Abstract: Printed circuit board (PCB) positioning mechanisms can be employed in an electronic module, such as an electronic or optoelectronic transceiver or transponder module. The PCB positioning mechanisms enable completely automated positioned and securing of a PCB within an electronic module. The PCB positioning mechanisms also eliminate the need to secure the PCB with screws or other fasteners, thus decreasing assembly cost, assembly time, and assembly complexity, and can avoid assembly problems associated with manufacturing tolerances and tolerance stacking between components of the electronic module.
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Electronic modules, such as electronic or optoelectronic transceiver or transponder modules, are increasingly used in electronic and optoelectronic communication. Electronic modules typically include an internal printed circuit board (PCB) that is configured to communicate with a host device.

One common difficulty associated with the electronic modules concerns the assembly of the modules. For example, due to limitations in size and space, it can sometimes be difficult to accurately secure an internal circuit board within an electronic module. It can also be difficult to take up the tolerance variations in PCB construction. A need exists, therefore, for mechanisms that can accurately secure an internal circuit board within an electronic module.

SUMMARY OF SOME EXAMPLE EMBODIMENTS

In general, example embodiments of the invention relate to printed circuit board (PCB) positioning mechanisms that can be employed in an electronic module, such as an electronic or optoelectronic transceiver or transponder module. The example PCB positioning mechanisms disclosed herein can enable completely automated positioned and securing of a PCB within an electronic module.

In one example embodiment, a PCB positioning mechanism includes a solderable plate and a compressible structure attached to the solderable plate.

In another example embodiment, a PCB positioning system includes a PCB, and a plurality of PCB positioning mechanisms soldered to the PCB. Each of the PCB positioning mechanisms includes a solderable plate and a compressible structure attached to the solderable plate.

In yet another example embodiment, an optoelectronic transceiver module includes a multi-piece shell, a PCB at least partially positioned within the multi-piece shell, a TOSA electrically connected to the PCB, and a ROSA electrically connected to the PCB. A first piece of the multi-piece shell defines a plurality of posts. The optoelectronic transceiver module also includes a plurality of PCB positioning mechanisms soldered to the PCB. Each of the PCB positioning mechanisms includes a solderable plate and a compressible structure attached to the solderable plate. Each of the
plurality of posts corresponds to one of the PCB positioning mechanisms such that when
the first piece of the multi-piece shell is engaged with a second piece of the multi-piece
shell, the plurality of posts compress the plurality of PCB positioning mechanisms such
that the PCB is substantially secured in the y-direction within the optoelectronic
transceiver module.

These and other aspects of example embodiments of the invention will become
more fully apparent from the following description and appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

To further clarify certain aspects of the present invention, a more particular
description of the invention will be rendered by reference to example embodiments
thereof which are disclosed in the appended drawings. It is appreciated that these
drawings depict only example embodiments of the invention and are therefore not to be
considered limiting of its scope. Aspects of the invention will be described and explained
with additional specificity and detail through the use of the accompanying drawings in
which:

Figure 1A is a top perspective view of an example optoelectronic transceiver
module;
Figure 1B is a bottom perspective view of the example optoelectronic transceiver
module of Figure 1A;
Figure 1C is an exploded perspective view of the example optoelectronic
transceiver module of Figure 1A;
Figure 1D is a cross-sectional side view of the example optoelectronic transceiver
module of Figure 1A;
Figure 2 is a perspective view of an example printed circuit board (PCB)
positioning mechanism;
Figure 3A is a perspective view of another example PCB positioning mechanism;
Figure 3B is a side view of the example PCB positioning mechanism of Figure 3A
in a relaxed state;
Figure 3C is a front view of the example PCB positioning mechanism of Figure
3A in a relaxed state;
Figure 3D is a side view of the example PCB positioning mechanism of Figure 3A
in a compressed state;
Figure 3E is a front view of the example PCB positioning mechanism of Figure 3A in a compressed state;
Figure 4A is a top view of an example tape-and-reel system; and
Figure 4B is a cross-sectional side view of the example tape-and-reel system of Figure 4A.

**DETAILED DESCRIPTION OF SOME EXAMPLE EMBODIMENTS**

Example embodiments of the present invention relate to printed circuit board (PCB) positioning mechanisms that can be employed in an electronic module, such as an electronic or optoelectronic transceiver or transponder module. The example PCB positioning mechanisms disclosed herein can enable completely automated positioned and securing of a PCB within an electronic module. The example PCB positioning mechanisms disclosed herein can also eliminate the need to secure the PCB with screws or other fasteners, thus decreasing assembly cost, assembly time, and assembly complexity. The example PCB positioning mechanisms disclosed herein can also help avoid assembly problems associated with manufacturing tolerances and tolerance stacking between components of the electronic module.

Reference will now be made to the drawings to describe various aspects of some example embodiments of the invention. It is to be understood that the drawings are diagrammatic and schematic representations of such example embodiments, and are not limiting of the present invention, nor are they necessarily drawn to scale.

1. **Example Optoelectronic Transceiver Module**

Reference is first made to Figures 1A-1C which disclose aspects of an example optoelectronic transceiver module 100 for use in transmitting and receiving optical signals in connection with a host device (not shown). As disclosed in Figures 1A and 1B, the optoelectronic transceiver module 100 includes various components, including a shell 102 that includes a rotatable top shell 104 and a bottom shell 106. The rotatable top shell 104 is rotatable with respect to the bottom shell 106. An output port 108 and an input port 110 are defined in the bottom shell 106. The rotatable top shell 104 and the bottom shell 106 can be formed using a die casting process, machining operation, or any other suitable process(es). One example material from which the rotatable top shell 104 and the bottom shell 106 can be die cast is zinc, although the rotatable top shell 104 and the bottom shell
106 may alternatively be die cast or otherwise constructed from other suitable materials such as aluminum, or any other suitable material(s).

As disclosed in Figure 1C, the example optoelectronic transceiver module 100 also includes a transmitter optical subassembly (TOSA) 112, a receiver optical subassembly (ROSA) 114, electrical interfaces 116 and 118, and a PCB 120 having an edge connector 122. The two electrical interfaces 116 and 118 are used to electrically connect the TOSA 112 and the ROSA 114, respectively, to the PCB 120.

The TOSA 112 of the optoelectronic transceiver module 100 includes a barrel 126 within which an optical transmitter, such as a laser, (not shown) is disposed. The optical transmitter is configured to convert electrical signals received through the PCB 120 from a host device (not shown) into corresponding optical signals. The TOSA 112 also includes a flange 128 and a nose piece 130. The nose piece 130 defines a port 132. The port 132 is configured to optically connect the optical transmitter disposed within the barrel 126 with a fiber-ferrule (not shown) disposed within the output port 108.

Similarly, the ROSA 114 of the optoelectronic transceiver module 100 includes a barrel 134, a flange 136, and a nose piece 138. The nose piece 138 defines a port 140. The port 140 is configured to optically connect an optical receiver, such as a photodiode (not shown), disposed within the barrel 134 to a fiber-ferrule (not shown) disposed within the input port 110. The optical receiver is configured to convert optical signals received from the fiber-ferrule into corresponding electrical signals for transmission to a host device (not shown) through the PCB 120.

The optoelectronic transceiver module 100 can be configured for optical signal transmission and reception at a variety of per-second data rates including, but not limited to, 1 Gbit, 2 Gbit, 2.5 Gbit, 4 Gbit, 8 Gbit, 10 Gbit, 17 Gbit, 40 Gbit, 100 Gbit, or higher. Furthermore, the optoelectronic transceiver module 100 can be configured for optical signal transmission and reception at various wavelengths including, but not limited to, 850 nm, 1310 nm, 1470 nm, 1490 nm, 1510 nm, 1530 nm, 1550 nm, 1570 nm, 1590 nm, or 1610 nm. Further, the optoelectronic transceiver module 100 can be configured to support various communication standards including, but not limited to, Fast Ethernet, Gigabit Ethernet, 10 Gigabit Ethernet, and Ix, 2x, 4x, and 10x Fibre Channel. In addition, although one example of the optoelectronic transceiver module 100 is configured to have a form factor that is substantially compliant with the SFP+ (IPF) MSA, the optoelectronic transceiver module 100 can alternatively be configured to have a variety of different form factors.
factors that are substantially compliant with other MSAs including, but not limited to, the
SFF MSA, the XFP MSA, or the SFP MSA.

With continued reference to Figure 1C, the optoelectronic transceiver module 100 also includes a latching mechanism 141 which includes a bail 142 and a latch 144. The optoelectronic transceiver module 100 further includes an optical subassembly (OSA) positioning plate 146, a collar clip 148, an interlocking seam 150, an angular seam 152, and four PCB positioning mechanisms 200. Aspects of example embodiments of the PCB positioning mechanism 200 will be discussed in greater detail below in connection with Figures 1C, ID, and 2.

2. Example PCB Positioning Mechanism

With continuing reference to Figure 1C, and with reference now also to Figure ID, aspects of the example PCB positioning mechanisms 200 are disclosed. As disclosed in Figure 1C, four example PCB positioning mechanisms 200 are soldered to the PCB 120 and four posts 154 are formed in the rotatable top shell 104 of the optoelectronic transceiver module 100 (only two of which are viewable in Figure 1C). As disclosed in Figure 1C, each of the posts 154 corresponds to one of the example PCB positioning mechanisms 200. Also disclosed in Figure 1C are four shelf structures 156 defined in the bottom of the bottom shell 106 (only two of which are viewable in Figure 1C).

With reference now to Figure ID, the optoelectronic transceiver module 100 is disclosed after the top shell 104 has been rotated and closed on the bottom shell 106 during the assembly of the optoelectronic transceiver module 100. As disclosed in Figure ID, as the posts 154 compress the PCB positioning mechanisms 200, the PCB positioning mechanisms 200 bias the PCB 120 against the shelf structures 156 such that the PCB 120 is secured in the y-direction within the optoelectronic transceiver module 100. As the PCB positioning mechanisms 200 are compressible, the PCB positioning mechanisms 200 can take up tolerance variation in the PCB 120. The PCB positioning mechanisms 200 can also eliminate the need for screws or other fasteners when securing the PCB 120 in the bottom shell 106. The PCB positioning mechanisms 200 can therefore enable quick installation of the PCB 120 into the optoelectronic transceiver module 100, as well as the quick extraction of the PCB 120 from the optoelectronic transceiver module 100.

As disclosed in Figure 1C, the bottom shell 106 can also include a pair of half-posts 158 defined in the wall of the bottom shell 106 that are configured to engage a pair of grooves 160 formed in the PCB 120. As disclosed in Figure ID, when the PCB 120 is
positioned within the bottom shell 106, the engagement of the half-posts 158 with the grooves 160 aid in the securement of the PCB in an x-direction and a z-direction within the optoelectronic transceiver module 100.

With reference now to Figure 2, additional aspects of the example PCB positioning mechanism 200 are disclosed. In general, the example PCB positioning mechanism 200 includes a solderable plate 202 and a compressible structure 204 attached to the solderable plate 202. The solderable plate 202 may be formed from any solderable material including, but not limited to, nickel, copper, or tin plated steel. The compressible structure 204 comprises a metal spring.

The example PCB positioning mechanism 200 can utilize surface mount technology (SMT) so that the processes of soldering the example PCB positioning mechanism 200 to the PCB 120 and securing the PCB 120 in the x-direction, y-direction, and z-direction within the optoelectronic transceiver module 100 are completely automated. The example PCB positioning mechanism 200 can be packaged into a tape-and-reel system (similar to the tape-and-reel system 400 disclosed below in connection with Figures 4A and 4B) from which they are selected and soldered to the PCB 120 using a pick-and-place system.

The compressible structure 204 of the PCB positioning mechanism 200 is not limited to the diamond shaped metal spring disclosed in Figure 2, but can be implemented using any solder mountable spring or other spring equivalent that is capable of being both packaged into a tape-and-reel system and being attached to the solderable plate 102 and/or soldered directly to the PCB 120 using a pick-and-place system. Example alternative springs or other spring equivalents include, but are not limited to, coil springs, s-bend springs, compressible polymers on metal, cantilevers, or any other structure(s) of comparable functionality. In addition, the compressible structure 204 can be formed from any combination of compressible elastic materials and/or metals that are capable of being attached to the solderable plate 102 and/or soldered directly to the PCB 120. It is understood, therefore, that the solderable plate 202 may be optional where the compressible structure 204 can itself be soldered directly to the PCB 120.

The example PCB positioning mechanism 200 can enable completely automated positioned and securing of the PCB 120 within the optoelectronic transceiver module 100. The example PCB positioning mechanism 200 can also eliminate the need to secure the PCB 120 with screws or other fasteners, thus decreasing assembly cost, assembly time, and assembly complexity. The example PCB positioning mechanism 200 can also help
avoid assembly problems associated with manufacturing tolerances and tolerance stacking between components of the optoelectronic transceiver module 100. For example, the example PCB positioning mechanism 200 can also help avoid assembly problems relating to the thickness of the PCB 120 by taking up any slack between the PCB 120 and the posts 154.

3. Another Example PCB Positioning Mechanism

With reference now to Figures 3A-3E, aspects of another example PCB positioning mechanism 200' are disclosed. As disclosed in Figure 3A, the example PCB positioning mechanism 200' is similar to the example PCB positioning mechanism 200 of Figures 1C-2 in that the example PCB positioning mechanism 200' generally includes a solderable plate 202 and a compressible structure 204' attached to the solderable plate 202. However, unlike the compressible structure 204 of Figures 1C-2, the compressible structure 204' of Figure 3A comprises a dielectric silicone rubber. In some example embodiments, the dielectric silicone rubber comprises silicone rubber KE-5620W-U.

Being formed from a dielectric enables the compressible structure 204' to be employed to mechanically secure a PCB without causing electrical interference with the electronic circuitry of the PCB. The compressible structure 204' can be formed from other materials having elastic properties and dielectric properties similar to silicone rubber. Figures 3B and 3C are side and front views of the example PCB positioning mechanism 200' in a relaxed state. Figures 3D and 3E are side and front views of the example PCB positioning mechanism 200' in a compressed state.

4. Example Tape-and-Reel System

With reference now to Figures 4A and 4B, aspects of an example tape-and-reel system 300 are disclosed. As disclosed in Figure 4A, the example tape-and-reel system 300 generally includes a tape 302, perforations 304 defined in the tape 302, and multiple PCB positioning mechanism 200' from Figures 3A-3E embedded in the tape 302. The perforations 304 enable the tape 302 to be employed in connection with automated SMT in PCB pick-and-place component stuffing operations.

As disclosed in Figure 4B, each of the PCB positioning mechanisms 200' in the example tape-and-reel system 300 is embedded in the tape 302 with the solderable plate 202 embedded more deeply than the compressible structure 204'. It is understood that the example tape-and-reel system 300 is not limited to the PCB positioning mechanisms 200',
but may instead be used in connection with the PCB positioning mechanisms 200, or any other the PCB positioning mechanism disclosed herein.

In addition to the electronic module environment disclosed herein, the example PCB positioning mechanisms disclosed herein can be employed in any other environment that requires secure positioning of electrical components.

Further, some example PCB positioning mechanisms may be employed using non-solder attachment methods. For example, adhesives may be employed to attach one of the compressible structures disclosed herein to the PCB 120 and/or to the posts 154 defined in the rotatable top shell 104 (see Figure 1C). Using adhesives may make feasible the positioning of the compressible structure over other electrical elements in the PCB 120, such as traces or vias, without creating an electrical short. Mechanical attachment methods may alternatively be employed. For example, the compressible structure 204, as disclosed in Figure 2, may include a tab that interlocks with the post 154 of the rotatable top shell 104 (see Figure 1C) to hold the compressible structure 204 in place.
What is claimed is:

1. A printed circuit board (PCB) positioning mechanism comprising:
   a solderable plate; and
   a compressible structure attached to the solderable plate.

2. The PCB positioning mechanism as recited in claim 1, wherein the solderable plate comprises nickel.

3. The PCB positioning mechanism as recited in claim 1, wherein the compressible structure comprises dielectric silicone rubber.

4. The PCB positioning mechanism as recited in claim 3, wherein the dielectric silicone rubber comprises silicone rubber KE-5620W-U.

5. The PCB positioning mechanism as recited in claim 1, wherein the compressible structure comprises a metal spring.

6. A tape-and-reel system comprising:
   a perforated tape; and
   a plurality of PCB positioning mechanisms as recited in claim 1, wherein each of the plurality of PCB positioning mechanisms is embedded in the perforated tape.

7. The tape-and-reel system as recited in claim 6, wherein each of the plurality of PCB positioning mechanisms is embedded in the perforated tape with the solderable plate embedded more deeply than the compressible structure.

8. The tape-and-reel system as recited in claim 6, wherein the tape-and-reel system is substantially compliant with automated solder mount technology such that each of the plurality of PCB positioning mechanisms can be soldered to a PCB using automated PCB pick-and-place component stuffing operations.

9. A PCB positioning system comprising:
   a PCB; and
   a plurality of PCB positioning mechanisms soldered to the PCB, each of the PCB positioning mechanisms comprising:
   a solderable plate; and
   a compressible structure attached to the solderable plate.

10. The PCB positioning system as recited in claim 9, wherein each solderable plate comprises nickel.
11. The PCB positioning system as recited in claim 9, wherein the compressible structure comprises dielectric silicone rubber.

12. The PCB positioning system as recited in claim 11, wherein the dielectric silicone rubber comprises silicone rubber KE-5620W-U.

13. The PCB positioning system as recited in claim 9, wherein the compressible structure comprises a metal spring.

14. An optoelectronic transceiver module comprising:
   a multi-piece shell, a first piece of the multi-piece shell defining a plurality of posts;
   a PCB at least partially positioned within the multi-piece shell;
   a transmitter optical subassembly (TOSA) electrically connected to the PCB;
   a receiver optical subassembly (ROSA) electrically connected to the PCB;
   and
   a plurality of PCB positioning mechanisms soldered to the PCB, each of the PCB positioning mechanisms comprising:
   a solderable plate; and
   a compressible structure attached to the solderable plate
   wherein each of the plurality of posts corresponds to one of the PCB positioning mechanisms such that when the first piece of the multi-piece shell is engaged with a second piece of the multi-piece shell, the plurality of posts compress the plurality of PCB positioning mechanisms such that the PCB is substantially secured in the y-direction within the optoelectronic transceiver module.

15. The optoelectronic transceiver module as recited in claim 14, wherein the solderable plate comprises nickel.

16. The optoelectronic transceiver module as recited in claim 14, wherein the compressible structure comprises dielectric silicone rubber KE-5620W-U.

17. The optoelectronic transceiver module as recited in claim 14, wherein the compressible structure comprises a metal spring.

18. The optoelectronic transceiver module as recited in claim 14, wherein the optoelectronic transceiver module is substantially complaint with the SFP+ MSA.

19. The optoelectronic transceiver module as recited in claim 14, wherein the optoelectronic transceiver module is substantially complaint with the XFP MSA.
20. The optoelectronic transceiver module as recited in claim 14, wherein the plurality of PCB positioning mechanisms comprises four PCB positioning mechanisms.
### A. CLASSIFICATION OF SUBJECT MATTER

**G02B 6/42(2006.01)1, H05K 7/14(2006.01)1**

According to International Patent Classification (IPC) or to both national classification and IPC.

### B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 8 G02B, H05K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

- Korean Utility Model and applications for Utility Model since 1975  
- IPC as above

Japanese Utility Model and applications for Utility Model since 1975  
- IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKIPASS (KIPO internal) "Keywords PCB, board, positioning, holding, compress, spring and similar terms"

### C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>See claims 1-6 and figures 4-6</td>
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