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(54) **ELECTRONIC MODULE**

(71) Applicant: **SHINDENGEN ELECTRIC MANUFACTURING CO., LTD.**, Tokyo (JP)

(72) Inventors: **Soichiro UMEDA**, Saitama (JP); **Atsushi KYUTOKU**, Saitama (JP)

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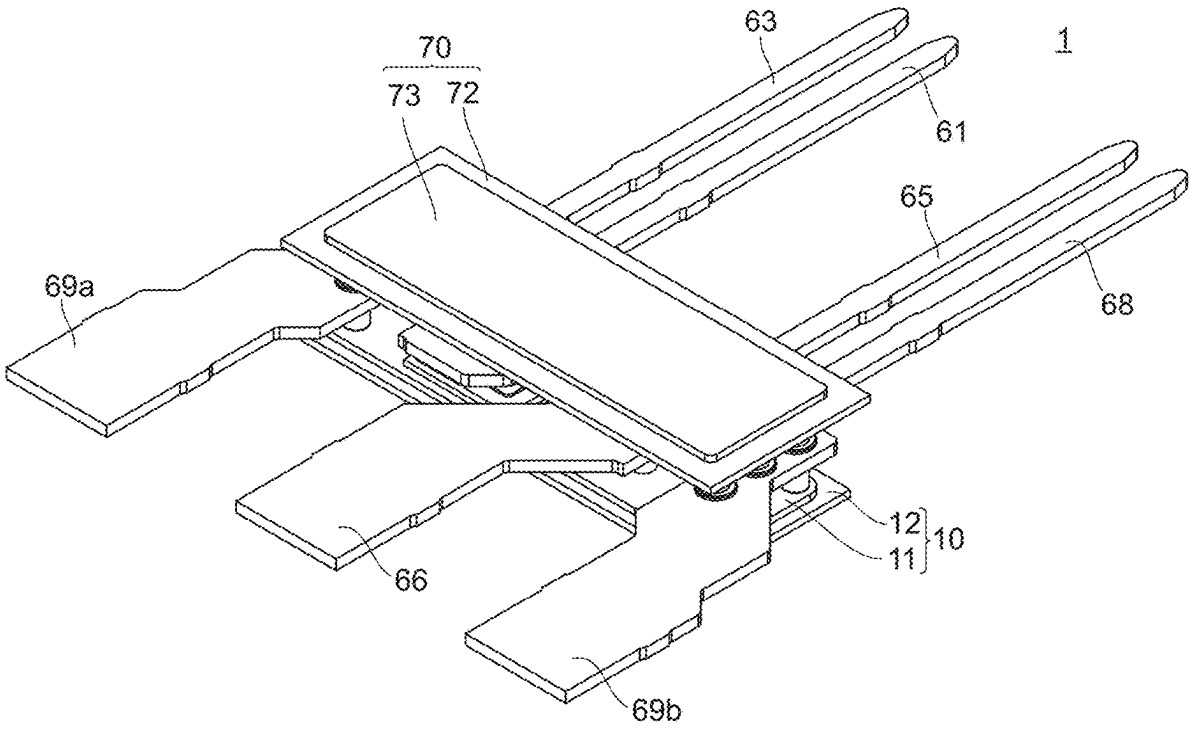
(57) **ABSTRACT**

An electronic module includes: a first board; a chip disposed on the first board and having a main electrode and a control electrode on a surface thereof on a side opposite to a surface thereof on a first board side; a power chip connection terminal disposed on the main electrode and being electrically connected to the main electrode; and a signal chip connection terminal having a columnar shape disposed on the control electrode and being electrically connected with the control electrode.



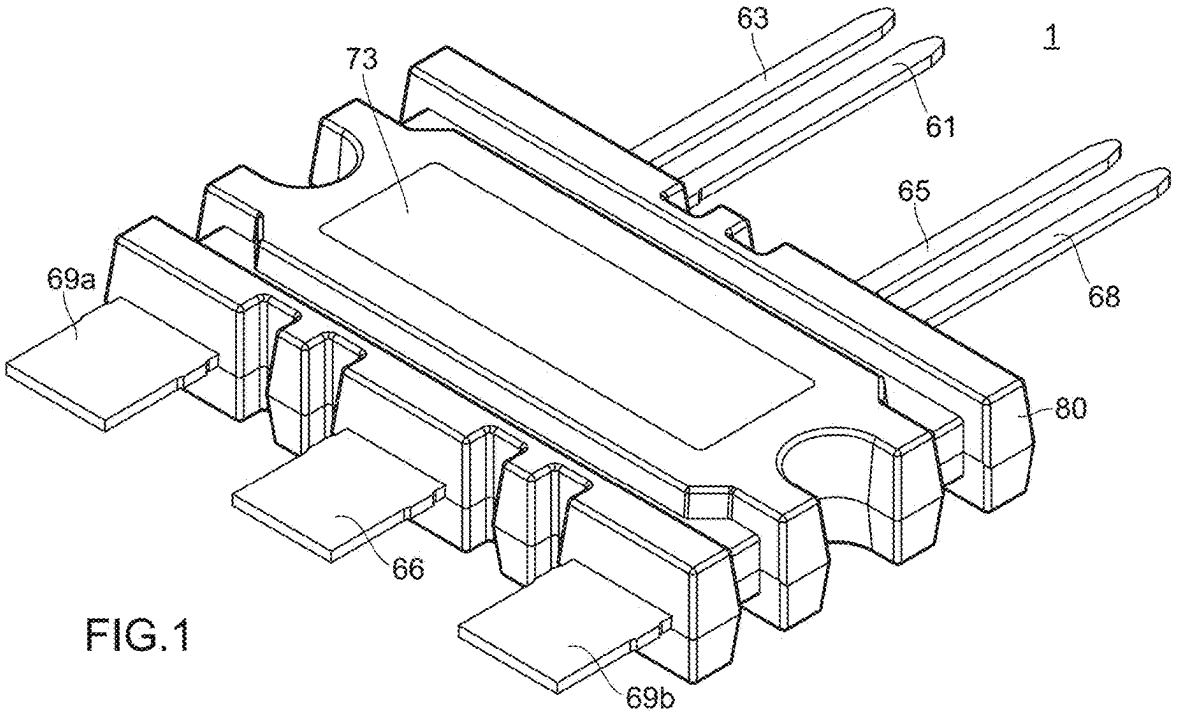

63
1
73
61
65
69a
68
80
66
69b

FIG.1

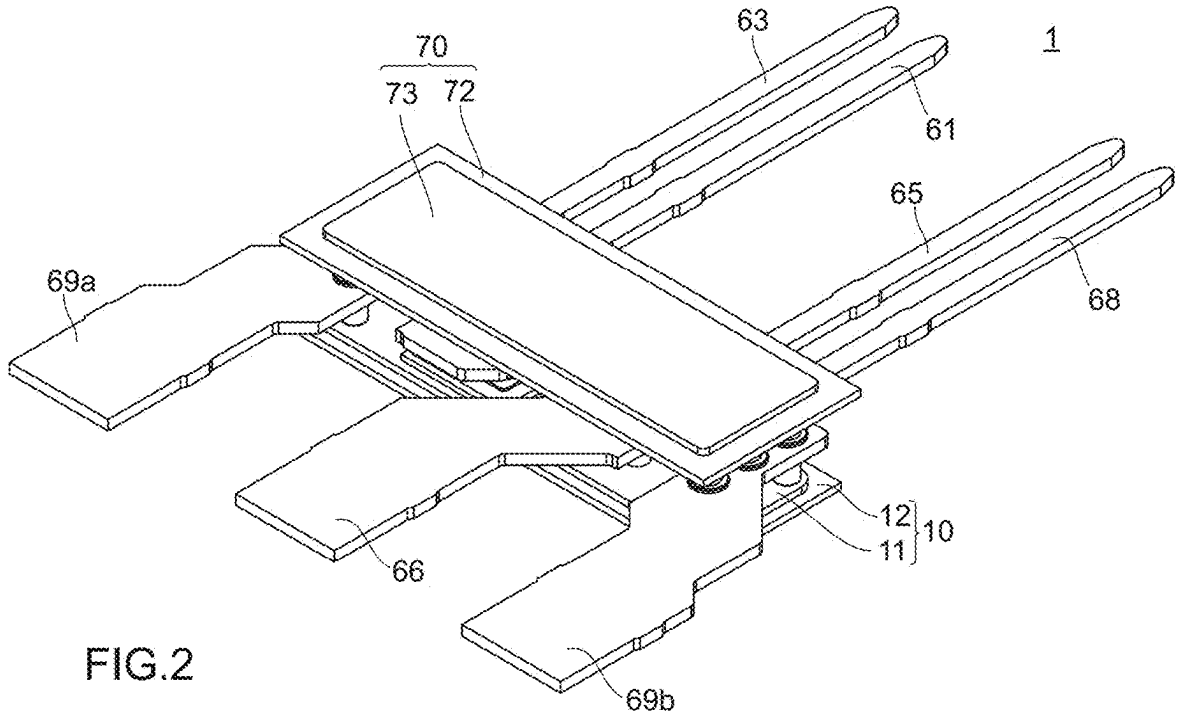

70
63
1
73
72
61
65
69a
68
12
10
11
66
69b

FIG.2

FIG.3A

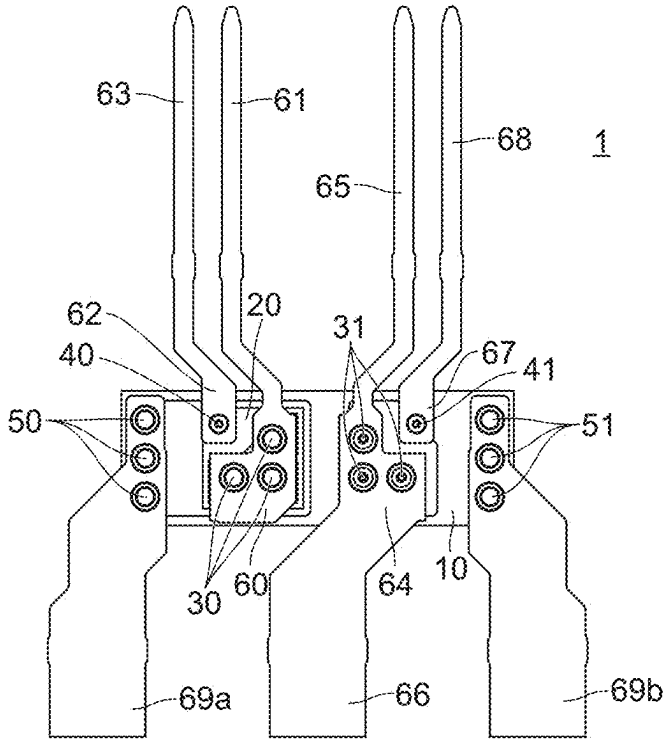
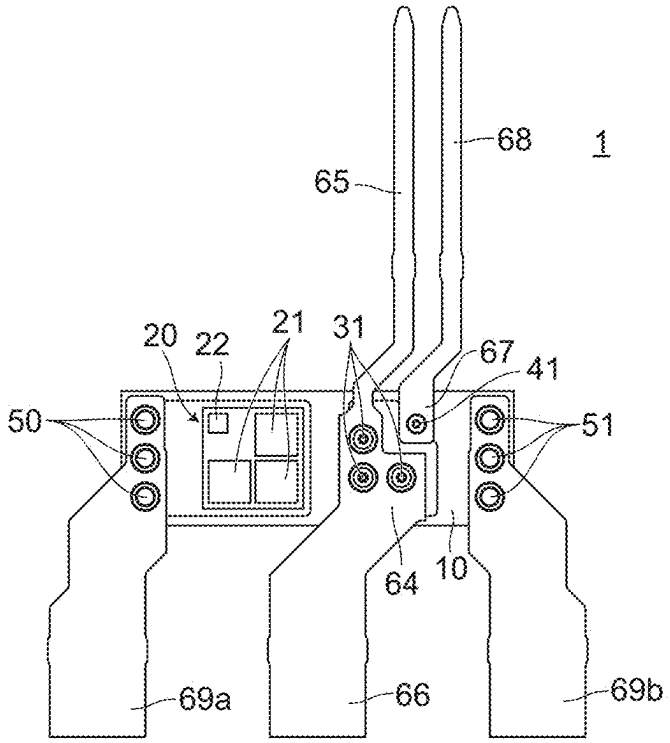

63
61
68
1
65
62
20
31
67
41
40
50
51
30
60
64
10
69a
66
69b

FIG.3B


68
1
65
20
22
21
31
67
41
50
51
64
10
69a
66
69b

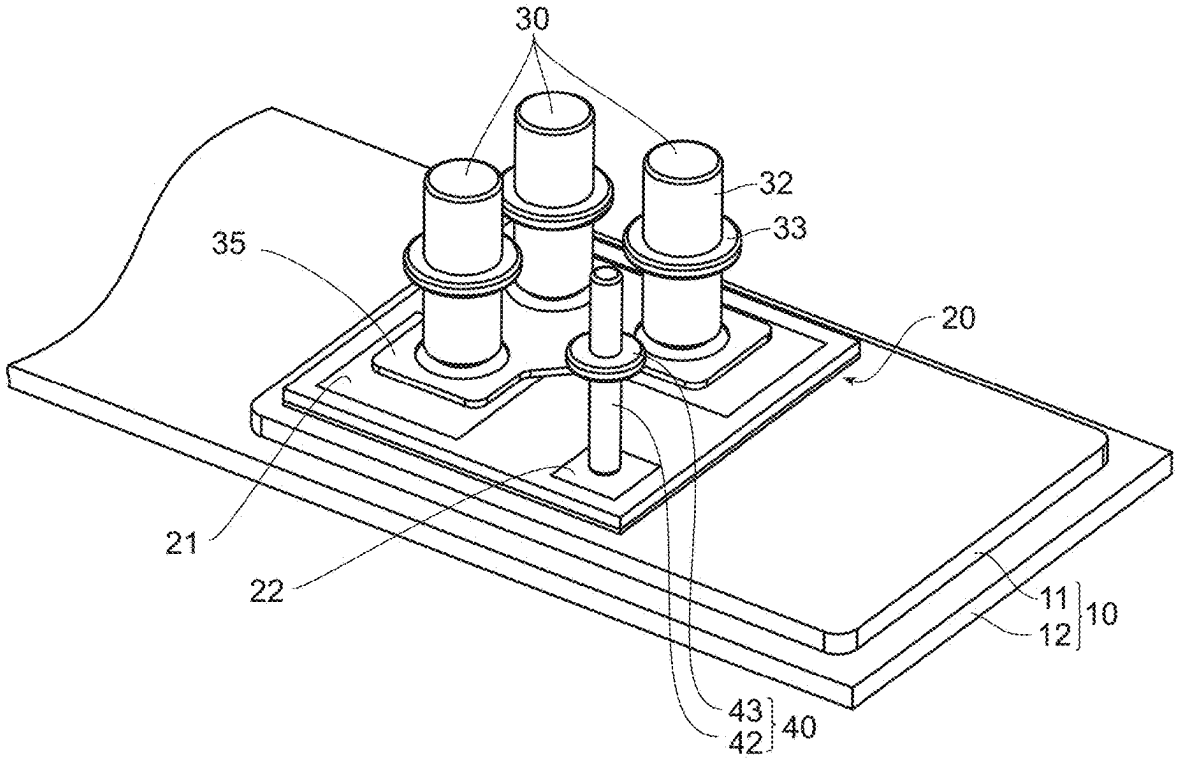

30
32
33
35
20
21
22
11
12
10
43
42
40

FIG.4A

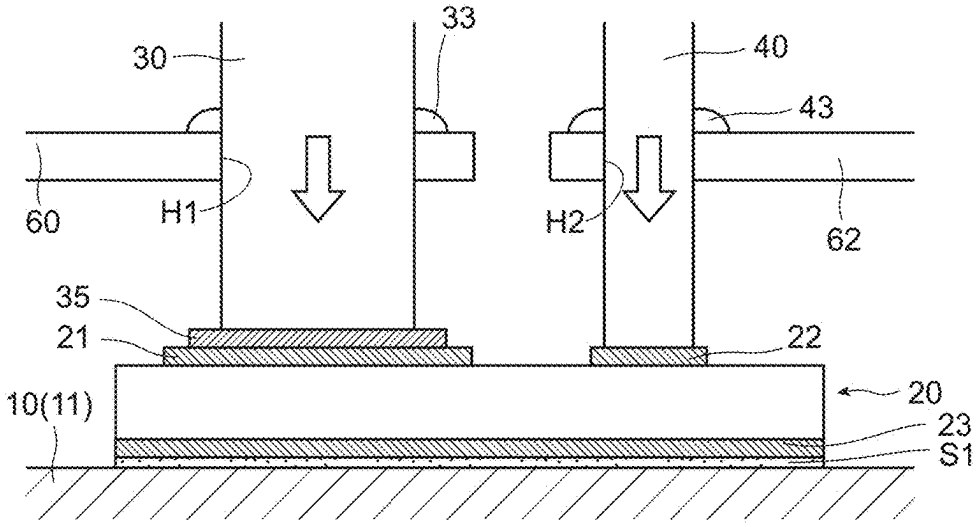

33
30
40
43
60
H1
H2
62
35
21
22
10(11)
20
23
S1

FIG.4B

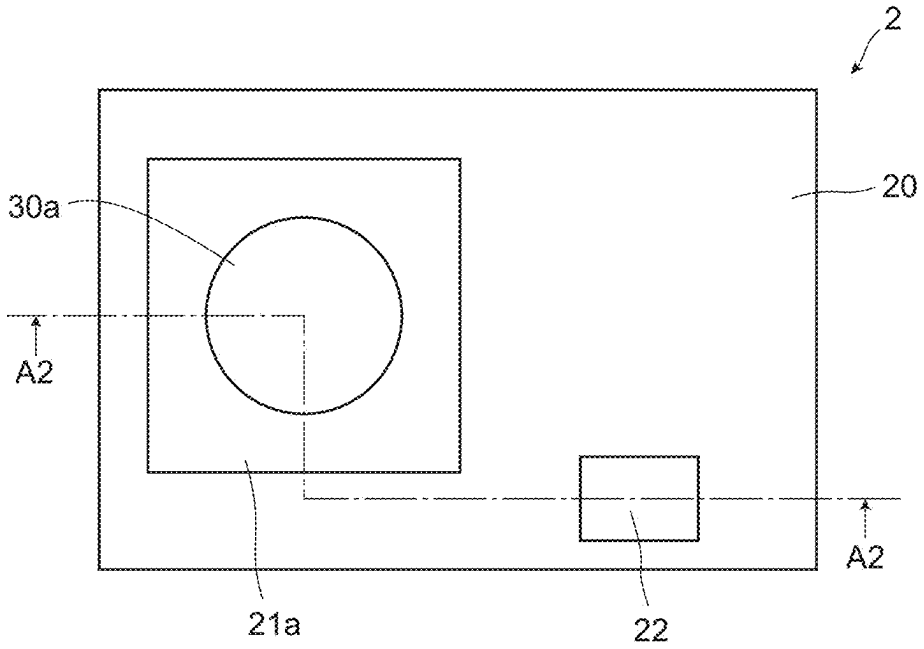



FIG.5A

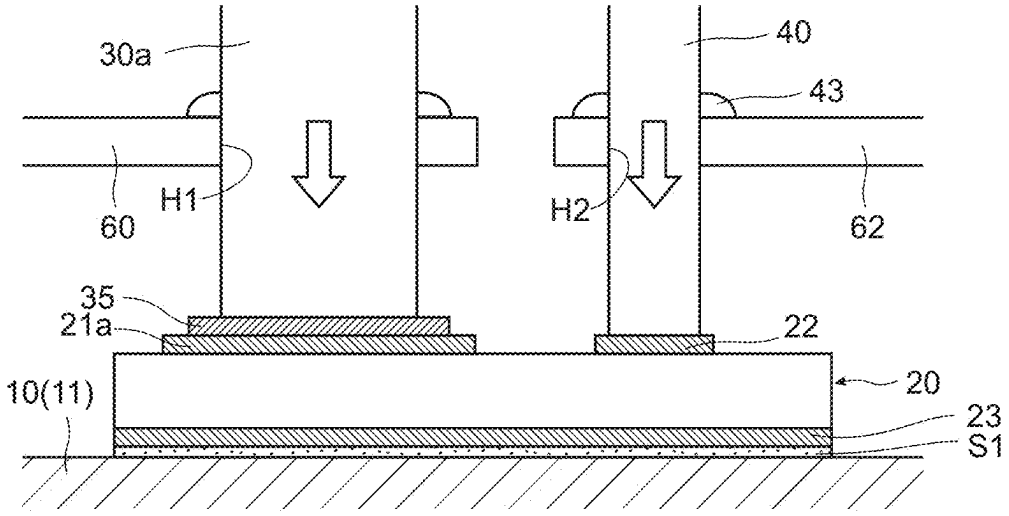



FIG.5B

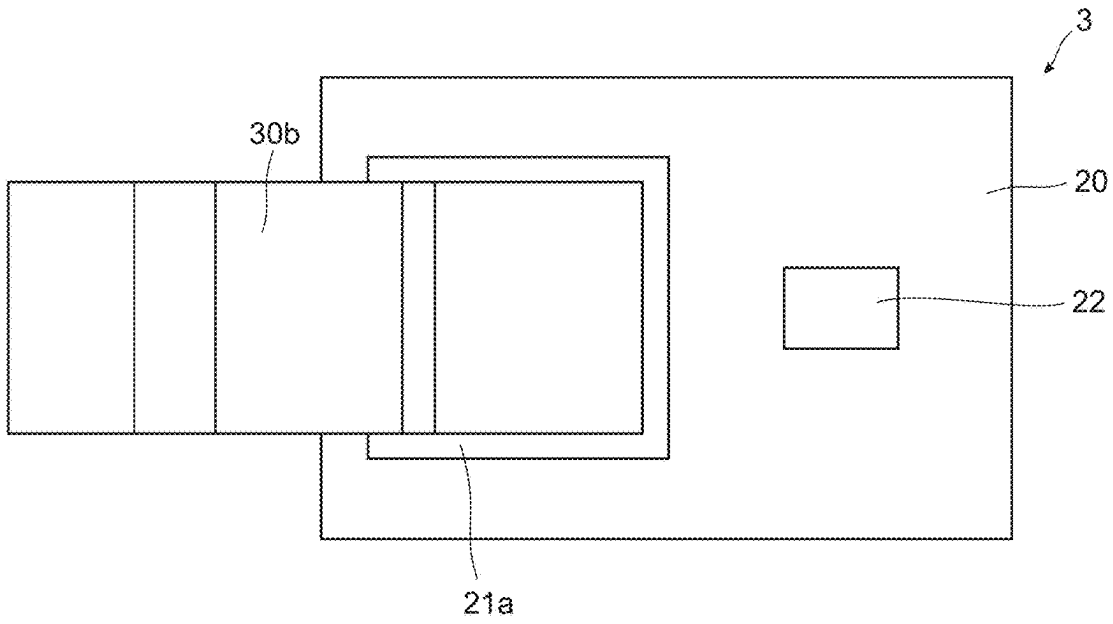



FIG.6A

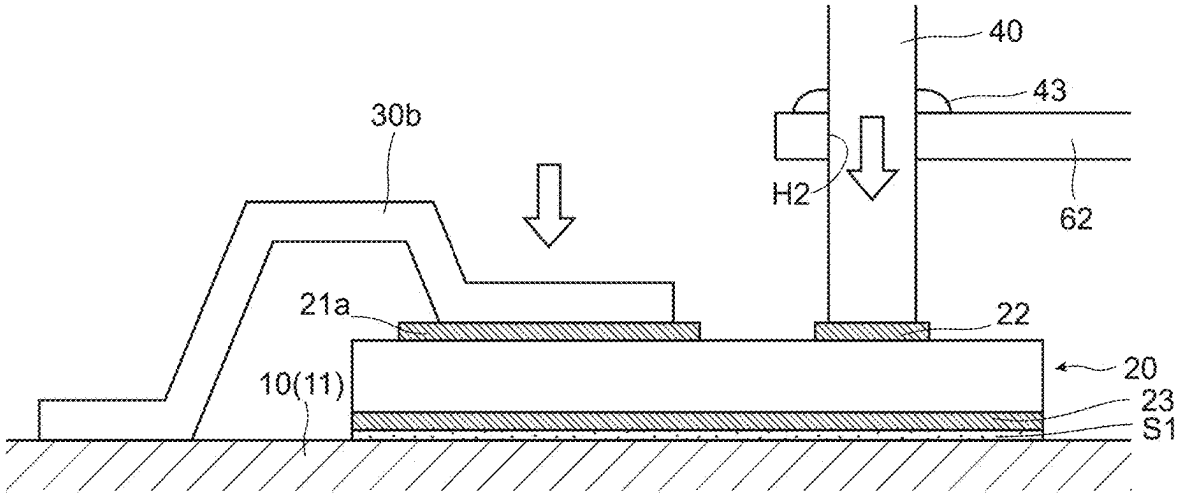



FIG.6B

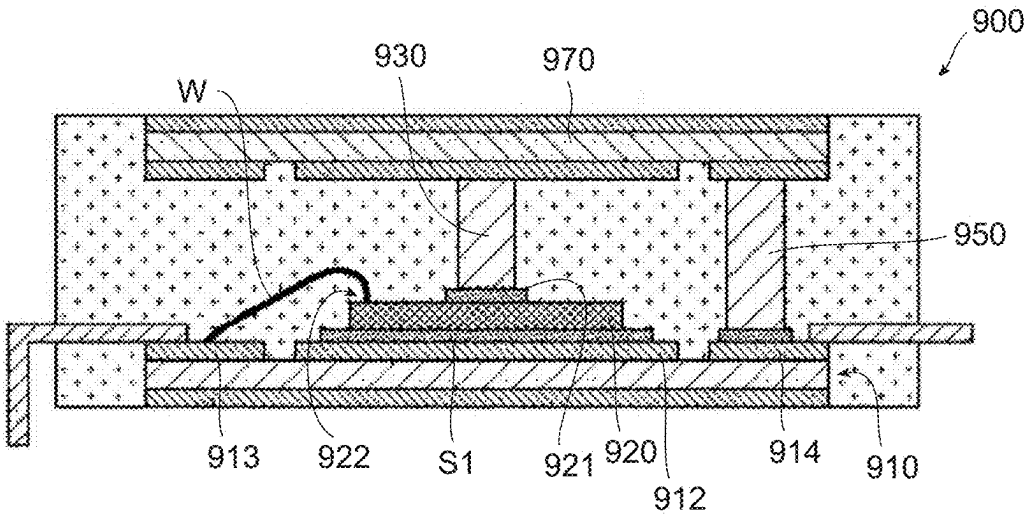

900
930
970
W
950
913
922
S1
921
920
912
914
910

FIG.7

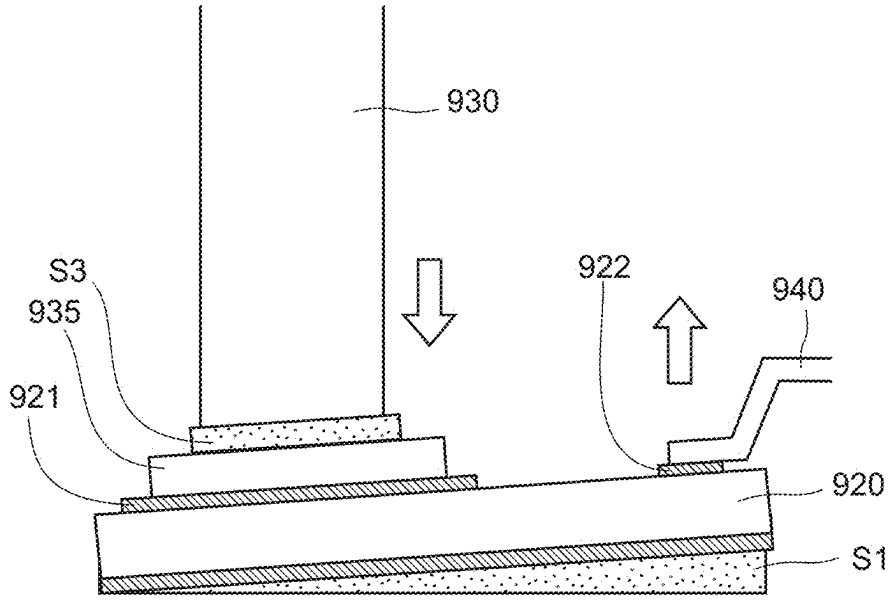

930
S3
935
921
922
940
920
S1

FIG.8

# ELECTRONIC MODULE

## CROSS REFERENCE TO RELATED APPLICATIONS

**[0001]** This application claims priority to Japanese Patent Application No. 2024-20367, filed on Feb. 14, 2024, which is expressly incorporated herein by reference in its entirety.

## TECHNICAL FIELD

**[0002]** The present invention relates to an electronic module.

## BACKGROUND ART

**[0003]** Conventionally, there has been known an electronic module that includes: a chip mounted on a board; and a power chip connection terminal mounted on a main electrode of the chip (see patent literature 1, for example).

**[0004]** As illustrated in FIG. **7**, a conventional electronic module **900** includes: a first board **910**; a chip **920** that is disposed on the first board **910** and has a main electrode **921** and a control electrode **922** on a surface thereof on a side opposite to a first board **910** side; and a power chip connection terminal **930** having a columnar shape that is disposed on the main electrode **921** and is electrically connected to the main electrode **921**. In the conventional electronic module **900**, the control electrode **922** is connected to a wiring **913** disposed on the first board **910** via a wire W.

**[0005]** In the conventional electronic module **900**, a second board **970** is disposed at a position that opposedly faces the first board **910**, and the chip **920** and the second board **970** are connected to each other via the power chip connection terminal **930**. Further, the first board **910** and the second board **970** are connected to each other by an internal connection terminal **950**.

## PRIOR ART LITERATURE

### Patent Literature

**[0006]** [Japanese Patent Literature 1] JP-A-2020-503697

## SUMMARY OF INVENTION

### Technical Problem

**[0007]** As described above with respect to the conventional electronic module **900**, in the case where the second board **970** is disposed at the position that opposedly faces the first board **910**, in a manufacturing process, it is necessary to perform a reflow in a state where the first board **910**, the chip **920**, the second board **970** and the like are pressed from both sides, that is, a first board **910** side and a second board **970** side.

**[0008]** However, in the case where the reflow is performed in a state where the first board **910** and the second board **970** are being pressed, as illustrated in FIG. **8**, the main electrode **921** is physically pressed by the power chip connection terminal **930** and hence, the chip **920** is inclined whereby the chip **920** may not be held horizontally with respect to the first board **910** thus giving rise to a possibility that it is difficult to secure the reliability of the electronic module **900** sufficiently. In FIG. **8**, a connection member **940** formed by applying working to a metal-made flat plate in place of the wire W, it is estimated that the same possibility arises.

**[0009]** With respect to this drawback, besides the case where the reflow is performed in a state where the first board **910** and the second board **970** are pressed, also in a case where the board is disposed on only one surface, the main electrode **921** is physically pressed by its own weight of the power chip connection terminal **930** or the like so that the chip **920** is inclined. Also in this case, there is a possibility that the chip **920** cannot be horizontally held with respect to the first board **910**.

**[0010]** The present invention has been made in view of the above-mentioned circumstances, and it is an object of the present invention to provide an electronic module that can sufficiently secure its reliability.

### Solution to Problem

**[0011]** An electronic module according to the present invention includes: a first board; a chip disposed on the first board and having a main electrode and a control electrode on a surface thereof on a side opposite to a surface thereof on a first board side; a power chip connection terminal disposed on the main electrode and being electrically connected to main electrode; and a signal chip connection terminal having a columnar shape disposed on the control electrode and being electrically connected with the control electrode.

### Advantageous Effects of the Present Invention

**[0012]** According to the electronic module of the present invention, the electronic module includes the signal chip connection terminal having a columnar shape that is disposed on the control electrode and is electrically connected with the control electrode and hence, even in a case where the main electrode is physically pressed by the power chip connection terminal, it is possible to prevent the occurrence of a phenomenon that the chip is inclined by pressing the control electrode using the signal chip connection terminal. Accordingly, the chip can be held horizontally with respect to the first board. As a result, the electronic module can secure sufficient reliability.

**[0013]** In a case where a connection member is formed by bending a small part (see symbol **940** in FIG. **8**, for example), it is difficult to increase bending accuracy and hence, it is difficult to perform positioning of the connection member with respect to a small connection region such as a gate electrode with high accuracy. However, according to the electronic module of the present invention, the electronic module includes the signal chip connection terminal having a columnar shape and hence, it is unnecessary to bend a small part whereby the connection terminal can be positioned with respect to a small connection region such as the gate electrode.

## BRIEF DESCRIPTION OF DRAWINGS

**[0014]** FIG. **1** is perspective view of an electronic module **1** according to an embodiment 1.

**[0015]** FIG. **2** is a view illustrating an internal structure of the electronic module **1** according to the embodiment 1. FIG. **2** is a view where the illustration of a mold resin **80** is omitted from the perspective view in FIG. **1**.

**[0016]** FIG. **3**A and FIG. **3**B are views illustrating an internal structure of the electronic module **1** according to the embodiment 1. FIG. **3**A is a plan view where the illustration

of the configuration on a second board **70** side and the mold resin **80** is omitted from FIG. **1**, and FIG. **3**B is a plan view where the illustration of a first support member **60** and a second support member **62** is omitted from FIG. **3**A.

**[0017]** FIG. **4**A and FIG. **4**B are views illustrating a power chip connection terminal **30** and a signal chip connection terminal **40** in the embodiment 1. FIG. **4**A is a perspective view illustrating the power chip connection terminal **30** and the signal chip connection terminal **40**, and FIG. **4**B is a schematic side view illustrating the power chip connection terminal **30** and the signal chip connection terminal **40**. Arrows in FIG. **4**B indicate forces (pressures) applied to a chip **20**. The same goes for the configuration illustrated in FIG. **5**B and FIG. **6**B. Further, for the sake of brevity of the description, the illustration of conductive bonding materials other than a conductive bonding material S**1** between the first board **10** and the chip **20** is omitted. The same goes for the configuration illustrated in FIG. **5**B and FIG. **6**B.

**[0018]** FIG. **5**A and FIG. **5**B are views illustrating a power chip connection terminal **30***a* and a signal chip connection terminal **40** in an embodiment 2. FIG. **5**A is a plan view illustrating the power chip connection terminal **30***a* and a gate electrode **22**, and FIG. **5**B is a schematic side view illustrating the power chip connection terminal **30***a* and the signal chip connection terminal **40**.

**[0019]** FIG. **6**A and FIG. **6**B are views illustrating a power chip connection terminal **30***b* and the signal chip connection terminal **40** in an embodiment 3. FIG. **6**A is a plan view illustrating the power chip connection terminal **30***b* and the gate electrode **22**, and FIG. **6**B is a schematic side view illustrating the power chip connection terminal **30***b* and the signal chip connection terminal **40**.

**[0020]** FIG. **7** is a side view illustrating a conventional electronic module **900**. In FIG. **7**, symbols **912**, **914** indicate wirings and symbol S**1** indicates solder.

**[0021]** FIG. **8** is a schematic essential portion enlarged side view illustrating a drawback of the conventional electronic module **900**. Symbol S**3** indicates a solder, and symbol **935** indicates a spacer. Further, an arrow in the vicinity of a power chip connection terminal **930** in FIG. **8** indicates a force (pressure) applied to the chip **920**, and an arrow in the vicinity of a connection member **940** indicates a direction of a force that lifts a control electrode **922** side of the chip **920**.

## DESCRIPTION OF EMBODIMENTS

**[0022]** Hereinafter, electronic modules according to the present invention are described based on embodiments illustrated in the drawings. The embodiments described hereinafter are not intended to limit the present invention called for in claims. Further, it is not always the case that all of various elements described in the embodiments and combinations of these elements are indispensable as means to solve the problem of the present invention.

### Embodiment 1

#### 1. Configuration of Electronic Module **1** According Embodiment 1

**[0023]** As illustrated in FIG. **1**, the electronic module **1** according to the embodiment 1 is an electronic module molded by a mold resin **80**. A metal plate for heat radiation is disposed on upper surface and a lower surface of the electronic module **1** (the metal plate on the upper surface of the electronic module **1** being indicated by **73** and the lower surface of the electronic module **1** being not illustrated). Power terminals **69***a*, **66**, **69***b* that constitute external terminals through which a main current flows extend from one side surface of the electronic module **1**, and signal terminals **63**, **68** and sensor terminals **61**, **65** that constitute external terminals extend from the other side surface of the electronic module **1**.

**[0024]** As illustrated in FIG. **1** to FIG. **4**B, the electronic module **1** includes: a first board **10**, a chip **20**; power chip connection terminals **30**, **31**; a spacer **35**; signal chip connection terminals **40**, **41**; internal connection terminals **50**, **51**; first support members **60**, **64**; second support members **62**, **67**; external terminals (power terminals **69***a*, **66**, **69***b*, signal terminals **63**, **68** and SENSE terminals **61**, **65**), a second board **70** (see FIG. **2**); and the mold resin **80** (see FIG. **1**).

**[0025]** The first board **10** is a direct copper bonding board (DCB board) that includes: an insulation board (ceramic board) **12**; a circuit wiring **11** formed on one surface (upper surface) of the insulation board **12**; and a metal plate for heat radiation (not illustrated in the drawing) formed on the other surface (lower surface) of the insulation board **12**.

**[0026]** The second board **70** is also a DCB board that includes: an insulation board (ceramic board) **72**; a circuit wiring (not illustrated in the drawing) formed on one surface (lower surface in FIG. **2**) of the insulation board **12**; and a metal plate **73** for heat radiation formed on the other surface (upper surface in the drawing) of the insulation board **72**. The first board **10** and the second board may be formed of a suitable board such as a printed circuit board.

**[0027]** The chip **20** is disposed on the circuit wiring **11** of the first board **10** and is formed of a metal-oxide-semiconductor field-effect transistor (MOSFET) of a vertical type where a source electrode **21** (main electrode) and a gate electrode **22** (control electrode) are disposed on a surface of the chip **20** on a side opposite to a surface of a first board **10** side, and a drain electrode **23** (see FIG. **4**B) is formed on the surface on the first board **10** side. The source electrode **21** is divided in three, and occupies three regions in a case where the rectangular chip **20** as viewed in a plan view is divided in four. In the chip **20** divided in four as viewed in a plan view, the gate electrode **22** is formed at a corner portion that is an outer edge of a region where the source electrode **21** is not formed. The drain electrode **23** is formed on the entire surface of the chip **20** on the first board **10** side.

**[0028]** To secure a large area of the main electrode, the source electrode **21** occupies a considerable portion of a surface of the chip **20**. On the other hand, to prevent short circuiting between the source electrode **21** and the control electrode (gate electrode **22**), it is necessary to dispose the source electrode **21** spaced apart from a control electrode (gate electrode **22**) by a predetermined distance. As a result, a possibility that the power chip connection terminal **30** is connected at a position away from the center of gravity of the chip **20** is increased and hence, the chip **20** is liable to be inclined. The signal chip connection terminal **40** described later is particularly effective also with respect to such a case.

**[0029]** The spacer **35** is a plate-shaped member formed straddling over the three divided source electrode **21**. Recesses that receive power chip connection terminals **30** described later are formed on the spacer **35**, and the spacer

**35** is bonded to the power chip connection terminals **30** in the recesses via a conductive bonding material (for example, solder).

**[0030]** The power chip connection terminal **30** is a columnar member made of a conductive material (for example, a metal material). The power chip connection terminal **30** is disposed on the source electrode **21** (main electrode). One end (lower side end portion) of the power chip connection terminal **30** is electrically connected with the source electrode **21** (main electrode), and the other end (upper side end portion) is electrically connected to a wiring (not illustrated in the drawing) of the second board **70**. A lower side end portion of the power chip connection terminal **30** is bonded to the recess of the spacer **35** via a conductive bonding material (for example, solder), and upper side end portion of the power chip connection terminal **30** is bonded to a wiring of the second board **70** via a conductive bonding material (for example, solder).

**[0031]** As illustrated in FIG. **3**A, the power chip connection terminal **30** is supported by the first supporting member **60** in a state where the power chip connection terminal **30** passes through a first through hole H**1** (see FIG. **4**B) formed in the first support member **60** described later. The power chip connection terminal **30** is press-fitted into the first through hole H**1**.

**[0032]** As illustrated in FIG. **4**A, the power chip connection terminal **30** has a body portion **32** having a circular columnar shape and a flange portion **33** having a ring shape formed at an intermediate position of the body portion **32** in a height direction. A lower surface of the flange portion **33** is bonded to the first support member **60**. The shape of the body portion **32** is not limited to a circular columnar shape, and may be a rectangular columnar shape, or may adopt as suitable columnar shapes.

**[0033]** The signal chip connection terminal **40** is a columnar member made of a conductive material (for example, a metal material). The signal chip connection terminal **40** is mounted on the gate electrode **22** (control electrode). One end (lower side end portion) of the signal chip connection terminal **40** is electrically connected with the gate electrode **22** (control electrode), and the other end (upper side end portion) of the signal chip connection terminal **40** is electrically connected to a wiring disposed on the second board **70** (not illustrated in the drawing). The lower side end portion of the signal chip connection terminal **40** is bonded to the gate electrode **22** (control electrode) via a conductive bonding material (for example, solder), and the upper side end portion of the signal chip connection terminal **40** is connected to the wiring disposed on the second board **70** via a conductive bonding material (for example, solder). The signal chip connection terminal **40** may not be bonded to the second board **70**.

**[0034]** As illustrated in FIG. **3**A, the signal chip connection terminal **40** is supported by a second support member **62** in a state where the signal chip connection terminal **40** passes through a second through hole H**2** (see FIG. **4**B) formed in the second support member **62** described later. The signal chip connection terminal **40** is inserted into the second through hole H**2**.

**[0035]** As illustrated in FIG. **4**A, the signal chip connection terminal **40** has a body portion **42** having a circular columnar shape and a flange portion **43** having a ring shape formed at an intermediate position of the body portion **42** in a height direction. A lower surface of the flange portion **43** is bonded to the second support member **62**. The shape of the body portion **42** is not limited to a circular columnar shape, and may be a rectangular columnar shape, or may adopt other suitable columnar shapes. The signal chip connection terminal **40** may not have the flange portion **43**.

**[0036]** A chip (not illustrated in the drawing) is disposed on a circuit wiring (not illustrated in the drawing) of the second board **70**. A spacer (not illustrated in the drawing) and the power chip connection terminal **31** are disposed over the source electrode (a side where the chip is disposed with respect to the second board **70** being set as an upper side) of the chip (not illustrated in the drawing), and the signal chip connection terminal **41** is disposed over the gate electrode. These configurations are the same configurations with the configurations obtained by arranging the chip **20**, the spacer **35**, the power chip connection terminal **30** and the signal chip connection terminal **40** on the first board **10** upside down. Accordingly, the description of these configurations is omitted.

**[0037]** Further, as illustrated in FIG. **3**A and FIG. **3**B, the first support member **64** is disposed at the intermediate position of the power chip connection terminal **31** in the height direction, and the power chip connection terminal **31** is supported by the first support member **64**. Further, the second support member **67** is disposed at the intermediate position of the signal chip connection terminal **41** in the height direction, and the signal chip connection terminal **41** is supported by the first support member **64**.

**[0038]** The internal connection terminals **50**, **51** are columnar members that connect to the first board **10** and the second board **70** to each other. In the embodiment 1, three internal connection terminals **50**, **51** are disposed at an end portion of the first board **10**. At an intermediate position of the internal connection terminal **50** in a height direction, the power terminal **69***a* that constitutes an external terminal is connected, and the power terminal **69***b* that constitutes an external terminal is connected at an intermediate position of the internal connection terminal **51** in a height direction.

**[0039]** The first support member **60** is a conductive plate-shaped member having three first through holes H**1**. The power chip connection terminal **30** is inserted (press-fitted) to each first through hole H**1**. The first support member **60** extends in a horizontal direction toward the outside the mold resin **80** (see FIG. **1**). A portion of the first support member **60** outside the mold resin **80** forms the SENSE terminal **61** that constitutes an external terminal.

**[0040]** The first support member **64** is a conductive plate-shape member that has three first through holes. The first support member **64** extends horizontally outside the mold resin **80** (see FIG. **1**) in a direction opposite to a direction that the SENSE terminal **61** extends, and a portion of the first support member **64** outside the mold resin **80** constitutes an external terminal. An external terminal that extends in the same direction as the SENSE terminal **61** is a SENSE terminal **65** that is connected to a source electrode of a chip (not illustrated in the drawing) disposed on the second board **70**, and an external terminal that extends in the direction opposite to the SENSE terminal **61** is a power terminal **66**.

**[0041]** The second support member **62** is a conductive plate-shaped member having one second through hole H**2**. The second support member **62** extends horizontally outside the mold resin **80** (see FIG. **1**), and a portion of the second support member **62** outside the mold resin **80** constitutes an external terminal (signal terminal **63**).

**[0042]** The second support member **67** is a plate-shaped member having one second through hole (not illustrated in the drawing). The second support member **67** extends horizontally outside the mold resin **80** (see FIG. **1**), and a portion of the second support member **67** outside the mold resin **80** constitutes an external terminal (signal terminal **68**).

**[0043]** The first support members **60**, **64**, the second support members **62**, **67**, the external terminals (signal terminals **63**, **68**, SENSE terminals **61**, **65**, power terminals **66**, **69***a*, **69***b*) may be formed of one lead frame.

**[0044]** The mold resin **80** (see FIG. **1**) seals the first board **10**, the chip **20**, the first support member **60**, the second support member **62**, the power chip connection terminal **30** and the signal chip connection terminal **40**. The mold resin **80** is made of a thermosetting molding material obtained by adding a silica filler and the like to the epoxy resin that is a main component. The mold resin **80** protects the chip **20** and the like from heat, light, moisture and the like.

## 2. Advantageous Effects Acquired by Embodiment 1

**[0045]** The electronic module **1** according to the embodiment 1 includes the signal chip connection terminal **40** that is disposed on the control electrode (gate electrode **22**) and is electrically connected with the control electrode (gate electrode **22**). With such a configuration, even in a case where the main electrode (source electrode **21**) is physically pressed by the power chip connection terminal **30**, it is possible to prevent the occurrence of the phenomenon that the chip **20** is inclined by pressing the control electrode (gate electrode **22**) using the signal chip connection terminal **40**. Accordingly, the chip **20** can be held horizontally with respect to the first board **10**. As a result, the electronic module **1** can secure sufficient reliability.

**[0046]** In a case where the conventional connection member is formed by bending a small part (see symbol **940** in FIG. **8**, for example), it is difficult to increase bending accuracy and hence, it is difficult to perform positioning of the connection member with respect to a connection region such as the control electrode having a small connection area with high accuracy. However, according to the electronic module **1** of the embodiment 1, the electronic module **1** includes the signal chip connection terminal **40** having a columnar shape and hence, it is unnecessary to bend a small part whereby the connection terminal can be positioned with respect to a small connection region such as the gate electrode **22** with high accuracy.

**[0047]** The electronic module **1** of the embodiment 1 includes the plate-shaped first support member **60** having the first through hole H**1** and the second support member **62** having the second through hole H**2**, the power chip connection terminal **30** is supported by the first support member **60** in a state where the power chip connection terminal **30** passes through the first through hole H**1**, the signal chip connection terminal **40** is supported by the second support member **62** in a state where the signal chip connection terminal **40** passes through the second through hole H**2** and hence, the power chip connection terminal **30** and the signal chip connection terminal **40** can be stably supported in a state where the power chip terminal **30** and the signal chip connection terminal **40** stand upright. Further, a circuit wiring can be constituted by the first support member **60**, the second support member **62**, the power chip connection terminal **30** and the signal chip connection terminal **40** and hence, a mounting area for wiring on the first board **10** and the second board **70** can be made small whereby downsizing of the electronic module can be realized. Further, the wiring can be constituted in a stereoscopic space and hence, it is possible to provide the module having high degree of freedom in designing the module. Still further, by uniformly pressing the chip **20**, the chip **20** can be held horizontally with respect to the first board **10** with more certainty and hence, it is possible to provide the module that secures more reliability.

**[0048]** According to the electronic module **1** of the embodiment 1, the second support members **62**, **67** extend in a horizontal direction to the outside the mold resin **80**, and portions of the second support members **62**, **67** outside the mold resin **80** constitute the signal terminals **63**, **68** of the gate electrode **22**. Accordingly, a circuit that connects the gate electrode **22** of the chip **20** and the signal terminals **63**, **68** can be constituted of the signal chip connection terminals **40**, **41** and the second support members **62**, **67**. Accordingly, mounting areas for wiring on the first board **10** and the second board **70** can be made small and hence, downsizing of the electronic module is further enhanced and, at the same time, it is possible to provide the electronic module having the further higher degree of freedom in designing the electronic module.

**[0049]** According to the electronic module **1** of the embodiment 1, the first support members **60**, **64** extend in a horizontal direction to the outside the mold resin **80**, and portions disposed outside the mold resin **80** constitute the external terminals (SENSE terminals **61**, **65** and the power terminal **66**) and hence, a circuit that connects the source electrode **21** of the chip **20** and the external terminals to each other can be constituted by the power chip connection terminals **30**, **31** and the first support members **60**, **64**. Accordingly, also from this point of view, mounting areas for wiring on the first board **10** and the second board **70** can be made small and hence, downsizing of the electronic module is further enhanced.

**[0050]** According to the electronic module **1** of the embodiment 1, the second board **70** is disposed at a position that opposedly faces the first board **10**, and the power chip connection terminal **30** and the signal chip connection terminal **40** are connected to the second board **70**. Accordingly, heat can be radiated from both surfaces of the first board **10** and the second board **70** thus providing the electronic module having high heat radiation property. Further, the first board **10**, the chip **20**, the second board **70** and a chip (being disposed on the second board) can be connected to each other by the power chip connection terminal **30** and the signal chip connection terminal **40** and hence, the shape stability of the electronic module **1** can be enhanced.

**[0051]** According to the electronic module **1** of the embodiment 1, the main electrode (source electrode **21**) is divided into a plurality of (three) electrode portions, and the power chip connection terminals **30**, **31** are disposed corresponding to three respectively divided electrode portions and hence, the supply of electricity between the power chip connection terminals **30**. **31** and three divided electrode portions is facilitated. A bias of a current density minimally occurs and hence, heat generated from the chip **20** can be radiated (transferred) to the second board **70** via the power chip connection terminals **30**, **31**.

**[0052]** In the electronic module **1** of the embodiment 1, the gate electrode **22** is disposed on an outer edge portion of the

chip **20**. With such a configuration, the gate electrode **22** can be connected with the outside easily and, at the same time, the source electrode **21** can secure a large area.

**[0053]** According to the electronic module **1** of the embodiment 1, the spacer **35** is disposed between the main electrode (source electrode **21**) and the power chip connection terminal **30** and hence, a thermal stress applied to a conductive bonding material between the main electrode (source electrode **21**) and the power chip connection terminal **30** can be alleviated.

## Embodiment 2

**[0054]** An electronic module **2** according to the embodiment 2 has basically substantially the same configuration as the electronic module **1** according to the embodiment 1. However, the electronic module **2** according to the embodiment 2 differs from the electronic module **1** according to the embodiment 1 with respect to the configuration of a source electrode and the configuration of a power chip connection terminal. That is, in the electronic module **2** according to the embodiment 2, as illustrated in FIG. **5**A and FIG. **5**B, a source electrode is not divided in three and one source electrode **21***a* having a relatively large area is formed, and one power chip connection terminal **30***a* that corresponds to the source electrode **21***a* is disposed.

**[0055]** In this manner, the electronic module **2** according to the embodiment 2 differs from the case of the electronic module **1** according to the embodiment 1 with respect to the configuration of the source electrode and the configuration of the power chip connection terminal. However, in the same manner as the electronic module **1** according to the embodiment 1, the electronic module **2** includes a signal chip connection terminal **40** that is disposed on the gate electrode **22**, and is electrically connected to the gate electrode **22**. Accordingly, the electronic module **2** can secure sufficient reliability and, at the same time, the signal chip connection terminal **40** can be positioned with high accuracy also with respect to a small connection region such as the gate electrode **22**.

**[0056]** The semiconductor module **2** according to the embodiment 2 has basically substantially the same configuration as the semiconductor module **1** according to the embodiment 1 with respect to the points other than the configuration of the source electrode and the configuration of the power chip connection terminal. Accordingly, the semiconductor module **2** according to the embodiment 2 can acquire advantageous effects corresponding to the advantageous effects of the semiconductor module **1** according to the embodiment 1 amongst all the advantageous effects that the embodiment 1 acquires.

## Embodiment 3

**[0057]** An electronic module **3** according to the embodiment 3 has basically substantially the same configuration as the electronic module **1** according to the embodiment 1. However, the electronic module **3** according to the embodiment 3 differs from the electronic module **2** according to the embodiment 2 with respect to the configuration of a power chip connection terminal. That is, in the electronic module **3** according to the embodiment 3, as illustrated in FIG. **6**A and FIG. **6**B, the power chip connection terminal **30***b* is not a terminal having a columnar shape, but is formed in a shape such that the power chip connection terminal **30***b* spans or is bridged between two electrode portions (so-called a clip shape or a connector shape) as a bridge (so-called clip shape or connector shape).

**[0058]** In the embodiment 3, the power chip connection terminal **30***b* is not a terminal having a columnar shape. A chip **20** is pressed when the power chip connection terminal **30***b* is placed on a source electrode **21***a* of the chip **20**, or the chip **20** is pressed due to its own weight of the power chip connection terminal **30***b*. Also in this case, floating of the chip can be prevented by providing a signal chip connection terminal.

**[0059]** In the embodiment 3, the power chip connection terminal **30***b* is not a terminal having a columnar shape and hence, a member that corresponds to a first support member does not exist.

**[0060]** In this manner, although the electronic module **3** according to the embodiment 3 differs from the electronic module **2** according to the embodiment 2 with respect to the configuration of the power chip connection terminal, in the same manner as the electronic module **2** according to the embodiment 2, the electronic module **3** includes the signal chip connection terminal **40** that is disposed on the gate electrode **22**, and is electrically connected with the gate electrode **22**. Accordingly, the electronic module **3** can secure reliability sufficiently and, at the same time, the power chip connection terminal can be positioned with high accuracy even with respect to a small connection region such as a gate electrode **22**.

**[0061]** The semiconductor module **3** according to the embodiment 3 has basically substantially the same configuration as the semiconductor module **2** according to the embodiment 2 with respect to the points other than the power chip connection terminal. Accordingly, the semiconductor module **3** according to the embodiment 3 can acquire advantageous effects corresponding to the advantageous effects of the semiconductor module **2** according to the embodiment 2 amongst all the advantageous effects that the embodiment 2 acquires.

**[0062]** The present invention has been described based on the above-mentioned embodiments heretofore, the present invention is not limited to the above-mentioned embodiments. The present invention can be carried out in various modes without departing from the gist of the present invention, and the following modifications are conceivable.

**[0063]** (1) The positions, the connections, the numbers and the like of the constitutional elements described in the above-mentioned respective embodiments (also including the respective modifications, the same understanding being applicable to the following description) are provided for an exemplifying purpose, and these values can be suitably changed so long as the technical feature of the present invention are not impaired.

**[0064]** (2) In the above-mentioned respective embodiments, a vertical type MOSFET is used as a chip. However, the present invention is not limited to such a MOSFET. A horizontal type MOSFET, that is, a horizontal MOSFET where a drain electrode is formed on a side opposite to a board side may be used. In this case, the MOSFET may be connected to both the source electrode and the drain electrode using power chip connection terminals, or the MOSFET may be connected to only either the source electrode or the drain electrode using the power chip connection terminal. Further, the chip is not limited to the MOSFET, and a

transistor other than the MOSFET such as an IGBT, a thyristor or a triac may be also used as the chip. That is, so long as the chip includes the control electrode and the main electrode, any suitable element may be used.

**[0065]** (3) In the above-mentioned respective embodiments, the signal chip connection terminal is supported using the second support member. However, the present invention is not limited to such a configuration. The signal chip connection terminal may be supported without using the second support member.

**[0066]** (4) In the above-mentioned embodiment, the case is described where the present invention is applied to the electronic module that includes two chips. However, the present invention is not limited to such a configuration. The present invention may be applied to an electronic module that includes one chip, or the present invention may be applied to an electronic module that includes three or more chips.

**[0067]** (5) In the above-mentioned embodiments, a thickness of the first support members **60**, **64** is set equal to a thickness of the second support members **62**, **67**. However, the present invention is not limited to such a configuration. The thickness of the first support members **60**, **64**, may be larger than the thickness of the second support members **62**, **67**. With such a configuration, the first support members **60**, **64** connected to the source electrode allow a relatively large current to flow therethrough and, at the same time, can secure a sufficient width for supporting the power chip connection terminals **30**, **31** having a relatively large cross-sectional area. Further, a diameter of the through hole can be increased and hence, it is possible to allow the power chip connection terminal **30**, **31** having a relatively large cross-sectional area to pass through the through hole.

**[0068]** The signal chip connection terminals **40**, **41** are formed of a pin terminal having a relatively small cross-sectional area through which a small amount of current flows. To allow such a signal chip connection terminal **40**, **41** to pass through, it is necessary to make a diameter of the second through hole H**2** small. However, in a case where a thickness of the second support member is large, it is not easy to form such a through hole having a small diameter. Accordingly, by setting a thickness of the second support members **62**, **67** smaller than a thickness of the first support member **60**, **64**, the second through hole H**2** having a small diameter can be formed.

**[0069]** (6) In the above-mentioned embodiment, a gap between the signal chip connection terminal **40**, **41** and the second through hole H**2** may be set larger than a gap between the power chip connection terminal **30**, **31** and the first through hole H**1**. With such a configuration, in a manufacturing process, the signal chip connection terminal **40**, **41** itself can be positioned at a proper position (enabling self alignment).

**1**. An electronic module comprising: a first board;

a chip disposed on the first board and having a main electrode and a control electrode on a surface thereof on a side opposite to a surface thereof on a first board side;

a power chip connection terminal disposed on the main electrode and being electrically connected to main electrode; and

a signal chip connection terminal having a columnar shape disposed on the control electrode and being electrically connected with the control electrode.

**2**. The electronic module according to claim **1**, further comprising:

a first support member having a plate shape that includes a first through hole: and

a second support member having a plate shape that includes a second though hole, wherein

the power chip connection terminal is supported by the first support member in a state where the power chip connection terminal passes through the first though hole, and

the signal chip connection terminal is supported by the second support member in a state where the signal chip connection terminal passes through the second through hole.

**3**. The electronic module according to claim **2**, wherein,

the first board, the chip, the first support member, the second support member, the power chip connection terminal and the signal chip connection terminal are sealed by a mold resin, and

the second support member extends to an outside the mold resin, and a portion of the second support member disposed outside the mold resin constitutes an external terminal of the control electrode.

**4**. The electronic module according to claim **2**, wherein

the first board, the chip, the first support member, the second support member, the power chip connection terminal and the signal chip connection terminal are sealed by a mold resin, and

the first support member extends to an outside the mold resin, and a portion of the first support member disposed outside the mold resin constitutes an external terminal connected to the main electrode.

**5**. The electronic module according to claim **1**, further comprising a second board disposed at a position that opposedly faces the first board, and the power chip connection terminal and the signal chip connection terminal are connected to the second board respectively.

**6**. The electronic module according to claim **2**, wherein a thickness of the first support member is set larger than a thickness of the second support member.

**7**. The electronic module according to claim **2**, wherein a gap formed between the signal chip connection terminal and the second through hole is larger than a gap formed between the power chip connection terminal and the first through hole.

**8**. The electronic module according to claim **1**, wherein the main electrode is divided into a plurality of electrode portions, and the power chip connection terminal is disposed corresponding to the respective divided electrode portions.

**9**. The electronic module according to claim **1**, wherein the control electrode is disposed on an outer peripheral portion of the chip.

**10**. The electronic module according to claim **1**, wherein a spacer is disposed between the main electrode and the power chip connection terminal.

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