

Optical Module

CROSS-REFERENCE TO RELATED PATENT APPLICATION

[0001] This application claims the benefit of priority to China Patent Application No. 202420538251.4, filed on March 20, 2024, and a name of invention is “Optical Module”. The entire content of the above identified application is incorporated herein by reference.

FIELD OF THE DISCLOSURE

[0002] The present disclosure relates to the technical field of printed circuit board, and more particularly relates to an optical module having a reinforcing structural member.

BACKGROUND OF THE DISCLOSURE

[0003] A PCB is a printed circuit board that is assembled and divided from important raw materials such as prepreg and copper foil, and then processed by various other processes. The printed circuit board serves as an important carrier for supporting and connecting components. A printed circuit board assembly (PCBA) is a finished circuit board formed by mounting components on a surface of the PCB through processes such as surface mount technology (SMT) and dual in-line package (DIP).

[0004] PCBA is a core component of an optical module, and an assembly process and a heat dissipation design thereof have a significant influence on overall performance of the optical module. When PCBA is subjected to stress within a module housing, the printed circuit board may warp and deform,

resulting in abnormal optical output of the module. In severe cases, excessive bending stress may cause cracking of electronic components or optical components, thereby leading to product failure. Meanwhile, the heat dissipation design also has a significant impact on the performance of the optical module. When heat dissipation is insufficient, overall power consumption of the module increases, and performance of a DSP chip is adversely affected.

SUMMARY OF THE DISCLOSURE

[0005] An objective of the present disclosure is to provide an optical module, so as to reduce an influence on main components on a circuit board when the circuit board is subjected to stress.

[0006] In order to achieve the above objective, an embodiment of the present disclosure provides an optical module, comprising a housing and a circuit board assembly disposed in the housing. The circuit board assembly includes a circuit board body, at least one component, and a reinforcing structural member. The circuit board body has a first surface and a second surface opposite to the first surface. The component is disposed on the first surface. The reinforcing structural member is disposed on the first surface or the second surface, and an orthographic projection of the reinforcing structural member on the first surface completely covers an orthographic projection of the component on the first surface.

[0007] As a further improvement of an embodiment of the present disclosure, a side surface of the reinforcing structural member facing the circuit board body has an accommodation space. The accommodation space is configured to accommodate the component. At least two sides of the accommodation space are configured to be connected to and fixed to the circuit board body. An area of an

orthographic projection of the accommodation space on the first surface is smaller than an area of an orthographic projection of a portion of the reinforcing structural member connected to and fixed to the circuit board body on the first surface.

[0008] As a further improvement of an embodiment of the present disclosure, the accommodation space extends through a portion of a peripheral side surface of the reinforcing structural member in a direction parallel to the first surface.

[0009] As a further improvement of an embodiment of the present disclosure, the reinforcing structural member is disposed on the first surface. The first surface includes a plurality of first component mounting regions and a first connection region connected to the reinforcing structural member. The first component mounting regions are configured for mounting the component, and a portion of the first component mounting regions is located within the first connection region.

[0010] A heat dissipation member is disposed on a side surface of the reinforcing structural member away from the first surface. The heat dissipation member is thermally connected to the reinforcing structural member. The component disposed in the portion of the first component mounting regions is thermally connected to the reinforcing structural member.

[0011] As a further improvement of an embodiment of the present disclosure, the reinforcing structural member is disposed on the second surface. The second surface includes a plurality of second component mounting regions and a second connection region connected to the reinforcing structural member. The second component mounting regions are configured for mounting other components. The second connection region corresponds in position to a portion of the component

disposed on the first surface, and the second connection region is a copper surface.

[0012] As a further improvement of an embodiment of the present disclosure, a plurality of copper-filled thermal vias are provided on the copper surface. The copper-filled thermal vias extend through the copper surface and the first surface. Heat generated by the component on the first surface is conducted to the reinforcing structural member through the copper-filled thermal vias.

[0013] As a further improvement of an embodiment of the present disclosure, a thermal adhesive layer is provided at a connection between the reinforcing structural member and the circuit board body.

[0014] As a further improvement of an embodiment of the present disclosure, the component includes a driver, a transimpedance amplifier, and a DSP chip.

[0015] As a further improvement of an embodiment of the present disclosure, a heat dissipation material is filled between the reinforcing structural member and the housing, and the reinforcing structural member is made of a metal material.

[0016] As a further improvement of an embodiment of the present disclosure, the housing includes an upper housing and a base connected to each other. The first surface of the circuit board body faces the upper housing.

[0017] When the reinforcing structural member is disposed on the second surface, the heat dissipation material is filled between the reinforcing structural member and the base.

[0018] An advantageous effect of the present disclosure is that the reinforcing structural member is disposed on the first surface or the second surface of the circuit board body, and the orthographic projection of the reinforcing structural member on the first surface completely covers the orthographic projection of the

component on the first surface. When the circuit board assembly is subjected to stress, the reinforcing structural member enhances the structural strength of an area surrounding the component, thereby preventing cracking and failure of the component caused by the stress.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] FIG. 1 is a schematic view of a structure of a first surface of a circuit board assembly according to an embodiment of the present disclosure;

[0020] FIG. 2 is a schematic view of a structure of a second surface of the circuit board assembly according to the embodiment of the present disclosure; and

[0021] FIG. 3 is a schematic view of a structure of a reinforcing structural member according to the embodiment of the present disclosure.

DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

[0022] In order to make the objectives, technical solutions, and advantages of the present disclosure more clearly understood, the technical solutions of the present disclosure are described in a clear and complete manner below with reference to specific embodiments and corresponding drawings. It should be understood that the described embodiments are merely a part of the embodiments of the present disclosure rather than all embodiments. All other embodiments obtained by a person of ordinary skill in the art based on the embodiments of the present disclosure without creative efforts shall fall within the protection scope of the present disclosure.

[0023] Embodiments of the present disclosure are described in detail below.

Examples of the embodiments are illustrated in the drawings, in which the same or similar reference numerals denote the same or similar elements or elements having the same or similar functions throughout. The embodiments described below with reference to the drawings are exemplary and are merely used for explaining the present disclosure, and shall not be construed as limiting the present disclosure.

[0024] The present disclosure provides an optical module. The optical module includes a housing and a circuit board assembly disposed in the housing. The circuit board assembly includes a circuit board body, at least one component, and a reinforcing structural member. The circuit board body has a first surface and a second surface opposite to the first surface. The component is disposed on the first surface. The reinforcing structural member is disposed on the first surface or the second surface. The orthographic projection of the reinforcing structural member on the first surface completely covers the orthographic projection of the component on the first surface.

[0025] As shown in FIG. 1 to FIG. 3, the present embodiment provides a circuit board assembly including a circuit board body 100, a plurality of components 200, and a reinforcing structural member 300.

[0026] The circuit board body 100 has a first surface 110 and a second surface 120 opposite to the first surface 110.

[0027] The components 200 are disposed on the first surface 110.

[0028] The second surface 120 can also be provided with corresponding components 200 according to actual product requirements.

[0029] In the present embodiment, the components 200 include, but are not limited to, a driver, a transimpedance amplifier, and a DSP chip.

[0030] More specifically, main operating components such as the driver, the transimpedance amplifier, and the DSP chip are disposed on the first surface 110.

[0031] The reinforcing structural member 300 is disposed on the first surface 110 or the second surface 120. The orthographic projection of the reinforcing structural member 300 on the first surface 110 completely covers the orthographic projection of the components 200 on the first surface 110. That is, when the reinforcing structural member 300 is disposed on the first surface 110, the reinforcing structural member 300 can completely cover the components 200. When the reinforcing structural member 300 is disposed on the second surface 120, an orthographic projection of the components 200 on the first surface 110 is a first projection, and an orthographic projection of the reinforcing structural member 300 on the first surface 110 is a second projection, in which an outer contour of the first projection is completely located within an outer contour of the second projection. When the circuit board assembly is subjected to stress, the reinforcing structural member 300 can enhance the structural strength of areas surrounding the components 200, thereby preventing cracking and failure of the components 200 caused by the stress.

[0032] In a specific embodiment of the present disclosure, the orthographic projection of the reinforcing structural member 300 on the first surface 110 has a rectangular shape.

[0033] However, the specific shape and projection area of the reinforcing structural member 300 on the first surface 110 are not limited in the present disclosure, and can be adjusted according to the number and arrangement positions of the components 200 to be covered.

[0034] Specifically, a side surface of the reinforcing structural member 300

facing the circuit board body 100 is provided with an accommodation space 310. The accommodation space 310 is configured to accommodate the components 200. The accommodation space 310 can be designed according to whether the components 200 are mounted at a corresponding position and according to sizes and quantities of the components 200. When the reinforcing structural member 300 is disposed on the first surface or the second surface, if the components 200 are mounted at the corresponding position of the reinforcing structural member 300, the accommodation space 310 can be configured to fully accommodate the components 200.

[0035] More specifically, at least two sides of the accommodation space 310 are configured to be connected to and fixed to the circuit board body 100. An area of the orthographic projection of the accommodation space 310 on the first surface 110 is smaller than an area of an orthographic projection of a portion of the reinforcing structural member 300 connected to and fixed to the circuit board body 100 on the first surface 110.

[0036] The reinforcing structural member 300 includes a first surface 320 connected to the circuit board body 100, a second surface 330 opposite to the first surface 320, and a peripheral side surface 340 connecting the first surface 320 and the second surface 330. That is, when components 200 are mounted at a position corresponding to the reinforcing structural member 300, the first surface 320 is parallel to and close to a connection surface between the components 200 and the circuit board body 100, the second surface 330 is parallel to and close to a surface of the components 200 opposite to the connection surface with the circuit board body 100, and the peripheral side surface 340 surrounds the components 200.

[0037] More specifically, the accommodation space 310 extends through a portion of the peripheral side surface 340 of the reinforcing structural member 300 in a direction parallel to the first surface 110. Referring to FIG. 3, the accommodation space 310 extends through a portion of the peripheral side surface 340 at at least one end of the reinforcing structural member 300 in a width direction of the reinforcing structural member 300. That is, the accommodation space 310 can extend through a portion of the peripheral side surface 340 at one end of the reinforcing structural member 300 in the width direction of the reinforcing structural member 300, or can extend through portions of the peripheral side surface 340 at opposite ends of the reinforcing structural member 300 in the width direction of the reinforcing structural member 300. Such a configuration avoids insufficient bonding strength between the reinforcing structural member 300 and the circuit board body 100 caused by excessively thin two side walls of the reinforcing structural member 300 in a length direction of the accommodation space 310, and facilitates manufacturing of the reinforcing structural member 300.

[0038] The accommodation space 310 can also extend through a portion of the peripheral side surface 340 at at least one end of the reinforcing structural member 300 in a length direction of the reinforcing structural member 300, or extend through the peripheral side surface 340 of the reinforcing structural member 300 in other directions. The present disclosure is not limited thereto. The size and position of the accommodation space 310 are related to the relative position between the reinforcing structural member 300 and the components 200 and to the shapes and sizes of the components 200.

[0039] In a specific embodiment of the present disclosure, the accommodation

space 310 is configured as a rectangular parallelepiped structure.

[0040] However, the present disclosure does not limit the specific structure and dimensions of the accommodation space 310 or the number of accommodation spaces 310 provided on the reinforcing structural member 300, and such parameters can be adjusted according to the number and sizes of the components 200 to be accommodated.

[0041] The reinforcing structural member 300 is made of a metal material. The present disclosure also does not limit the specific material of the reinforcing structural member 300. The reinforcing structural member 300 can be made of tungsten-copper or other metal materials having high strength, bondability, and high thermal conductivity.

[0042] Exemplarily, the components 200 mainly include a driver and a transimpedance amplifier disposed on the first surface 110. Since the driver and the transimpedance amplifier are main operating components of the circuit board, when the circuit board is subjected to stress, stress at positions of the driver and the transimpedance amplifier and surrounding areas thereof is relatively high. Therefore, the designed reinforcing structural member 300 only needs to have an orthographic projection on the first surface 110 capable of simultaneously covering the driver and the transimpedance amplifier.

[0043] Specifically, the reinforcing structural member 300 is disposed on the second surface 120. Outer contours of orthographic projections of the driver and the transimpedance amplifier on the first surface 110 are both completely located within an outer contour of the orthographic projection of the reinforcing structural member 300 on the first surface 110. The reinforcing structural member 300 can provide support and reinforcement for the components 200, namely the driver

and the transimpedance amplifier, and surrounding areas thereof, thereby reducing an influence caused by stress in these areas.

[0044] The reinforcing structural member 300 can also be disposed on the first surface 110, such that the reinforcing structural member 300 completely covers the driver and the transimpedance amplifier and surrounding areas thereof, and corresponding accommodation spaces 310 are provided at positions covering the driver and the transimpedance amplifier.

[0045] When the reinforcing structural member 300 is disposed on the second surface 120, whether other components are mounted at a position area of the second surface corresponding to the driver and the transimpedance amplifier to be covered also needs to be considered. If other components are mounted at that area, corresponding accommodation spaces 310 also need to be designed to prevent interference with the components 200 mounted at corresponding positions. If no other components are mounted at that area, the reinforcing structural member 300 can be directly designed as a rectangular parallelepiped structure without providing the accommodation spaces 310.

[0046] In one embodiment, the reinforcing structural member 300 is disposed on the first surface 110. The first surface 110 includes a plurality of first component mounting regions 111 (dashed-line regions in FIG. 1) and a first connection region connected to the reinforcing structural member 300. The first component mounting regions 111 are configured for mounting components 200. A portion of the first component mounting regions 111 is located within the first connection region. That is, orthographic projections of components 200 disposed in the portion of the first component mounting regions 111 on the first surface 110 are completely located within the orthographic projection of the reinforcing

structural member 300 on the first surface 110. The reinforcing structural member 300 can enhance stress resistance around the portion of the first component mounting regions 111. That is, corresponding to the components 200 disposed in the portion of the first component mounting regions 111, the reinforcing structural member 300 is provided with corresponding accommodation spaces 310, such that the reinforcing structural member 300 does not interfere with the components 200 disposed in the portion of the first component mounting regions 111.

[0047] A heat dissipation member is further disposed on a side of the reinforcing structural member 300 away from the first surface 110. The heat dissipation member is thermally connected to the reinforcing structural member 300. The components 200 disposed in a portion of the first component mounting regions located within the first connection region are thermally connected to the reinforcing structural member 300. In this way, heat generated by the components 200 disposed in the portion of the first component mounting regions can be transferred to the heat dissipation member through the reinforcing structural member 300.

[0048] In another embodiment, the reinforcing structural member 300 is disposed on the second surface 120. The second surface 120 includes a plurality of second component mounting regions 121 and a second connection region 122 connected to the reinforcing structural member 300 (dashed-line region in FIG. 2). The second component mounting regions 121 are configured for mounting other components. The second connection region 122 is provided corresponding to an area in which a portion of components on the first surface 110 are located. That is, the second connection region 122 corresponds in position to a portion of

components disposed on the first surface 110. The reinforcing structural member 300 disposed in the second connection region 122 is configured to enhance the strength of areas surrounding components at corresponding positions on the first surface 110.

[0049] In the present embodiment, a portion of the second component mounting regions 121 may be located within the second connection region 122. In that case, the reinforcing structural member 300 disposed corresponding to the second connection region 122 is provided with an accommodation space, such that the accommodation space can accommodate components located in the portion of the second component mounting regions 121. Alternatively, no components may be disposed within the second connection region 122. In that case, the reinforcing structural member 300 disposed in the second connection region 122 is a complete rectangular parallelepiped structure, and no accommodation space needs to be provided.

[0050] Specifically, the second connection region 122 is a copper surface. Generally, the second surface 120 of the circuit board body is covered with an ink layer. That is, the second connection region 122 of the second surface 120 connected to the reinforcing structural member 300 is etched to expose the copper surface.

[0051] More specifically, a plurality of copper-filled thermal vias are provided on the copper surface at positions corresponding to areas of the components 200 on the first surface 110. The copper-filled thermal vias extend through the copper surface and the first surface 110. Heat generated by the components 200 on the first surface 110 during operation can be conducted to the reinforcing structural member 300 through the copper-filled thermal vias. That is, if the strength of

areas surrounding the driver and the transimpedance amplifier disposed on the first surface 110 needs to be enhanced, the reinforcing structural member 300 is provided on the second surface 120 at positions corresponding to the driver and the transimpedance amplifier, and a plurality of copper-filled thermal vias are provided at positions corresponding to the driver and the transimpedance amplifier, such that heat generated by the driver and the transimpedance amplifier is transferred to the reinforcing structural member 300 through the copper-filled thermal vias.

[0052] In the present embodiment, a heat dissipation member can also be disposed on a side surface of the reinforcing structural member 300 away from the copper surface, thereby further facilitating heat dissipation of the components 200.

[0053] A thermal adhesive layer is provided at a connection between the reinforcing structural member 300 and the circuit board body 100, and can further transfer heat generated by components on the circuit board body 100 to the reinforcing structural member 300.

[0054] In a specific embodiment of the present disclosure, the reinforcing structural member 300 is fixedly bonded to the copper surface through the thermal adhesive layer.

[0055] The present disclosure does not limit a specific material of the thermal adhesive layer. The thermal adhesive layer includes, but is not limited to, adhesive materials having characteristics such as non-volatility, aging resistance, high bonding strength, and high thermal conductivity, for example, silver adhesive.

[0056] Further, a heat dissipation material is filled between the reinforcing

structural member 300 and the housing. That is, heat generated by the components 200 can be transferred to the housing of the optical module through the reinforcing structural member 300 and the heat dissipation material, so as to transfer the heat into ambient air and improve heat dissipation performance of the optical module. When a heat dissipation member is disposed on a side of the reinforcing structural member 300 away from the circuit board body, the heat dissipation material is filled between the heat dissipation member and the housing.

[0057] The heat dissipation material of the present disclosure includes, but is not limited to, a thermally conductive gel material, a thermally conductive pad, and thermal grease.

[0058] Specifically, the housing includes an upper housing and a base connected to each other. The upper housing and the base are joined to form a space for accommodating the circuit board assembly. The first surface 110 of the circuit board body 100 faces the upper housing.

[0059] Generally, the base of the optical module can provide a heat dissipation function. When the reinforcing structural member 300 is disposed on the second surface 120 and the heat dissipation material is filled between the reinforcing structural member 300 and the base, heat generated by the components 200 on the first surface 110 can be transferred to the reinforcing structural member 300 through the copper-filled thermal vias, and then transferred to the base of the optical module through the heat dissipation material, thereby further improving heat dissipation performance.

[0060] In summary, the present disclosure provides the reinforcing structural member on the first surface or the second surface of the circuit board body, and

the orthographic projection of the reinforcing structural member on the first surface completely covers the orthographic projection of the component on the first surface. When the circuit board assembly is subjected to stress, the reinforcing structural member enhances the structural strength of an area surrounding the component, thereby preventing cracking and failure of a part of the component caused by the stress.

[0061] It should be understood that, although the present specification is described according to embodiments, not every embodiment includes only a single independent technical solution. Such description in the specification is provided for clarity only, and a person of ordinary skill in the art should consider the specification as a whole. Technical solutions in different embodiments may also be appropriately combined to form other embodiments that can be understood by a person of ordinary skill in the art.

[0062] The above detailed descriptions are merely specific descriptions of feasible embodiments of the present disclosure, and are not intended to limit the protection scope of the present disclosure. Any equivalent embodiments or modifications made without departing from the technical spirit of the present disclosure shall fall within the protection scope of the present disclosure.

CLAIMS

What is claimed is:

[Claim 1] An optical module, comprising:

a housing and a circuit board assembly disposed in the housing,
wherein the circuit board assembly includes a circuit board body, at least one component, and a reinforcing structural member,
wherein the circuit board body has a first surface and a second surface opposite to the first surface,
wherein the component is disposed on the first surface,
wherein the reinforcing structural member is disposed on the first surface or the second surface, and
wherein an orthographic projection of the reinforcing structural member on the first surface completely covers an orthographic projection of the component on the first surface.

[Claim 2] The optical module according to claim 1, wherein a side surface of the reinforcing structural member facing the circuit board body is provided with an accommodation space, the accommodation space is configured to accommodate the component, at least two sides of the accommodation space are configured to be connected to and fixed to the circuit board body, and an area of an orthographic projection of the accommodation space on the first surface is smaller than an area of an orthographic projection of a portion of the reinforcing structural member connected to and fixed to the circuit board body on the first surface.

[Claim 3] The optical module according to claim 2, wherein the accommodation space extends through a portion of a peripheral side surface of the reinforcing structural member in a direction parallel to the first surface.

[Claim 4] The optical module according to claim 3, wherein the reinforcing structural member is disposed on the first surface, the first surface includes a plurality of first component mounting regions and a first connection region connected to the reinforcing structural member, the first component mounting regions are configured for mounting the component, and a portion of the first component mounting regions is located within the first connection region; wherein a heat dissipation member is disposed on a side surface of the reinforcing structural member away from the first surface, the heat dissipation member is thermally connected to the reinforcing structural member, and the component disposed in the portion of the first component mounting regions is thermally connected to the reinforcing structural member.

[Claim 5] The optical module according to claim 1, wherein the reinforcing structural member is disposed on the second surface, the second surface includes a plurality of second component mounting regions and a second connection region connected to the reinforcing structural member, the second component mounting regions are configured for mounting other components, the second connection region corresponds in position to a portion of the component disposed on the first surface, and the second connection region is a copper surface.

[Claim 6] The optical module according to claim 5, wherein a plurality of copper-filled thermal vias are provided on the copper surface, the copper-filled thermal vias extend through the copper surface and the first surface, and wherein heat generated by the component on the first surface is conducted to the reinforcing structural member through the copper-filled thermal vias.

[Claim 7] The optical module according to claim 1, wherein a thermal adhesive layer is provided at a connection between the reinforcing structural member and the circuit board body.

[Claim 8] The optical module according to claim 1, wherein the component includes a driver, a transimpedance amplifier, and a DSP chip.

[Claim 9] The optical module according to claim 1, wherein a heat dissipation material is filled between the reinforcing structural member and the housing, and the reinforcing structural member is made of a metal material.

[Claim 10] The optical module according to claim 9, wherein the housing includes an upper housing and a base connected to each other, the first surface of the circuit board body faces the upper housing, and wherein, when the reinforcing structural member is disposed on the second surface, the heat dissipation material is filled between the reinforcing structural member and the base.