ELECTRICAL CONNECTOR

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to and the benefit of Chinese Patent Application No. 202420736466.7, filed on April 10, 2024, entitled " ELECTRICAL CONNECTOR." This application claims priority to and the benefit of Chinese Patent Application No. 202410430691.2, filed on April 10, 2024, entitled " ELECTRICAL CONNECTOR." The contents of these applications are incorporated herein by reference in their entirety.

TECHNICAL FIELD

[0002] The present application relates to the field of electrical connectors and, more particularly, to socket connectors.

BACKGROUND OF THE INVENTION

[0003] RJ45 electrical connectors are typically used in the connection for communication devices of Ethernet etc. A mating connector (e.g., a plug) connected to the RJ45 electrical connector is typically connected to the RJ45 electrical connector in a configuration in which the tabs of the mating connector (e.g., a plug) face the main printed circuit board or face away from the main printed circuit board. In a standard RJ45 electrical connector, the printed circuit board of the electrical connector is typically located at the bottom of the electrical connector, in which case the terminals connected to the printed circuit board of the electrical connector may be connected directly to the main printed circuit board located below the electrical connector, thereby enabling transmission of signals and/or data.

[0004] However, in some cases, the RJ45 electrical connector may need to be mounted in a configuration in which the RJ45 electrical connector is rotated by 90 degrees with respect to the main printed circuit board disposed below the electrical connector, in which case the printed circuit board of the electrical connector is located at a side of the electrical connector, and the terminals connected to the printed circuit board of the electrical connector extend in the lateral direction. In this case, connecting the printed circuit board of the electrical connector to the main printed circuit board located below the electrical connector requires to use a further wiring structure or a board-to-board connector, which results in reduced signal reliability and increased connection costs.

[0005] In this regard, in order to ensure signal integrity and reliability and to reduce connection costs, there is a need to provide an electrical connector which can be directly connected to another printed circuit board even if the electrical connector is rotated 90 degrees with respect to the main printed circuit board.

SUMMARY OF THE INVENTION

[0006] This section provides a general overview of the present application, rather than a full disclosure of the full scope or features of the present application.

[0007] In view of the above problems in the related art, the present application provides an electrical connector, thereby at least partially solving the above problems.

[0008] The electrical connector provided by the present application may comprise a housing and a printed circuit board assembly. The housing may have a receiving cavity for receiving a mating connector, the receiving cavity passing through the housing in an insertion direction of the mating connector into the housing. The housing may have a front side for insertion of the mating connector, and a back side opposite the front side. The printed circuit board assembly may be mounted in the housing and connected to the back side. The printed circuit board assembly may comprise a plurality of first terminals, a plurality of second terminals and a printed circuit board. The plurality of first terminals may be connected to a first face of the printed circuit board facing the receiving cavity. The plurality of second terminals may be connected to the printed circuit board and extend in a perpendicular direction perpendicular to the insertion direction. That is, a plurality of second terminals may extend toward the main printed circuit board to connect to the main printed circuit board, thereby establishing an electrical connection between the electrical connector and the mating electrical connector.

[0009] In the present application, the transmission speed of the electrical connector can be significantly increased by locating the printed circuit board of the electrical connector at the back side of the housing and directly connecting the second terminal to the main printed circuit board. For example, the electrical connector of the present application enables a user to realize a high-speed Ethernet connection of up to 1 G, optionally 10 G, per second. In addition, the printed circuit board assembly of the electrical connector provided in the present application has a printed circuit board employing a 6-layer printed circuit board configuration, thereby providing capacitance compensation. Further, the electrical connectors of the present application meet Cat5e performance and support links up to 100m in applications.

[0010] In some exemplary embodiments, the plurality of first terminals may be arranged in the perpendicular direction, and individual first terminals may be connected to a corresponding connecting pad formed on the first face of the printed circuit board. The plurality of first terminals may be soldered to the printed circuit board by surface mounting techniques, thereby simplifying the design and assembly process of the printed circuit board. Preferably, the plurality of first terminals may be connected to the printed circuit board by reflow soldering.

[0011] In some exemplary embodiments, each of the plurality of first terminals may be formed by a bending process, the first terminal may comprise a first portion, a second portion, and a bending portion connecting the first portion and the second portion; a free end of the first portion may form a connection by a bending process, the connection being fixedly connected to the connecting pad of the first face of the printed circuit board. The connection area between the first terminal and the printed circuit board is enlarged by forming a connection for soldering to the printed circuit board using a bending process, thereby improving the stability of soldering.

[0012] In some exemplary embodiments, a lower side of the printed circuit board in the perpendicular direction may comprise a plurality of second terminal connecting holes. The plurality of second terminal connecting holes may comprise a first row of second terminal connecting holes and a second row of second terminal connecting holes arranged parallel to each other along a transverse direction which is perpendicular to both of the insertion direction and the perpendicular direction. The second terminal connecting holes in the first row of second terminal connecting holes and the second terminal connecting holes in the second row of second terminal connecting holes may be arranged on the printed circuit board in such a way that they are staggered from each other by the same distance in the transverse direction.

[0013] In some exemplary embodiments, the plurality of second terminals may be provided in correspondence with the plurality of second terminal connecting holes and are connected to the printed circuit board via the second terminal connecting holes.

[0014] In some exemplary embodiments, each of the plurality of second terminals may comprise a mounting end which may be inserted into the second terminal connecting hole and a mating end which may extend in the perpendicular direction. That is, the mating end may extend toward the main printed circuit board and connect to the main printed circuit board.

[0015] With the electrical connector provided by the above embodiment of the present application, the second terminal is directly connected to the main printed circuit board, thereby significantly increasing the signal transmission speed of the electrical connector and ensuring signal integrity. In addition, the electrical connector is directly connected to the main printed circuit board via the second terminal, eliminating the need for a further wiring structure or board-to-board connector, thereby reducing the number of components required for the connection and lowering the cost of the connection.

[0016] In some exemplary embodiments, the lower side of the printed circuit board may comprise an accommodating portion which may be formed by being recessed upwards from an edge of the lower side of the printed circuit board in the perpendicular direction, and a pair of fixing through-holes which may be formed at two ends of the printed circuit board in the transverse direction.

[0017] In some exemplary embodiments, the printed circuit board assembly may further comprise a guide for guiding the plurality of second terminals, and the guide may be mounted in the accommodating portion of the printed circuit board.

[0018] In some exemplary embodiments, the guide may comprise a fixing protrusion corresponding to the fixing through-hole, and the fixing protrusion may be inserted into the fixing through-hole respectively to connect the guide to the printed circuit board.

[0019] In some exemplary embodiments, the mating end may pass through the guide and extend in the perpendicular direction. That is, the mating end may extend toward the main printed circuit board and connect to the main printed circuit board.

[0020] With the electrical connector provided by the above embodiments of the present application, the guide provides support and guidance function for the plurality of second terminals, thereby enabling the plurality of second terminals to be securely connected to the main printed circuit board.

[0021] In some exemplary embodiments, the back side of the housing may comprise a locating protrusion protruding in the insertion direction, and the locating protrusion may be inserted into a locating through-hole formed in the printed circuit board to connect the printed circuit board to the back side of the housing. The signal transmission speed of the electrical connector is increased and the integrity of the signal is ensured by providing the printed circuit board on the back side of the housing and connecting the mounting end of the second terminal to the printed circuit board and connecting the mating end directly to the main printed circuit board. Moreover, no further wiring structure or board-to-board connector is

required, and thus the number of components required for the connection is reduced and the cost of the connection is reduced.

[0022] In some exemplary embodiments, the electrical connector may comprise a cover which may be connected to the housing to cover the printed circuit board assembly.

[0023] In some exemplary embodiments, an end face of the cover may comprise a connecting projection which may be inserted into an aperture formed in a corresponding side of the housing to connect the cover to the housing.

[0024] In some exemplary embodiments, the electrical connector may further comprise a light-emitting diode mounted in the housing in an inserted manner from a lower side of the housing in the perpendicular direction and exposed from an exposing opening formed in the front side of the housing, the exposing opening being configured in the front side to be immediately adjacent to the lower side of the housing. The light emitting diode may indicate information regarding, for example connection integrity and/or speed verification by displaying various colors. In this manner, a user can visualize the information regarding the corresponding aspect of the electrical connector via the light emitting diode, thereby providing convenience to the user.

[0025] In some exemplary embodiments, the electrical connector may further comprise a shield that prevents electromagnetic interference, the shield being sleeved on an outer surface of the housing, providing solder strength to the electrical connector.

[0026] In some exemplary embodiments, the electrical connector may comprise a housing having a receiving cavity configured to receive a mating connector. The housing may further have a bottom side configured to connect to a main printed circuit board, a top side opposite the bottom side, and a sidewall extending between the bottom side and the top side and extending between a front side and a back side of the housing relative to an insertion direction of the mating connector, and the receiving cavity may have a tab receiving portion facing the sidewall.

[0027] In some exemplary embodiments, the sidewall may be a left side or a right side of the housing relative to the insertion direction of the mating connector.

[0028] In some exemplary embodiments, the electrical connector may further comprise a printed circuit board assembly located at the back side of the housing, and the printed circuit board assembly may be configured to connect to the main printed circuit board.

[0029] In some exemplary embodiments, the electrical connector may comprise a housing which may have a receiving cavity configured to receive a mating connector, and which may

have a front side and a back side relative to an insertion direction of the mating connector; and a printed circuit board assembly located at the back side of the housing, the printed circuit board assembly being configured to connect to the main printed circuit board.

[0030] In some exemplary embodiments, the printed circuit board assembly may comprise at least 6 layers of conductors.

[0031] In some exemplary embodiments, the printed circuit board assembly may comprise a plurality of first terminals, and each of the plurality of first terminals may be configured to contact each corresponding terminal of the plurality of terminals of the mating connector, respectively.

[0032] In some exemplary embodiments, the printed circuit board assembly may further comprise a plurality of second terminals, each of the plurality of second terminals being configured to connect to each corresponding first terminal of the plurality of first terminals, and the plurality of second terminals being configured to connect to the main printed circuit board.

[0033] In some exemplary embodiments, respective connections between the plurality of first terminals and the plurality of second terminals through the printed circuit board assembly have approximately equal signal path lengths, and optionally respective connections between the plurality of first terminals and the plurality of second terminals through the printed circuit board assembly have approximately equal signal path lengths offset within 5% or 1% of one another.

[0034] In some exemplary embodiments, the electrical connector may comprise: a housing having a receiving cavity configured to receive a mating connector, the housing further having a bottom side, a top side opposite the bottom side, and a sidewall extending between the top side and the bottom side and extending between a front side and a back side of the housing relative to an insertion direction of the mating connector, the receiving cavity has a tab receiving portion facing the sidewall; and a plurality of light emitting diodes located at the front side of the housing, the plurality of light emitting diodes being located below or above the receiving cavity.

[0035] In some exemplary embodiments, the plurality of light emitting diodes may emit light of a plurality of colors.

[0036] In some exemplary embodiments, the plurality of light emitting diodes may be configured to be soldered to a main printed circuit board.

[0037] In some exemplary embodiments, the electrical connector may further comprise a shield configured to be soldered to the main printed circuit board.

[0038] With the electrical connector provided by the present application, the need for a further wiring structure or board-to-board electrical connector to connect to the main printed circuit board after the electrical connector has been rotated 90 degrees relative to the main printed circuit board is eliminated, thereby ensuring signal integrity and reliability. In addition, the electrical connector of the present application enables a user to realize a high-speed Ethernet connection of up to 1 G, optionally 10 G, per second, without the need to replace existing mechanical components, thereby minimizing costs. In addition, the electrical connector of the present application provides convenience to the user by enabling the light-emitting diode to indicate various information by displaying different colors. Further, the electrical connector of the present application is soldered to the main printed circuit board in a more securing manner by means of a shield and provides reliability for the connection to the mating connector.

BRIEF DESCRIPTION OF THE DRAWINGS

[0039] Drawings required for use in the embodiments will be introduced briefly below in order to explain the embodiments of the present application more clearly. It will be apparent that the drawings described below are merely illustrative of some embodiments of the present application, and those skilled in the art can also obtain, from these drawings, other drawings without inventive effort.

[0040] FIG. 1 illustrates a front view of an electrical connector provided according to an exemplary embodiment of the present application in a connected state with a main printed circuit board;

[0041] FIG. 2 illustrates a perspective exploded view of the electrical connector provided according to an exemplary embodiment of the present application;

[0042] FIG. 3 illustrates a front perspective view of a housing of the electrical connector provided according to an exemplary embodiment of the present application;

[0043] FIG. 4 illustrates a rear perspective view of a housing of the electrical connector provided according to an exemplary embodiment of the present application;

[0044] FIG. 5 illustrates a perspective view of a printed circuit board assembly of the electrical connector provided according to an exemplary embodiment of the present application;

[0045] FIG. 6 illustrates a perspective view of a printed circuit board and a second terminal of the printed circuit board assembly shown in FIG. 5;

[0046] FIG. 7 illustrates a perspective view of a guide of the printed circuit board assembly shown in FIG. 5;

[0047] FIG. 8 illustrates a perspective view of a cover of the electrical connector provided by an exemplary embodiment of the present application;

[0048] FIG. 9 illustrates a perspective view of a shield of the electrical connector provided by an exemplary embodiment of the present application;

[0049] FIG. 10 illustrates a perspective view of a housing and a printed circuit board assembly in a connected state of the electrical connector provided by an exemplary embodiment of the present application; and

[0050] FIG. 11 illustrates a schematic view of a cross-section taken along line A-A of FIG. 10.

[0051] List of Reference of Signs:

[0052] 1-electrical connector; 2-main printed circuit board; 10-housing; 20-printed circuit board assembly; 30-cover; 11-receiving cavity; 12-front side; 13-back side; 14-aperture; 15-groove; 16-bottom side; 17-top side; 18-sidewall; 120-exposing opening; 121-tab receiving portion; 130-locating protrusion; 131-through portion; 21-first terminal; 22-second terminal; 23-printed circuit board; 230-first face; 231-lower side; 232-second terminal connecting hole; 233-accommodating portion; 234-fixing through-hole; 235-locating through-hole; 2301-connecting pad; 210-first portion; 211-second portion; 212-bending portion; 213-connection; 220-mounting end; 221-mating end; 223-bending portion; 24-guide; 240-fixing protrusion; 31-connecting projection; 32-concave portion; 40-light-emitting diode; 41-contact portion; 50-shield; 51-overhanging elastic sheet.

DETAILED DESCRIPTION OF THE INVENTION

[0053] The present application will be described in detail below with reference to the drawings by means of exemplary embodiments. It is to be noted that the exemplary embodiments of the present application are intended to enable those ordinarily skilled in the art to readily carry out the present application, and should not be construed as being limited to the embodiments set forth in the present application. Various embodiments of the present application may be carried out in many different forms. Accordingly, the following detailed description of the present application is for illustrative purposes only and is in no way a

limitation of the present application. In addition, the same reference sign is used in each of the drawings to indicate the same component. In addition, the terms "first", "second", etc. are used for descriptive purposes only and are not to be construed as indicating or implying relative importance or relative order.

[0054] It should also be noted that, for the sake of clarity, not all features of the actual particular embodiment are described and shown in the description and drawings, and that, in order to avoid unnecessary details from obscuring the technical solution concerned by the present application, only the arrangement that is closely related to the technical solution of the present application is described and illustrated in the drawings and specification, while other details that have little to do with the technical content of the present application and are known to those skilled in the art are omitted.

[0055] It is to be understood that orientation or positional relations indicated by terms such as “inside”, “outside”, “above” and “below” are based on the orientation or positional relations as shown in the figures, only for facilitating description of the present application and simplifying the description, rather than indicating or implying that the referred devices or elements must be in a particular orientation or configured or operated in the particular orientation, and therefore they should not be construed as limiting the present application.

[0056] The electrical connectors of some embodiments of the present application will be described in detail below in connection with the accompanying drawings. For the sake of clarity and conciseness of description, an insertion direction X in which a mating connector (e.g., a plug) is inserted into the electrical connector of the present application, a perpendicular direction Y perpendicular to the insertion direction X, and a transverse direction Z perpendicular to both of the insertion direction X and the perpendicular direction Y are labeled in the drawings.

[0057] According to one aspect of the present application, there is provided an electrical connector which is a modular socket having an internal printed circuit board incorporated to provide capacitive compensation. In some examples, the RJ45 connector is an example of a modular socket.

[0058] As shown in FIG. 1, the electrical connector 1 is configured to receive a mating connector (e.g., a plug) in such a way that a tab of the mating connector (e.g., the plug) is inserted into the electrical connector in a lateral direction. The electrical connector 1 is connected to the main printed circuit board 2 for data transmission. Preferably, the electrical

connector 1 may be configured to be surface mounted on the main printed circuit board 2, as shown in FIG. 1.

[0059] As shown in FIGS. 2 through 4, the electrical connector 1 may comprise a housing 10 and a printed circuit board assembly 20. The housing 10 may have a receiving cavity 11 for receiving a mating connector, the receiving cavity 11 passing through the housing 10 in the insertion direction X. The housing 10 may have a front side 12 for insertion of the mating connector, and a back side 13 opposite the front side 12. In some examples, the housing 10 may be molded from an insulating material such as plastic. Plastics may include, but are not limited to, liquid crystal polymers, high temperature nylon, polyphenylene oxide, or polypropylene, or the plastics may use other materials. In some examples, the plastic may be a thermoset plastic. In some examples, the plastic may include, for example, a glass fiber reinforced insulating material. In some examples, the housing 10 may generally be an integral member. In some examples, the housing 10 may be an injection molded member.

[0060] In some exemplary embodiments, the front side 12 of the housing 10 may have a shape that corresponds to the shape of a mating electrical connector (such as a plug). As shown in FIG. 3, a tab receiving portion 121 of the front side 12 of the housing 10 for receiving a tab of a mating electrical connector (e.g., a plug) is located in the transverse direction Z of the electrical connector 1. In some examples, the plug may be, for example, a Cat5e, Cat6, or Cat6a plug.

[0061] In some exemplary embodiments, as shown in FIG. 2, the printed circuit board assembly 20 may be mounted in the housing 10 and connected to the back side 13 of the housing 10.

[0062] As shown in FIG. 5, the printed circuit board assembly 20 may include a plurality of first terminals 21, a plurality of second terminals 22, and a printed circuit board 23. The plurality of first terminals 21 may be connected to a first face 230 of the printed circuit board 23 facing the receiving cavity 11. The plurality of second terminals 22 may be connected to the printed circuit board 23 and extend in the perpendicular direction Y. That is, the plurality of second terminals may be connected to the printed circuit board 23 and extend towards the main printed circuit board 2 located below the electrical connector 1 to connect to the main printed circuit board 2, thereby enabling transmission of data/information. In some examples, the plurality of first terminals and the plurality of second terminals may be made of, for example, a metal such as copper, aluminum, or tin and other conductive materials. The first

terminals and the second terminals may typically be formed as an integral member, respectively.

[0063] In addition, as shown in FIG. 5, the plurality of first terminals 21 may be arranged in the perpendicular direction Y, and individual first terminals may be connected to a corresponding connecting pad 2301 formed on the first face 230 of the printed circuit board 23. In some examples, the plurality of first terminals 21 may be spaced apart and aligned with each other along the perpendicular direction Y, and individual first terminals are connected to a corresponding connecting pad 2301 formed on the first face 230 of the printed circuit board 23. Preferably, in the embodiment shown in FIG. 5, the printed circuit board assembly 20 may comprise eight first terminals, the eight first terminals being spaced apart and aligned with each other along the perpendicular direction Y, and the individual first terminals are connected to a corresponding one of the eight connecting pads 2301 on the first face 230 of the printed circuit board 23. However, the embodiment is not limited thereto, and it will be appreciated by those skilled in the art that the number of first terminals may be determined based on the number of connecting pads on the printed circuit board.

[0064] In addition, as shown in Figure 5, each of the plurality of first terminals 21 may be formed by a bending process to comprise a first portion 210, a second portion 211, and a bending portion 212 connecting the first portion 210 and the second portion 211. A free end of the first portion 210 may form a connection 213 by a bending process, the connection 213 being fixedly connected to the connecting pad 2301 of the first face 230 of the printed circuit board 23. Preferably, the connection 213 of the first portion 210 of the first terminal 21 is soldered to the corresponding connecting pad 2301. The connection area between the first terminal 20 and the printed circuit board 23 is enlarged by forming the connection for soldering to the printed circuit board using a bending process, thereby improving the stability of soldering.

[0065] In some examples, the connection 213 of each of the plurality of first terminals may be connected to the printed circuit board 23 using surface mount technology (SMT), thereby simplifying the process of designing and assembling the printed circuit board. Surface mounting means that an element or a contact is mounted directly to a surface of the printed circuit board.

[0066] Specifically, the connection 213 of each of the plurality of first terminals may be connected to a corresponding connecting pad 2301 of the printed circuit board 23 via reflow soldering. Reflow soldering is an important soldering technique in the SMT process, and is

based on the principle of soldering surface-mounted elements to printed circuit boards. In the reflow soldering process, the printed circuit board is transported to a specified temperature area by a conveyor belt or hot air device, and the soldering material is melted by high temperature, such that a mechanical and electrical connection is formed between the surface-mounted element and the printed circuit board, resulting in a reliable circuit. The reflow soldering process forms solder joints by first preheating the element, the printed circuit board, or the soldering material, and then allowing the solder material to melt without causing damage due to overheating.

[0067] In some examples not shown, in the process of soldering a plurality of first terminals that have been subjected to the bending process to the printed circuit board, the plurality of first terminals are connected to a fixing member for assisting the soldering, and the connections of the plurality of first terminals are securely soldered to the printed circuit board with the help of the fixing member. After the soldering is completed, the fixing member is removed from the plurality of first terminals and the plurality of first terminals are trimmed.

[0068] In alternative embodiments, each of the plurality of first terminals may be inserted into a through-hole formed in the printed circuit board and connected to the printed circuit board by reflow soldering.

[0069] As shown in FIG. 6, a lower side 231 of the printed circuit board 23 in the perpendicular direction Y may comprise a plurality of second terminal connecting holes 232. The plurality of second terminal connecting holes 232 may be provided in rows such that individual rows include the same number of second terminal connecting holes; the individual rows are parallel to each other along the transverse direction Z, and one row of second terminal connecting holes and another row of second terminal connecting holes in the individual rows are arranged on the printed circuit board 23 in such a way that they are staggered from each other by the same distance in the transverse direction. Preferably, the plurality of second terminal connecting holes 232 may comprise a first row of second terminal connecting holes and a second row of second terminal connecting holes arranged parallel to each other along a transverse direction Z. The second terminal connecting holes in the first row of second terminal connecting holes and the second terminal connecting holes in the second row of second terminal connecting holes are arranged on the printed circuit board 23 in such a way that they are staggered from each other by the same distance in the transverse direction. For example, in the exemplary embodiment shown in FIG. 6, the printed circuit board 23 includes eight second terminal connecting holes 232, which are provided in

two rows, with four second terminal connecting holes in each row, and the four second terminal connecting holes in the first row and the four terminal connecting holes in the second row are staggered from each other by the same distance in the transverse direction Z.

[0070] In some exemplary embodiments, the plurality of second terminals 22 may be provided in correspondence with the plurality of second terminal connecting holes 232 and are connected to the printed circuit board via the plurality of second terminal connecting holes. Preferably, in the embodiment shown in FIG. 5, the four second terminals in the first row each are inserted into the four second terminal connecting holes in the first row and connected to the printed circuit board, and the four second terminals in the second row each are inserted into the four second terminal connecting holes in the second row and connected to the printed circuit board. However, the embodiment is not limited to this, as long as the number of second terminals and the number of second terminal connecting holes correspond to the number of first terminals.

[0071] In some exemplary embodiments, as shown in FIG. 6, each of the plurality of second terminals 22 may comprise a mounting end 220 which may be inserted into the second terminal connecting hole 232 and a mating end 221 which may extend in the perpendicular direction Y. That is, the mating end 221 may extend toward and connect to the main printed circuit board 2. Preferably, the mating ends 221 may extend parallel to each other towards and connect to the main printed circuit board 2.

[0072] In some exemplary embodiments, as shown in FIG. 6, each of the plurality of second terminals 22 may further include one or more bending portions 223 provided between the mounting end 220 and the mating end 221. Specifically, in the embodiment shown in FIG. 6, each of the four second terminals in the first row includes three bending portions, and each of the four second terminals in the second row includes one bending portion, such that the mating ends of the four second terminals in the first row and the mating ends of the four terminals in the second row are staggered from each other in a parallel manner to form two rows. However, the embodiment is not limited thereto, and the second terminals in the first row and the second terminals in the second row may include other numbers of bending portions, as long as the bending portions of the second terminals in the first row and the bending portions of the second terminals in the second row are provided in such a way that the mating ends 221 of the second terminals extend toward the main printed circuit board 2 to connect to the main printed circuit board 2.

[0073] Typically, the printed circuit board of the electrical connector is located at the bottom of the electrical connector and the main printed circuit board is located below the electrical connector, and in the case where it is necessary to mount the electrical connector 1 in a configuration in which the electrical connector is rotated by 90 degrees with respect to the main printed circuit board 2 which is located below the electrical connector 1, the printed circuit board of the electrical connector is located at the side of the electrical connector such that terminals connected to the printed circuit board of the electrical connector extend in the lateral direction (i.e., the transverse direction Z). In this case, connecting the printed circuit board of the electrical connector to the main printed circuit board located below the electrical connector requires the use of an additional wiring structure or a board-to-board connector, which inevitably leads to a reduction in signal reliability and an increase in the cost of connection. With the electrical connector 1 provided by the present application, since the printed circuit board 23 of the electrical connector 1 is located at the back side 13 of the housing 10 and the second terminal 22 is directly connected to the main printed circuit board 2, the transmission speed of the electrical connector can be significantly increased, and the components required for the connection is reduced, thereby reducing the connection cost. For example, the electrical connector of the present application enables a user to realize a high-speed Ethernet connection of up to 1 G, optionally 10 G, per second.

[0074] In some examples, the printed circuit board (conductor) 23 employs a printed circuit board having multiple conductive layers. In some examples, the printed circuit board (conductor) 23 may employ a printed circuit board having 4-6 conductive layers. The plurality of first terminals and the plurality of second terminals are connected through the printed circuit board having multiple conductive layers in a one-to-one correspondence manner, and the connections realized through the printed circuit board between each of the plurality of first terminals and each of the plurality of second terminals are distributed in each layer of the printed circuit board, and the trace lengths (i.e., the signal path lengths) of the individual connections are equal, so as to provide a capacitive compensation for signal integrity and compliance with requirements of Cat5e, Cat6, or Cat6a plugs. In some examples, the trace length of the individual connections may be provided in the software of the printed circuit board.

[0075] In some exemplary embodiments, as shown in FIG. 6, the lower side 231 of the printed circuit board 23 may comprise an accommodating portion 233 which may be formed by being recessed upwards from an edge of the lower side 231 of the printed circuit board 23

in the perpendicular direction Y, and a pair of fixing through-holes 234 which may be formed at two ends of the printed circuit board 23 in the transverse direction Z. Preferably, in the embodiment shown in FIG. 6, two of the plurality of second terminal connecting holes 232 closest to two ends of the printed circuit board 23 in the transverse direction Z are spaced apart a certain distance from a corresponding one of said two ends, and the pair of fixing through-holes 234 are formed between a corresponding one of said two second terminal connecting holes and a corresponding one of said two ends. That is, as shown in FIG. 6, the outermost second terminal connecting hole of the plurality of second terminal connecting holes 232 in the transverse direction Z is spaced apart a certain distance from a side edge of the printed circuit board 23 in the transverse direction Z to form a side, where the fixing through-holes 234 are located. Of course, the position where the fixing through-hole 234 is formed is not limited thereto, and may be changed appropriately according to the specific shape of the printed circuit board 23, and furthermore, the number of fixing through-holes 234 is not limited to two, but may be more.

[0076] In some exemplary embodiments, as shown in FIGS. 5 and 7, the printed circuit board assembly 20 may further comprise a guide 24 for guiding the plurality of second terminals 22, and the guide 24 may be mounted in the accommodating portion 223 of the printed circuit board 23, such that the guide 24 abuts against the top of the accommodating portion 223.

[0077] The guide 24 may include a fixing protrusion 240 corresponding to a fixing through-hole 234 of the printed circuit board 23, and the fixing protrusion 240 may be inserted into the fixing through-hole 234 respectively to connect the guide 24 to the printed circuit board 23. Preferably, in the embodiments shown in FIGS. 5 and 7, the fixing protrusion 240 protrude from two sides of the guide 24 in the transverse direction Z along the insertion direction X and are inserted into the fixing through-holes 234 of the printed circuit board 23 to connect the guide 24 to the printed circuit board 23. Of course, the number of fixing protrusions 240 is not limited thereto, as long as they correspond to the fixing through-holes 234 and are capable of connecting the guide 24 to the printed circuit board 23.

[0078] In some exemplary embodiments, as shown in FIGS. 5 and 6, the mating end 221 of each of the plurality of second terminals 22 may pass through the guide 24 and extend in the perpendicular direction Y. In other words, the mating end 221 of each of the plurality of second terminals 22 may pass through the guide 24, and extend toward and connect to the main printed circuit board 2. Therefore, the guide 24 provides support and guidance function

for the plurality of second terminals 22, thereby enabling the plurality of second terminals 22 to be securely connected to the main printed circuit board 2.

[0079] In some examples, one or more bending portions 223 of each of the plurality of second terminals 22 may be provided in the guide 24. In particular, the plurality of second terminals 22 and the guide 24 are formed as an integral member by molding, such that the one or more bending portions 223 are molded inside the guide 24, thereby securely connecting the plurality of second terminals 22 to the main printed circuit board 2.

[0080] In some exemplary embodiments, referring to FIGS. 4 and 5, the back side 13 of the housing 10 may comprise a locating protrusion 130 protruding in the insertion direction X, and the locating protrusion 130 may be inserted into a locating through-hole 235 formed in the printed circuit board to connect the printed circuit board 23 to the back side 13 of the housing 10. In particular, in the embodiment shown in FIG. 5, the locating through-hole 235 is formed in an upper side opposite the lower side 231 of the printed circuit board 23. Of course, the position where the locating through-hole 235 is formed is not limited thereto, and may be changed appropriately according to the specific shape of the printed circuit board 23, as long as that it corresponds to the locating protrusion 130 and is capable of connecting the back side 13 of the housing 10 to the printed circuit board 23.

[0081] In some exemplary embodiments, the electrical connector 1 may further comprise a cover 30 which may be connected to the housing 10 to cover the printed circuit board assembly 20.

[0082] As shown in FIGS. 3 and 8, an end face of the cover 30 may include a connecting projection 31 that is inserted into an aperture 14 formed in a corresponding side of the housing 10 to connect the cover 30 to the housing 10. Preferably, in the embodiment shown in FIG. 8, the upper end face of the cover 30 in the perpendicular direction Y comprises two connecting projections 31 that each is inserted into the two apertures 14 in the upper side of the housing 10 in the perpendicular direction Y, and each of the two end faces of the cover 30 in the transverse direction Z comprises one connecting projection 31 inserted into the aperture 14 in each of the two sides in the transverse direction Z of the housing 10, thereby connecting the cover 30 to the housing 10. Of course, the number of connecting projections 31 is not limited thereto, as long as they can correspond to the number of apertures 14 and can connect the cover 30 to the housing 10.

[0083] In some exemplary embodiments, the cover 30 may include a concave portion 32 for mounting the guide 24. The shape of the concave portion 32 matches the shape of the guide 24.

[0084] In some examples, the housing 10 and the cover 30 may be formed integrally as an integral member.

[0085] In some exemplary embodiments, as shown in FIG. 2, the electrical connector 1 may further comprise a light-emitting diode 40 for indicating various information, such as status information of the electrical connector, where the light-emitting diode 40 is mounted in the housing 10 in an inserted manner from a lower side of the housing 10 in the perpendicular direction Y and exposed from an exposing opening 120 formed in the front side 12 of the housing 10, the exposing opening 120 being configured in the front side 12 to be immediately adjacent to the lower side of the housing 10. The light emitting diode 40 may indicate information regarding, for example, connection integrity and/or speed verification by displaying various colors. Preferably, in the present application, the electrical connector 1 can comprise two light emitting diodes for indicating relevant information. These two light emitting diodes can be exposed from the exposing opening 120 of the front side 12 and are immediately adjacent to the lower side of the housing 10. Of course, the number of light-emitting diodes is not limited thereto, as long as the light-emitting diodes are able to be exposed from the front side and are immediately adjacent to the lower side of the housing 10. As shown in FIG. 2, the contact 41 of the light emitting diode 40 may extend toward and be connected to the main printed circuit board 2.

[0086] Referring to FIG. 2, the electrical connector 1 may further comprise a shield 50 that prevents electromagnetic interference, and the shield 50 may be sleeved onto an outer surface of the housing 10. The shape and size of the shield 50 may match the shape and size of the housing 10. The shield 50 may be made of, for example, a metal such as silver, copper, zinc, tin. Preferably, the shield may be made of copper. Preferably, the shield may be an integral sheet metal member. In this way, the strength of the shield 50 is higher and the processing is simple and less costly. The shield 50 can effectively shield the electrical connector 1 from external electromagnetic interference. In addition, the shield 50 surrounds the connection portion between the connector and the mating connector, thereby preventing external interference signals from entering the socket, and effectively protecting the stability of data transmission.

[0087] In some exemplary embodiments, the shield 50 may be sleeved onto an outer surface of sides other than the lower side of the housing 10 in the perpendicular direction Y, such that the lower side of the housing 10 in the perpendicular direction Y can be at least partially exposed to the main printed circuit board 2.

[0088] In some exemplary embodiments, the shield 50 may be soldered to the main printed circuit board 2, thereby providing stable support and soldering strength for the entire electrical connector 1.

[0089] In some exemplary embodiments, as shown in FIG. 9, the shield 50 may include an overhanging elastic sheet 51 for holding the mating connector, the overhanging elastic sheet 51 forming a free end by extending from the front side of the shield 50 toward the receiving cavity 11. When the mating connector is inserted into the electrical connector 1, the mating connector presses down on the overhanging elastic sheet 51, thereby deforming the overhanging elastic sheet 51 toward the housing 10 and securely holding the mating connector in the receiving cavity 11 of the housing.

[0090] In some exemplary embodiments, as shown in FIGS. 10 and 11, the housing 10 may include a first terminal receiving portion for receiving a plurality of first terminals 21, and the first terminal receiving portion may include a plurality of grooves 15 formed on an inner surface of one side of the housing 10 in the transverse direction Z as well as a plurality of through portions 131 extending along the insertion direction X formed in the back side 13 of the housing 10. A first portion 210 of each of the plurality of first terminals 21 may extend along the inner surface of said side of the housing 10 in the transverse direction X such that the bending portion 212 is embedded in a corresponding one of the plurality of grooves 15, and a second portion 211 of each of the plurality of first terminals 21 may extend into a corresponding one of the plurality of through portions 131 and abuts against a side of the through portion, thereby spacing the second portions of the first terminals from each other. In the case where the mating connector (plug) is inserted into the electrical connector 1 (socket), the corresponding terminal of the mating connector presses the second portion 211 of the first terminal 21 along the insertion direction X, such that the second portion 211 of the first terminal 21 elastically deforms in the through portion along the insertion direction X, so as to provide a securing mating between the corresponding terminal of the mating connector and the first terminal.

[0091] In some exemplary embodiments, the electrical connector 1 may comprise a housing 10 which may have a receiving cavity 11 configured to receive a mating connector. The

housing 10 may further have a bottom side 16 configured to connect to a main printed circuit board 2, a top side 17 opposite the bottom side 16, and a sidewall 18 extending between the bottom side 16 and the top side 17 and extending between a front side 12 and a back side 13 of the housing 10 relative to an insertion direction X of the mating connector, and the receiving cavity 11 may have a tab receiving portion 121 facing the sidewall 18.

[0092] In some exemplary embodiments, as shown in FIG. 3, the sidewall 18 of the receiving cavity 11 is a left-side of the housing 10 in the insertion direction X, with the tab receiving portion 121 facing the sidewall that serves as the left-side in this case. Optionally, in some exemplary embodiments not shown, the sidewall 18 of the receiving cavity 11 is a right side of the housing 10 in the insertion direction X, with the tab receiving portion 121 facing the sidewall that serves as the right side, in this case, the arrangement structure of the printed circuit board assembly, which will be described in detail below, is mirrored to the right.

[0093] In some exemplary embodiments, the electrical connector 1 may further comprise a printed circuit board assembly 20 located at the back side 13 of the housing 10, the printed circuit board assembly 20 being configured to connect to the main printed circuit board 2.

[0094] In some exemplary embodiments, the electrical connector may comprise a housing 10 which may have a receiving cavity 11 configured to receive a mating connector, and which may further have a front side 12 and a back side 13 relative to an insertion direction X of the mating connector; and a printed circuit board assembly 20 located at the back side 13 of the housing 10, the printed circuit board assembly 20 being configured to connect to the main printed circuit board 2.

[0095] In some exemplary embodiments, the printed circuit board assembly may comprise at least 6 layers of conductors.

[0096] In some exemplary embodiments, the printed circuit board assembly may comprise a plurality of first terminals 21, and each of the plurality of first terminals 21 is configured to contact each corresponding terminal of the plurality of terminals of the mating connector, respectively.

[0097] In some exemplary embodiments, the printed circuit board assembly may further comprise a plurality of second terminals 22, each of the plurality of second terminals 22 being configured to connect to each corresponding first terminal of the plurality of first terminals 21, and the plurality of second terminals 22 being configured to connect to the main printed circuit board 2.

[0098] In some exemplary embodiments, respective connections between the plurality of first terminals 21 and the plurality of second terminals 22 through the printed circuit board assembly 20 have approximately equal signal path lengths, and optionally respective connections between the plurality of first terminals and the plurality of second terminals through the printed circuit board assembly have approximately equal signal path lengths offset within 5% or 1% of one another.

[0099] In some exemplary embodiments, the electrical connector 1 may comprise: a housing 10 having a receiving cavity 11 configured to receive a mating connector, where the housing 10 may further have a bottom side 16, a top side 17 opposite the bottom side 16, and a sidewall 18 extending between the top side 17 and the bottom side 16 and extending between a front side 12 and a back side 13 of the housing 10 relative to an insertion direction X of the mating connector, and the receiving cavity 11 may have a tab receiving portion 121 facing the sidewall 18; and a plurality of light emitting diodes 40 located at the front side 12 of the housing 10, the plurality of light emitting diodes 40 being located below or above the receiving cavity 11. In the examples shown in FIGS. 2 and 3, the light emitting diode 40 is located below the receiving cavity 11. In other embodiments not shown, the light emitting diode 40 is located above the receiving cavity 11.

[0100] In some exemplary embodiments, the plurality of light emitting diodes 40 may emit light of a plurality of colors.

[0101] In some exemplary embodiments, the plurality of light emitting diodes 40 may be configured to be soldered to a main printed circuit board 2.

[0102] In some exemplary embodiments, the electrical connector 1 may further comprise a shield 50 configured to be soldered to the main printed circuit board 2.

[0103] The electrical connector 1 of the present application is assembled by the following steps: Step 1: providing the housing 10; Step 2: mounting the printed circuit board assembly 20 into the housing 10; Step 3: connecting the cover 30 to the housing 10 to cover the printed circuit board assembly 20; and Step 4: sleeving the shield 50 onto an outer surface of the housing 10.

[0104] In step 2, the printed circuit board 23 of the printed circuit board assembly 20 is mounted into the housing 10 from the back side 13 of the housing 10 such that the locating protrusion 130 on the back side of the housing 10 is inserted into the locating through-hole of the printed circuit board 23. In step 3, the connecting projection 31 of the cover 30 is inserted into the aperture in the corresponding side of the housing 10 such that the cover 30 abuts

against the printed circuit board 23 and covers the printed circuit board 23 of the printed circuit board assembly.

[0105] While the present application has been described with reference to exemplary embodiments, it should be understood that the present application is not limited to the specific embodiments described and illustrated in detail herein. Various modification may be made to the exemplary embodiments by those skilled in the art without departing from the scope defined by the claims of the present application.

[0106] The features mentioned and/or illustrated in the above description of the exemplary embodiments of the present application may be combined in the same or similar manner with one or more other embodiments, combining with features in other embodiments or substituted for corresponding features in other embodiments. These technical solutions obtained by combination or substitution shall also be deemed to be comprised within the scope of the present application.

CLAIMS

1. An electrical connector (1), characterized in that:

the electrical connector (1) comprises a housing (10) and a printed circuit board assembly (20), the housing (10) having a receiving cavity (11) for receiving a mating connector, the receiving cavity (11) passing through the housing (10) in an insertion direction (X) of the mating connector into the housing (10), the housing (10) having a front side (12) for insertion of the mating connector, and a back side (13) opposite the front side (12), the printed circuit board assembly (20) being mounted in the housing (10) and connected to the back side (13);

the printed circuit board assembly (20) comprises a plurality of first terminals (21), a plurality of second terminals (22) and a printed circuit board (23), the plurality of first terminals (21) being connected to a first face (230) of the printed circuit board (23) facing the receiving cavity (11), the plurality of second terminals (22) being connected to the printed circuit board (23) and extending in a perpendicular direction (Y) perpendicular to the insertion direction (X).

2. The electrical connector (1) according to claim 1, characterized in that the plurality of first terminals (21) are arranged in the perpendicular direction (Y) and individual first terminals (21) are connected to a corresponding connecting pad (2301) formed on the first face (230) of the printed circuit board (23).

3. The electrical connector (1) according to claim 2, characterized in that,

each of the plurality of first terminals (21) is formed by a bending process, the first terminal (21) comprising a first portion (210), a second portion (211), and a bending portion (212) connecting the first portion (210) and the second portion (211);

a free end of the first portion (210) forms a connection by a bending process, the connection being fixedly connected to the connecting pad (2301) of the first face (230) of the printed circuit board (23).

4. The electrical connector (1) according to any one of claims 1 to 3, characterized in that,

a lower side (231) of the printed circuit board (23) in the perpendicular direction (Y) comprises a plurality of second terminal connecting holes (232);

the plurality of second terminal connecting holes (232) comprises a first row of second terminal connecting holes and a second row of second terminal connecting holes arranged parallel to each other along a transverse direction (Z) which is perpendicular to both of the insertion direction (X) and the perpendicular direction (Y);

the second terminal connecting holes in the first row of second terminal connecting holes and the second terminal connecting holes in the second row of second terminal connecting holes are arranged on the printed circuit board (23) in such a way that they are staggered from each other by the same distance in the transverse direction (Z).

5. The electrical connector (1) according to claim 4, characterized in that the plurality of second terminals (22) are provided in correspondence with the plurality of second terminal connecting holes and are connected to the printed circuit board (23) via the second terminal connecting holes.

6. The electrical connector (1) according to claim 4, characterized in that each of the plurality of second terminals (22) comprises a mounting end (220) inserted into the second terminal connecting hole and a mating end (221) extending in the perpendicular direction (Y).

7. The electrical connector (1) according to claim 4, characterized in that the lower side (231) of the printed circuit board (23) comprises an accommodating portion (233) formed by being recessed upwards from an edge of the lower side (231) of the printed circuit board (23) in the perpendicular direction (Y), and a pair of fixing through-holes (234) formed at two ends of the printed circuit board (23) in the transverse direction (Z).

8. The electrical connector (1) according to claim 7, characterized in that the printed circuit board assembly (20) further comprises a guide (24) for guiding the plurality of second terminals (22), the guide (24) being mounted in the accommodating portion (233) of the printed circuit board (23).

9. The electrical connector (1) according to claim 8, characterized in that the guide (24) comprises a fixing protrusion (240) corresponding to the fixing through-hole (234), the fixing protrusion (240) being inserted into the fixing through-hole (234) respectively to connect the guide (24) to the printed circuit board (23).

10. The electrical connector (1) according to claim 8, characterized in that the mating end (221) passes through the guide (24) and extends in the perpendicular direction (Y).

11. The electrical connector (1) according to any one of claims 1 to 10, characterized in that the back side (13) of the housing (10) comprises a locating protrusion (130) protruding in the insertion direction (X), the locating protrusion (130) being inserted into a locating through-hole (235) formed in the printed circuit board (23) to connect the printed circuit board (23) to the back side (13) of the housing (10).

12. The electrical connector (1) according to any one of claims 1 to 10, characterized in that the electrical connector comprises a cover (30) connected to the housing (10) to cover the printed circuit board assembly (20).

13. The electrical connector (1) according to claim 12, characterized in that an end face of the cover (30) comprises a connecting projection (31) inserted into an aperture (14) formed in a corresponding side of the housing (10) to connect the cover (30) to the housing (10).

14. The electrical connector (1) according to any one of claims 1 to 10, characterized in that the electrical connector (1) further comprises a light-emitting diode (40) mounted in the housing (10) in an inserted manner from a lower side of the housing (10) in the perpendicular direction (Y) and exposed from an exposing opening (120) formed in the front side (12) of the housing (10), the exposing opening (120) being configured in the front side (12) to be immediately adjacent to the lower side of the housing (10).

15. The electrical connector (1) according to any one of claims 1 to 10, characterized in that the electrical connector (1) further comprises a shield (50) sleeved on an outer surface of the housing (10).

16. An electrical connector (1), characterized in that:

the electrical connector (1) comprises a housing (10) having a receiving cavity (11) configured to receive a mating connector, the housing (10) further having a bottom side (16) configured to connect to a main printed circuit board (2), a top side (17) opposite the bottom

side (16), and a sidewall (18) extending between the bottom side (16) and the top side (17) and extending between a front side (12) and a back side (13) of the housing (10) relative to an insertion direction (X) of the mating connector,

wherein the receiving cavity (11) has a tab receiving portion (121) facing the sidewall 18.

17. The electrical connector (1) according to claim 16, characterized in that the sidewall (18) is a left side or a right side of the housing (10) relative to the insertion direction (X) of the mating connector.

18. The electrical connector (1) according to claim 16 or 17, characterized in that the electrical connector (1) further comprises a printed circuit board assembly (20) located at the back side (13) of the housing (10), the printed circuit board assembly (20) being configured to connect to the main printed circuit board (2).

19. An electrical connector (1), characterized in that the electrical connector (1) comprises:

a housing (10) having a receiving cavity (11) configured to receive a mating connector, the housing (10) having a front side (12) and a back side (13) relative to an insertion direction (X) of the mating connector; and

a printed circuit board assembly (20) located at the back side (13) of the housing (10), the printed circuit board assembly (20) being configured to connect to the main printed circuit board (2).

20. The electrical connector (1) according to claim 19, characterized in that the printed circuit board assembly (20) comprises conductors having conductive layers in the range of 4-6 layers.

21. The electrical connector (1) according to claim 19 or 20, characterized in that the printed circuit board assembly (20) comprises a plurality of first terminals (21), each of the plurality of first terminals being configured to contact each corresponding terminal of the plurality of terminals of the mating connector, respectively.

22. The electrical connector (1) according to claim 21, characterized in that the printed circuit board assembly (20) further comprises a plurality of second terminals (22), each of the plurality of second terminals (22) being configured to connect to each corresponding first terminal of the plurality of first terminals (21), and the plurality of second terminals (22) being configured to connect to the main printed circuit board (2).

23. The electrical connector (1) according to claim 22, characterized in that respective connections between the plurality of first terminals (21) and the plurality of second terminals (22) through the printed circuit board assembly (20) have approximately equal signal path lengths, and optionally respective connections between the plurality of first terminals (21) and the plurality of second terminals (22) through the printed circuit board assembly (20) have approximately equal signal path lengths offset within 5% or 1% of one another.

24. An electrical connector (1), characterized in that the electrical connector (1) comprises:

a housing (10) having a receiving cavity (11) configured to receive a mating connector, the housing (10) further having a bottom side (16), a top side (17) opposite the bottom side (16), and a sidewall (18) extending between the top side (17) and the bottom side (16) and extending between a front side (12) and a back side (13) of the housing (10) relative to an insertion direction (X) of the mating connector, wherein the receiving cavity (11) has a tab receiving portion (121) facing the sidewall; and

a plurality of light emitting diodes (40) located at the front side of the housing (10), the plurality of light emitting diodes (40) being located below the receiving cavity (11), or the plurality of light emitting diodes (40) being located above the receiving cavity (11).

25. The electrical connector (1) according to claim 24, characterized in that the plurality of light emitting diodes (40) emit light of a plurality of colors.

26. The electrical connector (1) according to claim 24 or 25, characterized in that the plurality of light emitting diodes (40) are configured to be soldered to a main printed circuit board (2).

27. The electrical connector (1) according to any one of claims 24 to 26, characterized in that the electrical connector (1) further comprises a shield (50) configured to be soldered to the main printed circuit board (2).