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(54) **THERMAL MANAGEMENT STRUCTURES FOR OPTOELECTRONIC MODULES**

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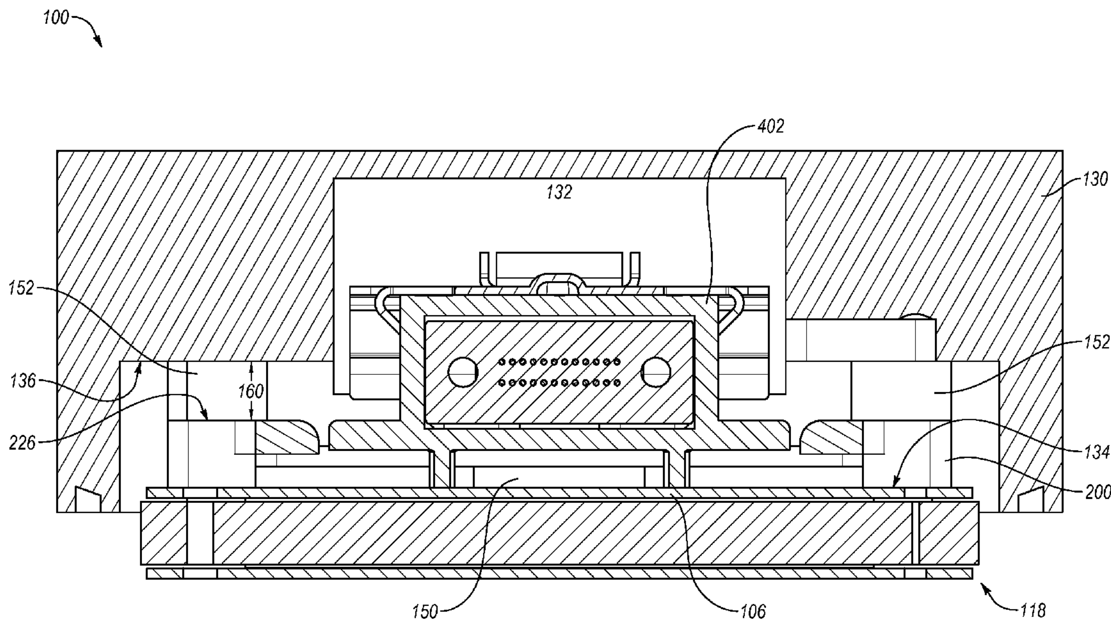
(57) **ABSTRACT**

An example embodiment includes optoelectronic module. The optoelectronic module may include a lens assembly, a module board, heat-generating components, and a thermally conductive plate. The lens assembly may be secured to the module board. The module board may include a printed circuit board (PCB). The heat-generating components may be mounted to the PCB. The thermally conductive plate may be secured to a surface of the module board. The thermally conductive plate may define an opening that receives at least a portion of the lens assembly. The thermally conductive plate may be configured to absorb at least a portion of thermal energy generated during operation of the heat-generating components and to transfer the thermal energy away from the heat-generating components.



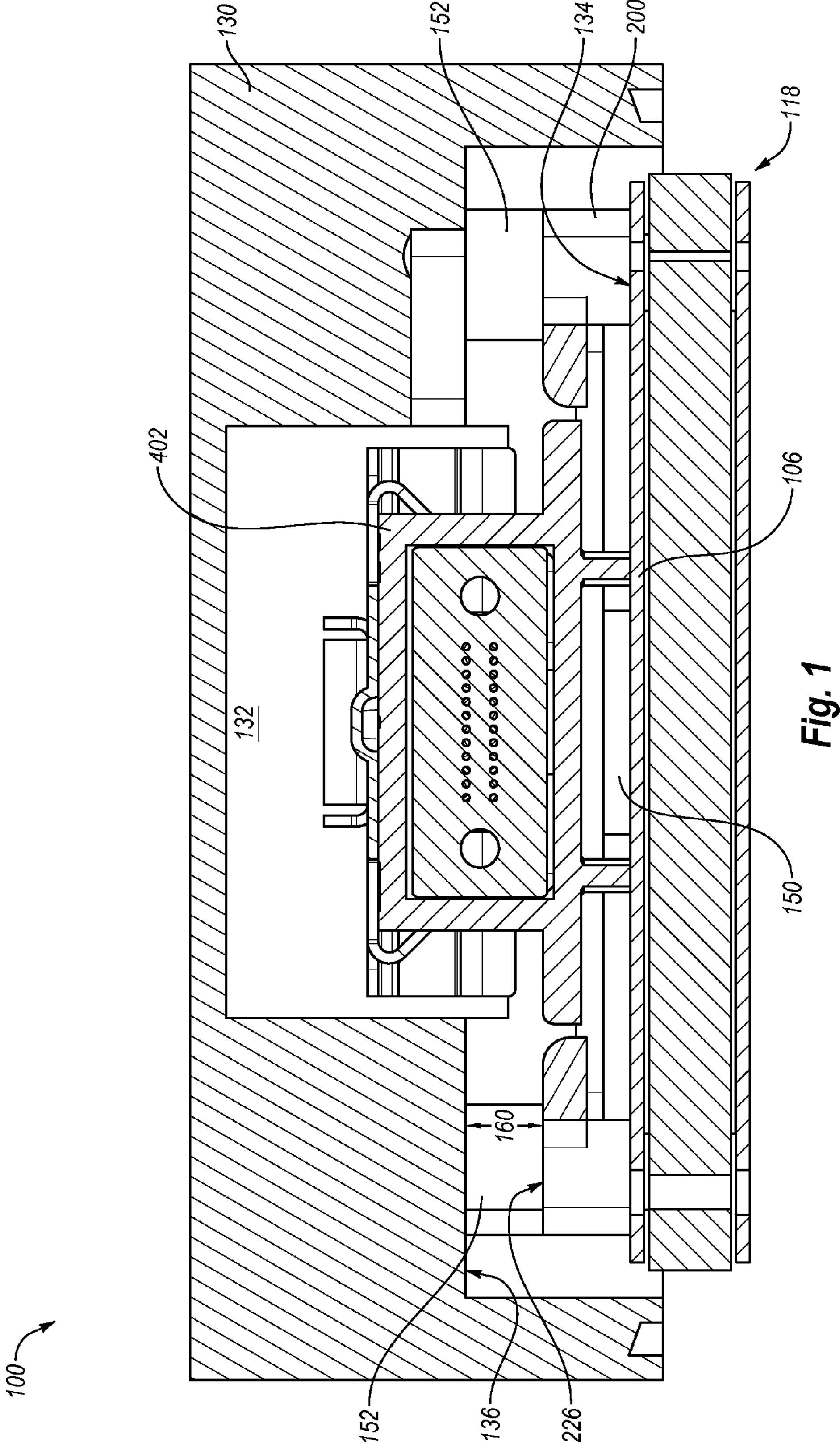


Fig. 1

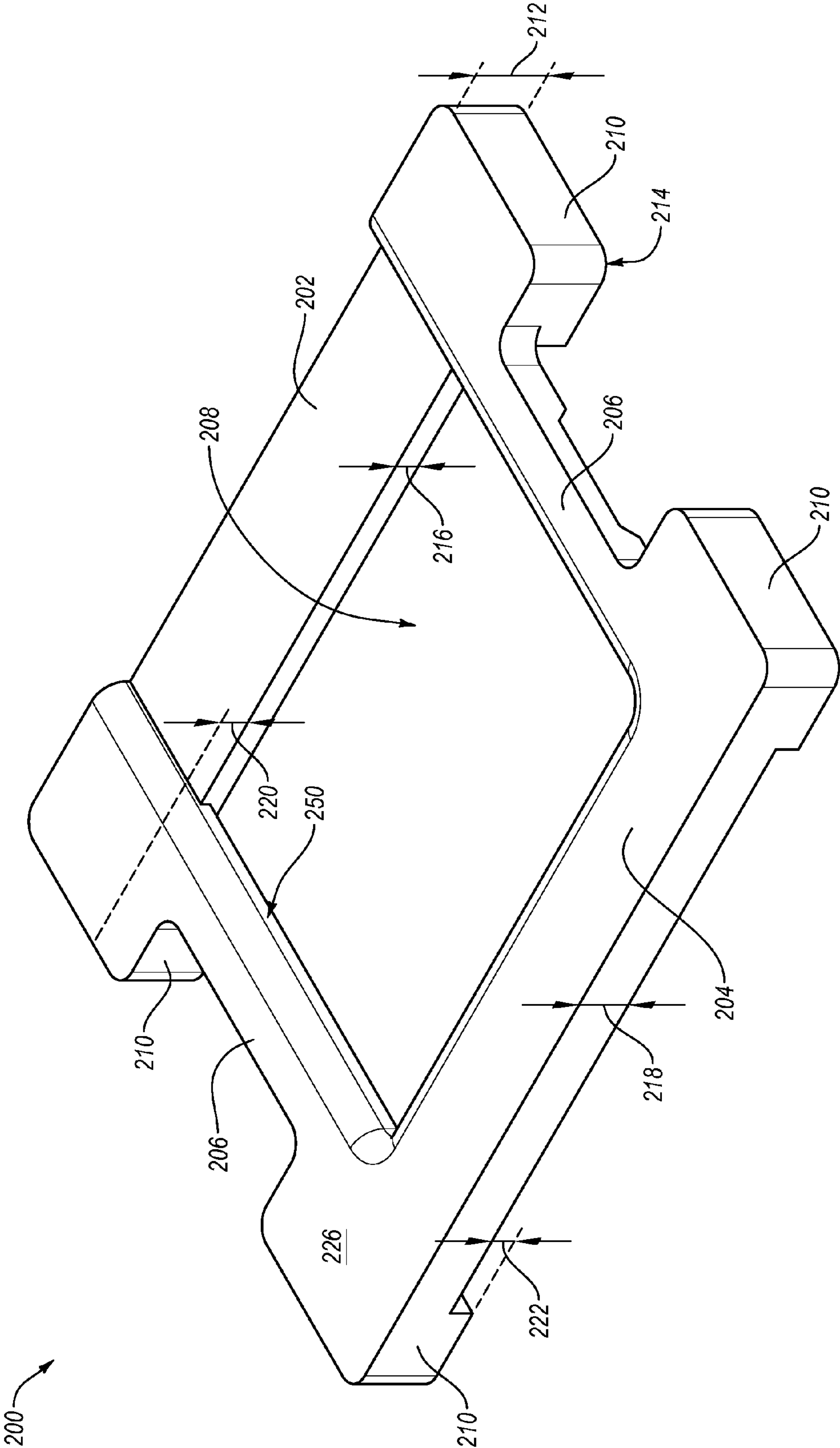


Fig. 2

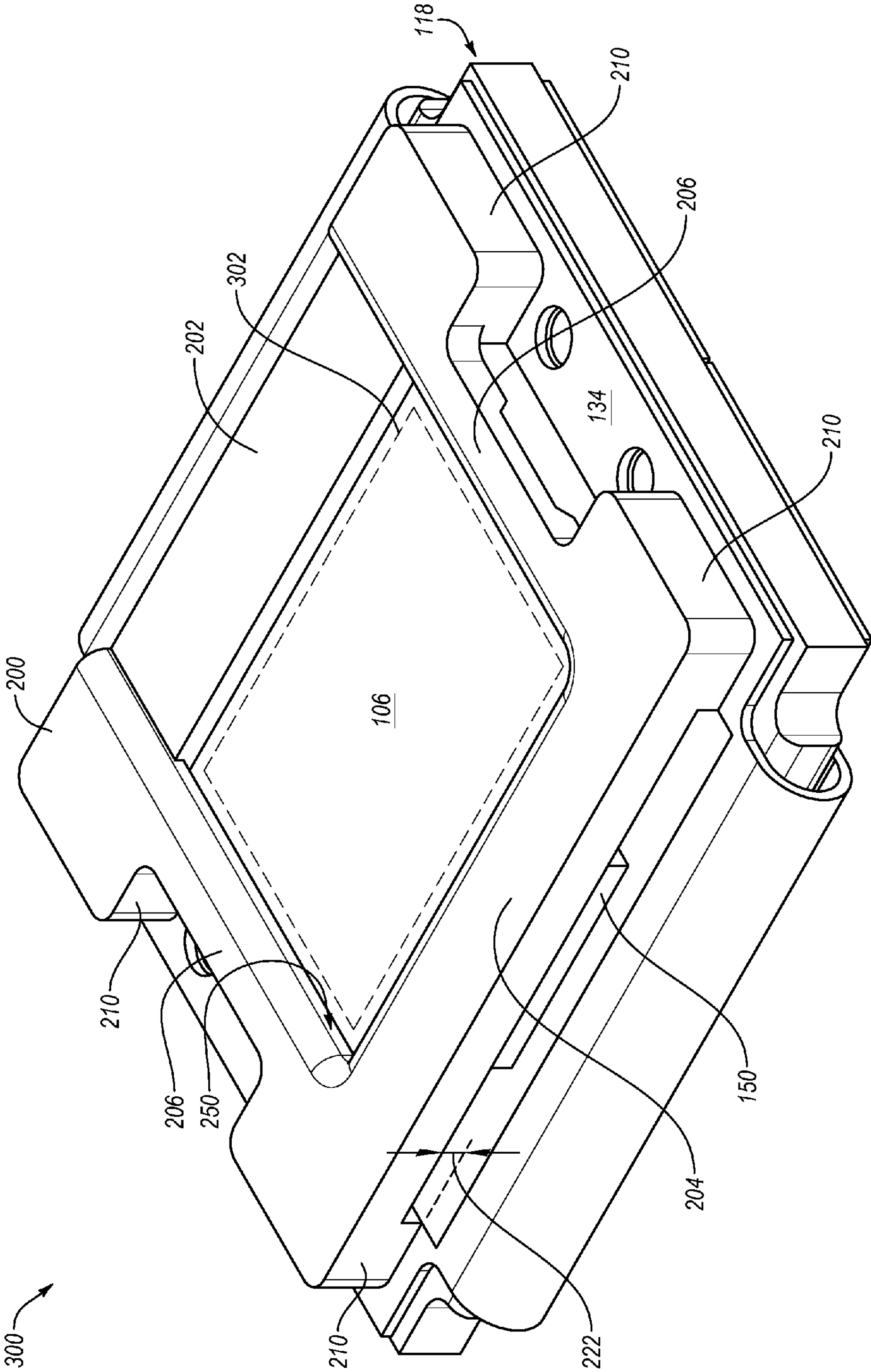


Fig. 3

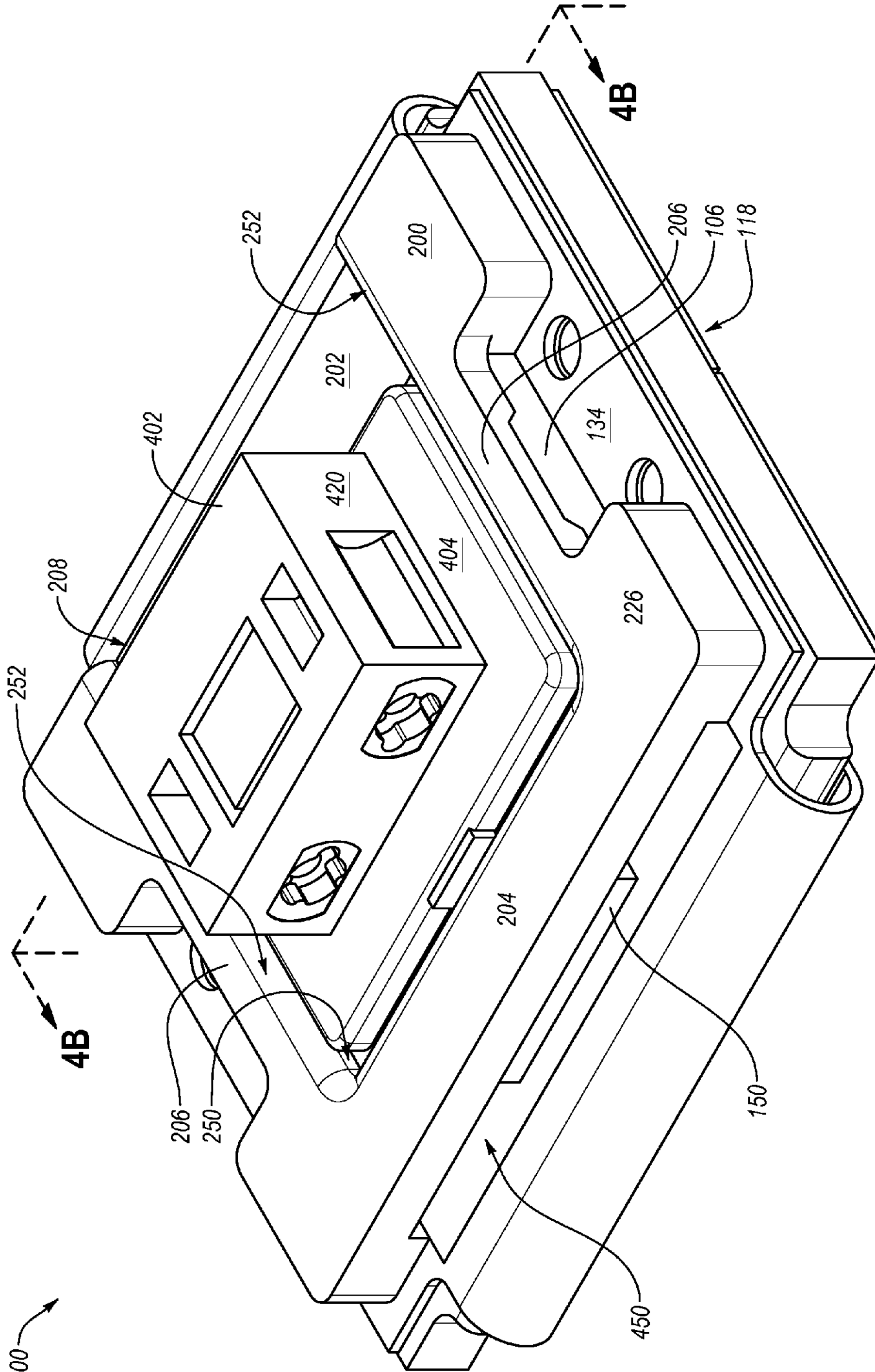


Fig. 4A

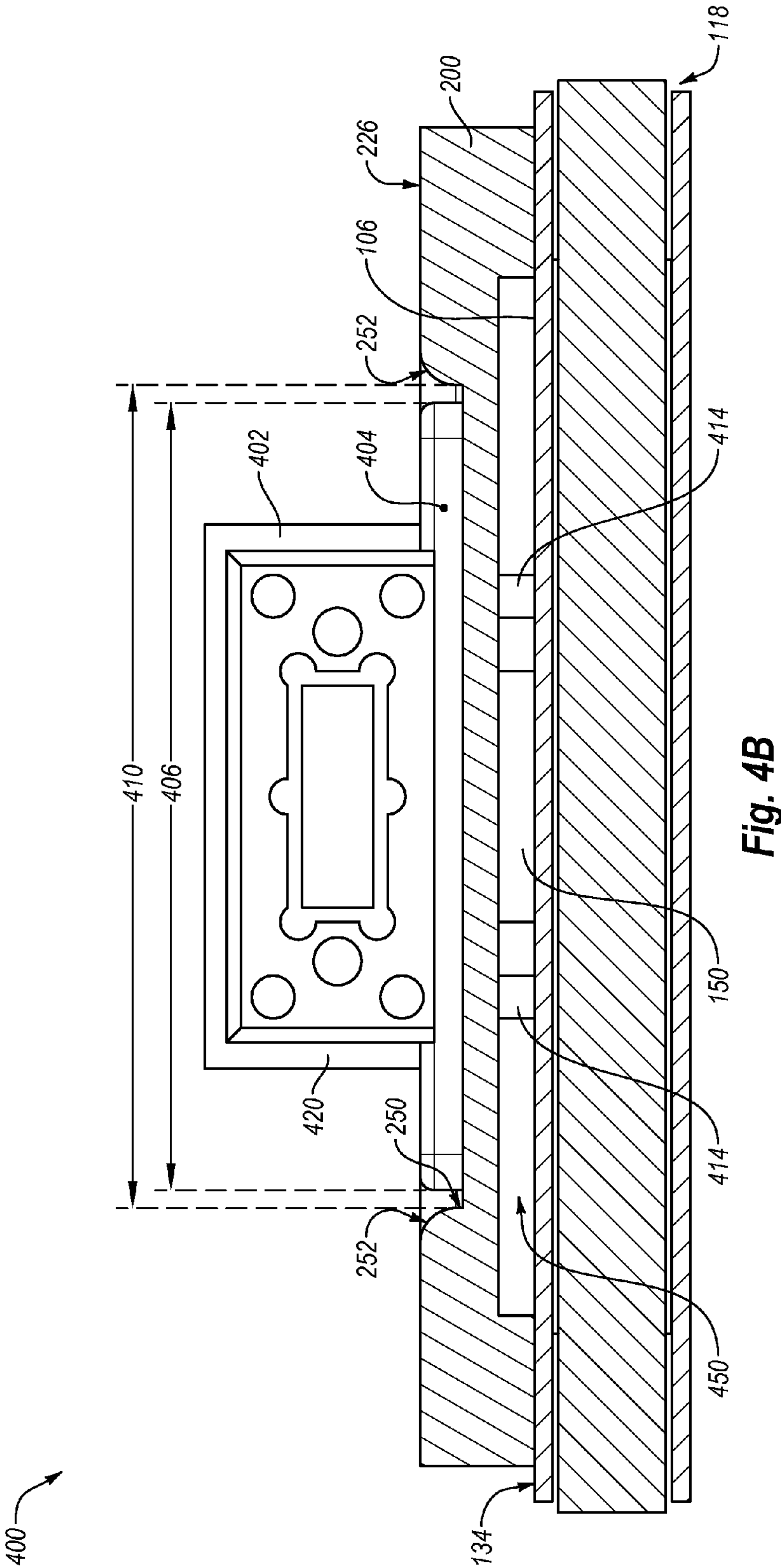


Fig. 4B

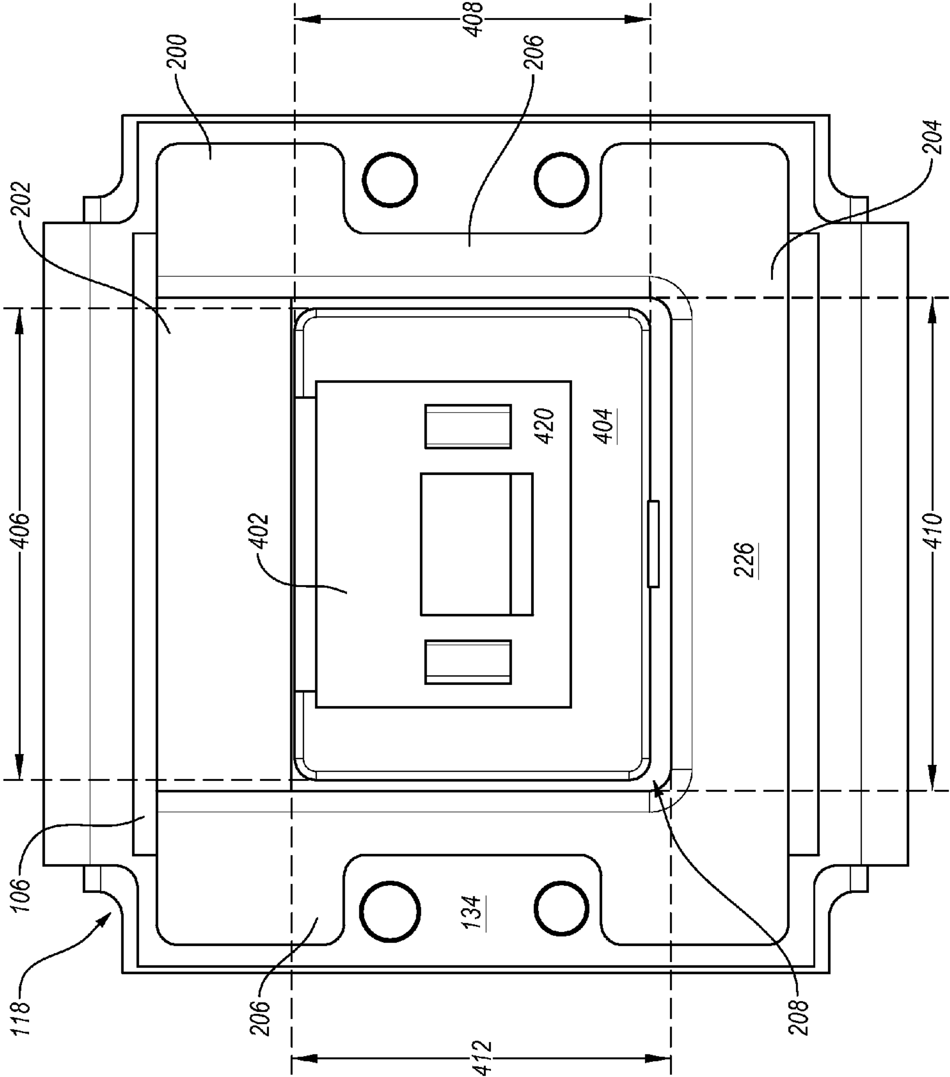


Fig. 4C

THERMAL MANAGEMENT STRUCTURES FOR OPTOELECTRONIC MODULES

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This patent application claims the benefit of and priority to U.S. Provisional Patent Application No. 61/817,784 filed Apr. 30, 2013, which is incorporated herein by reference in its entirety.

FIELD

[0002] Embodiments disclosed herein relate to optical components. More particularly, some example embodiments relate to heat dissipation in optoelectronic modules.

BACKGROUND

[0003] Some data transmission involves the conversion of optical signals to electrical signals and/or electrical signals to optical signals. In some applications, the conversion occurs at a circuit board. For example, an optical fiber carrying one or more optical signals interfaces with a board-mounted optical engine. At the optical engine, the optical signals may be converted from optical signals to electrical signals using optical receivers. The electrical signals may then be communicated along etched copper traces integrated into the circuit board to a destination. Likewise, electrical signals may be communicated along copper traces to the optical engine. At the optical engine, the electrical signals may be converted to optical signals by optical transmitters. The optical signals may then be further communicated along the optical fiber.

[0004] The conversion of the data between optical and electrical domains generates heat. In some circumstances, the heat generated may cause problems with proper function of the components involved in conversion. Additionally, excess heat may shorten the life or cause failure of components involved in the transductions. Moreover, the heat may leak to surrounding components on the circuit board and cause similar problems.

[0005] The subject matter claimed herein is not limited to embodiments that solve any disadvantages or that operate only in environments such as those described above. Rather, this background is only provided to illustrate one exemplary technology area where some embodiments described herein may be practiced.

SUMMARY

[0006] An example embodiment includes an optoelectronic module. The optoelectronic module may include a lens assembly, a module board, heat-generating components, and a thermally conductive plate. The lens assembly may be secured to the module board. The module board may include a printed circuit board (PCB). The heat-generating components may be mounted to the PCB. The thermally conductive plate may be secured to a surface of the module board. The thermally conductive plate may define an opening that receives at least a portion of the lens assembly. The thermally conductive plate may be configured to absorb at least a portion of thermal energy generated during operation of the heat-generating components and to transfer the thermal energy away from the heat-generating components. The lens assembly may be secured to the module board or secured to both the module board and the thermally conductive plate.

[0007] An example embodiment includes a thermal energy dissipation system configured for use in an optoelectronic module. The system may include a cover and a thermally conductive plate. The cover may define a cavity. The cavity may be defined to substantially enclose a top surface of a module board and to at least partially surround a lens assembly secured to the module board and one or more heat-generating components mounted to the top surface of the module board. The thermally conductive plate may be positioned on the top surface of the module board. The thermally conductive plate may be configured to absorb thermal energy generated during operation of the one or more heat-generating components and to dissipate the thermal energy to the cavity and the cover.

[0008] Another embodiment may include a thermally conductive plate (plate). The thermally conductive plate may be configured to dissipate heat from one or more heat-dissipating components of an optoelectronic module. The thermally conductive plate may include a front portion, a rear portion opposite the front portion, two side portions, plate feet, and a bottom surface. The two side portions may connect the front portion to the rear portion. The plate feet may have a foot thickness that is greater than thicknesses of the front portion, the rear portion, and the two side portions. The plate feet may be configured to be secured to a module board such that the front portion, the rear portion, and the side portions are separate from a top surface of the module board. At least a portion of the bottom surface is configured to contact a heat-generating component mounted to the top surface of the module board. The front portion, the rear portion, and the two side portions may define an opening configured to receive at least a portion of a lens assembly.

[0009] The object and advantages of the embodiments will be realized and achieved at least by the elements, features, and combinations particularly pointed out in the claims.

[0010] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are not restrictive of the invention, as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Example embodiments will be described and explained with additional specificity and detail through the use of the accompanying drawings in which:

[0012] FIG. **1** illustrates an example optoelectronic module in which one or more embodiments described herein may be implemented;

[0013] FIG. **2** illustrates an example embodiment of a thermally conductive plate (plate) that may be implemented in the optoelectronic module of FIG. **1**;

[0014] FIG. **3** illustrates an example arrangement of the plate of FIG. **2** with respect to a module board that may be implemented in the optoelectronic module of FIG. **1**; and

[0015] FIGS. **4A-4C** illustrate an example arrangement of a lens assembly in relationship to the plate and the module board of FIGS. **2-3** that may be implemented in the optoelectronic module of FIG. **1**.

DESCRIPTION OF SOME EXAMPLE EMBODIMENTS

[0016] Some embodiments described herein relate to heat dissipation in optoelectronic modules. In an example embodiment, an optoelectronic module includes a lens assembly, a

module board, multiple heat-generating components, a cover, and a thermally conductive plate (plate). The heat-generating components include one or more clock and data recovery (CDR) chips mounted to a printed circuit board (PCB) included on the module board. The plate is configured such that the plate rests on the CDR chips to absorb thermal energy generated during operation of the CDR chips. Some of the thermal energy absorbed by the plate is dissipated throughout the optoelectronic module. In addition, the cover is configured to contact the plate. The contact between the plate and the cover enables further dissipation of the thermal energy through the cover.

[0017] The plate defines an opening configured to at least partially receive the lens assembly. The lens assembly may be received within the opening and adjusted to align or orient the lens assembly with respect to one or more of the heat-generating components. Additionally, the plate supports the lens assembly. Specifically, the lens assembly is bonded to the plate rather than to the PCB.

[0018] Reference will now be made to the drawings to describe various aspects of some additional embodiments. It is to be understood that the drawings are diagrammatic and schematic representations of the embodiments, and are not meant to be limiting, nor are they necessarily drawn to scale. Throughout the appended drawings, like numbers generally reference like structures unless described otherwise.

[0019] FIG. **1** illustrates an example optoelectronic module **100** in which one or more embodiments described herein may be implemented. The optoelectronic module **100** illustrated in FIG. **1** is an optical engine, although the embodiments described herein are not limited to optical engines. In these and other embodiments, the optoelectronic module **100** may be designed for high-speed (e.g., 25 gigabits per second (G) or higher) optical interconnects between integrated circuits and/or between circuit boards.

[0020] FIG. **1** is a sectional view of the optoelectronic module **100**. In the optoelectronic module **100**, a lens assembly **402** and a plate **200** may be positioned within a cavity **132**, which may be defined at least partially by a cover **130**. The cavity **132** may be at least partially bordered or enclosed by a module board **118**. In the depicted configuration, the cover **130** substantially surrounds the lens assembly **402** and substantially encloses a top surface **134** of the module board **118** and components (e.g., **402** and **200**) position or arranged thereon. In this and other embodiments, the cover **130** may be removably secured to the module board **118** or another structure using one or more fasteners (not shown), for instance.

[0021] The optoelectronic module **100** may include one or more optical components, electronic components, and intra-component connections used in optical and/or electrical communication. The optical components, electronic components, and intra-component connections are collectively referred to herein as "heat-generating components" and are represented in FIG. **1** by component **150**. The heat-generating components **150** may include, but are not limited to, a lens, a laser or another optical transmitter, a p region/intrinsic region/n region (PIN) photodiode or another optical receiver, a CDR chip, a monitor photodiode, etc. One or more of the heat-generating components **150** may be mounted to a PCB **106** included in the module board **118**. As used to describe the relationship between the heat-generating components and the PCB **106**, the term "mounted" may include physically and/or electrically coupling the heat-generating components **150** to the PCB.

[0022] During operation of the heat-generating components **150**, thermal energy may be generated. The thermal energy may have the potential to damage one or more of the heat-generating components **150** and/or cause fluctuations in operation of the heat-generating components **150** if the thermal energy is not properly controlled/mitigated. To dissipate some portion of the thermal energy and thereby reduce thermal damage and/or excessive operating fluctuations, the optoelectronic module **100** may include the plate **200**. The plate **200** may be positioned with respect to the heat-generating components **150** such that the thermal energy generated during operation may be absorbed by the plate **200**. The plate **200** may be configured such that the thermal energy absorbed from the heat-generating components may be dissipated.

[0023] In some embodiments, the plate **200** may dissipate the thermal energy to the cavity **132**. The thermal energy may then be conducted to the cover **130** and dissipated to an exterior environment. In these and other embodiments, the plate **200** may be sized to optimize surface area and volume surrounding the plate **200** within the cavity **132**. For example, a cover separation **160**, which is defined between a lower surface **136** of the cover **130** and an upper surface **226** of the plate **200**, may be optimized in these embodiments.

[0024] Alternatively or additionally, some portion of the cover **130** may contact some portion of the plate **200**. For example, a portion of the lower surface **136** may contact a portion of the upper surface **226** of the plate **200**. Accordingly, in these embodiments, the cover separation **160** may be essentially zero. The plate **200** may transfer a portion of the thermal energy absorbed from the heat-generating components **150** to the cover **130**. The thermal energy may then be dissipated to the surrounding environment. In these and other embodiments, the plate **200** may also transfer a portion of the thermal energy to the cavity **132**.

[0025] Alternatively or additionally, a thermal pad **152** may be positioned between a portion of the upper surface **226** of the plate **200** and a portion of the lower surface **136** of the cover **130**. For example, the thermal pad **152** may fill a volume created by the cover separation. The thermal energy, or some portion thereof, may be transferred from the plate **200** to the thermal pad **152**, and then transferred to the cover **130**. The thermal energy may then be dissipated to the surrounding environment. The thermal pad **152** may be composed of a flexible and/or compressible material configured to accommodate for imperfections of the upper surface **226** and/or the lower surface **136**. In these and other embodiments, the plate **200** may also transfer some of the thermal energy to the cavity **132** and/or there may be direct contact between the plate **200** and the cover **130**.

[0026] The optoelectronic module **100** may include the lens assembly **402**. The lens assembly **402** may be configured to receive an optical interface and communicate optical signals carried along the optical interface to one or more of the heat-generating components **150**.

[0027] The optical interface that may be received by the lens assembly **402** may be configured to secure one or more optical fibers used in the communication of optical signals to and from the optoelectronic module **100**. For example, the optical interface may include a pluggable, twenty-four optical channel connector configured to interface with the lens assembly **402** and to communicate twenty-four channels of optical data.

[0028] FIG. **2** illustrates an example embodiment of the plate **200** that may be implemented in the optoelectronic

module **100** of FIG. **1**. The plate **200** may be configured to absorb thermal energy generated during operation of one or more heat-generating components and dissipate the thermal energy. The plate **200** may be composed of a thermally conductive material. For example, the plate **200** may be composed, at least partially, of copper. Alternatively or additionally, the plate **200** may be composed of gold, silver, other metals and/or metal alloys, other thermally conductive material(s), or a combination of materials. In some embodiments, the plate **200** may be a single piece or one or more portions (e.g., **202**, **204**, **208**, or **210**) may be manufactured independently and attached to the other portions. In these and other embodiments, the portions may be composed of the same or differing materials.

[0029] The plate **200** may include a front portion **202**, a rear portion **204**, and two side portions **206** that may connect the front portion **202** to the rear portion **204**. In this and other embodiments, the front portion **202** may be designated as "front" due to a relationship between the plate **200** and a lens assembly when installed into an optoelectronic module. Front indicates the portion of the optoelectronic module (e.g., optoelectronic module **100** of FIG. **1**) in which the optoelectronic module receives an optical interface. The rear portion **204** is generally opposite and parallel to the front portion and the side portions **206** run between the front portion **202** and the rear portion **204** and are generally perpendicular to the front portion **202** and the rear portion **204**.

[0030] The front portion **202**, the rear portion **204**, and the two side portions **206** may define an opening **208**. The opening **208** may be configured to receive a lens assembly such as the lens assembly **402** of FIG. **1** or some portion thereof (discussed below). A sidewall **250** may be defined as an interior surface of the plate **200** that defines and borders the opening **208**. The sidewall **250** is generally a perimeter of the opening **208**. The sidewall **250** may include curved portions and substantially flat portions.

[0031] The plate **200** may also include one or more plate feet **210**. The plate feet **210** may be configured to secure the plate **200** to a module board such as the module board **118**. The plate feet **210** may include a foot thickness **212** defined from the upper surface **226** to a bottom surface **214**. Additionally, the front portion **202** may include a front thickness **216** and the rear portion **204** may include a rear thickness **218**. The front thickness **216** may be defined from the upper surface **226** to a bottom surface **214** of the front portion **202**. The rear thickness **218** may be defined between the upper surface **226** to the bottom surface **214** of the rear portion **204**.

[0032] The foot thickness **212** may be greater than the front thickness **216** and the rear thickness **218**. The foot thickness **212** may accordingly separate the front portion **202**, the rear portion **204**, and the side portions **206** from a module board when the plate **200** is secured to the module board. Lifting the front portion **202**, the rear portion **204**, and the side portions **206** may position the front portion **202**, the rear portion **204**, the side portions **206**, or some combination thereof such that the bottom surface **214** of the respective portion **202**, **204**, or **206** contacts a heat-generating component (e.g., **150** of FIG. **1**). Due to the bottom surface **214** contacting the heat-generating component, thermal energy may be transferred from the heat-generating component to the plate **200**.

[0033] For example, a difference **222** between the rear thickness **218** and the foot thickness **212** may be about equal to a height of a heat-generating component. Thus, the plate **200** may be positioned such that the bottom surface **214** of the rear portion **204** contacts the heat-generating component. Thermal energy may accordingly be transferred directly, e.g., via thermal conduction, from the heat-generating component to the rear portion **204**.

[0034] Additionally in some embodiments, the front thickness **216** may differ from the rear thickness **218**, which may create a clearance **220**. The clearance **220** may enable introduction of an optical interface (not shown) to a lens assembly received in the opening **208**.

[0035] FIG. **3** illustrates an example arrangement **300** of the plate **200** of FIG. **2** with respect to the module board **118** that may be implemented in the optoelectronic module **100** of FIG. **1**. In FIG. **3**, the plate **200** described with reference to FIG. **2** is depicted secured to the module board **118** of FIG. **1**. Accordingly, some components and features (e.g., **106**, **134**, **150**, **208**, **210**, **222**, and **250**) already described with reference to FIGS. **1** and **2** are included in FIG. **3**. Some details of these components and features are not repeated with reference to FIG. **3**.

[0036] The arrangement **300** generally includes the plate **200** being secured to the top surface **134** of the module board **118** via the plate feet **210**. The module board **118** includes the PCB **106**. The PCB **106** may include a central portion of the top surface **134**. One or more heat-generating components **150** may be mounted to the PCB **106**.

[0037] In this and other embodiments, each of the plate feet **210** may be positioned within an area of the top surface **134**, which is outside the PCB **106**. By positioning the plate feet **210** outside the PCB **106**, the plate **200** may be electrically isolated from the heat-generating components **150** mounted to the PCB **106**.

[0038] Additionally, the plate **200** may be positioned on the module board **118** with respect to one or more of the heat-generating components **150**. For example, the front portion **202**, the rear portion **204**, the side portions **206**, or some combination thereof may be positioned such that the bottom surface **214** of the respective portion **202**, **204**, and/or **206** contacts one or more of the heat-generating components **150**. Specifically, the difference **222** may enable the heat-generating component **150** to be positioned directly below the rear portion **204** and may further enable the rear portion **204** to contact a top surface of the heat-generating component **150**.

[0039] Additionally, the opening **208** defined by the plate **200** may be positioned over a middle portion of the PCB **106**. The middle portion is represented in FIG. **3** by a boxed area with a dashed border **302**. The heat-generating components (not shown) mounted to the middle portion **302** of the PCB **106** may be involved in the communication of optical data, for instance.

[0040] FIGS. **4**A-**4**C illustrate an example arrangement **400** of the lens assembly **402** in relationship to the plate **200** and the module board **118** of FIGS. **2**-**3** that may be implemented in the optoelectronic module **100** of FIG. **1**. Specifically, FIG. **4**A depicts a perspective view of the arrangement **400**. FIG. **4**B depicts a sectional view of the arrangement **400**. FIG. **4**C depicts a top view of the arrangement **400**. In some embodiments, FIGS. **4**A-**4**C may substantially depict the optoelectronic module **100** of FIG. **1** with the cover **130** removed. The arrangement **400** of FIGS. **4**A-**4**C includes components and features (e.g., **106**, **134**, **150**, **200**, **202**, **204**, **206**, **208**, and **250**) already described with reference to FIGS. **1**-**3**. Some details of the components and features are not repeated with reference to FIGS. **4**A-**4**C.

[0041] As discussed with reference to FIG. **3**, the plate **200** may be secured to the top surface **134** of the module board **118**. For example, the plate **200** may be secured to the outside portion of the top surface **134** that includes the PCB **106**. The plate **200** may further be arranged such that one or more of the front portion **202**, the rear portion **204**, and the side portions **206** contact a heat-generating component **150** mounted to the PCB **106**. The opening **208** defined by the plate **200** may be positioned over a middle portion (**302** of FIG. **3**) of the PCB **106** such that one or more heat-generating components mounted to the middle portion of the PCB **106** are not covered by the plate **200**.

[0042] The lens assembly **402** may be positioned with respect to the opening **208**. The positioning of the lens assembly **402** may enable communication of data between the heat-generating components in the middle portion of the PCB through the lens assembly **402** and to an optical interface (not shown) received in the lens assembly **402**.

[0043] In the depicted embodiment, the lens assembly **402** or some portion thereof may be received within the opening **208** defined in the plate **200**. Specifically, the lens assembly **402** may include a lens base **404**. The lens base **404** may include a portion of the lens assembly **402** that structurally supports a receiving portion **420** of the lens assembly **402**.

[0044] The lens base **404** may include a base length **406** (FIGS. **4**B and **4**C only) and a base width **408** (FIG. **4**C only). The base length **406** and the base width **408** may be less than an opening length **410** (FIGS. **4**B and **4**C only) and an opening width **412** (FIG. **4**C only), respectively. In these and other embodiments, a difference between the base length **406** and the opening length **410** and/or a difference between the base width **408** and the opening length **410** may enable adjustment of the lens assembly **402** with respect to the plate **200** and/or the PCB **106**. An adjustment of the lens assembly **402** may further enable alignment of the lens assembly **402** with respect to one or more heat-generating components mounted to the middle portion of the PCB **106**.

[0045] Additionally, in this and other embodiments, the lens assembly **402** may include one or more lens supports **414** (FIG. **4**B only). The lens supports **414** may extend from the lens base **404** to be secured to the PCB **106** and/or the module board **118**. Inclusion of the lens supports **414** may enable a reduction in an area on the PCB **106** occupied by the lens assembly **402** when compared to embodiments without the lens supports **414**. For example, in embodiments without lens supports **414**, the lens assembly **402** may be secured the PCB **106**. An area occupied by the lens assembly **402** may be about equal to an area of a bottom surface of the lens base **404**. However, with the lens supports **414**, the lens assembly **402** may only occupy an area on the PCB **106** about equal to a sum of areas of bottom surfaces of the lens supports **414**.

[0046] Additionally, as best illustrated in FIG. **4**B, the lens supports **414** may elevate the lens assembly **402**. A volume **450** between lens assembly **402** and the PCB **106** may enable circulation, thus dissipating of some thermal energy. For instance, the circulation may dissipate thermal energy generated by operation of one or more heat-generating components mounted to the PCB **106**.

[0047] Additionally, by elevating the lens assembly **402**, the "real estate" of the PCB **106** below the lens assembly **402** available for components may increase. An increase in the real estate below the lens assembly **402** may further enable positioning of a larger variety of components below the lens assembly **402**. For example, in some optoelectronic modules the lens assembly **402** may define the area on the PCB **106** in which optical components are positioned. For instance, optical drivers and receivers may be positioned on a portion of a PCB **106** within the lens assembly **402**. However, by elevating the lens assembly **402** there may be additional space where other components may be positioned.

[0048] In some embodiments, the lens base **404** may be configured such that the lens assembly **402** may be secured to the sidewall **250** (FIGS. **4**A and **4**B only) of the opening **208**. In these and other embodiments, the base length **406** may be about equal to the opening length **410** and/or the base width **408** may be about equal to the opening width **412**. In these and other embodiments, rather than the lens base **404** being entirely received into the opening **208**, the lens assembly **402** may be secured to the sidewall **250** of the opening **208**.

[0049] Additionally, in some embodiments in which the lens assembly **402** is secured to the sidewall **250** of the opening **208**, the lens base **404** may be affixed, bonded, or epoxied to the sidewall **250**. For instance, the lens assembly **402** may be affixed around a perimeter of the lens base **404**. Affixing the lens assembly **402** to the sidewall **250** may seal the opening **208** defined by the plate **200**. By sealing the opening **208**, one or more of the heat-generating components **150** may be protected. Additionally or alternatively, emission of electromagnetic radiation (EMR) generated by the heat-generating components **150** may be reduced. For example, the EMR may be substantially prevented from escaping through the opening **208** and may accordingly be sealed within a volume between the plate **200** and the top surface **134** of the module board **118**. Additionally, in embodiments in which the lens assembly **402** is secured to the sidewall **250** of the opening **208**, the lens assembly **402** may include one or more lens supports **414**, which may function and provide one or more benefits as described above.

[0050] Additionally, in some embodiments in which the lens assembly **402** is secured to the sidewall **250** of the opening **208**, the lens base **404** may be secured (e.g., affixed, bonded, or epoxied) to the sidewall **250** along some portion of the sidewall **250**. The portion of the sidewall **250** along which the lens base **404** is secured may be optimized to reduce thermal stresses induced on the lens assembly **400**. In some embodiments, the portion along which the lens base **404** is secured to the plate **200** may be minimized such that the lens assembly **400** is held in a particular position with respect to one or more of the heat-generating components **150** and such that the thermal stresses imposed on the lens assembly **400** by the plate **200** may be minimized. For example, the rear portion **204** of the plate **200** may contact the heat-generating components **150**. According, the lens base **404** may be secured to the sidewall **250** along side portions **252** (FIG. **4**A only) of the sidewall **250**. By securing the lens base **404** along the side portions **252**, the lens assembly **400** may be held in a particular position while leaving some space between the lens base **404** and rear portion **204** of the plate **200**, which may reduce thermal stresses imposed on the lens assembly **400**. In other embodiments, the lens base **404** may be secured along another section and/or one or more other sections of the sidewall **250**. For example, the lens base **404** may be secured at one or more corners of the opening **208**, along one of the side portions **252**, a section of one of the side portions **252**, along a section of the lens base **404** near the rear portion **204**, the side portions **206** or the front portions, or any combination thereof.

[0051] The present invention may be embodied in other specific forms. The described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

What is claimed is:

1. An optoelectronic module comprising:

a lens assembly;

a module board including a printed circuit board (PCB), wherein the lens assembly is secured to the module board;

heat-generating components mounted to the PCB; and

a thermally conductive plate secured to a surface of the module board, wherein the thermally conductive plate defines an opening that receives at least a portion of the lens assembly and the thermally conductive plate is configured to absorb at least a portion of thermal energy generated during operation of the heat-generating components and to transfer the thermal energy away from the heat-generating components.

2. The optoelectronic module of claim **1**, wherein the opening is configured to receive a lens base of the lens assembly and to allow for positional adjustment of the lens assembly with respect to at least one of the heat-generating components.

3. The optoelectronic module of claim **2**, wherein:

the lens assembly is further secured to a portion of a sidewall of the opening; and

the portion of the sidewall along which the lens assembly is secured is minimized such that the lens assembly is held in a particular position with respect to the at least one of the heat-generating components and such that thermal shock imposed by the thermally conductive plate is minimized.

4. The optoelectronic module of claim **1**, wherein the lens assembly includes:

a lens base that is secured to at least a portion of a sidewall of the opening; and

one or more lens supports that extend from the lens base and are configured to contact the PCB.

5. The optoelectronic module of claim **4**, wherein the lens base is secured to the thermally conductive plate along the sidewall to reduce electromagnetic radiation emission from the heat-generating components.

6. The optoelectronic module of claim **1**, further comprising a cover that contacts at least a portion of the thermally conductive plate to receive at least some of the thermal energy from the thermally conductive plate.

7. The optoelectronic module of claim **1**, further comprising:

a cover including a lower surface that is separated from an upper surface of the thermally conductive plate by a cover separation; and

the thermal pad positioned in between the lower surface and the upper surface that is configured to accommodate imperfections of the upper surface or the lower surface.

8. The optoelectronic module of claim **1**, wherein the heat-generating components include one or more clock and data recovery (CDR) chips, the thermally conductive plate contacting the CDR chips to absorb thermal energy generated during operation of the CDR chips.

9. The optoelectronic module of claim **1**, wherein the thermally conductive plate comprises copper.

10. A thermal energy dissipation system configured for use in an optoelectronic module, the system comprising:

a cover defining a cavity, wherein the cavity is defined to substantially enclose a top surface of a module board and to at least partially surround a lens assembly secured to the module board and one or more heat-generating components mounted to the top surface of the module board; and

a thermally conductive plate positioned on the top surface of the module board, wherein the thermally conductive plate is configured to absorb thermal energy generated during operation of the one or more heat-generating components and to dissipate the thermal energy to the cavity and the cover.

11. The system of claim **10**, wherein:

the thermally conductive plate includes a front portion, a rear portion, and two side portions; and

a bottom surface of the front portion and the rear portion is configured to contact at least some of the one or more heat-generating components.

12. The system of claim **11**, wherein the cover includes a lower surface configured to contact an upper surface of the two side portions of the thermally conductive plate such that thermal energy may be transferred from the thermally conductive plate to the cover via thermal conduction.

13. The system of claim **11**, wherein:

the thermally conductive plate defines an opening configured to receive at least a portion of the lens assembly;

the thermally conductive plate includes a sidewall that defines the perimeter of the opening; and

a portion of the sidewall is configured to be secured to the lens assembly to hold the lens assembly in a particular position and minimize thermal stresses imposed on the lens assembly.

14. The system of claim **10**, wherein:

the thermally conductive plate includes a front portion having a front thickness, a rear portion having a rear thickness, two side portions, and plate feet having a foot thickness;

the foot thickness that is greater than the rear thickness and the front thickness; and

the plate feet are configured to contact the top surface of the module board such that the front portion, the rear portion, and the side portions are separated from the top surface of the module board.

15. The system of claim **14**, wherein the front thickness is sized to provide clearance for introduction of an optical interface to the lens assembly.

16. The system of claim **10**, wherein the cover includes a lower surface configured to be positioned above a portion of an upper surface of the thermally conductive plate, the system further comprising a thermal pad positioned in between the lower surface and the upper surface that is configured to accommodate imperfections of the upper surface or the lower surface.

17. The system of claim **10**, wherein the heat-generating components include a clock and data recovery (CDR) chip.

18. A thermally conductive plate configured to dissipate heat from one or more heat-dissipating components of an optoelectronic module, the thermally conductive plate comprising:

a front portion;
a rear portion opposite the front portion;
two side portions connecting the front portion to the rear portion;
plate feet having a foot thickness that is greater than thicknesses of the front portion, the rear portion, and the two side portions, wherein the plate feet are configured to be secured to a module board of the optoelectronic module such that the front portion, the rear portion, and the side portions are separated from a top surface of the module board; and
a bottom surface, wherein at least a portion of the bottom surface is configured to contact a heat-generating component mounted to the top surface of the module board,
wherein the front portion, the rear portion, and the two side portions define an opening configured to receive at least a portion of a lens assembly.

19. The thermally conductive plate of claim **18**, wherein:
the front portion includes a front thickness;
the rear portion includes a rear thickness; and
the front thickness is less than the rear thickness to provide clearance for introduction of an optical interface to the lens assembly received in the opening.

20. The thermally conductive plate of claim **18**, wherein the opening is configured to receive a lens base of the lens assembly and to allow for positional adjustment of the lens assembly with respect to at least one of the heat-generating components.

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