MECHANICALLY REINFORCED ELECTRICAL PACKAGES WITH ELONGATED INTERCONNECT MEMBERS

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of priority U.S. Provisional Patent Application No. 63/296,424, filed January 4, 2022 and titled "PACKAGES WITH ELONGATED INTERCONNECT MEMBERS," U.S. Provisional Patent Application No. 63/296,425, filed January 4, 2022 and titled "PACKAGES WITH REINFORCED INTERCONNECT MEMBERS," and U.S. Provisional Patent Application No. 63/305,985, filed February 2, 2022 and titled "MECHANICALLY REINFORCED ELECTRICAL PACKAGES," the contents of each of which are hereby incorporated by reference in their entirety.

BACKGROUND

Technical Field

[0002] Embodiments of this disclosure relate to packaging of circuit devices, such as radio frequency modules that can be mounted on a circuit board, and more particularly to packaging of circuit devices with interconnect members of different shapes or sizes.

Description of Related Technology

[0003] Circuit devices, such as radio frequency modules, can be implemented in a packaged module. Such devices can be connected to a mother board (e.g., of an electronic device) via solder joints (e.g., solder balls). Mechanical shock tests (e.g., drop tests) are often performed to test the connection between the mother board and the circuit devices (e.g., the connection provided by the solder joints). As the size of the pads of circuit boards (e.g., mother boards) in electronic devices decrease (e.g., to decrease the size of the electronic device), which require a corresponding decrease in size of the connections in packages mounted to the circuit board, stresses during testing can result in increased failure rate of packages.

SUMMARY

[0004] The innovations described in the claims each have several examples, no single one of which is solely responsible for its desirable attributes. Without limiting the scope of the claims, some prominent features of this disclosure will now be briefly described.

[0005] Various examples disclosed herein can relate to an electrical package, which can include a substrate having a first side and a second side opposite the

first side, one or more electrical components mounted to the substrate, and a plurality of electrically conductive interconnect members coupled to the second side of the substrate. At least one of the interconnect members can have an elongated shape with a length that is longer than a width.

[0005a] In one aspect, the present disclosure refers to an electrical package comprising a substrate having a first side and a second side opposite the first side, one or more electrical components mounted to the substrate, and a plurality of electrically conductive interconnect members coupled to the second side of the substrate, including at least one of the interconnect members that has an elongated shape with a length that is longer than a width.

[0006] The one or more electrical components can be mounted to the first side of the substrate. One or more additional electrical components can be mounted to the second side of the substrate. The electrical package can include a mold structure extending over at least part of the second side of the substrate and/or at least partially surrounding the one or more additional electrical components. The electrical package can include a mold structure extending over at least part of the first side of the substrate and/or at least partially surrounding the one or more electrical components. The substrate can have a generally rectangular shape in plan view with four corners. The interconnect member with the elongated shape positioned can be at or proximate one of the corners. Others of the interconnect members can have a generally circular shape in plan view and can be disposed inward from the one of the corners. The substrate can have a corner, and the closest interconnect member to the corner can have the elongated shape. A plurality of the interconnect members can have a generally circular shape in plan view with a substantially uniform diameter. The at least one of the interconnect members with the elongated shape can have a width that is substantially equal to the diameter of the circular interconnect members and a length that is at least two times the diameter of the circular interconnect members. The interconnect member with the elongated shape can be a furthest interconnection member from a center of the package. The at least one interconnect member with the elongated shape can have a length L that is substantially equal to $n \cdot W + (n-1) \cdot G$, where n is a positive integer, W is a width of the interconnect member, and G is a distance between adjacent interconnect members. The interconnect members can be arranged as a grid, with a group of the interconnect members each occupying a single grid cell, and the interconnect member with the elongated shape occupying at least two grid cells arranged linearly. The package can be a dual-sided molded package.

[0007] Various examples disclosed herein can relate to an electrical package, which can include a substrate having a first side and a second side opposite the first side, one or more electrical components mounted to the substrate, a plurality of first electrically conductive interconnect members coupled to the second side of the substrate and having substantially uniform widths, and at least one second electrically conductive

interconnect member having a width that is substantially the same as the substantially uniform widths of the first interconnect members and a length that is greater than or equal to a combined length of two of the first interconnect members.

[0007a] In another aspect, the present disclosure refers to an electrical package comprising a substrate having a first side and a second side opposite the first side, one or more electrical components mounted to the substrate, a plurality of first electrically conductive interconnect members coupled to the second side of the substrate and having substantially uniform widths, and at least one second electrically conductive interconnect member having a width that is substantially the same as the substantially uniform widths of the first interconnect members and a length that is greater than or equal to a combined length of two of the first interconnect members.

[0008] The one or more electrical components can be mounted to the first side of the substrate. One or more additional electrical components can be mounted to the second side of the substrate. The electrical package can include a mold structure extending over at least part of the second side of the substrate and/or at least partially surrounding the one or more additional electrical components. The electrical package can include a mold structure extending over at least part of the first side of the substrate and/or at least partially surrounding the one or more electrical components. The substrate can have a generally rectangular shape in plan view with four corners. The at least one second interconnect member can be positioned at or proximate to at least one of the corners. The first interconnect members can have a generally circular shape in plan view. At least one of the second interconnect members can be a furthest interconnection member from a center of the package. The at least one interconnect member with the elongated shape can have a length L that is substantially equal to $n \cdot W + (n-1) \cdot G$, where n is a positive integer, W is the width of the first interconnect members, and G is a distance between adjacent first interconnect members. The interconnect members can be arranged as a grid, with the first interconnect members each occupying a single grid cell, and the second interconnect member each occupying at least two grid cells. The second interconnect member can have a shape of two of the first interconnect members coupled by a bridge portion. The second interconnect member can have a generally capsular shape. The package can be a dual-sided molded package.

[0009] Various examples disclosed herein can relate to an electrical package, which can include a substrate having a first side and a second side opposite the first side, one or more electrical components mounted to the substrate, and a plurality of electrically conductive interconnect members arranged as a two-dimensional array on the second side of the

substrate. A plurality of the interconnect members can each occupy one array location. At least one of the interconnect members can occupy at least two array locations.

[0009a] In yet another aspect, the present disclosure refers to an electrical package comprising a substrate having a first side and a second side opposite the first side, one or more electrical components mounted to the substrate, and a plurality of electrically conductive interconnect members arranged as a two-dimensional array on the second side of the substrate, including a plurality of the interconnect members that each occupy one array location, and at least one of the interconnect members that occupies at least two array locations.

[0010] The one or more electrical components can be mounted to the first side of the substrate. One or more additional electrical components can be mounted to the second side of the substrate. The electrical package can include a mold structure extending over at least part of the second side of the substrate and/or at least partially

surrounding the one or more additional electrical components. The electrical package can include a mold structure extending over at least part of the first side of the substrate and/or at least partially surrounding the one or more electrical components. The package can be a dual-sided molded package. The interconnect members that occupy one array location can have a generally circular shape. The substrate can have a generally rectangular shape in plan view with four corners. The at least one interconnect member that occupies at least two array locations can be positioned at or proximate to at least one of the corners. The at least one interconnect member that occupies at least two array locations can be a furthest interconnection member from a center of the package. The at least one interconnect member that occupies at least two array locations can have a length L that is substantially equal to $n \cdot W + (n-1) \cdot G$, where n is a positive integer, W is the width of the interconnect members, and G is a distance between adjacent interconnect members. The second interconnect member can have a generally capsular shape.

[0011] Various examples disclosed herein can relate to an electrical package, which can include a substrate having a first side, a second side opposite the first side, and at least one corner. One or more electrical components can be mounted to the substrate. A plurality of electrically conductive interconnect members can be coupled to the second side of the substrate. At least one of the interconnect members can be closest to the corner and can have a larger size than inner interconnect members that are positioned further inward away from the corner.

[0011a] In yet another aspect, the present disclosure refers to an electrical package comprising a substrate having a first side, a second side opposite the first side, and at least one corner, one or more electrical components mounted to the substrate, and a plurality of electrically conductive interconnect members coupled to the second side of the substrate, including at least one of the interconnect members that is closest to the corner and has a larger size than inner interconnect members that are positioned further inward away from the corner.

[0012] The one or more electrical components can be mounted to the first side of the substrate. One or more additional electrical components can be mounted to the second side of the substrate. The electrical package can include a mold structure extending over at least part of the second side of the substrate and/or at least partially surrounding the one or more additional electrical components. The electrical package can include a mold structure extending over at least part of the first side of the substrate and/or at least partially surrounding the one or more electrical components. At least some of the inner interconnect members can have a generally circular shape. The at least one interconnect member that is closest to the corner can have a

generally capsular shape. The interconnect members can be arranged as a grid. At least some of the inner interconnect members can occupy a single grid cell. The interconnect member that is closest to the corner can occupy at least two grid cells.

[0013] Various examples disclosed herein can relate to an electrical package, which can include a substrate having a first side and a second side opposite the

first side, one or more electrical components mounted to the substrate, and a plurality of electrically conductive interconnect members coupled to the second side of the substrate. At least one of the interconnect members that is furthest from a center of the substrate can have a larger size than others of the interconnect members that are positioned closer to the center.

[0013a] In yet another aspect, the present disclosure refers to an electrical package comprising a substrate having a first side and a second side opposite the first side, one or more electrical components mounted to the substrate, and a plurality of electrically conductive interconnect members coupled to the second side of the substrate, including at least one of the interconnect members that is furthest from a center of the substrate and has a larger size than others of the interconnect members that are positioned closer to the center.

[0014] The one or more electrical components can be mounted to the first side of the substrate. One or more additional electrical components can be mounted to the second side of the substrate. The electrical package can include a mold structure extending over at least part of the second side of the substrate and/or at least partially surrounding the one or more additional electrical components. The electrical package can include a mold structure extending over at least part of the first side of the substrate and/or at least partially surrounding the one or more electrical components. At least some of the others of the interconnect members can have a generally circular shape. The at least one interconnect member that is furthest from the center can have a generally capsular shape. The at least one interconnect member that is furthest from the center can be positioned at or proximate to a corner of the package. The interconnect members can be arranged as a grid, with at least some of the other interconnect members each occupying a single grid cell, and the interconnect member that is furthest from the center can occupy at least two grid cells.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] Embodiments of this disclosure will now be described, by way of non-limiting example, with reference to the accompanying drawings.

[0016] Figure 1 shows a cross-sectional schematic view of an example of an electrical package.

[0017] Figure 2 shows a cross-sectional schematic view of an example of an electrical package and an associated circuit board.

[0018] Figure 3 shows a plan view of a second side of an example of a package.

[0019] Figure 4 shows example interconnect members.

[0020] Figure 5 shows additional example interconnect members.

[0021] Figure 6 shows a plan view of a second side of an example of a package.

[0022] Figure 7 shows a plan view of a second side of an example of a package.