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Optical communication connection device

Abstract

The invention relates to an optical communication connection device, which includes an optical receiving unit, an optical transmitting unit, a circuit board and a connection interface. The optical receiving unit and the optical transmitting unit are connected to the connection interface through the circuit board, and the connection interface is used to connect to an external circuit board. The connection interface has a plurality of first connection terminals connected to the circuit board and a plurality of second connection terminals being used to connect to the external circuit board. The second connection terminal is substantially parallel to the external circuit board, and is connected to the external circuit board through surface mount technology, which is not only conducive to reduce the size of the optical communication connection device, but also improve the high-frequency characteristics thereof.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS (1) This non-provisional application claims priority claim under 35 U.S.C. § 119(e) on U.S. Provisional Patent Application No. 63/318,667 filed on Mar. 10, 2022, the entire contents of which are incorporated herein by reference.

TECHNICAL FIELD
(1) This disclosure is an optical communication connection device, which is not only conducive to reduce the size of the optical communication connection device, but also improve the high-frequency characteristics.
BACKGROUND
(2) Optical communication is a communicating technology using light to carry information, which is also known as optical telecommunication, wherein fiber-optic communication is nowadays the

most commonly used technology. The fiber-optic communication is mainly performed by transferring information within optical fibers, which is categorized as one type of wired communication. The fiber-optic communication has several advantages, such as capable of transferring large-size data, also with fine confidentiality, hence becomes mainstream of the wired communication technologies.

(3) In technic field of the optical communication, optic-connecting device is a significant component for receiving and transmitting optical signals, for example, gigabit interface converter (GBIC) is one type of the optic-connecting device. The optic-connecting device is mainly disposed on a console device, and includes an optical transmitter and an optical receiver. The optical transmitter is for converting electric signal into optical signal and transferring the optical signal via the optical fibers, where the optical receiver is for converting the optical signal back to electric signal and transferring to the console device.

SUMMARY

(4) Currently on-market optic-connecting devices are large-sized, which can be a drawback for assembling into computer. Therefore, this disclosure provide an optical communication connection device, wherein a connection interface of the optical communication connection device is connected to an external circuit board through surface mount technology, which is conducive to reduce the size of the optical communication connection device.

(5) Connection terminals of the optical communication connection device of this disclosure is approximately parallel to the surface of the external circuit board, and is connected to the external circuit board through surface mount technology to improve the high-frequency characteristics thereof.

(6) To achieve the aforementioned object, the disclosure provides an optical communication connection device, comprising: a circuit board; an optical receiving unit electrically connected to the circuit board for receiving an optical signal; an optical transmitting unit electrically connected to the circuit board for transmitting an optical signal; a connection interface including a plurality of first connection terminals and a plurality of second connection terminals, and an angle being defined between the plurality of first connection terminals and the plurality of second connection terminals, wherein the angle has a range from 45 degrees to 135 degrees, wherein the plurality of first connection terminals are connected to the circuit board, and the plurality of the second connection terminals are connected to an external circuit board through a surface mount technology; and a supporting frame located between the connection interface and the circuit board for supporting the circuit board.

(7) The disclose further provides an optical communication connection device, comprising: a circuit board; at least one chip disposed on a surface of the circuit board; a first heat conduction layer disposed on a surface of the at least one chip or the circuit board; an optical receiving unit electrically connected to the circuit board for receiving an optical signal; an optical transmitting unit electrically connected to the circuit board for transmitting an optical signal; a connection interface including a plurality of first connection terminals and a plurality of second connection terminals, and an angle being defined between the plurality of first connection terminals and the plurality of second connection terminals, wherein the angle has a range from 45 degrees to 135 degrees, wherein the plurality of first connection terminals are connected to the circuit board, and the plurality of the second connection terminals are connected to an external circuit board through a surface mount technology; and a supporting thermal column connected to the first heat conduction layer, and connected to the surface of the at least chip or connected to the surface of the circuit board via the first heat conduction layer.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) The structure as well as preferred modes of use, further objects, and advantages of this present disclosure will be best understood by referring to the following detailed description of some illustrative embodiments in conjunction with the accompanying drawings, in which:

(2) FIG. **1** is a three-dimensional exploded view of an optical communication connection device according to an embodiment of this disclosure.

(3) FIG. **2** is a connection schematic diagram of a bottom seat, a connection interface and an external circuit board of the optical communication connection device according to an embodiment of this disclosure.

(4) FIG. **3** is a three-dimensional schematic diagram of the optical communication connection device according to an embodiment of this disclosure.

(5) FIG. **4** is a three-dimensional exploded view of the optical communication connection device according to another embodiment of this disclosure.

(6) FIG. **5** is a cross section exploded view of the partial structure of the optical communication connection device according to an embodiment of this disclosure.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

(7) FIG. **1** and FIG. **3** are respectively a three-dimensional exploded view and a three-dimensional schematic diagram of an optical communication connection device according to an embodiment of this disclosure. The optical communication connection device **10** includes an optical receiving unit **111**, an optical transmitting unit **113**, a circuit board **15**, a supporting frame **16** and a connection interface **17**. The optical receiving unit **111** and the optical transmitting unit **113** are connected to the connection interface **17** through the circuit board **15**, and the connection interface **17** is configure to connect to an external circuit board **18**.

(8) The circuit board **15** may include a first circuit board **151** and a second circuit board **153**, and the first circuit board **151** is connected to the second circuit board **153** via a conductive portion **155**. For example, the conductive portion **155** may be a conductive wire. In addition, an angle is defined between the first circuit board **151** and the second circuit board **153**, and the angle may have a range from 45 degrees to 135 degree, and preferably 90 degrees, so that the first circuit board **151** and the second circuit board **153** have a cross section proximately L-shaped.

(9) The optical receiving unit **111** is configured to receive an optical signal, and is connected to the circuit board **15** via a first conductive unit **131**, such as conductive wire. For example, the optical receiving unit **111** is electrically connected to the first circuit board **151** and is located below the first circuit board **151**, and the connection interface **17** is connected to the second circuit board **153**. Specifically, the optical receiving unit **111** may include at least one photodetector to convert the received optical signal into an electric signal via photoelectric effect. The connecting interface **17** is an electric connection interface, wherein the converted electric signal from the optical receiving unit **111** is transferred to the connecting interface **17**.

(10) The optical transmitting unit **113** is configure to generate and emit an optical signal, and is connected to the circuit board **15** through a second conductive unit **133**, such as conductive wire. For example, the optical receiving unit **111** is electrically connected to the first circuit board **151**, and is located below the first circuit board **151**. Specifically, the optical transmitting unit **113** may include at least one light-emitting diode (LED) or at least one laser diode, to generate the optical signal in accordance with the electric signal transmitted by the connecting interface **17**.

(11) The circuit board **15** may not only be electrically connected to the optical receiving unit **111**, the optical transmitting unit **113** and the connecting interface **17**, but also disposed with a drive circuit, an amplifier circuit, a comparer and/or a phase-locked loop (not shown), etc. thereon. The drive circuit is electrically connected to the optical receiving unit **111** and/or the optical transmitting unit **113**, for such as driving the LED within the optical transmitting unit **113** to transmit the optical signal. The amplifier circuit, the comparer and the phase-locked loop are

electrically connected to the optical receiving unit **111**, in a manner such as to have a transimpedance amplifier (TIA) converting photo current into voltage signal, a limiting amplifier (LA) to amplify the voltage signal, then a clock and data recovery (CDR) to process the voltage signal and generate a square wave signal with a fixed clock period, for a post-staged digital circuit to process this converted square wave signal.
(12) In one embodiment of this disclosure, the optical communication connection device **10** is usually powered by a drive power source, for performing the conversion between optical signal and electric signal. Generally, the optical communication connection device **10** may be disposed in an electronic (e. g. computer), and the electronic supplies power to the optical communication connection device **10** via the connecting interface **17**. For example, the connecting interface **17** may include a power pin to receive power, for driving the entire optical communication connection device **10** to receive or transmit optical signal.
(13) The connection interface **17** is connected to the circuit board **15**. For example, the connection interface **17** may be connected to the second circuit board **153** of the circuit board **15**. In one embodiment of the disclosure, the connection interface **17** includes a main body **171**, a plurality of first connection terminals **172** and a plurality of second connection terminals **173**. An angle is defined between the first connection terminals **172** and the second connection terminals **173**, and the angle may have a range from 45 degrees to 135 degree, and preferably 90 degrees. The first connecting terminal **172** is used to connect to the circuit board **15**, and the second connecting terminal **173** is used to connect to an external circuit board **18**, wherein the external circuit board **18** is a circuit board disposed outside the optical communication connecting device **10**.
(14) Specifically, the extension direction of the first connection terminals **172** is approximately parallel to the surface of the second circuit board **153**, and the extension direction of the second connection terminals **173** is approximately parallel to the surface of the external circuit board **18**. The second connection terminals **173** is connected to the external circuit board **18** through surface mount technology (SMT), which not only helps to reduce the size of the optical communication connection device **10**, but also enables the optical communication connection device **10** to have better high frequency characteristic. In addition, the first connection terminals **172** may be connected to the second circuit board **153** through surface mount technology.
(15) In one embodiment of the disclosure, the appearance of the main body **171** may be similar to a cuboid or a plate, and the first connection terminals **172** and the second connection terminals **173** are respectively arranged on two adjacent surfaces of the main body **171**. For example, the first connection terminals **172** are disposed on the upper surface of the main body **171**, and the second connection terminals **173** are disposed on the side surface of the main body **171**, wherein the first connection terminals **172** may be approximately perpendicular to the second connection terminals **173**.
(16) The optical communication connection device **10** may include a bottom seat **191** and a cover shell **193**, wherein the optical receiving unit **111** and the optical transmitting unit **113** are disposed on the bottom seat **191**. Specifically, the bottom seat **191** may have two connecting holes **1911** disposed at an end or a side surface thereof, the optical receiving unit **111** and the optical transmitting unit **113** are respectively disposed toward the two connecting holes **1911** of the bottom seat **191**. In practical use, two optical connectors (not shown) may respectively plug into the two connecting holes **1911** of the bottom seat **191**, such that to align the optical connectors with the optical receiving unit **111** and the optical transmitting unit **113** within the connecting holes **1911**, and therefore able to receive and/or transmit optical signal by the optical communication connection device **10**.
(17) The connecting holes **1911** of the bottom seat **191** may be common optical connecting sockets (female connector), such as ST socket, SC socketcustom character FC socket or LC socket, etc., for plugging the corresponded optical connectors into the connecting holes **191**, such as ST plug to ST socket, SC plug to SC socket, FC plug to FC socket or LC plug to LC socket.

(18) In one embodiment of this disclosure, the bottom seat **191** may include an inverted U-shaped protrusion **1913**, and a connection hole **1915** is formed between the inverted U-shaped protrusion **1913** and the bottom seat **191**. For example, the inverted U-shaped protrusion **1913** and the optical connection hole **1911** are respectively located at two opposite ends of the bottom seat **191**.
(19) In addition, the main body **171** of the connection interface **17** may be provided with two grooves **175** and a protrusion **177**, wherein the protrusion **177** is located between the two grooves **175**. Specifically, one end or one side surface of the main body **171** is provided with the second connection terminals **173**, while the other end or the other side surface of the main body **171** is provided with two grooves **175** to form the protrusion **177** between two grooves **1751**, wherein the second connecting terminals **173** and the grooves **175** are respectively disposed on opposite ends or two side surfaces of the main body **171**. In actual application, the protrusion **177** of the connection interface **17** is inserted into the connection hole **1915** between the inverted U-shaped convex protrusion **1913** and the bottom seat **191**, and the two sides of the inverted U-shaped convex protrusion **1913** connected to the bottom seat **191** are respectively located in two grooves **175** to position the bottom seat **191** and the connection interface **17**, and connect and fix the bottom seat **191** and the connection interface **17**.
(20) In one embodiment of this disclosure, a plurality of positioning holes **179** may be provided on the main body **171** of the connecting interface **17**. For example, the number of positioning holes **179** may be two, and they are respectively provided outside the two grooves **175**. The bottom seat **191** is provided with a plurality of first positioning protrusions **1917**, and the position and number of the first positioning protrusions **1917** correspond to the positioning holes **179** of the main body **171**. For example, the number of the first positioning protrusions **1917** may be two, and they are located at both sides of the inverted U-shaped protrusion **1913**. As the protrusion **177** of the main body **171** is inserted into the connection hole **1915** between the bottom seat **191** and the inverted U-shaped protrusion **1913**, the first positioning protrusions **1917** can be further arranged in the positioning holes **179** to position the connection interface **17** and the bottom seat **191**.
(21) The cover shell **193** is configure to connect the bottom seat **191**, and the optical receiving unit **111**, the optical transmitting unit **113**, the circuit board **15**, the supporting frame **16** and/or the connection interface **17** are located inside of a containing space between the bottom seat **191** and cover shell **193** and hence protected by the bottom seat **191** and the cover shell **193**.
(22) As shown in FIG. **2**, the bottom seat **191** may be arranged on the external circuit board **18**, such as a motherboard or a network interface converter of a computer, and the second connection terminals **173** of the connection interface **17** are connected to the circuit on the external circuit board **18**. The second connection terminals **173** are parallel to the surface of the external circuit board **18**, and the second connection terminals **173** can be connected to the external circuit board **18** through surface mount technology. For example, the second connection terminals **173** are connected with the circuit on the external circuit board **18** through solder paste **174**.
(23) In one embodiment of this disclosure, a supporting frame **16** may be further provided between the connection interface **17** and the circuit board **15** to support and fix the position of the circuit board **15**. For example, the supporting frame **16** may be used to support the first circuit board **151** of the circuit board **15** to prevent the first circuit board **151** from moving toward the connection interface **17**.
(24) Specifically, the supporting frame **16** may be plate-shaped, such as an H-shaped supporting frame, wherein the top of the supporting frame **16** or both sides of the top surface may be provided with two bearing protrusions **161**, and a beating recess **163** is formed between the two bearing protrusions **161**. The first circuit board **151** of the circuit board **15** can be placed in the bearing recess **163** of the supporting frame **16**, while the bearing protrusions **161** are located on both sides and under side of the first circuit board **151**, so that the supporting frame **16** can be used to fix and support the first circuit board **151**. In addition, the side surface of the supporting frame **16** may be adjacent to the second circuit board **153** and may be used to limit the position of the second circuit

board **153**.
(25) In one embodiment of this disclosure, the bottom of the supporting frame **16** may be provided with two second positioning protrusions **165** that are configure to be arranged in the two positioning holes **179** of the connection interface **17**, so as to position and arrange the supporting frame **16** on the main body **171** of the connection interface **17**. For example, the positioning hole **179** may be a through hole penetrating through the upper and lower surfaces of the main body **171**.
(26) FIG. **4** is a three-dimensional exploded view of the optical communication connection device according to another embodiment of this disclosure. The optical communication connection device **20** of the embodiment includes an optical receiving unit **111**, an optical transmitting unit **113**, a circuit board **15**, a supporting thermal column **26**, at least one heat conduction layer and a connection interface **17**. The optical receiving unit **111** and the optical transmitting unit **113** are connected to the connection interface **17** via the circuit board **15**, and the connection interface **17** is configure to connected to an external circuit board **18**.
(27) The optical communication connection device **20** of this embodiment is similar to the optical communication connection device **10** of FIG. **1**. The optical communication connection device **20** of this embodiment replaces the supporting frame **16** of the optical communication connection device **10** in FIG. **1** with a support thermal column **26**.
(28) As shown in FIG. **5**, the support thermal column **26** may be a columnar body disposed on the bottom seat **191** and located between the optical connection hole **1911** and the connection hole **1915**. The first circuit board **151** of the circuit board **15** can be placed on the support thermal column **26** to support the first circuit board **151**.
(29) In one embodiment of this disclosure, at least one chip **157** is arranged on the upper surface and/or lower surface of the first circuit board **151**, and a first heat conduction layer **241** is disposed on the surface of the chip **157** located on the lower surface of the first circuit board **151**. The support thermal column **26** is connected to the chip **157** on the lower surface of the first circuit board **151** through the first heat conduction layer **241**. The first heat conduction layer **241** is a member with good heat conduction properties, such as a metal sheet or heat dissipation glue. In other embodiment of this disclosure, the first heat conduction layer **241** is disposed on the surface of the first circuit board **151** of the circuit board **15**, and the support thermal column **26** is connected to the first circuit board **151** through the first heat conduction layer **241**.
(30) The support thermal column **26** can be made of heat-conducting material. For example, the support thermal column **26** may be made of metal, so that heat generated by the chip **157** located on the lower surface of the first circuit board **151** can be transferred to the support thermal column **26** to reduce the operating temperature of the chip **157**.
(31) In one embodiment of this disclosure, the bottom seat **191** may be made of heat-conducting material. For example, the bottom seat **191** can be made of metal, so that the chip **157** arranged on the lower surface of the first circuit board **151** can transfer heat to the bottom seat **191** through the first head conduction layer **241** and support thermal column **26** in sequence, while the heat is transferred to the outside through the bottom seat **191** to further reduce the temperature of the chip **157**.
(32) In another embodiment of this disclosure, a second heat conduction layer **243** is disposed on the surface of the chip **157** disposed on the upper surface of the first circuit board **151**. After the cover shell **193** is connected to the bottom seat **191**, the cover shell **193** is connected to the chip **157** located on the upper surface of the first circuit board **151** through the second heat conduction layer **243**. In actual application, the cover shell **193** may be made of heat-conducting material. For example, the cover body **193** may be made of metal, so that the chip **157** arranged on the upper surface of the first circuit board **151** can transfer heat through the second heat conduction layer **243** to the cover shell **193**, and transfer heat to the outside through the cover shell **193** to reduce the temperature of the chip **157**.
(33) In one embodiment of this disclosure, the main body **171** of the connection interface **17** may

be a trapezoidal plate body. When one end of the connection interface **17** is inserted into the inverted U-shaped protrusion **1913**, the bottom of the connection interface **17** or the main body **171** is kept on the same plane as the bottom of the bottom seat **191**, so as to facilitate disposing the bottom seat **191** and the connection interface **17** on the surface of the external circuit board **18**. Then, the external circuit board **18** and the second connection terminals **173** of the connection interface **17** can be connected through the surface mount technology, which not only helps to further reduce the size of the optical communication connection device **20**, but also makes the optical communication connection device **20** have better high-frequency characteristics.
(34) The above disclosure is only the preferred embodiment of the present disclosure, and not used for limiting the scope of the present disclosure. All equivalent variations and modifications on the basis of shapes, structures, features and spirits described in claims of the present disclosure should be included in the claims of the present disclosure.

Claims

1. An optical communication connection device, comprising: a circuit board; at least one chip disposed on a surface of the circuit board; a first heat conduction layer disposed on a surface of the at least one chip or the circuit board; an optical receiving unit electrically connected to the circuit board for receiving an optical signal; an optical transmitting unit electrically connected to the circuit board for transmitting an optical signal; a connection interface including a plurality of first connection terminals and a plurality of second connection terminals, and an angle being defined between the plurality of first connection terminals and the plurality of second connection terminals, wherein the angle has a range from 45 degrees to 135 degrees, wherein the plurality of first connection terminals are connected to the circuit board, and the plurality of the second connection terminals are connected to an external circuit board through a surface mount technology; a supporting thermal column connected to the first heat conduction layer, and connected to the surface of the at least chip or connected to the surface of the circuit board via the first heat conduction layer; a bottom seat including two optical connection holes, wherein the optical receiving unit and the optical transmitting unit are respectively disposed toward the two optical connection holes, and the support thermal column is disposed on the bottom seat; at least one inverted U-shaped protrusion disposed on the bottom seat to form a connection hole between the bottom seat and the inverted U-shaped protrusion, wherein the connection interface includes a main body, and the plurality of first connection terminals and the plurality of second connection terminals are located on the main body; and two grooves and a protrusion disposed on the main body, wherein the protrusion is configure to insert into the connection hole between the bottom seat and the inverted U-shaped protrusion to position the connection interface and the bottom seat.
2. The optical communication connection device as claimed in claim 1, further comprising: a cover shell connected to the bottom seat, wherein the circuit board, the support thermal column and the connection interface are located between the bottom seat and the cover shell.
3. The optical communication connection device as claimed in claim 2, wherein the circuit board comprises a first circuit board and a second circuit board, the first circuit board is connected to the second circuit board via a conductive portion, and an angle is formed between the first circuit board and the second circuit board, wherein the angle between the first circuit board and the second circuit board has a range from 45 degrees to 135 degrees.
4. The optical communication connection device as claimed in claim 3, wherein the first connection terminals of the connection interface are parallel to a surface of the second circuit board, and the second connection terminals of the connection interface are parallel to a surface of the external circuit board.