasers using a proprietary Molecular Beam Epitaxy (MBE) fabrication process, which it believes is unique in its industry. The lasers are proven to be reliable over time and highly tolerant of changes in temperature and humidity (delivering millions of hours service), making them well-suited to the CATV and FTTH markets where networking equipment is often installed outdoors.

12. AOI has a state-of–the-art semiconductor component fab at its USA Headquarters near Houston, Texas.

DEFENDANT'S INFRINGING ACTIVITIES

13. On information and belief, Molex, either directly or through other entities under its control, imports, uses, offers for sale, and/or sells infringing products, including without limitation the Molex 100G QSFP28 PSM4 (Molex Part Number 1064271206) (the "Accused Products"). *See, e.g.*, Exhibits C and D.

14. On information and belief, Molex infringes the Asserted Patents by engaging in acts constituting infringement under 35 U.S.C. § 271, including without limitation by making, using, selling and/or offering for sale in and/or importing into the United States without authority one or more Accused Products that infringe one or more claims of the Asserted Patents.

15. On information and belief, Molex promotes, sells and/or offers to sell its products throughout the United States, including without limitation by offering the Accused Products through its sales people and/or for sale online through its distributor's website.

FIRST CAUSE OF ACTION

(Infringement of the '826 Patent)

16. AOI incorporates by reference as if fully set forth herein the allegations in Paragraphs 1-15 of this Complaint.

17. On information and belief, Molex infringes, literally and/or under the doctrine of

equivalents, one or more claims of the '826 Patent, by making, using, selling, offering for sale, and/or importing into the United States without authority products, including without limitation the Accused Products, that infringe one or more claims of the '826 Patent.

18. Defendant has directly infringed at least, for example, claims 1 and 7 of the '826 patent by making, using, selling, offering for sale, and/or importing into the United States without authority products, including without limitation the Accused Products.

19. The claim chart attached hereto as Exhibit C identifies on a limitation-by-limitation basis where each limitation of claims 1 and 7 of the '826 Patent is found within the exemplary Accused Product. Each limitation of claims 1 and 7 is literally present in the exemplary Accused Product. To the extent any limitation is found to be not present literally, such limitation is present in the exemplary Accused Product under the doctrine of equivalents because the exemplary Accused Product performs substantially the same function, in substantially the same way, to achieve substantially the same result as claims 1 and 7 of the '826 Patent.

20. Molex does not have a license to any of Plaintiff's patents or technology, including without limitation the Asserted Patents.

21. Molex has knowledge and notice of the Asserted Patent and its infringement since at least, and through, the filing of this Complaint.

22. As a direct and proximate result of Molex's infringement, AOI has suffered, and will continue to suffer, damage in an amount to be proved at trial.

23. As a result of the harm suffered as alleged herein, AOI is entitled to relief under the Patent Act, including damages adequate to compensate it for such infringement, but in no event less than a reasonable royalty.

24. AOI is informed and believes, and on the basis of such information and belief, alleges that Molex's infringement of the '826 Patent is willful and deliberate, at least at all times after the filing of the Complaint. Accordingly, AOI is entitled to enhanced damages pursuant to 35 U.S.C. § 284 and to an award of attorney's fees and costs incurred in prosecuting this action pursuant to 35 U.S.C. § 285.

25. On information and belief, unless enjoined by this Court, Molex will continue to do

the acts complained herein, and unless restrained and enjoined will continue to do so, all to AOI's irreparable damage. It would be difficult to ascertain the amount of compensation which would afford AOI adequate relief for such future and continuing acts. AOI does not have an adequate remedy at law to compensate it for injuries threatened. Thus, AOI is entitled to an injunction against further infringement by Molex.

SECOND CAUSE OF ACTION

(Infringement of the '432 Patent)

26. AOI incorporates by reference as if fully set forth herein the allegations in Paragraphs 1–25 of this Complaint.

27. On information and belief, Molex infringes, literally and/or under the doctrine of equivalents, one or more claims of the '432 Patent, by making, using, selling, offering for sale, and/or importing into the United States without authority products, including without limitation the Accused Products, that infringe one or more claims of the '432 Patent.

28. Defendant has directly infringed at least, for example, claim 1 of the '432 patent by making, using, selling, offering for sale, and/or importing into the United States without authority products, including without limitation the Accused Products.

29. The claim chart attached hereto as Exhibit D identifies on a limitation-by-limitation basis where each limitation of claim 1 of the '432 Patent is found within the exemplary Accused Product. Each limitation of claim 1 is literally present in the exemplary Accused Product. To the extent any limitation is found to be not present literally, such limitation is present in the exemplary Accused Product under the doctrine of equivalents because the exemplary Accused Product performs substantially the same function, in substantially the same way, to achieve substantially the same result as Claim 1 of the '432 Patent.

30. Molex does not have a license to any of Plaintiff's patents or technology, including without limitation the Asserted Patents.

31. Molex has knowledge and notice of the Asserted Patents and their infringement since at least, and through, the filing of this Complaint.

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32. As a direct and proximate result of Molex's infringement, AOI has suffered, and will continue to suffer, damage in an amount to be proved at trial.

33. As a result of the harm suffered as alleged herein, AOI is entitled to relief under the Patent Act, including damages adequate to compensate it for such infringement, but in no event less than a reasonable royalty.

34. AOI is informed and believes, and on the basis of such information and belief, alleges that Molex's infringement of the '432 Patent is willful and deliberate, at least at all times after the filing of the Complaint. Accordingly, AOI is entitled to enhanced damages pursuant to 35 U.S.C. § 284 and to an award of attorney's fees and costs incurred in prosecuting this action pursuant to 35 U.S.C. § 285.

35. On information and believe, unless enjoined by this Court, Molex will continue to do the acts complained herein, and unless restrained and enjoined will continue to do so, all to AOI's irreparable damage. It would be difficult to ascertain the amount of compensation which would afford AOI adequate relief for such future and continuing acts. AOI does not have an adequate remedy at law to compensate it for injuries threatened. Thus, AOI is entitled to an injunction against further infringement by Molex.

PRAYER FOR RELIEF

WHEREFORE, Plaintiffs respectfully pray that the Court grant the following relief:

A. For judgment that Molex has infringed and continues to infringe the '826 Patent;

B. For judgment that the '826 Patent is valid and enforceable;

C. For judgment that Molex has willfully infringed the '826 Patent;

D. For a preliminary and permanent injunction prohibiting , Molex and all persons or entities acting in concert with Molex, from infringing the '826 Patent;

E. For judgment that Molex has infringed and continues to infringe the '432 Patent;

F. For judgment that the '432 Patent is valid and enforceable;

G. For judgment that Molex has willfully infringed the '826 Patent;

H. For a preliminary and permanent injunction prohibiting , Molex and all persons or entities acting in concert with Molex, from infringing the '432 Patent;

I. An award of damages adequate to compensate Plaintiffs for the infringement, as well as prejudgment and post-judgment interest from the date the infringement began, but in no event less than a reasonable royalty as permitted by 35 U.S.C. § 284;

J. An award of treble damages and/or exemplary damages due to Molex's willful misconduct under 35 U.S.C. § 284;

K. A finding that this case is exceptional and an award of interest, costs, expenses, and attorneys' fees incurred by Plaintiffs in prosecuting this action as provided by 35 U.S.C. § 285;

L. For any other orders necessary to accomplish complete justice between the parties; and

M. For such other and further relief as this Court or a jury may deem just and proper.

JURY DEMAND

Pursuant to Rule 38 of the Federal Rules of Civil Procedure, Plaintiffs demand a trial by jury on all cause of actions and issues so triable.

Dated: September 18, 2023

WEINTRAUB TOBIN CHEDIAK COLEMAN GRODIN

By: */s/ Jo Dale Carothers*
Jo Dale Carothers

Attorneys for Plaintiff
Applied Optoelectronics, Inc.

EXHIBIT A

US009523826B2

(12) **United States Patent**
Tsai et al.

(10) **Patent No.: US 9,523,826 B2**
(45) **Date of Patent: Dec. 20, 2016**

(54) **PLUGGABLE OPTICAL TRANSCEIVER MODULE**

(71) Applicant: **Applied Optoelectronics, Inc.**, New Taipei (TW)

(72) Inventors: **Chao-Hung Tsai**, New Taipei (TW); **Chien-Te Lin**, New Taipei (TW); **Che-Shou Yeh**, New Taipei (TW)

(73) Assignee: **Applied Optoelectronics, Inc.**, Sugar Land, TX (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 88 days.

(21) Appl. No.: **14/504,500**

(22) Filed: **Oct. 2, 2014**

(65) **Prior Publication Data**

US 2015/0093083 A1 Apr. 2, 2015

(30) **Foreign Application Priority Data**

Oct. 2, 2013 (TW) ..... 102135723 A

(51) **Int. Cl.**
G02B 6/42 (2006.01)

(52) **U.S. Cl.**
CPC ***G02B 6/423*** (2013.01); ***G02B 6/4246*** (2013.01); ***G02B 6/4261*** (2013.01); ***G02B 6/4284*** (2013.01); ***G02B 6/4292*** (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,201,520	B2 *	4/2007	Mizue	G02B 6/4292 385/92
2011/0081114	A1 *	4/2011	Togami	G02B 6/4246 385/76

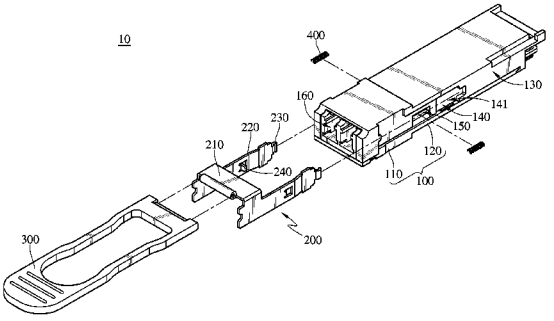
* cited by examiner

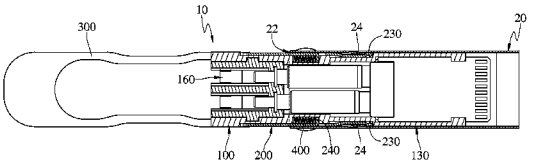
Primary Examiner — Michelle R Connelly
(74) *Attorney, Agent, or Firm* — Grossman Tucker Perreault & Pfleger, PLLC; Norman S. Kinsella

(57) **ABSTRACT**

A pluggable optical transceiver module for inserted into plugging slot includes main body and sliding component. The main body has opposite two side surfaces and two sliding slots. The two sliding slots are located at the two side surfaces. The sliding component includes linkage arm and two extending arms. The two extending arms are connected to the linkage arm. Each extending arm has a second fastening part. The main body is between the two extending arms. The two extending arms are disposed on the two sliding slots to have fastening position and releasing position. Two first fastening parts are fastened to the two second fastening parts when the two extending arms are located at fastening position. The two second fastening parts press the two first fastening parts, respectively, for the two first fastening parts being farther from each other when the two extending arms are located at releasing position.

7 Claims, 8 Drawing Sheets





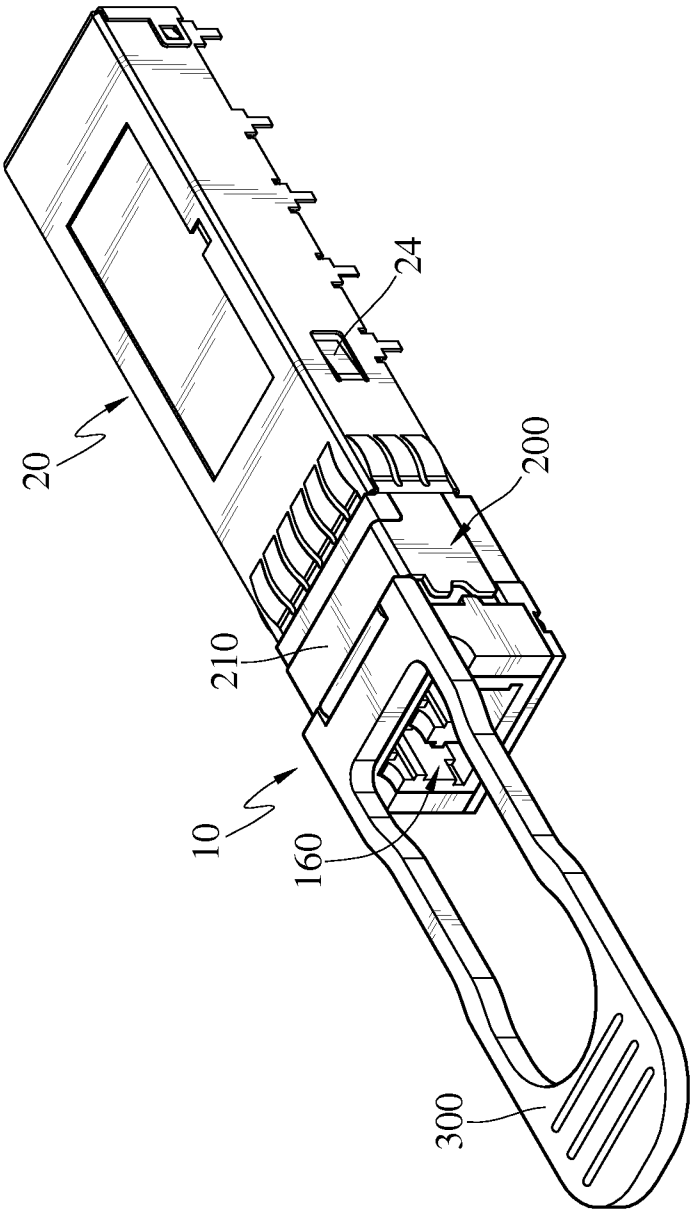


FIG. 1

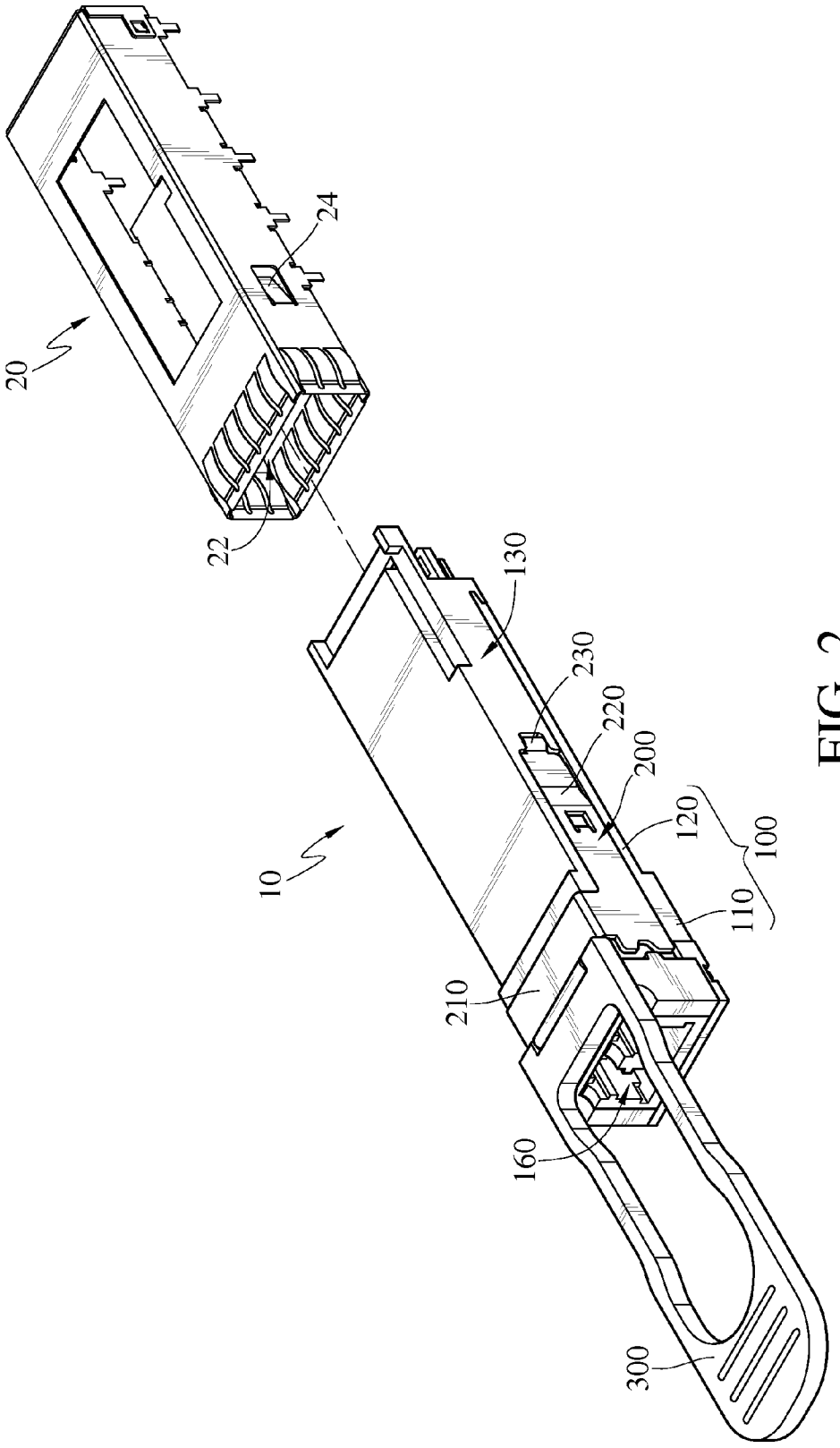


FIG. 2

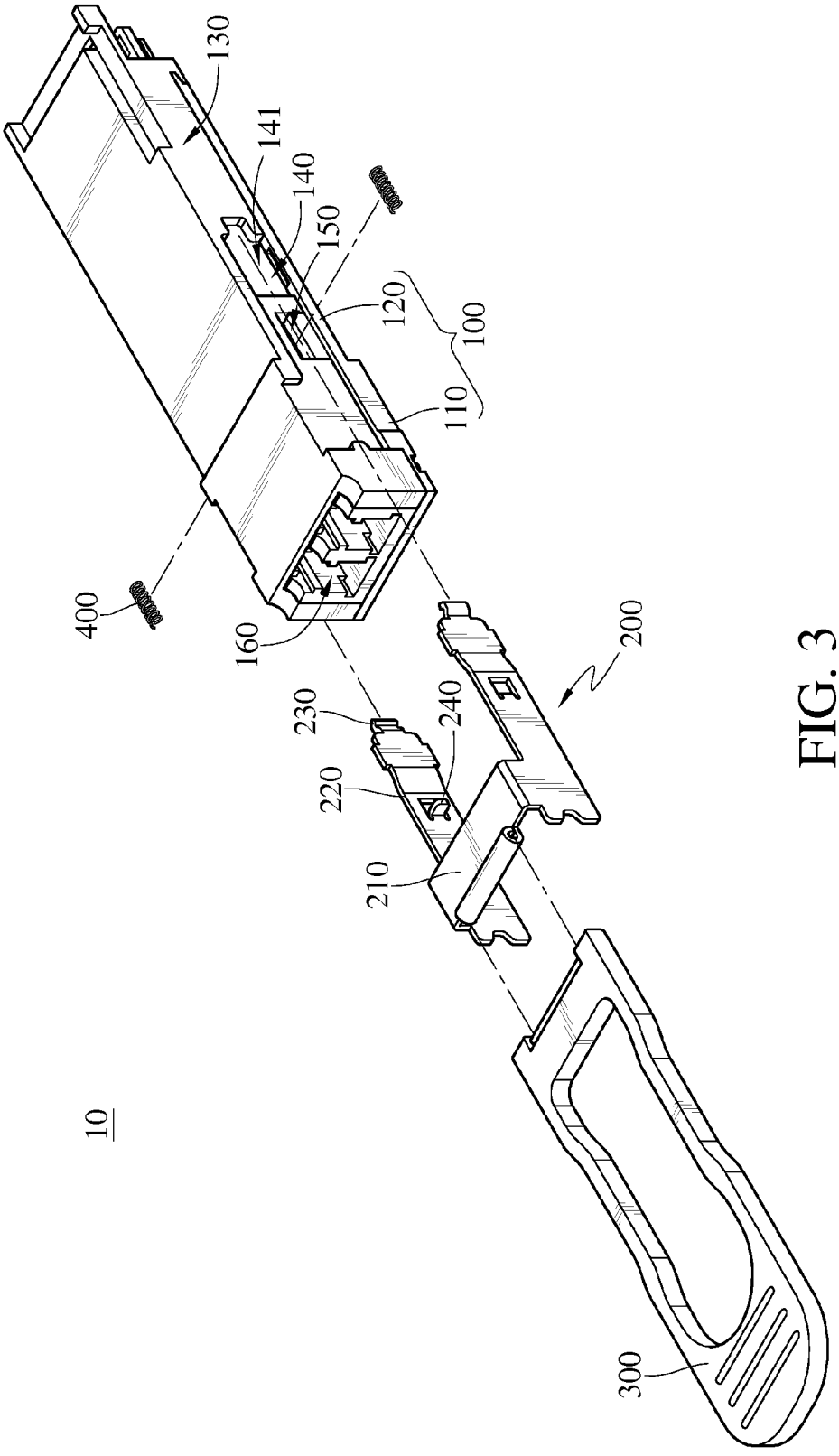


FIG. 3

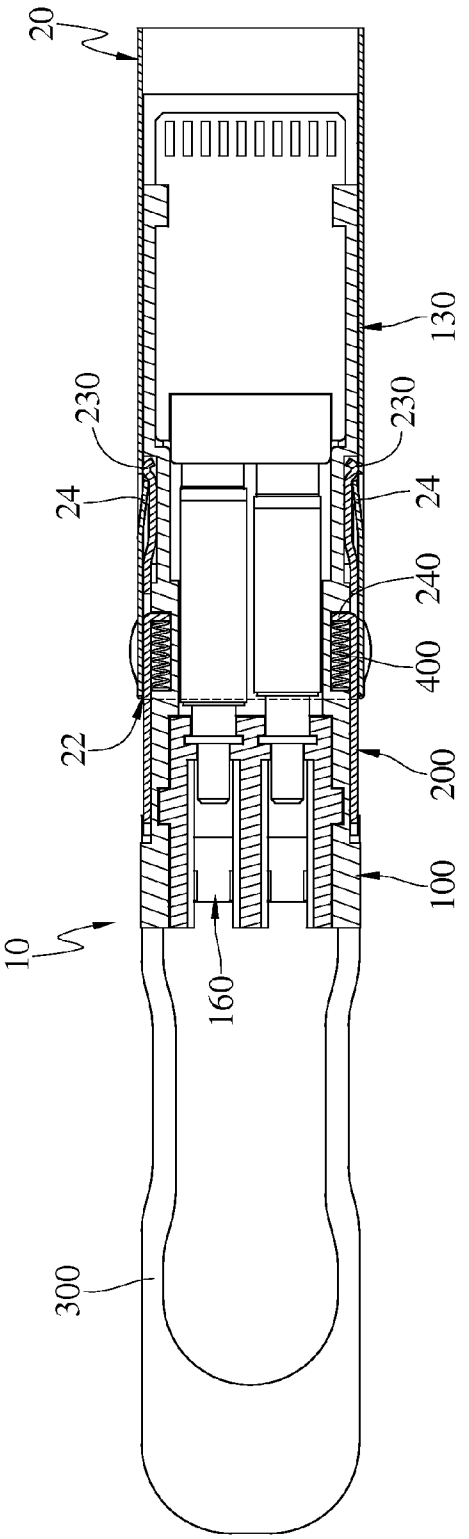


FIG. 4A

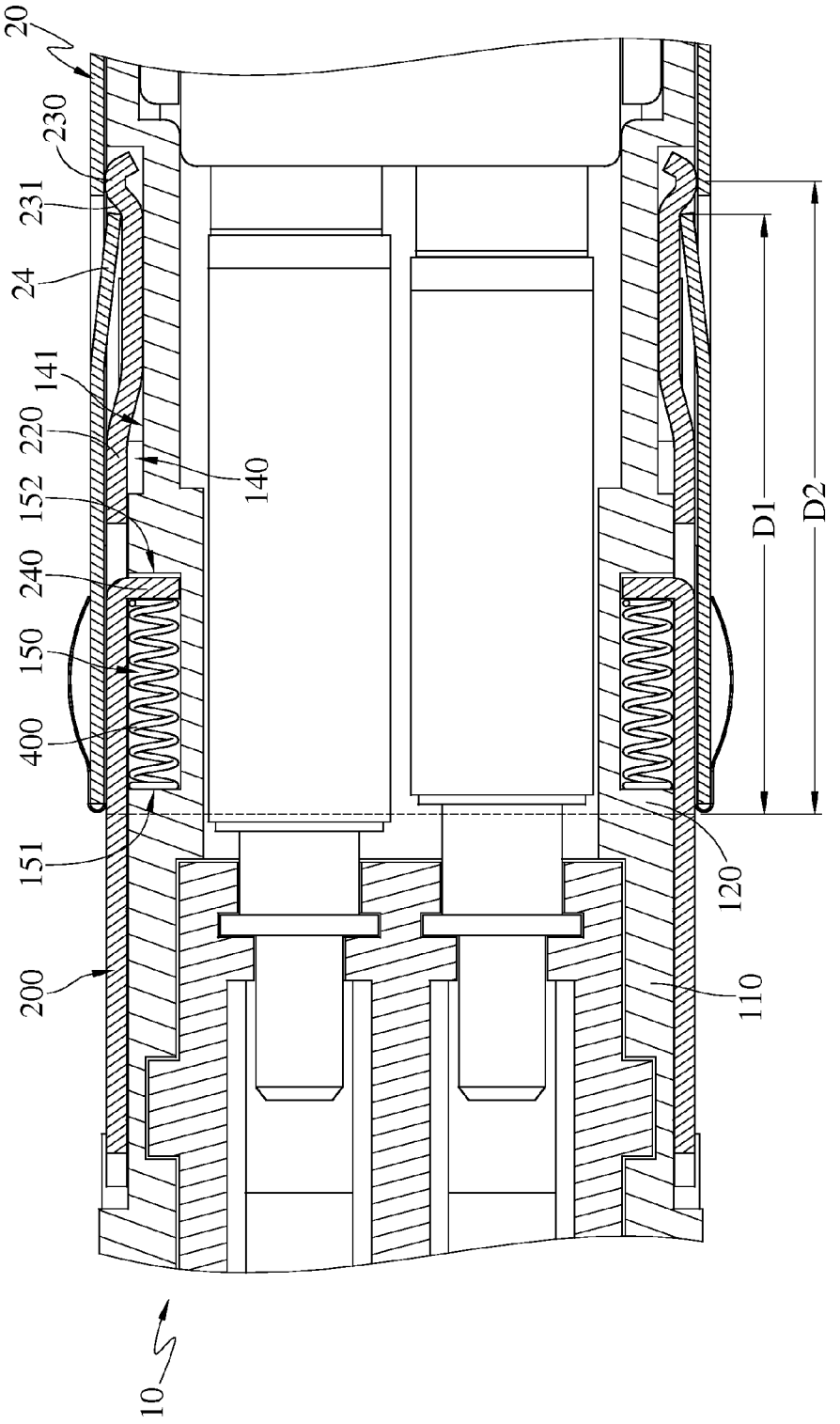


FIG. 4B

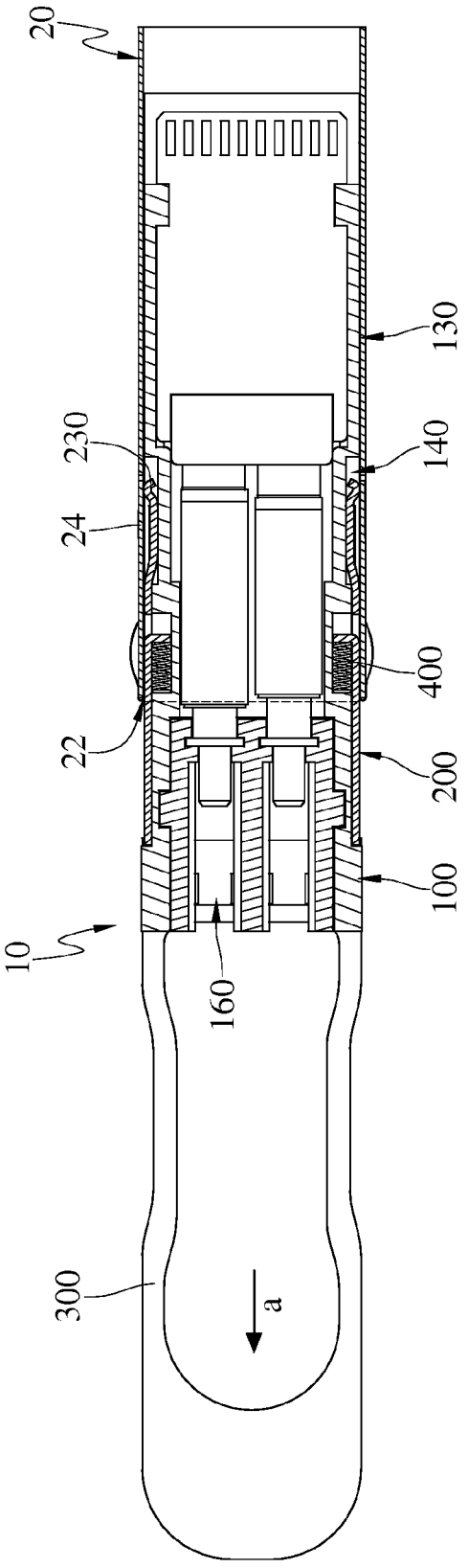


FIG. 5A

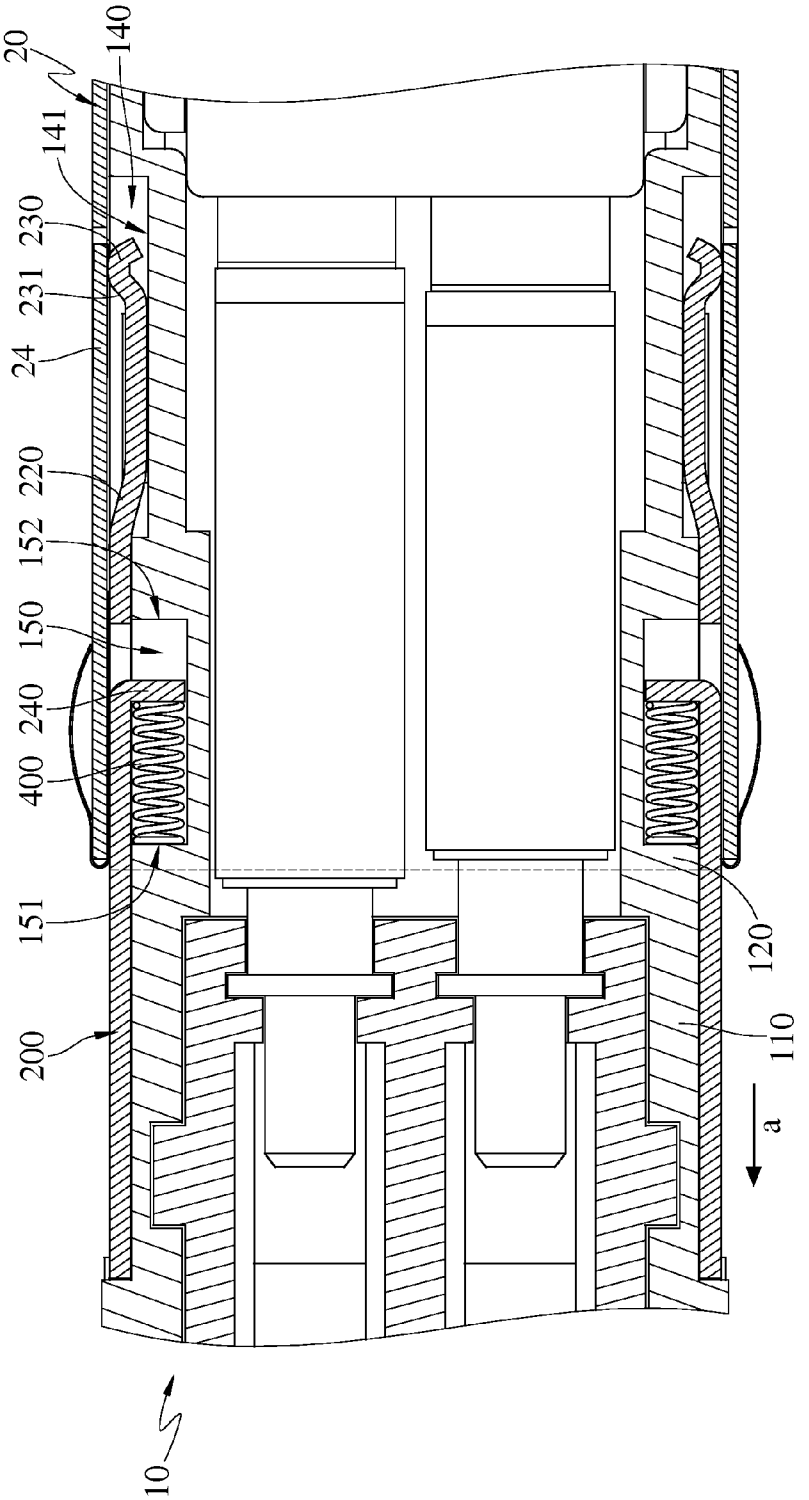


FIG. 5B

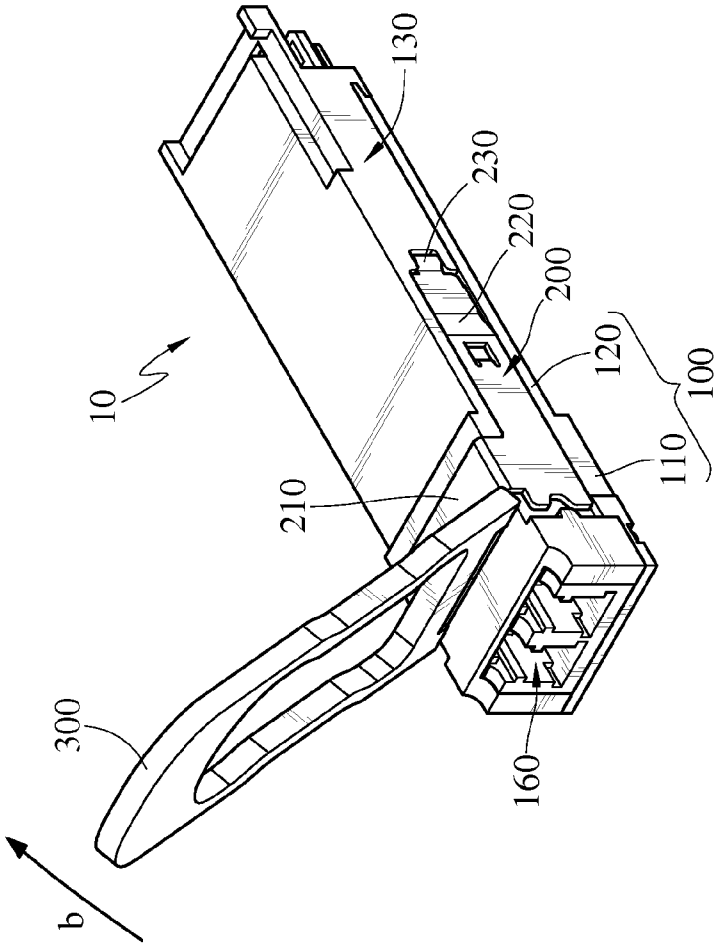


FIG. 6

PLUGGABLE OPTICAL TRANSCEIVER MODULE

CROSS-REFERENCE TO RELATED APPLICATIONS

This non-provisional application claims priority under 35 U.S.C. §119(a) on Patent Application No(s) 102135723. filed in Taiwan, R.O.C. on Oct. 2, 2013, the entire contents of which are hereby incorporated by reference.

TECHNICAL FIELD

The disclosure relates to an optical communication component, more particularly to a pluggable optical transceiver module.

BACKGROUND

An optical transceiver module is generally installed in an electronic communication facility in the modern high speed communication networks. In order to make the electronic communication facility flexible and easy to repair, the optical transceiver module is inserted into a corresponding socket disposed in the communication facility in a pluggable manner. In general, the socket is disposed on a circuit board. In order to define the electrical-to-mechanical interface of the optical transceiver module and the corresponding socket, different specifications have been provided such as XFP (10 Gigabit Small Form Factor Pluggable) used in 10 GB/s communication rate and QSFP (Quad Small Form-factor Pluggable).

A fastening mechanism is disposed in the socket corresponding to the optical transceiver module so that the optical transceiver module is securely fixed to the socket by the fastening mechanism. Therefore, it is indispensable that the optical transceiver module must have a releasing mechanism. This makes the optical transceiver module slip out from the socket by easily removing the lock.

On the other hand, a common communication facility, such as a hub, usually comprises at least one optical transceiver module for converting optical signals into electronic signals. When the common communication facility is used for a long time, dusts may drop on the surface of common communication facility. Thus, dusts may also drop on the optical transceiver module without any appropriate protection when the optical fiber cable is connected or removed from the optical transceiver module. Consequently, the dusts may damage the optical transceiver module and affect the transmission of the signals.

In view of this, it is important to improve the convenient connection and disconnection between the optical transceiver module and the socket and its dust-proof function.

SUMMARY

The disclosure provides a pluggable optical transceiver module configured to be inserted into a plugging slot. The pluggable optical transceiver module comprises a main body and a sliding component. The main body has two side surfaces opposite to each other and two sliding slots. The two sliding slots are located at the two side surfaces. The main body is configured to be inserted into the plugging slot. The sliding component comprises a linkage arm and two extending arms. The two extending arms are connected to two ends of the linkage arm, respectively. Each extending arm has a second fastening part. The main body is between the two extending arms. The two extending arms are slidably disposed on the two sliding slots to have a fastening position and a releasing position. Two first fastening parts are fastened to the two second fastening parts when the two extending arms are located at the fastening position. The two second fastening parts press the two first fastening parts, respectively, to make the two first fastening parts be farther away from each other when the two extending arms are located at the releasing position.

BRIEF DESCRIPTION OF THE DRAWINGS

The present disclosure will become more fully understood from the detailed description and the drawings given herein below for illustration only, thus does not limit the present disclosure, wherein:

FIG. **1** is a perspective view of a pluggable optical transceiver module according to a first embodiment;

FIG. **2** is an exploded view of the pluggable optical transceiver module in FIG. **1**;

FIG. **3** is another exploded view of the pluggable optical transceiver module in FIG. **1**;

FIG. **4**A is a cross-sectional view of the pluggable optical transceiver module in FIG. **1** when a sliding component is located at a fastening position;

FIG. **4**B is a partial enlarged view of the pluggable optical transceiver module in FIG. **4**A;

FIG. **5**A is a cross-sectional view of the pluggable optical transceiver module in FIG. **1** when the sliding component is located at a releasing position;

FIG. **5**B is a partial enlarged view of the pluggable optical transceiver module in FIG. **5**A; and

FIG. **6** is a perspective view of the pluggable optical transceiver module in FIG. **2** when a pull handle pivots on a main body.

DETAILED DESCRIPTION

In the following detailed description, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the disclosed embodiments. It will be apparent, however, that one or more embodiments may be practiced without these specific details. In other instances, well-known structures and devices are schematically shown in order to simplify the drawings.

FIG. **1** is a perspective view of a pluggable optical transceiver module according to a first embodiment. FIG. **2** is an exploded view of the pluggable optical transceiver module in FIG. **1**. In the first embodiment, a pluggable optical transceiver module **10** is configured to be inserted into a socket **20** to convert optical signals into electronic signals. The socket **20** has a plugging slot **22** and two first fastening parts **24**. Each first fastening part **24** is elastic. One end of the first fastening part **24** is connected to a case of the socket **20** and the other end of the first fastening part **24** is located in the plugging slot **22**. In this embodiment, the first fastening part **24** is an elastic slice.

FIG. **3** is another exploded view of FIG. **1**. FIG. **4**A is a cross-sectional view of FIG. **1** when a sliding component is located at a fastening position. FIG. **4**B is a partial enlarged view of FIG. **4**A. The pluggable optical transceiver module **10** comprises a main body **100**, a sliding component **200**, a pull handle **300** and two elastic components **400**. The main body **100** comprises a head part **110** and an inserted part **120** that are connected to each other. The inserted part **120** is configured to be inserted into the plugging slot **22** of the

socket **20**. The main body **100** has two side surfaces **130**, two sliding slots **140** and two limiting spaces **150**. The two side surfaces **130** are located at opposite two sides of the head part **110** and the inserted part **120**, respectively. The two sliding slots **140** are located at the two side surfaces **130**, respectively, and extend from the head part **110** to the inserted part **120**. Each sliding slot **140** has a bottom surface **141** which is, but not limited to, parallel to the side surface **130**. In other embodiments, the slot bottom surface **141** encloses an acute angle with the side surface **130**.

The two limiting spaces **150** are located at the bottom surfaces **141** of the two sliding slots **140**, respectively. Each limiting space **150** has a first limiting surface **151** and a second limiting surface **152**. Both of the first limiting surface **151** and the second limiting surface **152** are connected to the bottom surface **141**. The first limiting surface **151** is closer to the head part **110** than the second limiting surface **152**.

Moreover, the main body **100** is configured to accommodate a photoelectric conversion circuit (not shown in the figures). Both of the two sliding slots **140** and the two limiting spaces **150** do not penetrate through the inner surface of the main body **100**. Therefore, the main body **100** protects the photoelectric conversion circuit from being contaminated by atmospheric dust.

The head part **110** has at least one optical fiber terminal **160**. An optical fiber plug may plug into the photoelectric conversion circuit in the main body **100** through the optical fiber terminal **160**.

The sliding component **200** comprises a linkage arm **210** and two extending arms **220**. The two extending arms **220** are connected to two ends of the linkage arm **210**, respectively. The main body **100** is between the two extending arms **220**. The two extending arms **220** are slidably disposed on the two sliding slots **140**, respectively. Each extending arm **220** has a second fastening part **230** and a limited part **240**. The second fastening part **230** extends along a direction far away from the side surface **130**. Each second fastening part **230** has a fastening surface **231** located at one side of the second fastening part **230** facing the head part **110**. A distance D1 between one side of the fastening surface **231** which is close to the side surface **130** and the head part **110** is less than a distance D2 from another side of the fastening surface **231** which is far away from the side surface **130** from and the head part **110**. That is, the fastening surface **231** is an inclined surface enclosing an acute angle with the side surface **130**. The limited part **240** extends toward the side surface **130** and is located in the limiting space **150**. The limited part **240** is able to slide between the first limiting surface **151** and the second limiting surface **152** relative to the main body **100**. The sliding component is able to slide relative to the main body **100** to have a fastening position and a releasing position. The two first fastening parts **230** are farther from the head part **110** when the two extending arms **220** are located at the fastening position. The two first fastening parts **230** are closer to the head part **110** when the two extending arms **220** are located at the releasing position.

The pull handle **300** is pivoted on the linkage arm **210** of the sliding component **200** and extends outside from the main body **100**. The pull handle **300** is able to pivot about the sliding component **200** to be in front of the head part **110** or on the top of the head part **110**. In this embodiment, the pull handle **300** is configured to slide the sliding component **200** but the disclosure is not limited thereto. In other embodiments, the pluggable optical transceiver module **10** does not comprise the pull handle **300** and is able to be unplugged from the socket **20** by unplugging the linkage arm **210** directly. Furthermore, in this embodiment, the pull handle **300** is pivoted on the linkage arm **210** but the disclosure is not limited thereto. In other embodiments, the pull handle **300** is welded to the linkage arm **210** or screwed to the linkage arm **210**.

Moreover, the pull handle **300** is a band extending outside from the main body **100** in other embodiments. In detail, the band is made of soft rubber materials and rigid materials, which makes the band be highly tough and highly strengthened so that the band is difficult to be ruptured. Meanwhile, because the end of the band is soft rubber, the band has greater deformation so that the band may be temporarily deformed to be in accordance with the operation of the users.

Two elastic components **400** are located at the two limiting spaces **150**, respectively. Each elastic component **400** is sandwiched between the first limiting surface **151** disposed on the limiting space **150** and the limited part **240** of the extending arm **220**. The elastic component **400** normally presses the limited part **240** so that the second fastening part **230** is located at the fastening position. In this embodiment, both of the number of the limiting spaces **150** and that of the elastic components **400** are, for example, two. In other embodiments, both of the number of the limiting space **150** and that of the elastic component **400** are one.

FIG. **4**A is a cross-sectional view of the pluggable optical transceiver module in FIG. **1** when a sliding component is located at a fastening position. FIG. **4**B is a partial enlarged view of the pluggable optical transceiver module in FIG. **4**A. FIG. **5**A is a cross-sectional view of the pluggable optical transceiver module in FIG. **1** when the sliding component is located at a releasing position. FIG. **5**B is a partial enlarged view of the pluggable optical transceiver module in FIG. **5**A. As seen in FIG. **4**A and FIG. **4**B, the pluggable optical transceiver module **10** is inserted into the plugging slot **22** of the socket **20**. The two first fastening parts **24** are fastened to the two second fastening parts **230** when the two elastic components **400** respectively press the two limited parts **240** to locate the two second fastening parts **230** at the fastening position. Therefore, the pluggable optical transceiver module **10** is stably inserted into the plugging lot **22** and electrically connected to the socket **20**.

As seen in FIG. **5**A and FIG. **5**B, users is able to pull the pull handle **300** along the direction indicated by an arrow a when removing the pluggable optical transceiver module **10** from the socket **20**. The sliding component **200** is slid by the pull handle **300** relative to the main body **200** to be located at the releasing position. Since the fastening surface **231** is an inclined surface, the two first fastening parts **24** pressed by the fastening surface **231** are far away from each other when the sliding component **200** slides along the direction indicated by the arrow a. That is, the two second fastening parts **230** open the two first fastening parts **24** to release the two first fastening parts **24** from the two second fastening parts **230**. Therefore, it is more convenient to plug the pluggable optical transceiver module **10** into the socket **20** and unplug the pluggable optical transceiver module **10** from the socket **20**.

FIG. **6** is a perspective view of the pluggable optical transceiver module in FIG. **2** when a pull handle pivots on the top of the main body **200**. Users are able to apply a force to pull out the pluggable optical transceiver module **10** when the pull handle **300** is located in front of the head part **110**. The pull handle **300** is pivoted about the sliding component **200** along the direction indicated by an arrow b to be located above the head part **110** when users insert an optical fiber plug (not shown in the figure) into the optical fiber terminal **160**. Since the pull handle **300** does not interfere with the

optical fiber plug, it is more convenient for the users to insert the optical fiber plug into the optical fiber terminal **160**.

According to the pluggable optical transceiver module of the disclosure, by sliding the sliding component within the two sliding slots, a user is able to easily fasten or release the combination of the two first fastening parts and the two second fastening parts.

Moreover, the pull handle is pivoted about the sliding component so that the pull handle is located in front of the main body or on the top of the main body. Users are able to pull out the pluggable optical transceiver module when the pull handle is located in front of the main body. The pull handle does not interfere with the optical fiber plug when located on the main body. Therefore, it is more convenient for users to insert the optical fiber plug into the optical fiber terminal.

What is claimed is:

1. A pluggable optical transceiver module, for being inserted into a plugging slot of a socket, the socket comprising two first fastening parts located in the plugging slot, the pluggable optical transceiver module comprising:

a main body having two side surfaces that are opposite to each other and two sliding slots located at the two side surfaces, respectively, wherein the main body is configured to be inserted into the plugging slot, wherein the main body has at least one limiting space and two bottom surfaces forming the two sliding slots, respectively, the two bottom surfaces are parallel to the two side surfaces, the at least one limiting space is located at one of the two side surfaces;

a sliding component comprising a linkage arm and two extending arms, wherein the two extending arms are connected to two ends of the linkage arm, respectively, each extending arm has a second fastening part, the main body is between the two extending arms, the two extending arms are slidably disposed on the two sliding slots to have a fastening position and a releasing position, the two first fastening parts are fastened to the two second fastening parts when the two extending arms are located at the fastening position, and the two second fastening parts press the two first fastening parts, respectively, to make the two first fastening parts be farther away from each other when the two extending arms are located at the releasing position, wherein each extending arm has a limited part configured to move in the at least one limiting space; and

an elastic component, wherein the main body has a first limiting surface and a second limiting surface forming the limiting space, the first limiting surface is closer to the head part than the second limiting surface, and the elastic component is located in the limiting space and between the first limiting surface and the limited part and is covered by the extending arm such that the elastic component is confined by the main body and the sliding component.

2. The pluggable optical transceiver module according to claim **1**, wherein the main body comprises a head part and an inserted part connected to each other, the inserted part is configured to be inserted into the socket, the two side surfaces are located at two sides of the head part and the inserted part opposite to each other, respectively, wherein both the two sliding slots extend from the head part towards the inserted part, and the two extending arms are able to slide relative to the two sliding slots to have the fastening position which is farther away from the head part and the releasing position which is closer to the head part.

3. The pluggable optical transceiver module according to claim **2**, wherein each second fastening part has a fastening surface, and a distance between one side of the fastening surface which is close to the side surface and the head part is less than a distance between another side of the fastening surface which is far away from the side surface and the head part.

4. The pluggable optical transceiver module according to claim **2**, wherein the head part has at least one optical fiber terminal.

5. The pluggable optical transceiver module according to claim **1**, further comprising two elastic components, wherein the number of the at least one limiting surface is two, the main body has two first limiting surfaces and two second limiting surfaces forming the two limiting spaces together, respectively, the two first limiting surfaces are closer to the head part than the two second limiting surfaces, the two elastic components are located in the two limiting spaces, respectively, and each elastic component is between the first limiting surface and the limited part.

6. The pluggable optical transceiver module according to claim **1**, wherein the pluggable optical transceiver module further comprises a pull handle pivoted on the linkage arm of the sliding component.

7. A pluggable optical transceiver module, comprising:

a main body having a head part and an inserted part that are connected to each other, wherein the main body further comprises opposite two side surfaces and two sliding slots which are located at two sides of the head part and the inserted part opposite to each other, respectively, the two sliding slots are located at the two side surfaces, and the two sliding slots extend from the head part to the inserted part, respectively, wherein the main body has at least one limiting space and two bottom surfaces forming the two sliding slots, respectively, the two bottom surfaces are parallel to the two side surfaces, the at least one limiting space is located at one of the two side surfaces;

a sliding component comprising a linkage arm and two extending arms, wherein the linkage arm is connected between the two extending arms, each extending arm has a second fastening part, the main body is between the two extending arms, the two extending arms are able to slide relative to the two sliding slots to have a fastening position which is farther away from the head part and a releasing position which is closer to the head part, wherein each extending arm has a limited part configured to move in the at least one limiting space; and

an elastic component, wherein the main body has a first limiting surface and a second limiting surface forming the limiting space, the first limiting surface is closer to the head part than the second limiting surface, and the elastic component is located in the limiting space and between the first limiting surface and the limited part and is covered by the extending arm such that the elastic component is confined by the main body and the sliding component.

* * * * *

EXHIBIT B

US010466432B2

(12) **United States Patent**
Luo et al.

(10) **Patent No.: US 10,466,432 B2**
(45) **Date of Patent: Nov. 5, 2019**

(54) **HIGH SPEED OPTICAL TRANSCEIVER MODULE**

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(73) Assignee: **Global Technology Inc.**, Ningbo (CN)

(*) 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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(51) **Int. Cl.**
G02B 6/42 (2006.01)
H04B 10/40 (2013.01)
G02B 6/43 (2006.01)

(52) **U.S. Cl.**
CPC ***G02B 6/425*** (2013.01); ***G02B 6/43*** (2013.01); ***H04B 10/40*** (2013.01); *G02B 6/428* (2013.01)

(58) **Field of Classification Search**
CPC G02B 6/425; G02B 6/428; G02B 6/43; H04B 10/40
See application file for complete search history.

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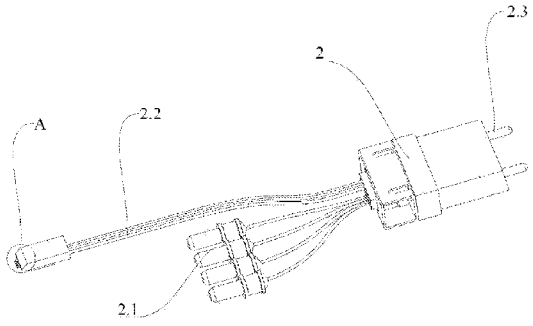
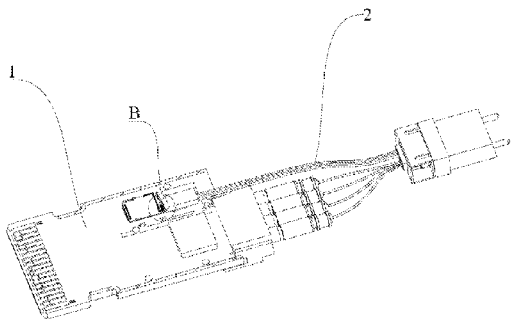
Primary Examiner — Daniel Petkovsek
(74) *Attorney, Agent, or Firm* — Grossman Tucker Perreault & Pfleger, PLLC

(57) **ABSTRACT**

The present disclosure discloses a high speed optical module having a PCBA component and a passive optical element. The PCBA component includes a receiver and a transmitter. The transmitter includes an amplifier chip and a photodiode array connected to pins of the amplifier chip. The transmitter includes a laser driving chip and a base. Multiple lasers are arranged side by side in the base. The lasers are connected to the laser driving chip. A plurality of fiber interfaces are arranged on output light paths corresponding to the plurality of lasers. The passive optical element includes ferrules corresponding to the plurality of fiber interfaces, and the ferrules are correspondingly inserted into the plurality of fiber interfaces in a one-to-one relationship. The passive optical element is inserted into the PCBA component by fiber interfaces arranged on the PCBA component.

7 Claims, 6 Drawing Sheets





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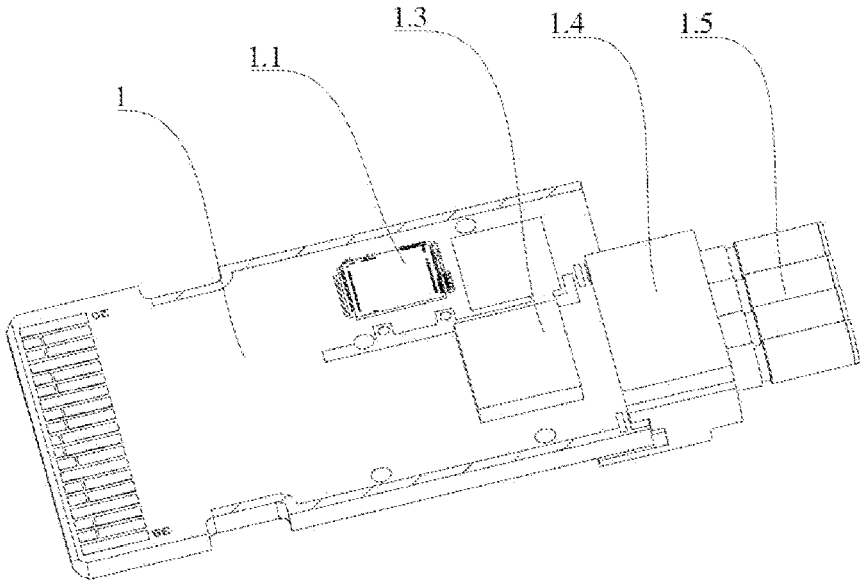


Figure 1

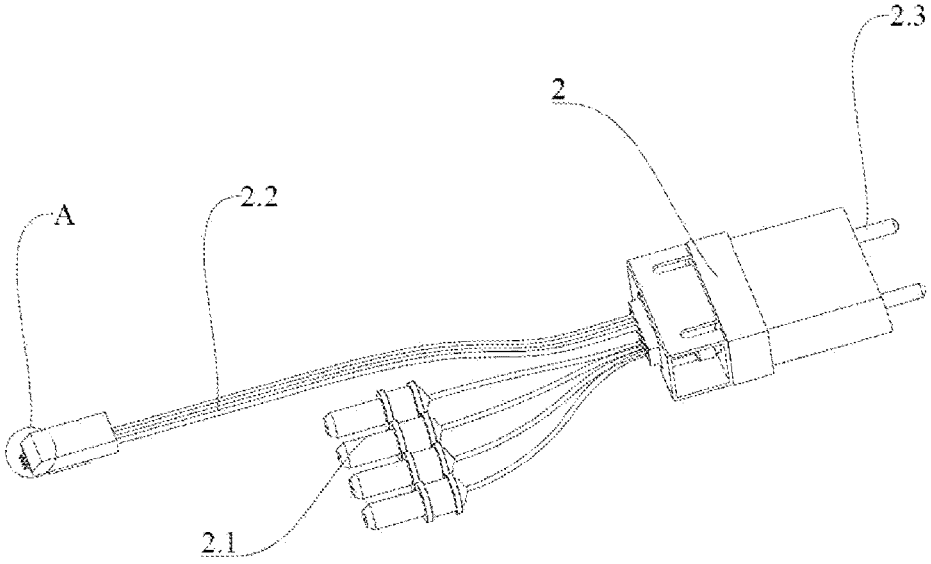


Figure 2

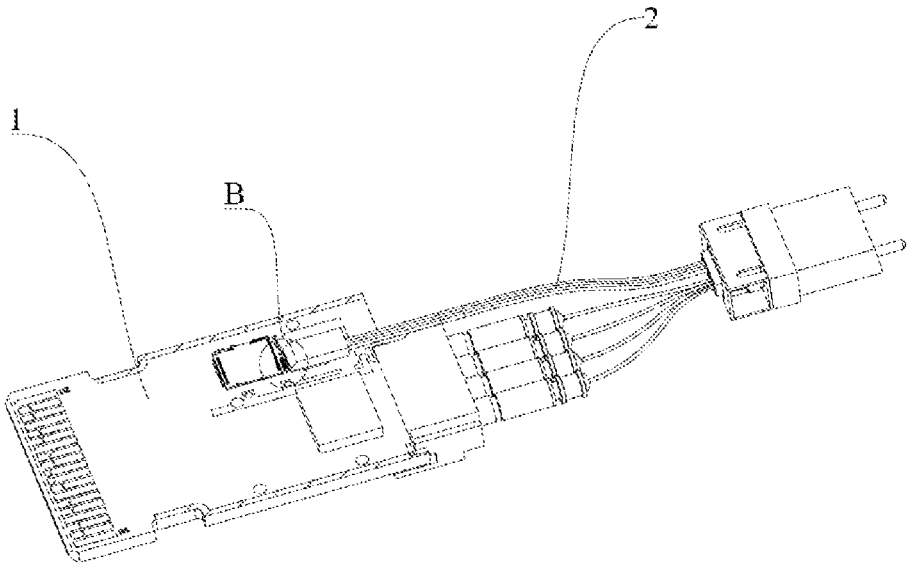


Figure 3

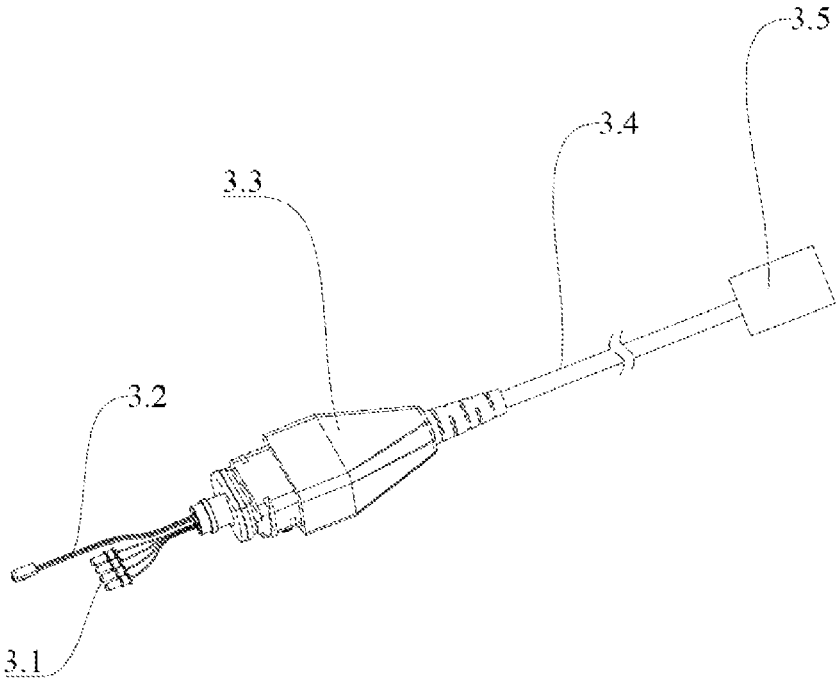


Figure 4

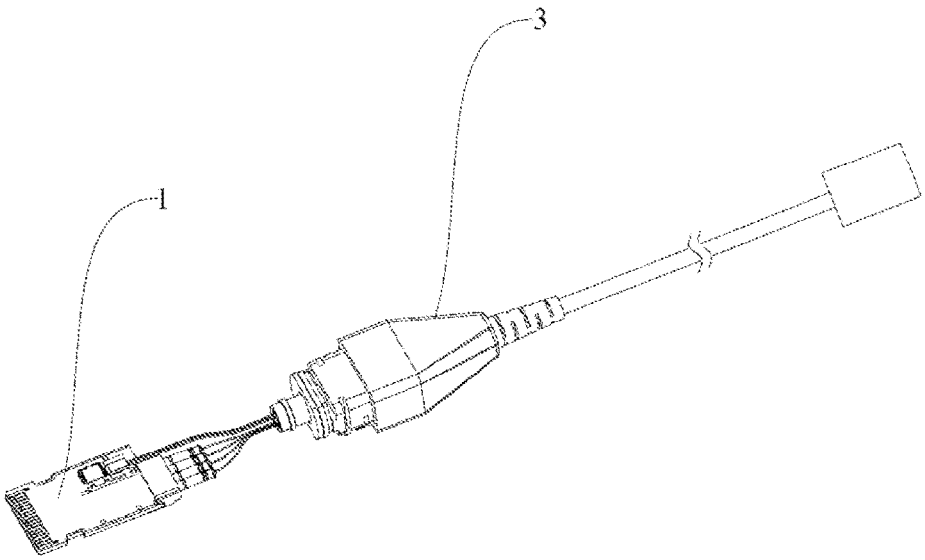


Figure 5

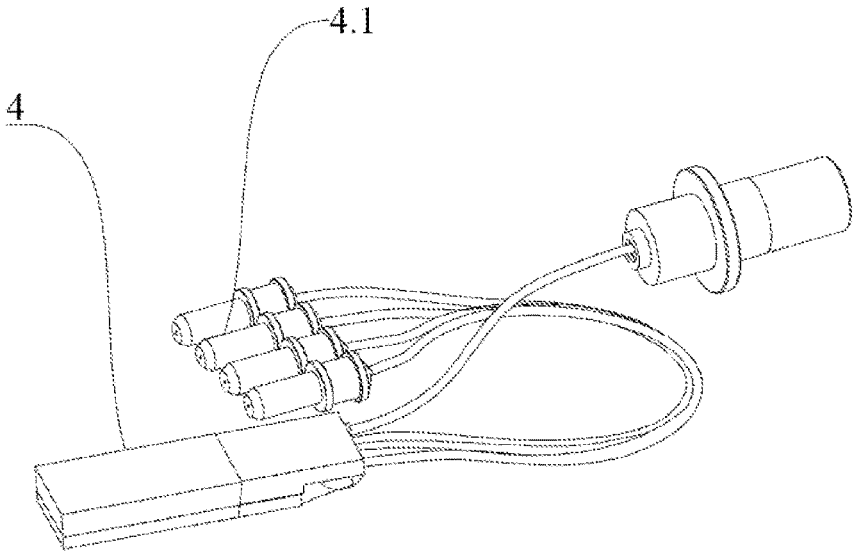


Figure 6

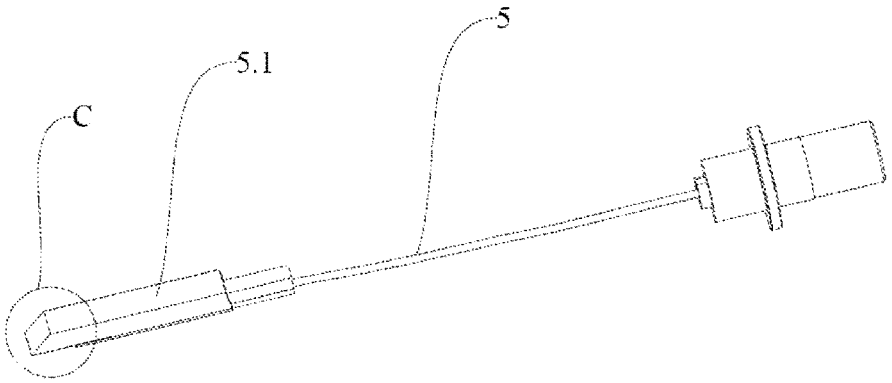


Figure 7

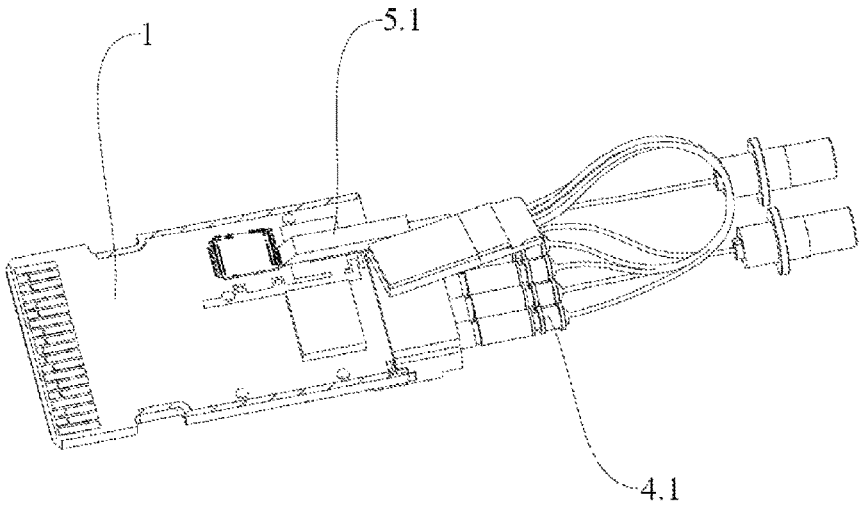


Figure 8

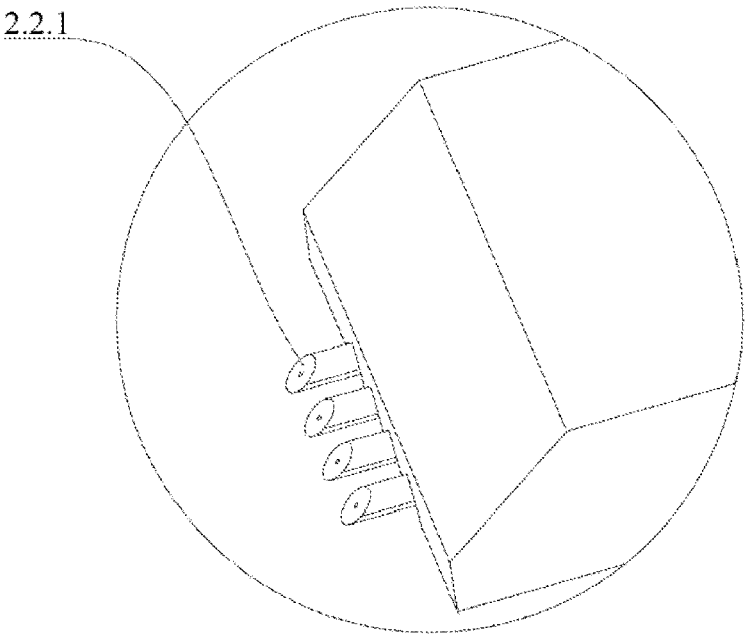


Figure 9

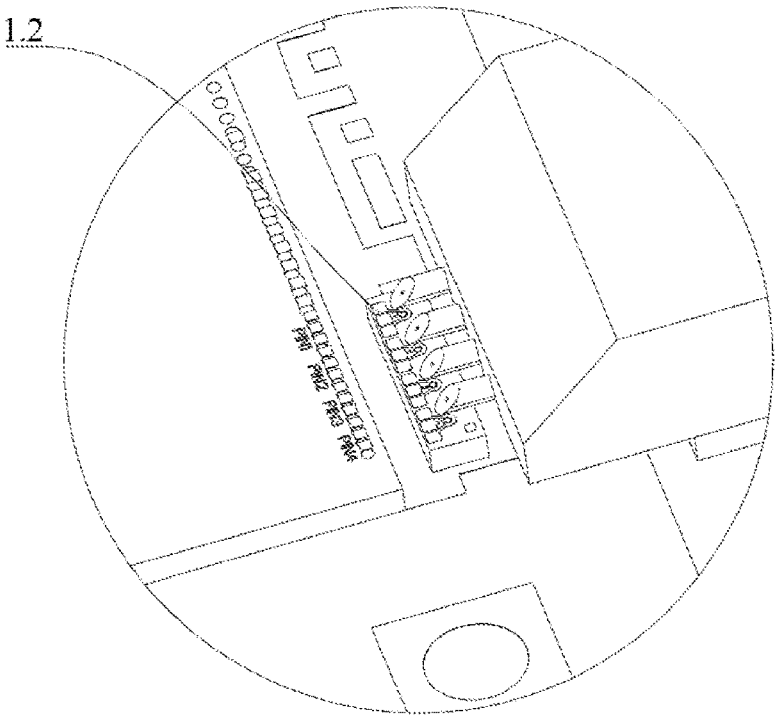


Figure 10

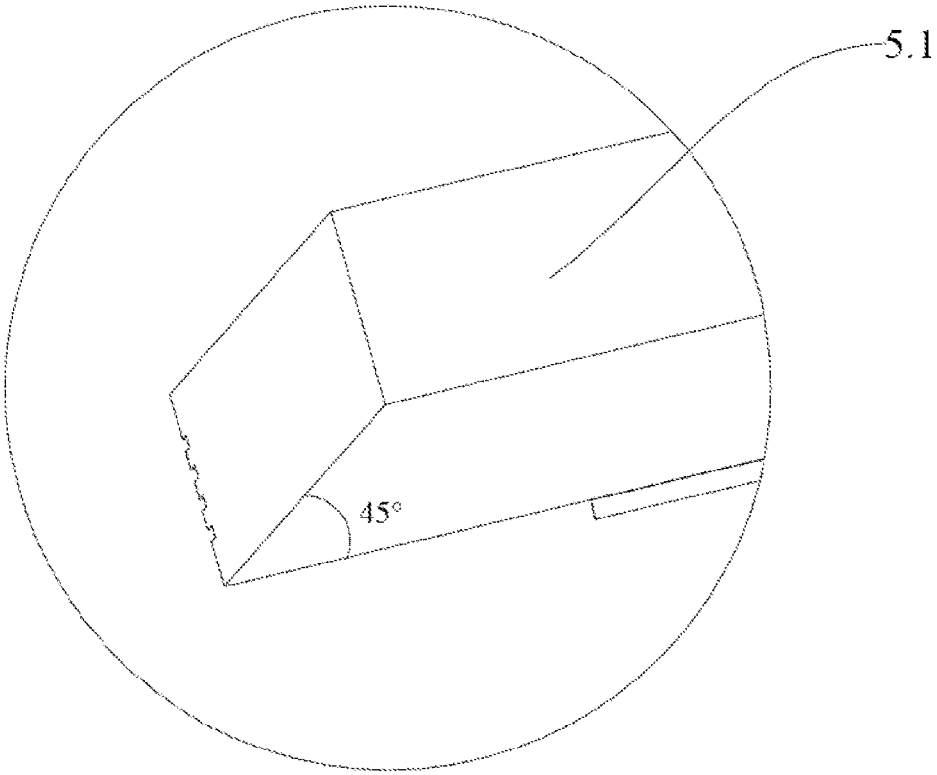


Figure 11

HIGH SPEED OPTICAL TRANSCEIVER MODULE

TECHNICAL FIELD

The present disclosure relates to the field of optical communication, and more particularly, to a high speed optical transceiver module.

BACKGROUND

High speed optical transceiver modules are primarily used in fields of optical communication such as data centers and Fiber to the Home (FTTH), and they are core communication modules in optical communication. Due to growing demands on transmission bandwidth and speed by upgraded communication systems, the configurations of optical transceiver modules are being developed to be with advantages of smaller in volume, better in integration and operating with multiple channels. The demands are also growing on cost-control and process-control. An existing high speed optical transceiver includes a printed circuit board assembly (PCBA) component and an optical engine which is usually directly soldered to the PCBA component. This design is not reliable when there is something wrong with soldered connection, which may result in inferiority of signal transmission in the high speed optical transceiver. Further, since such a design requires soldering the PCBA component to the optical engine, which just complicates the manufacture process, the yield rate remains a lot to be desired. Meanwhile, the corresponding complicated manufacturing process therefore includes handling the PCBA component first before soldering the optical engine to the PCBA component and mounting a protecting lid above the soldered position using screws.

SUMMARY

The present disclosure provides a high speed optical transceiver module including a PCBA component and a passive optical element.

The PCBA component includes a receiver and a transmitter. The receiver may include an amplifier chip and a photodiode array connected to pins of the amplifier chip. The transmitter may include a laser driving chip and a base. The base may include a plurality of lasers arranged side by side therein. The lasers are connected to the laser driving chip. A plurality of fiber interfaces are arranged on output light paths corresponding to the lasers. The passive optical element may include ferrules corresponding to the fiber interfaces, and the ferrules are correspondingly inserted into the fiber interfaces in a one-to-one relationship.

The present disclosure has the following advantages compared to prior arts.

The passive optical element is inserted into the PCBA component by the fiber interfaces arranged on the PCBA component. The connection approach is convenient, effective, and stable without resorting to soldering. Also, the PCBA component and the passive optical element can be manufactured separately, and assembled later. Modular production of the PCBA component and the passive optical element therefore can be achieved for the production of the disclosed optical transceiver module. Various types of products can be manufactured according to the type of the passive optical element. Therefore, the PCBA component can be used for general purposes. The functionalities of the high speed optical transceiver module could be more flexible to satisfy numerous needs. The production efficiency and the product yield are also enhanced consequently. In some embodiments, 4 lasers and 4 fiber interfaces could be found in the transceiver module. In some embodiments, the passive optical element is a multi push on (MPO) connector. The MPO connector may include a first plurality of ferrules and a first fiber array on one end and a mechanical transfer (MT) pin on the other end. The first ferrules are correspondingly connected to the fiber interfaces in a one-to-one relationship. An end of the first fiber array is mounted over or in the proximity of the photodiode array. The MT pin is used to connect other photoelectric devices. In some embodiments, the passive optical element is a MPO connector having a tail fiber. The MPO connector with the tail fiber may include a tail sleeve. The tail sleeve may include a second plurality of ferrules and a second fiber array on one end and the tail fiber on the other end. The second ferrules are correspondingly connected to the fiber interfaces in a one-to-one relationship. An end of the second fiber array is mounted over or in proximity of the photodiode array, and the tail fiber may include an optical connector on an end. The optical connector can be configured to allow for general-purpose usage of the MPO connector with the tail fiber.

In some embodiments, the optical connector is one of an arrayed connector, a lucent connector (LC), and a subscriber connector (SC).

In some embodiments, each of the first and second fiber arrays is a fiber array having an angle of 41 to 45 degrees. The light emitted from the fiber array would be incident on the photodiode array vertically to provide the shortest light path.

In some embodiments, the passive optical element is a wavelength division multiplexer including a multiplexing component and a de-multiplexing component. The multiplexing component comprises a third plurality of ferrules connected to the plurality of fiber interfaces in one-to-one correspondence. The demultiplexing component comprises an arrayed waveguide grating (AWG) chip, and an end of the AWG chip is mounted on the photodiode array. Wavelength division multiplexing can be achieved by the multiplexing component and the demultiplexing component. In some embodiments, an end face of the AWG chip is a slope having a slope angle of 41 to 45 degrees so that light may enter the photodiode array vertically.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a structural schematic of a PCBA component.

FIG. **2** is a structural schematic of a MPO connector.

FIG. **3** is a structural schematic of a PSM**4** module.

FIG. **4** is a MPO connector with a tail fiber.

FIG. **5** is a structural schematic of a PSM**4** module with a tail fiber.

FIG. **6** is a structural schematic of a multiplexing component.

FIG. **7** is a structural schematic of a demultiplexing component.

FIG. **8** is a structural schematic of a CWDM**4** module.

FIG. **9** is an enlarged view of the part A.

FIG. **10** is an enlarged view of the part B.

FIG. **11** is an enlarged view of the part C.

REFERENCE NUMBERS

1 PCBA component, **1.1** amplifier chip, **1.2** photodiode array, **1.3** laser driving chip, **1.4** base, **1.5** fiber interface, **2** MPO connector, **2.1** first plurality of ferrules, **2.2** first fiber

array, **2.2.1** end face of first fiber array, **2.3** MT pin, **3** MPO connector with a tail fiber, **3.1** second plurality of ferrules, **3.2** second fiber array, **3.3** tail sleeve, **3.4** tail fiber, **3.5** optical connector, **4** multiplexing component, **4.1** third plurality of ferrules, **5** de-multiplexing component, **5.1** AWG chip.

DETAILED DESCRIPTION

A high speed optical transceiver module may include a PCBA component **1** and a passive optical element. The PCBA component **1** may include a receiver and a transmitter. The receiver comprises an amplifier chip **1.1** and a photodiode array **1.2**. The photodiode array **1.2** is connected to pins of the amplifier chip **1.1**. The transmitter may include a laser driving chip **1.3** and a base **1.4**. The base **1.4** may include a plurality of lasers arranged side by side. The lasers are connected to the laser driving chip **1.3**. A plurality of fiber interfaces **1.5** are arranged on output light paths corresponding to the lasers. The passive optical element may include ferrules corresponding to the fiber interfaces **1.5**. The ferrules are correspondingly inserted into the fiber interfaces in another one-to-one relationship. Light emitted by the lasers is transmitted into the passive optical element through the ferrules of the passive optical element.

As shown in FIG. **1** to FIG. **5** and FIG. **9** to FIG. **10**, a parallel single-mode four-channel module, i.e., the PSM**4** module has two types of structures. A PSM**4** module of the first type may include a PCBA component **1** and a MPO connector **2**. The PCBA component **1** may include four lasers and four fiber interfaces. The MPO connector **2** may include a first plurality of ferrules **2.1** and a first fiber array **2.2** on one of its ends and a mechanical transfer (MT) pin **2.3** on the other end thereof. The first plurality of ferrules **2.1** are correspondingly connected to the fiber interfaces **1.5** in a one-to-one relationship. An end of the first fiber array **2.2** is disposed over the photodiode array **1.2**. The MT pin is a plug-in interface used to connect other photoelectric devices. Light emitted by the lasers enters the MPO connector **2** through the first plurality of ferrules **2.1**. After conversion, the light is transmitted from the end of the first fiber array **2.2** to the photodiode array **1.2**. The second type is a PSM**4** module with a tail fiber. The PSM**4** module in this embodiment may include a PCBA component **1** and a MPO connector with a tail fiber **3.4**. The MPO connector with the tail fiber **3.4** may include a tail sleeve **3.3**. The tail sleeve **3.3** may include a second plurality of ferrules **3.1** and a second fiber array **3.2** on one end with the tail fiber **3.4** on the other end. The second ferrules **3.1** are correspondingly connected to the fiber interfaces **1.5** in another one-to-one relationship. An end of the second fiber array **3.2** is mounted over or in proximity of the photodiode array **1.2**. A protecting lid is arranged at a predetermined position where the second fiber array **3.2** is disposed over or in proximity of the photodiode array **1.2**. The protecting lid is used to limit the end part of the second fiber array **3.2**. An optical connector **3.5** is arranged on an end part of the tail fiber **3.4**. The optical connector **3.5** could be chosen to meet different needs. For example, the optical connectors **3.5** could be MPO connectors, lucent connectors (LC), or subscriber connectors (SC). Both the first fiber array **2.2** and the second fiber array **3.2** are arrayed fibers having angles of 41 to 45 degrees. The light emitted from the first fiber array **2.2** or the second fiber array **3.2** would be incident on the photodiode array **1.2** vertically to provide the shortest light path, which might maintain the quality of the transmission signal.

As shown in FIGS. **6-8** and **11**, an optical transceiver module enabling wavelength multiplexing such as a CWDM**4** module including a PCBA component **1** and a wavelength division multiplexer is disclosed. The wavelength division multiplexer may include a MUX component **4** and a DEMUX component **5**. Four lasers and four fiber interfaces are arranged on the PCBA component **1**. The multiplexing component **4** may include a third plurality of ferrules **4.1**. The third plurality of ferrules **4.1** are connected to the fiber interfaces **1.5** on a one-to-one basis. The demultiplexing component **5** may include an arrayed waveguide grating (AWG) chip **5.1**. An end of the AWG chip **5.1** is mounted on the light receiving surface of the photodiode array **1.2**. The end face of the AWG chip **5.1** is oriented between 41 to 45 degrees so that the light path would be rotated by 90° before it is incident on the receiving surface of the photodiode array **1.2**. The angle of the end face of the AWG chip **5.1** can be adjusted according to different reflected volumes and required receiving responsiveness.

The PCBA component and the passive optical element of the present disclosure may be manufactured in modules separately before they are assembled together. High speed optical transceivers with various functionalities can be manufactured by combining various passive optical elements with the PCBA component. More functions may become available in the high speed optical transceiver. Modular production would also increase production efficiency and product yield.

What is claimed is:

1. A high-speed optical transceiver module, comprising:

a printed circuit board assembly (PCBA) component having a receiver and a transmitter; and

a passive optical element, wherein

the receiver comprises an amplifier chip and a photodiode array connected to pins of the amplifier chip;

the transmitter comprises a laser driving chip and a base;

the base comprises a plurality of lasers arranged side by side;

the plurality of lasers are connected to the laser driving chip;

a plurality of fiber interfaces are arranged on output light paths corresponding to the lasers;

the passive optical element comprises ferrules corresponding to the fiber interfaces and a fiber array for emitting light on the photodiode array of the receiver; and

the ferrules are inserted into the plurality of fiber interfaces in one-to-one correspondence.

2. The high-speed optical transceiver module of claim **1**, wherein the plurality of lasers comprise 4 lasers, and the plurality of fiber interfaces comprise 4 fiber interfaces.

3. The high-speed optical transceiver module of claim **2**, wherein the passive optical element is a multi push on (MPO) connector, the MPO connector having the ferrules and the fiber array at a first end and a mechanical transfer (MT) pin at a second end opposite the first end.

4. The high-speed optical transceiver module of claim **2**, wherein the passive optical element is a MPO connector having a tail fiber with an optical connector, the MPO connector comprises a tail sleeve, the tail sleeve comprises the ferrules and the fiber array on a first end and the tail fiber on a second end.

5. The high-speed optical transceiver module of claim **4**, wherein the optical connector is one of an arrayed connector, a lucent connector (LC), and a subscriber connector (SC).

6. The high-speed optical transceiver module of claim **2**, wherein the passive optical element is a wavelength division multiplexer comprising a multiplexing component and a demultiplexing component, the de-multiplexing component comprises an arrayed waveguide grating (AWG) chip, and an end of the AWG chip is mounted on the photodiode array.

7. The high-speed optical transceiver module of claim **6**, wherein an end face of the AWG chip is a slope having a slope angle of 41 to 45 degrees.

* * * * *

EXHIBIT C

EXHIBIT C
Representative Claim Chart for U.S. Patent No. 9,523,826

1. Molex 100G QSFP28 PSM4 (Molex P/N 1064271206)

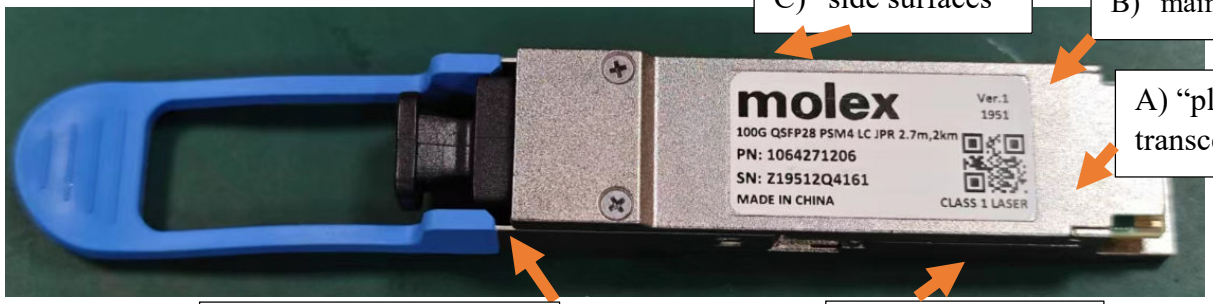


Figure 1

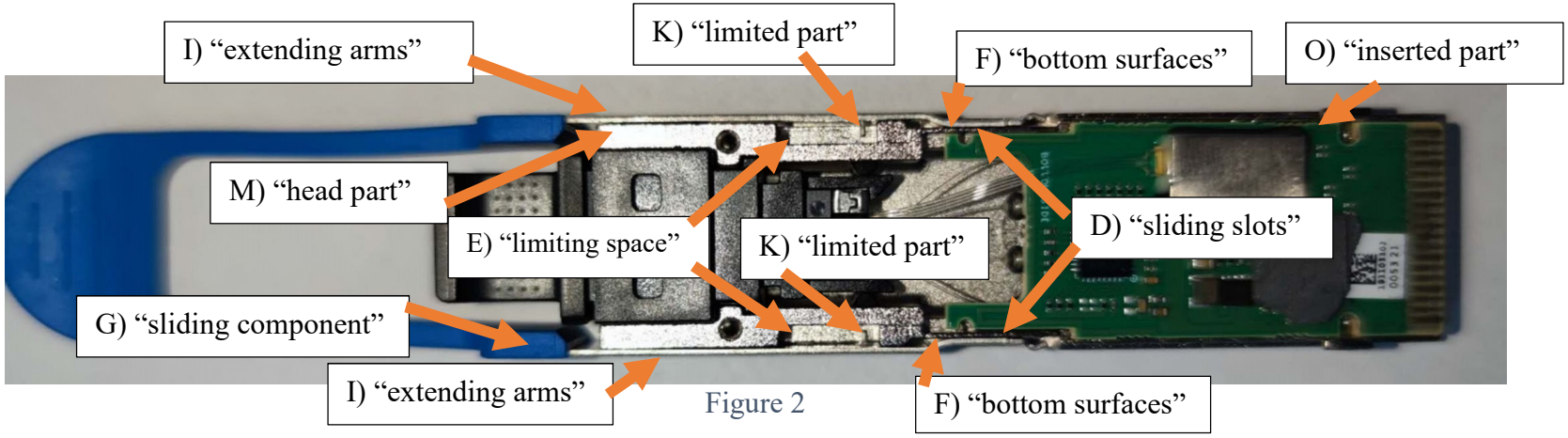


Figure 2

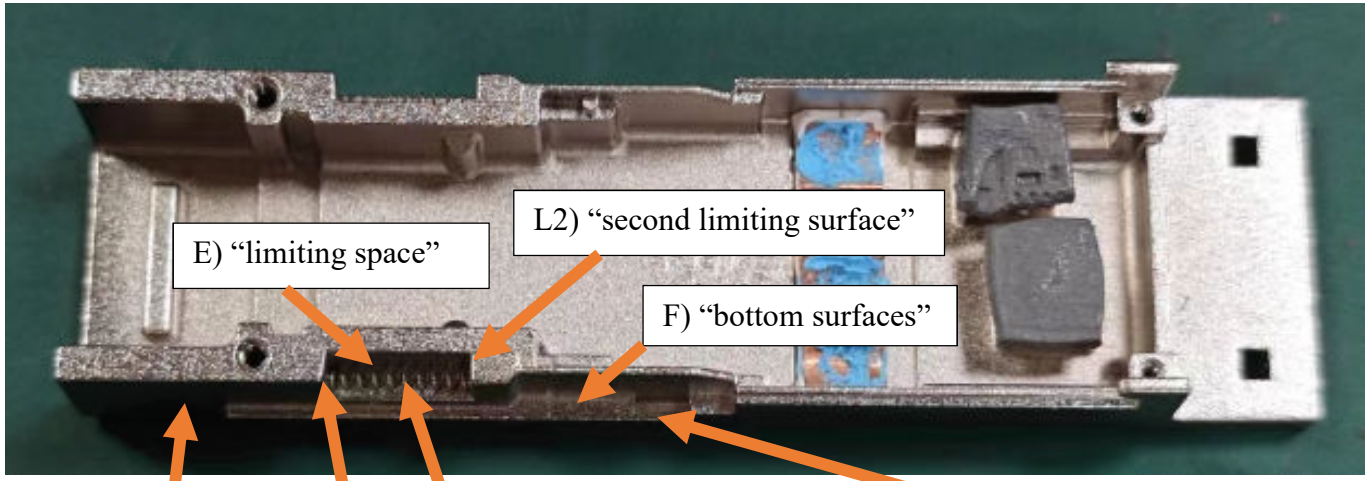


Figure 3

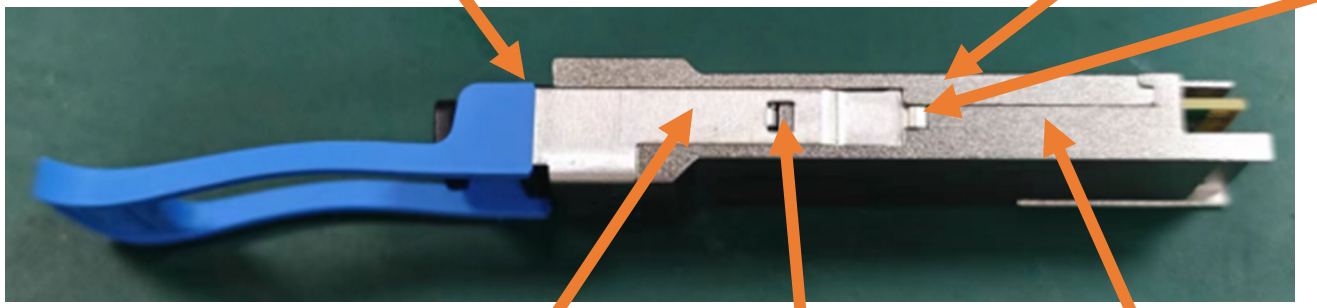
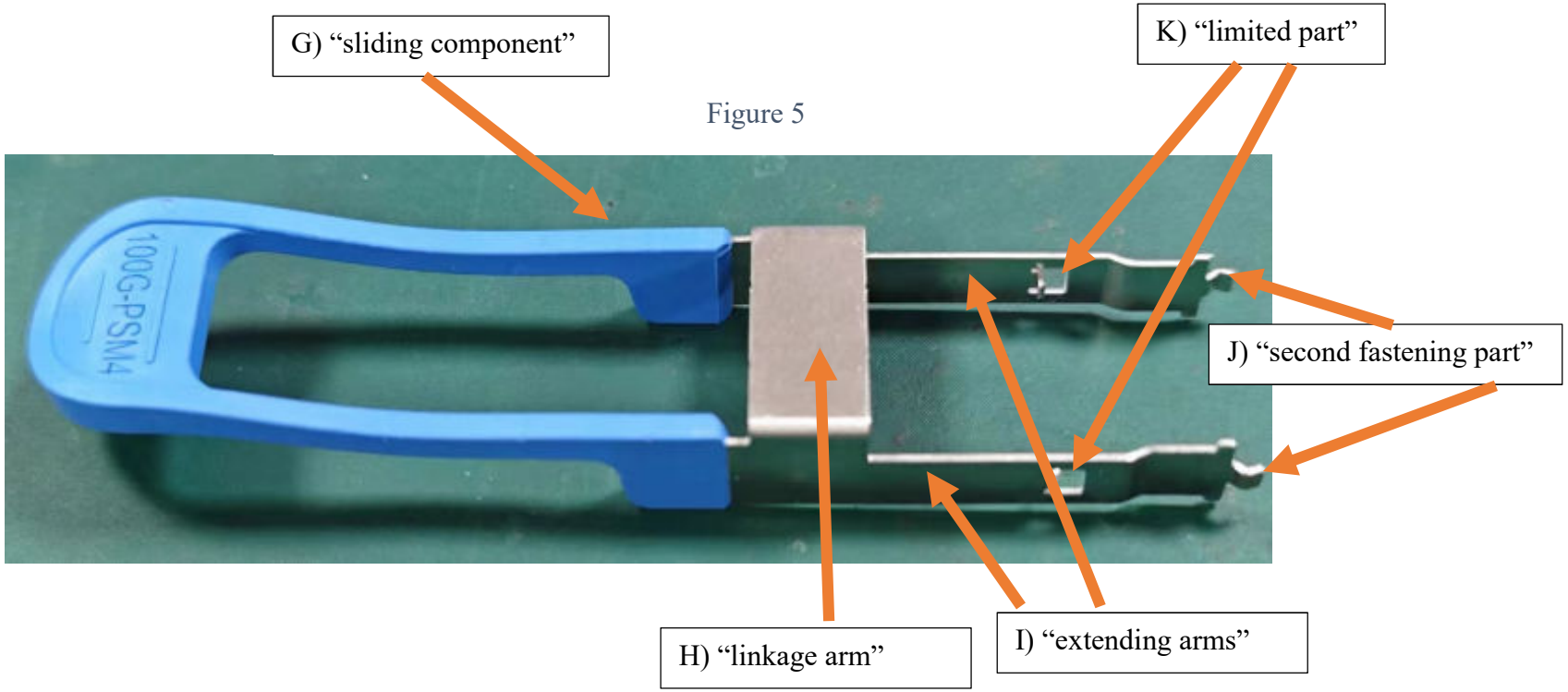


Figure 4

Figure 5


G) “sliding component”
K) “limited part”
J) “second fastening part”
H) “linkage arm”
I) “extending arms”
100G-PSM4

2. U.S. Patent No. 9,523,826

a. Independent Claim 1

U.S. Patent No. 9,523,826 Claim 1	Molex 100G QSFP28 PSM4
1. A pluggable optical transceiver module, for being inserted into a plugging slot of a socket, the socket comprising two first fastening parts located in the plugging slot, the pluggable optical transceiver module comprising:	Pluggable optical transceiver module **(A)** (100G QSFP28 PSM4) is shown in FIGS. 1–5.
a main body having two side surfaces that are opposite to each other and	Main body **(B)** has two side surfaces **(C)** that are opposite to each other. See FIGS. 1–5.
two sliding slots located at the two side surfaces, respectively,	Sliding slots **(D)** are located at the two side surfaces **(C)**. See FIG. 2.
wherein the main body is configured to be inserted into the plugging slot,	Main body **(B)** is configured to be inserted into a plugging slot. See FIGS. 1–5.
wherein the main body has at least one limiting space and two bottom surfaces forming the two sliding slots, respectively,	Main body **(B)** has at least one limiting space **(E)** and two bottom surfaces **(F)** forming the two sliding slots **(D)**. See FIGS. 2 and 3.
the two bottom surfaces are parallel to the two side surfaces,	Two bottom surfaces **(F)** are parallel to the two side surfaces **(C)**. See FIGs. 2 and 3.
the at least one limiting space is located at one of the two side surfaces;	The at least one limiting space **(E)** is located at one of the two side surfaces **(C)**. See FIGS. 2 and 3.
a sliding component comprising a linkage arm and two extending arms,	Sliding component **(G)** comprises a linkage arm **(H)** and two extending arms **(I)**. See FIGS. 2 and 5.
wherein the two extending arms are connected to two ends of the linkage arm, respectively,	The two extending arms **(I)** are connected to two ends of the linkage arm **(H)**. See FIGS. 2 and 5.
each extending arm has a second fastening part,	Each extending arm **(I)** has a second fastening part **(J).** See FIG. 5.
the main body is between the two extending arms,	The main body **(B)** is between the two extending arms **(I)**. See FIGS. 1, 2, and 4.
the two extending arms are slidably disposed on the two sliding slots to have a fastening position and a releasing position,	Two extending arms **(I)** are slidably disposed on the two sliding slots **(D)** to have a fastening position and releasing position. See FIS. 2–4.

U.S. Patent No. 9,523,826 Claim 1	Molex 100G QSFP28 PSM4
the two first fastening parts are fastened to the two second fastening parts when the two extending arms are located at the fastening position,	The two first fastening parts are configured to be fastened to the two second fastening parts **(J)** when the two extending arms **(I)** are located at the fastening position. See FIGS. 2–4.
and the two second fastening parts press the two first fastening parts, respectively, to make the two first fastening parts be farther away from each other when the two extending arms are located at the releasing position,	The two fastening parts **(J)** appear to press the two fastening parts (of the socket) to make the two first fastening parts (of the socket) to be farther away from each other when the two extending arms **(I)** are located at the releasing position. See FIGS. 2–4.
wherein each extending arm has a limited part configured to move in the at least one limiting space;	Each extending arm **(I)** has a limited part **(K)** configured to move in the at least one limiting space **(E)**. See FIG. 2.
and an elastic component,	An elastic component **(N).** See FIG. 3.
wherein the main body has a first limiting surface and a second limiting surface forming the limiting space,	The main body **(B)** has a first limiting **(L1)** surface and a second limiting surface **(L2)** forming the limiting space**.** See FIG. 3.
the first limiting surface is closer to the head part than the second limiting surface,	The first limiting surface **(L1)** is closer to the head part **(N)**. See FIG. 2.
and the elastic component is located in the limiting space and between the first limiting surface and the limited part and is covered by the extending arm such that the elastic component is confined by the main body and the sliding component.	The elastic component **(N)** is located in the limiting space **(E)** and between the first limiting surface **(L1)** and the second limiting surface **(L2)** such that the elastic component **(N)** is confined by the main body **(B)** and the sliding component **(G)**. See FIGS. 1–3.

b. Independent Claim 7

U.S. Patent No. 9,523,826 Claim 7	Molex 100G QSFP28 PSM4
A pluggable optical transceiver module, comprising:	Pluggable optical transceiver module (**A**) (100G QSFP28 PSM4) is shown in FIGs. 1-5.
a main body having a head part and an inserted part that are connected to each other,	Main body (**B**) having a head part (**M**) and an inserted part (**O**) that are connected to each other. See FIG. 2.
wherein the main body further comprises opposite two side surfaces	Main body (**B**) having two opposite side surfaces (**C**). See FIGs. 1 and 3-4.
and two sliding slots which are located at two sides of the head part and the inserted part opposite to each other, respectively,	Sliding slots (**D**) which are located at two sides of the head part (**M**) and the inserted part (**O**) opposite each other. See FIG. 2.
the two sliding slots are located at the two side surfaces, and the two sliding slots extend from the head part to the inserted part, respectively,	Sliding slots (**D**) shown located at the two side surfaces (**C**), and the two sliding slots (**D**) extend from the head part (**M**) to the inserted part (**O**). See FIG. 2.
wherein the main body has at least one limiting space and two bottom surfaces forming the two sliding slots, respectively,	Main body (**B**) has at least one limiting space (**E**), and two bottom surfaces (**F**) forming the two sliding slots (**D**). See FIGs. 2 and 3.
the two bottom surfaces are parallel to the two side surfaces,	Two bottom surfaces (**F**) are parallel to the two side surfaces (**C**). See FIGs. 2 and 3.
the at least one limiting space is located at one of the two side surfaces;	The at least one limiting space (**E**) is located at one of the two side surfaces (**C**). See FIGs. 2 and 3.
a sliding component comprising a linkage arm and two extending arms,	Sliding component (**G**) having a linkage arm (**H**) and two extending arms (**I**). See FIGs. 2 and 5.

U.S. Patent No. 9,523,826 Claim 7	Molex 100G QSFP28 PSM4
wherein the linkage arm is connected between the two extending arms,	Linkage arm (**H**) is connected between the two extending arms (I). See FIGs. 2 and 5.
each extending arm has a second fastening part,	Each extending arm (**I**) has a second fastening part (**J**). See FIG. 5.
the main body is between the two extending arms,	The main body (**B**) is between the two extending arms (**I**). See FIGs. 1-2 and 4.
the two extending arms are able to slide relative to the two sliding slots to have a fastening position which is farther away from the head part and a releasing position which is closer to the head part,	Two extending arms (**I**) are able to slide relative to the two sliding slots (**D**) to have a fastening position which appears further away from the head part (**M**), and releasing position which is closer to the head part (**M**). See FIGs. 2-4.
wherein each extending arm has a limited part configured to move in the at least one limiting space;	Each extending arm (**I**) has a limited part (**K**) configured to move in the at least one limiting space (**E**). See FIGs. 2-4.
and an elastic component,	An elastic component (**N**). See Fig. 3.
wherein the main body has a first limiting surface and a second limiting surface forming the limiting space,	The main body (**B**) has a first limiting (**L1**) surface and a second limiting surface (**L2**). See FIG. 3.
the first limiting surface is closer to the head part than the second limiting surface,	The first limiting surface (**L1**) is closer to the head part (**M**). See FIGs. 2-3.
and the elastic component is located in the limiting space and between the first limiting surface and the limited part and is covered by the extending arm such that the elastic component is confined by the main body and the sliding component.	The elastic component (**N**) is located in the limiting space (**E**) and between the first limiting surface (**L1**) and the first limited part (**K**) such that the elastic component (**N**) is covered by the extending arm (**I**) and is confined by the main body (**B**) and the sliding component (**G**). See FIGs. 2-4.

EXHIBIT D

EXHIBIT D
Representative Claim Chart for U.S. Patent No. 10,466,432

1. **Molex 100G QSFP28 PSM4 (Molex P/N 1064271206)**

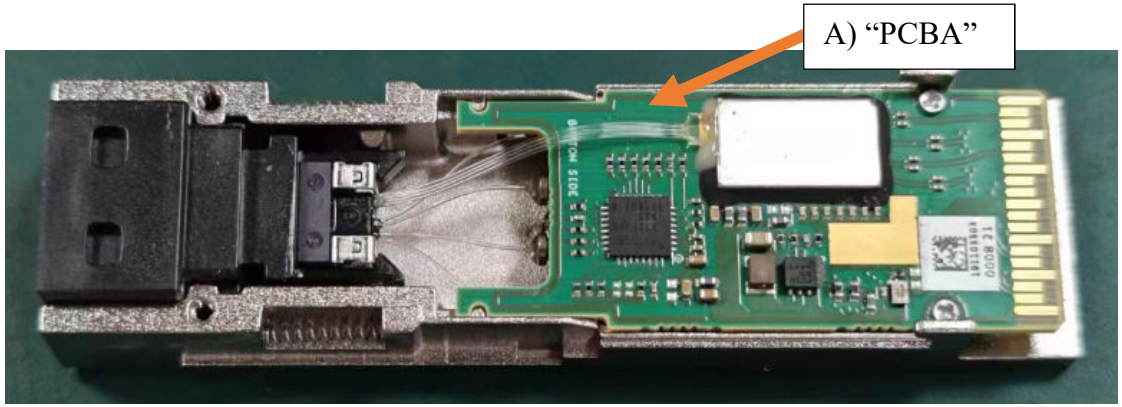


Figure 1

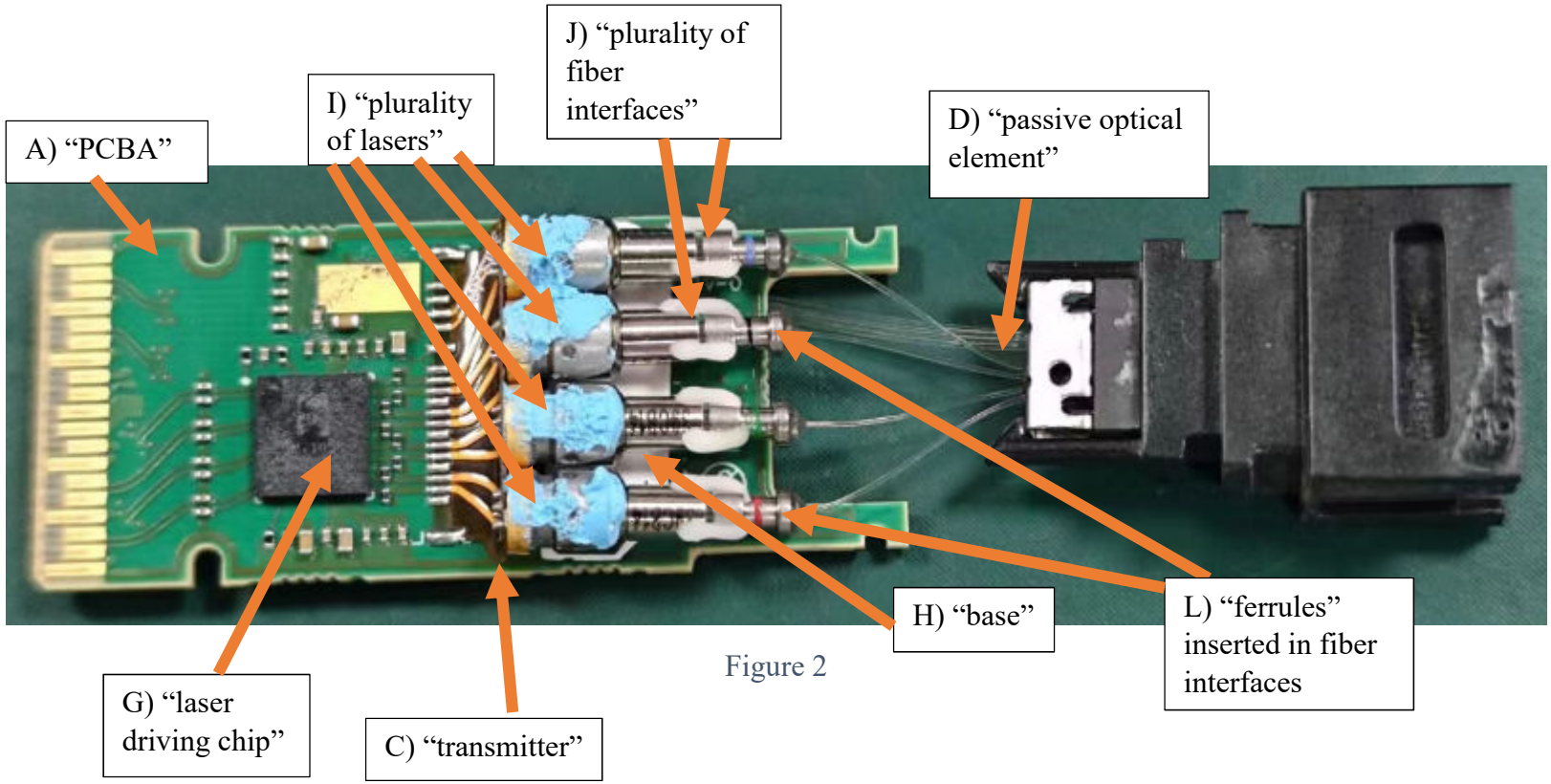

A) "PCBA"
I) "plurality of lasers"
J) "plurality of fiber interfaces"
D) "passive optical element"
H) "base"
L) "ferrules" inserted in fiber interfaces
G) "laser driving chip"
C) "transmitter"

Figure 2

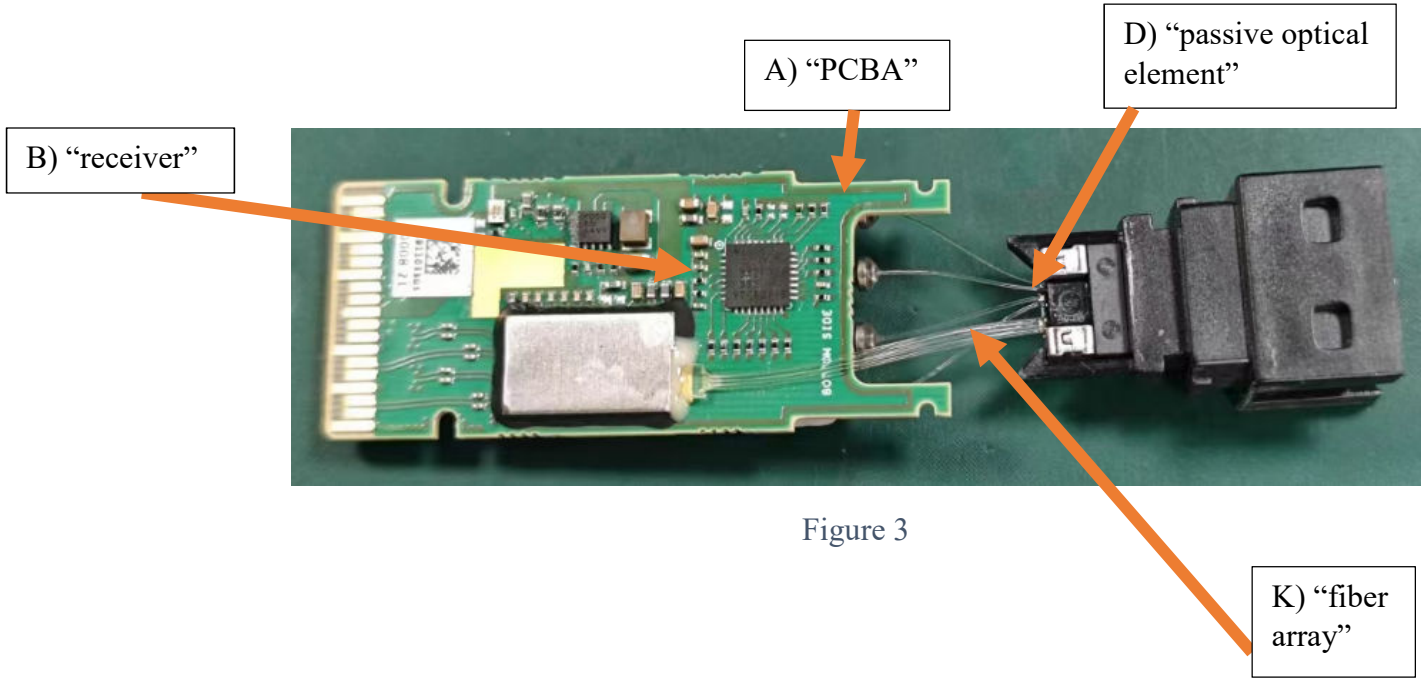


Figure 3

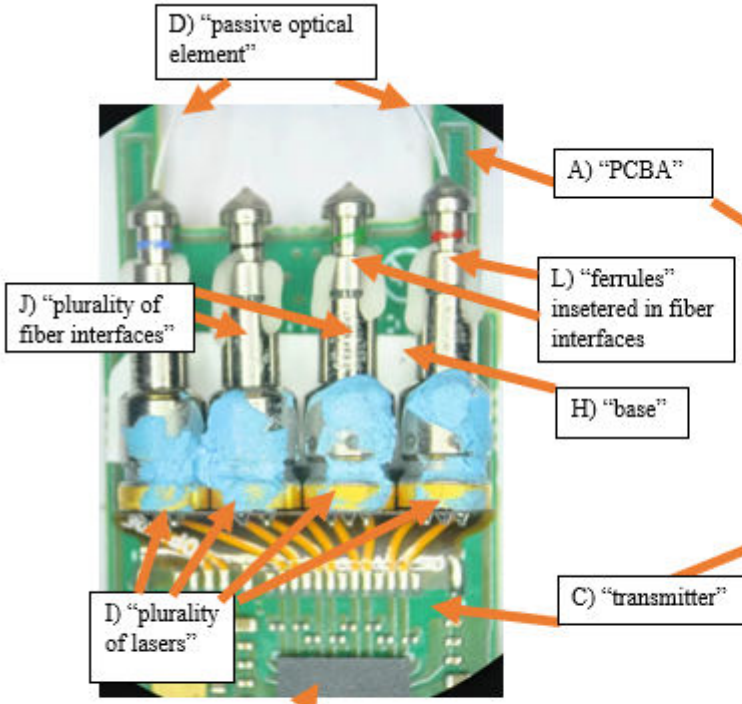


Figure 4

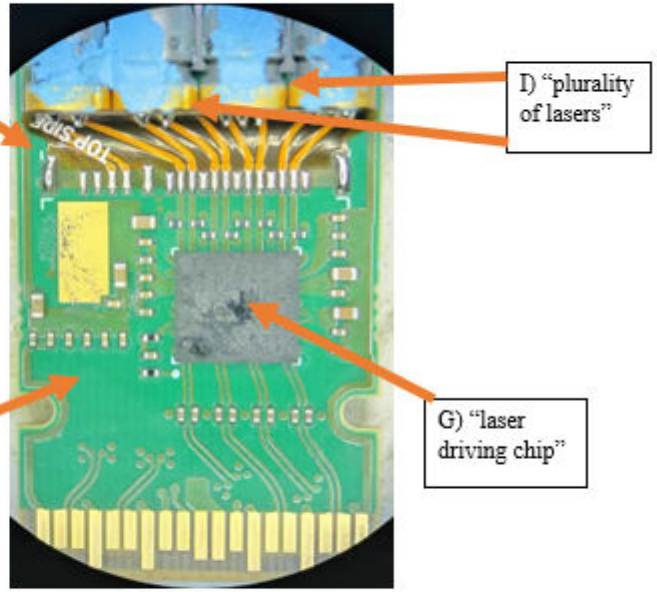


Figure 5

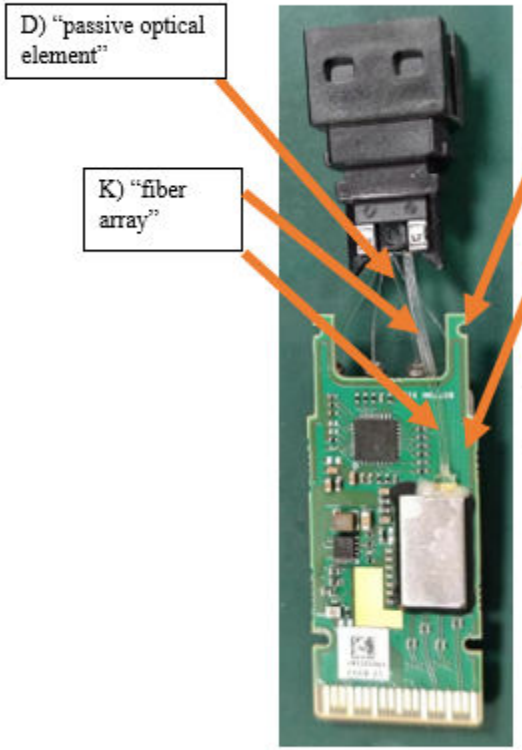


Figure 6

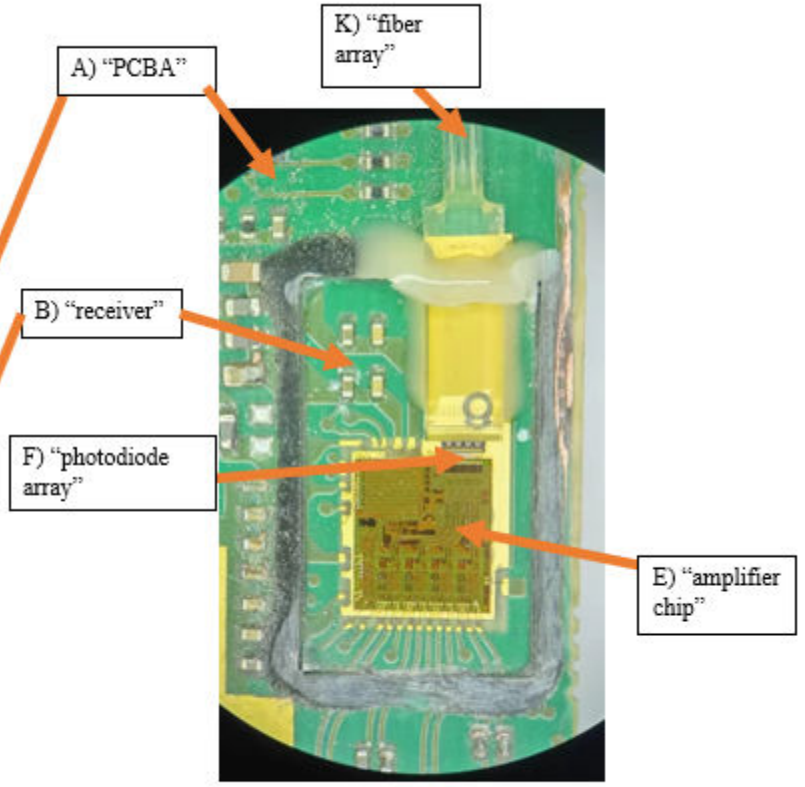


Figure 7

2. U.S. Patent No. 10,466,432

a. Independent Claim 1

U.S. Patent No. 10,466,432 Claim 1	Molex 100G QSFP28 PSM4
1. A high-speed optical transceiver module, comprising:	FIGs. 1–7 show a 4-channel, 100G transceiver, which is a high-speed optical transceiver module.
a printed circuit board assembly (PCBA) component having a receiver and a transmitter;	A printed circuit board assembly (PCBA) **(A)** is shown in FIGs. 1–7. PCBA **(A)** includes receiver **(B)** as shown in FIGs. 3, 6 and 7, and PCBA **(A)** includes transmitter **(C)** as shown in FIGs. 2, 4 and 5.
and a passive optical element,	a passive optical element **(D)** is shown in FIGS. 2-4 and 6.
wherein the receiver comprises an amplifier chip and a photodiode array connected to pins of the amplifier chip;	Receiver **(B)** includes an amplifier chip **(E)** and a photodiode array **(F)**, photodiode array **(F)** is connected to pins of amplifier chip **(E)** via wire bonds as shown in FIG. 7.
the transmitter comprises a laser driving chip and a base; the base comprises a plurality of lasers arranged side by side;	Transmitter **(C)** includes a laser driving chip **(G)** and base **(H)**, the base **(H)** comprises a plurality of lasers **(I)** arranged side by side as shown in FIGs. 2 and 4.
the plurality of lasers are connected to the laser driving chip;	The plurality of lasers **(I)** are connected to the laser driving chip **(G)**. See FIGs. 2 and 4-5.
a plurality of fiber interfaces are arranged on output light paths corresponding to the lasers;	Plurality of fiber interfaces **(J)** are arranged on output light paths corresponding to the lasers **(I)** as shown in FIGs. 2, 4, and 5.
the passive optical element comprises ferrules corresponding to the fiber interfaces	The passive optical element **(D)** comprises ferrules (**L**) corresponding to the fiber interfaces **(J)** as shown in FIGs. 2 and 4.
and a fiber array for emitting light on the photodiode array of the receiver;	Fiber array **(K)** is for emitting light on the photodiode array **(F)** of the receiver **(B)** as shown in FIGs. 3, 6 and 7.
and the ferrules are inserted into the plurality of fiber interfaces in one-to-one correspondence.	The ferrules (**L**) are shown inserted into the plurality of fiber interfaces **(J)** in one-to-one correspondence as shown in FIGs. 2 and 4.