US 20240047289A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2024/0047289 A1**

Bässler et al. (43) **Pub. Date: Feb. 8, 2024**

(54) **MOLDED POWER SEMICONDUCTOR MODULE AND METHOD FOR FABRICATING THE SAME**

(71) Applicant: **Infineon Technologies AG**, Neubiberg (DE)

(72) Inventors: **Marco Bässler**, Oeversee (DE); **Patrik Holt Jones**, Soest (DE); **Ludwig Busch**, Erwitte (DE); **Egbert Lamminger**, Soest (DE)

(21) Appl. No.: **18/356,762**

(22) Filed: **Jul. 21, 2023**

(30) **Foreign Application Priority Data**

Aug. 4, 2022 (DE) 102022119564.3
Aug. 4, 2022 (DE) 202022104434.1

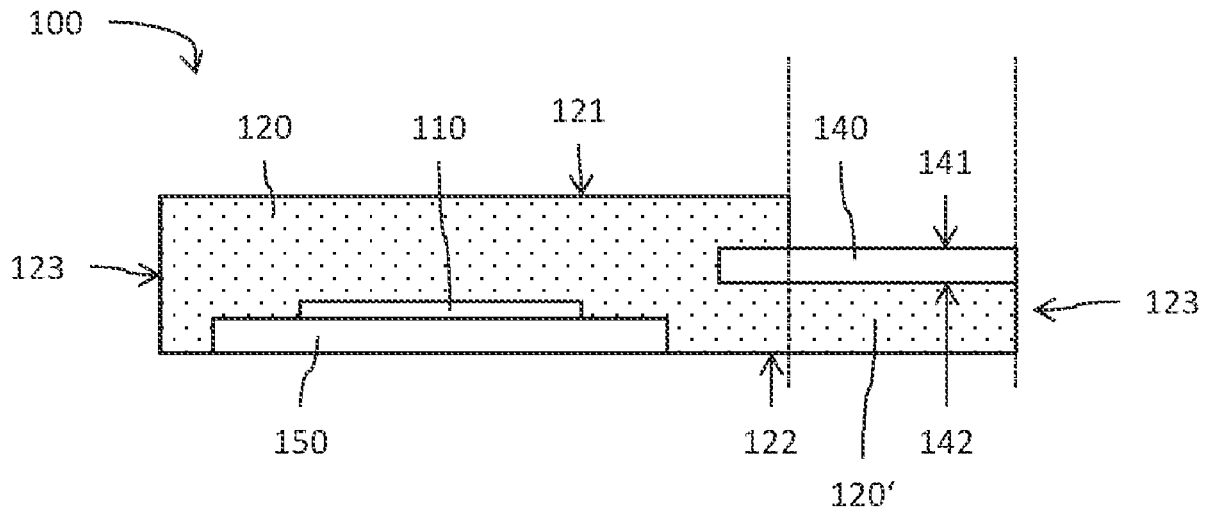
Publication Classification

(51) **Int. Cl.**
H01L 23/31 (2006.01)
H01L 21/56 (2006.01)
H01L 23/48 (2006.01)
H01L 23/495 (2006.01)

(52) **U.S. Cl.**
CPC ***H01L 23/3121*** (2013.01); ***H01L 21/56*** (2013.01); ***H01L 23/48*** (2013.01); ***H01L 23/495*** (2013.01); *H01L 25/07* (2013.01)

(57) **ABSTRACT**

A molded power semiconductor module includes: one or more power semiconductor dies; a molded body at least partially encapsulating each power semiconductor die and having opposing first and second sides, and lateral sides connecting the first and second sides; and first and second power contacts arranged laterally next to each other at a first one of the lateral sides of the molded body and electrically coupled to the power semiconductor die(s). The power contacts each have opposing first and second sides, each first side having an exposed part exposed from the molded body, each second side having a part that is arranged in a vertical direction below an outline of the respective exposed part of the first side and that is at least partially covered by a protrusion part of the molded body. The vertical direction is perpendicular to the first and second sides of the power contacts.



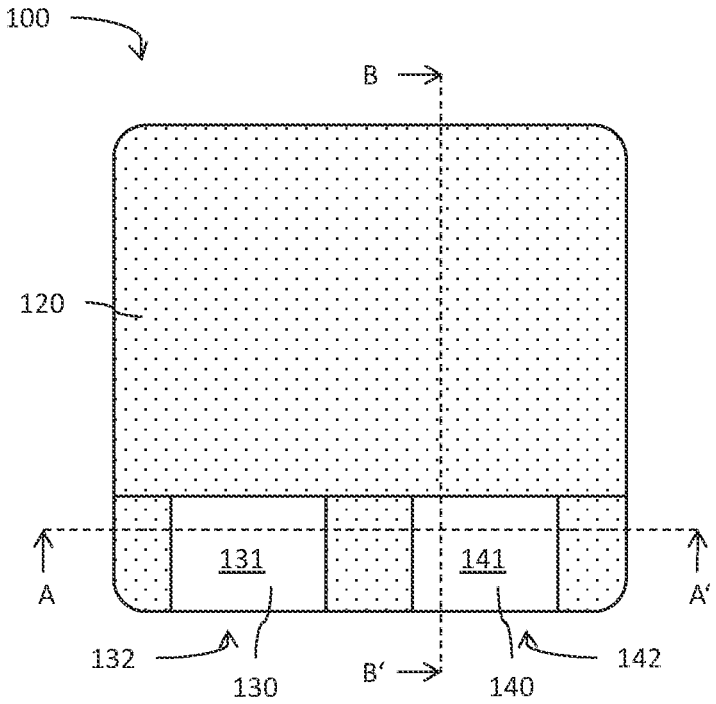

100
B
120
A
131
141
A'
132
130
B'
140
142

Fig. 1A

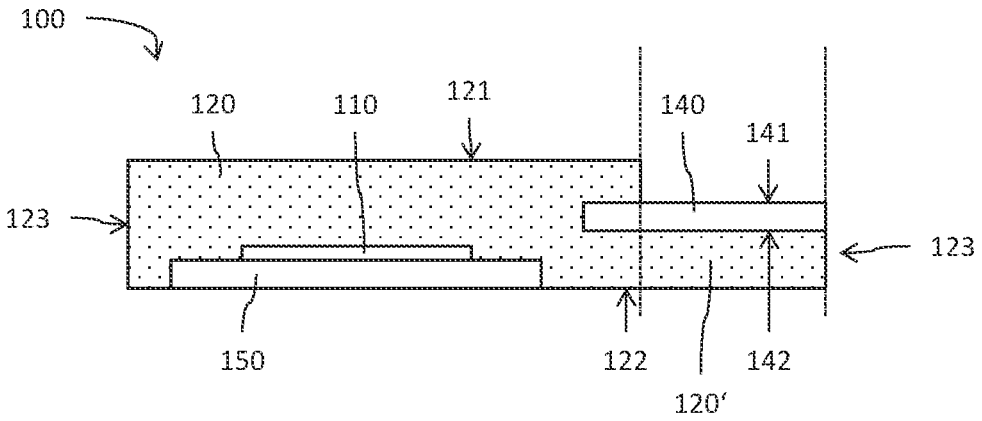

100
120
110
121
140
141
123
123
150
122
142
120'

Fig. 1B

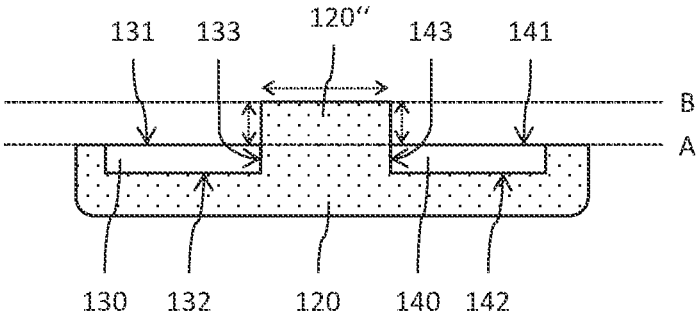

131
133
120''
143
141
B
A
130
132
120
140
142

Fig. 2

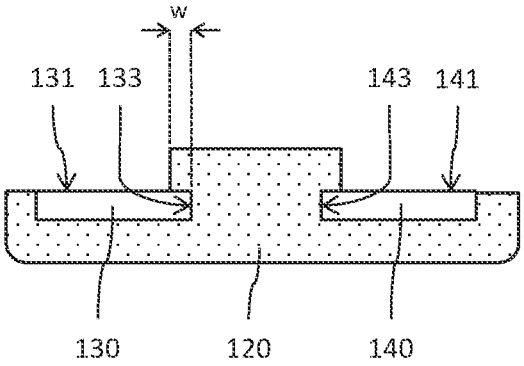

w
131
133
143
141
130
120
140

Fig. 3

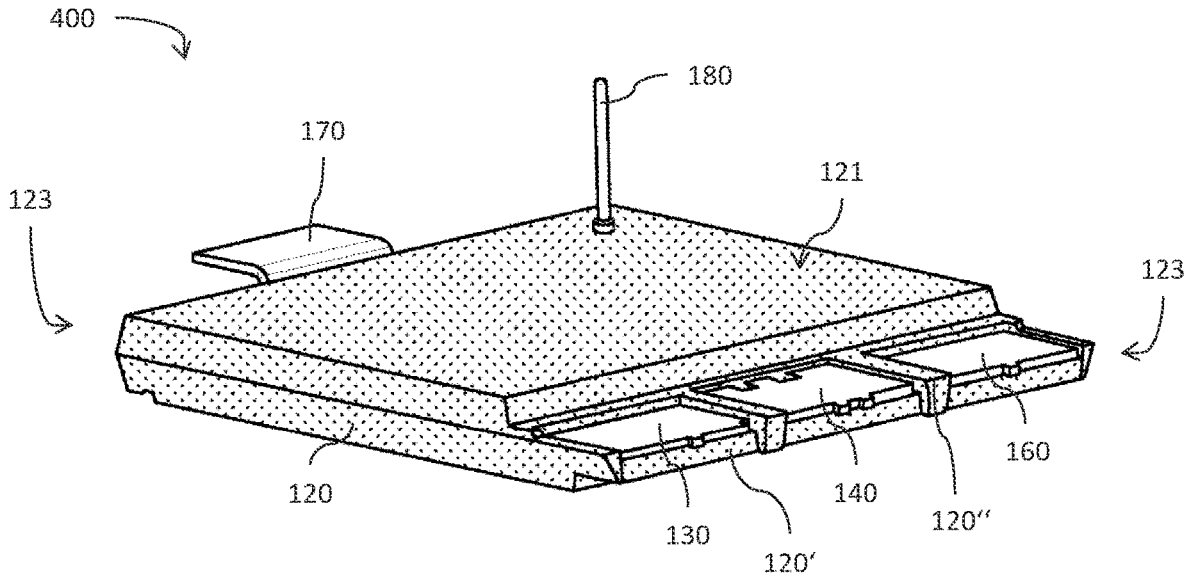

400
180
170
121
123
123
160
120
140
130
120''
120'

Fig. 4

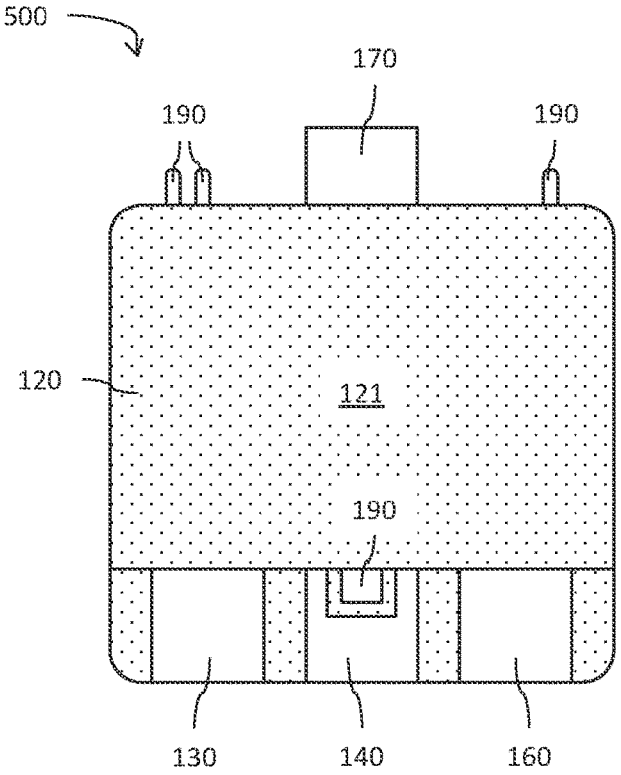

500
170
190
190
120
121
190
130
140
160

Fig. 5

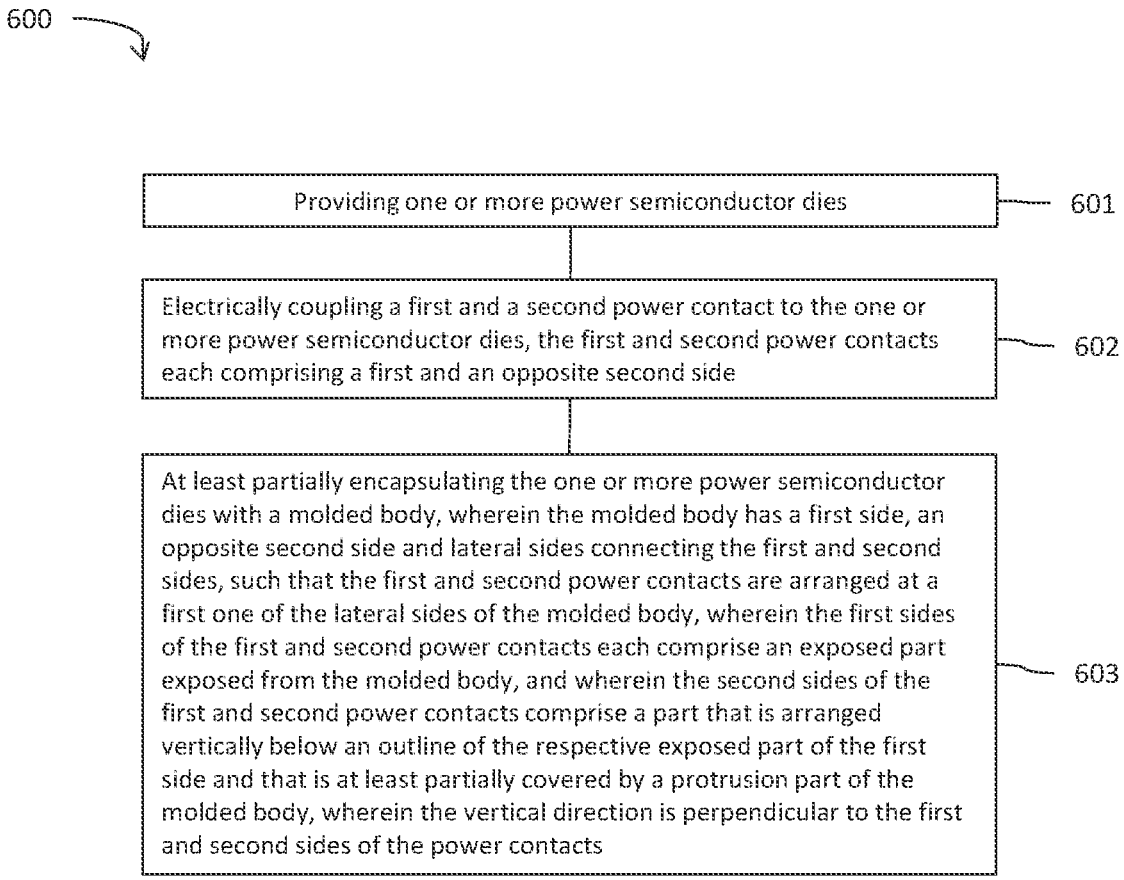

600
Providing one or more power semiconductor dies
601
Electrically coupling a first and a second power contact to the one or more power semiconductor dies, the first and second power contacts each comprising a first and an opposite second side
602
At least partially encapsulating the one or more power semiconductor dies with a molded body, wherein the molded body has a first side, an opposite second side and lateral sides connecting the first and second sides, such that the first and second power contacts are arranged at a first one of the lateral sides of the molded body, wherein the first sides of the first and second power contacts each comprise an exposed part exposed from the molded body, and wherein the second sides of the first and second power contacts comprise a part that is arranged vertically below an outline of the respective exposed part of the first side and that is at least partially covered by a protrusion part of the molded body, wherein the vertical direction is perpendicular to the first and second sides of the power contacts
603

Fig. 6

MOLDED POWER SEMICONDUCTOR MODULE AND METHOD FOR FABRICATING THE SAME

TECHNICAL FIELD

[0001] This disclosure relates in general to a molded power semiconductor module as well as to a method for fabricating such a molded power semiconductor module.

BACKGROUND

[0002] Power semiconductor modules may comprise an encapsulation, e.g. a molded body, as well as power contacts that are exposed from the encapsulation and that are configured to electrically couple the power semiconductor module to an external appliance. Fabricating a low inductance joint between the power contacts and the external appliance may for example comprise welding the power contacts to the external appliance. The power contacts may be mechanically pressed onto the external appliance during the fabrication of the joint. In order to prevent the power contacts from, taking damage or from bending out of shape due to the mechanical pressure, it may be necessary to take special care and/or to provide a dedicated support for the power contacts. This may e.g. increase the costs for installing the power semiconductor module. Furthermore, the power contacts of a power semiconductor module have to be arranged at a minimum distance relative to each other in order to ensure proper electrical isolation from one another. However, the larger this distance is the worse the inductance of the power semiconductor module may become. Improved molded power semiconductor modules as well as improved methods for fabricating molded power semiconductor modules may help to solve these and other problems.

[0003] The problem on which the invention is based is solved by the features of the independent claims. Further advantageous examples are described in the dependent claims.

SUMMARY

[0004] Various aspects pertain to a molded power semiconductor module, comprising: one or more power semiconductor dies, a molded body at least partially encapsulating the one or more power semiconductor dies, the molded body having a first side, an opposite second side and lateral sides connecting the first and second sides, a first and a second power contact arranged laterally next to each other at first one of the lateral sides of the molded body and electrically coupled to the one or more power semiconductor dies, the first and second power contacts each comprising a first and an opposite second side, wherein the first sides of the first and second power contacts each comprise an exposed part exposed from the molded body, and wherein the second sides of the first and second power contacts comprise a part that is arranged vertically below an outline of the respective exposed part of the first side and that is at least partially covered by a protrusion part of the molded body, wherein the vertical direction is perpendicular to the first and second sides of the power contacts.

[0005] Various aspects pertain to a method for fabricating a molded power semiconductor module, the method comprising: providing one or more power semiconductor dies, electrically coupling a first and a second power contact to the one or more power semiconductor dies, the first and second power contacts each comprising a first and an opposite second side, and at least partially encapsulating the one or more power semiconductor dies with a molded body, wherein the molded body has a first side, an opposite second side and lateral sides connecting the first and second sides, such that the first and second power contacts are arranged at a first one of the lateral sides of the molded body, wherein the first sides of the first and second power contacts each comprise an exposed part exposed from the molded body, and wherein the second sides of the first and second power contacts comprise a part that is arranged vertically below an outline of the respective exposed part of the first side and that is at least partially covered by a protrusion part of the molded body, wherein the vertical direction is perpendicular to the first and second sides of the power contacts.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The accompanying drawings illustrate examples and together with the description serve to explain principles of the disclosure. Other examples and many of the intended advantages of the disclosure will be readily appreciated in view of the following detailed description. The elements of the drawings are not necessarily to scale relative so each other. Identical reference numbers designate corresponding similar parts.

[0007] FIGS. **1**A and **1**B show a plan view (FIG. **1**A) and a sectional view (FIG. **1**B) of a molded power semiconductor module, wherein a protrusion part of the molded body is arranged below and mechanically supports the power contacts.

[0008] FIG. **2** shows a sectional view of she molded power semiconductor module of FIGS. **1**A and **1**B according to a specific example.

[0009] FIG. **3** shows a sectional view of the molded power semiconductor module of FIGS. **1**A and **1**B according to another specific example.

[0010] FIG. **4** shows a perspective view of a further molded power semiconductor module which comprises the power contacts, the protrusion part of the molded body and also control or sensing contacts.

[0011] FIG. **5** shows a plan view of a further molded power semiconductor module which comprises the components shown in FIGS. **1**A and **1**B and which additionally comprises testing contacts.

[0012] FIG. **6** is a flow chart of an exemplary method for fabricating a molded power semiconductor module.

DETAILED DESCRIPTION

[0013] In the following detailed description, directional terminology, such as "top", "bottom", "left", "right", "upper", "lower" etc. , is used with reference to the orientation of the Figure(s) being described. Because components of the disclosure can be positioned in a number of different orientations, the directional terminology is used for purposes of illustration only. It is to be understood that other examples may be utilized and structural or logical changes may be made.

[0014] In addition, while a particular feature or aspect of an example may be disclosed with respect to only one of several implementations, such feature or aspect may be combined with one or more other features or aspects of the other implementations as may be desired and advantageous for any given or particular application, unless specifically

noted otherwise or unless technically restricted. Furthermore, to the extent that the terms "include", "have", "with" or other variants thereof are used in either the detailed description or the claims, such terms are intended to be inclusive in a manner similar to the term "comprise". The terms "coupled" and "connected", along with derivatives thereof may be used. It should be understood that these terms may be used to indicate that two elements cooperate or interact with each other regardless whether they are in direct physical or electrical contact, or they are not in direct contact with each other; intervening elements or layers may be provided between the "bonded", "attached", or "connected" elements. However, it is also possible that the "bonded", "attached", or "connected" elements are in direct contact with each other. Also, the term. "exemplary" is merely meant as an example, rather than the best or optimal.

[0015] The examples of a molded power semiconductor module may use various types of semiconductor dies or circuits incorporated in the semiconductor dies, among them AC/DC or DC/DC converter circuits, power MOS transistors, power Schottky diodes, JFETs (Junction Gate Field Effect Transistors), power bipolar transistors, logic integrated circuits, analogue integrated circuits, mixed signal integrated circuits, sensor circuits, power integrated circuits, etc. The examples may also use semiconductor dies comprising MOSFET transistor structures or vertical transistor structures like, for example, IGBT (Insulated Gate Bipolar Transistor) structures or, in general, transistor structures in which at least one electrical contact pad is arranged on a first main face of the semiconductor die and at least one other electrical contact pad is arranged on a second main face of the semiconductor die, opposite to the first-main face of the semiconductor die.

[0016] An efficient molded power semiconductor module may for example reduce material consumption, ohmic losses, chemical waste, etc. and may thus enable energy and/or resource savings. Improved molded power semiconductor modules as well as improved methods for fabricating a molded power semiconductor module, as specified in this description, may thus at least indirectly contribute to green technology solutions, i.e. climate-friendly solutions providing a mitigation of energy and/or resource use.

[0017] FIGS. **1**A and **1**B show a molded power semiconductor module **100**. FIG. **1**A shows a plan view and FIG. **1**B shows a sectional view along the line B-B' in FIG. **1**A.

[0018] The molded power semiconductor module **100** comprises one or more power semiconductor dies **110**, a molded body **120**, a first power contact **130** and a second power contact **140**.

[0019] The one or more power semiconductor dies **110** may be configured to operate with a high voltage and/or a strong electrical current. The one or more power semiconductor dies **110** may be electrically coupled to form any suitable type of electrical circuit, e.g. a converter circuit, an inverter circuit, a half-bridge circuit, etc.

[0020] In the case that the molded power semiconductor module **100** comprises more than one power semiconductor die **110**, the power semiconductor dies **110** may all be of the same type or the power semiconductor dies **110** may be of different types.

[0021] According to an example, the molded power semiconductor module **100** comprises one or more carriers **150**, wherein the one or more power semiconductor dies **110** are arranged on the carrier (s) **150**. Each power semiconductor die **110** may be arranged on a separate carrier **150** or several of the power semiconductor dies **110** or all of the power semiconductor dies **110** may be arranged on the same carrier **150**. The one or more carriers **150** may for example be power electronic substrates. The carrier (s) **150** may comprise a layer structure comprising at least one electrically conductive layer and at least one electrically isolating laver. The carrier (s) **150** may for example be of the type direct copper bond (DCB), direct aluminum bond (DAB), or active metal braze (AMB). According to another example, the carrier(s) **150** may be leadframe parts.

[0022] The power contacts **130**, **140** may be electrically coupled to the carrier (s) **150** and/or to the power semiconductor die (s) **110** for example using electrical connectors like bond wires, ribbons or contact clips.

[0023] The molded body **120** at least partially encapsulates the one or more power semiconductor dies **110**. The molded body **120** has a first side **121**, an opposite second side **122** and lateral sides **123** connecting the first and second sides **121**, **122**.

[0024] The molded body **120** may comprise any suitable mold material. The molded body **120** may for example be fabricated by injection molding, transfer molding or compression molding. The molded body **120** may comprise filler particles, in particular inorganic filler particles configured to reduce the thermal resistance of the molded body **120**.

[0025] As shown in FIG. **1**B, the one or more carriers **150** may be exposed from the molded body **120** at the second side **122**. However, it is also possible that the carrier (s) **150** are not exposed from the molded body **120**.

[0026] The second side **122** of the molded body **120** may be configured to be arranged over a baseplate and/or a heatsink. The heatsink may be configured for air cooling or the heatsink may be configured to use a cooling fluid for direct or indirect liquid cooling of the molded power semiconductor module **100**.

[0027] The first power contact **130** and the second power contact **140** are arranged laterally next to each other at a first one of the lateral sides **123** of the molded body **120**. The molded power semiconductor module **100** may comprise only the two power contacts **130**, **140** as shown in FIG. **1**A. However, it is also possible that the molded power semiconductor module **100** comprises one or more further power contacts. The one or more further power contacts may be arranged laterally next to the first and second power contacts **130**, **140** at the first one of the lateral sides **123** of the molded body **120**. However, it is also possible that one or more further power contacts are arranged at one or more other ones of the lateral sides **123**.

[0028] According to an example, the molded power semiconductor module **100** further comprises one or more control or sensing contacts. The control or sensing contacts may for example be arranged at the first side **121** of the molded body and/or at one of the lateral sides **123**. The control or sensing contacts may for example comprise pins, in particular pressfit pins, or leadframe parts. The control or sensing contacts may be configured to couple the molded power semiconductor module **100** to an application board.

[0029] The first and second power contacts **130**, **140** are electrically coupled to the one or more power semiconductor dies **110**. The power contacts **130**, **140** may e.g. be configured to provide a respective supply voltage to the power semiconductor die(s) **110**. The respective supply voltage may for example be a positive or a negative supply voltage.

However, it is also possible that the power contacts **130**, **140** are configured as output contacts of the power semiconductor die(s) **110**.

[0030] The power contacts **130**, **140** may for example be leadframe parts. The power contacts **130**, **140** may for example comprise or consist of Al, Cu or Fe. The power contacts **130**, **140** may comprise a coating, e.g. a Ni coating.

[0031] The first and second power contacts **130**, **140** each comprise a first side **131**, **141** and an opposite second side **132**, **142**. The first sides **131**, **141** of the first and second power contacts **130**, **140** each comprise an exposed part exposed from the molded body **120**. In FIG. **1**B, the exposed part of the first side **141** of the second power contact **140** is framed by vertical dashed lines.

[0032] On the other hand, the second sides **132**, **142** of the first and second power contacts **130**, **140** comprise a part that is arranged vertically below an outline of the respective exposed part of the respective first side **131**, **132**. Furthermore, this part of the second sides **132**, **142** is at least partially covered by a protrusion part **120'** of the molded body **120**. In FIG. **1**B, the protrusion part **120'** is that part of the molded body **120** that is arranged between the vertical dashed lines. The protrusion part **120'** may be contiguous with the rest of the molded body **120**.

[0033] For example during installation of the molded power semiconductor module **100**, it may be necessary to exert a mechanical force onto the power contacts **130**, **140**. The power contacts **130**, **140** may for example be configured to be coupled (e.g. welded) to an external appliance like a bus bar. In order to create a firm joint, the power contacts **130**, **140** may be pressed onto the bus bar during the welding process. The protrusion part **120'** of the molded body **120** may be configured to mechanically support the power contacts **130**, **140** during this process and to prevent the power contacts **130**, **140** from bending out of shape. The molded power semiconductor module **100** comprising the protrusion part **120'** may dispense with the need to provide a dedicate external support for the power contacts **130**, **140** during the installation process (which may e.g. comprise a welding process as mentioned above).

[0034] The molded power semiconductor module **100** may therefore have a simplified installation process and may consequently offer cost reductions.

[0035] The protrusion part **120'** may for example be configured to support the power contacts **130**, **140** against a mechanical force of 0.5N or more, or 1N or more, or 1.5N or more, or 2N or more. The protrusion part may for example have a thickness measured between the second side **122** of the molded body **120** and the second side **132**, **142** of the power contacts **130**, **140** of 0.5 mm or more, or 1 mm or more, or 1.5 mm or more, or 2 mm or more, or 5 mm or more. The protrusion part **120** may cover more than 50% or more than 70% or more than 90% or it may cover 100% of the surface area of the second sides **132**, **142** of the power contacts **130**, **140**.

[0036] FIG. **2** shows a sectional view of a specific example of the molded power semiconductor module **100** along the line A-A' in FIG. **1**A.

[0037] As shown in FIG. **2**, the first and second power contacts **130**, **140** may also comprise lateral sides **133**, **143** connecting the first and second sides **131**, **132**, respectively **141**, **142**. Furthermore, a lateral side **133** of the first power contact **130** is arranged opposite a lateral side **143** of the second power contact **140**.

[0038] In the example shown in FIG. **2**, the molded body **120** completely shields the opposite lateral sides **133**, **143** from one another such that a creepage distance between the first and second power contacts **130**, **140** is increased. In other words, the molded body **120** may comprise a ridge part **120"** which is arranged between the opposite lateral sides **133**, **143** of the power contacts **130**, **140**. The first sides **131**, **141** of the power contacts **130**, **140** are arranged in a first plane (plane A) and the ridge part **120"** extends up to a second plane (plane B) which is arranged above the first plane. The creepage distance between the power contacts **130**, **140** is increased by twice the height difference between the two planes A and B. As shown in FIG. **2**, the molded body **120** does not necessarily have to extend above plane A at the outer lateral sides of the power contacts **130**, **140** because no creepage distance has to be increased there.

[0039] In order to couple the molded. power semiconductor module **100** comprising the ridge part **120"** to an external appliance (e.g. a bus bar), it may be necessary that the external appliance comprises contacts with a fitting shape which take into account the presence of the ridge part **120"**.

[0040] According to an example, the molded power semiconductor module **100** does not comprise the ridge part **120"**, meaning that the molded body **120** does not extend above the plane A between the power contacts **130**, **140**. In this case, the creepage distance between the power contacts **130**, **140** is not increased.

[0041] FIG. **3** shows a sectional view of a further specific example of the molded power semiconductor module **100** along the line A-A' in FIG. **1**A.

[0042] As shown in the specific example of FIG. **3**, the molded body **120** may at least partially cover an edge portion of the first side **131**, **141** of the first and second power contacts **130**, **140**. By covering the edge portion of the first sides **131**, **141**, the creepage distance between the power contacts **130**, **140** may be increased further.

[0043] The edge portion of the first sides **131**, **141** of the power contacts **130**, **140** that is covered by the molded body **120** may for example have a width w of 0.1 mm or more, or 0.3 mm or more, or 0.6 mm or more, or 0.9 mm or more, or 1.5 mm or more, or 2 mm or more, or 5 mm or more.

[0044] Edge portions along a single lateral side **133** **143** of a power contact **130**, **140** may be covered by the molded body **120**, as shown in the example of FIG. **3**. However, it is also possible that edge portions along both lateral sides **133**, **143** of a power contact **130**, **140** are covered by the molded body **120**.

[0045] Furthermore, it should be noted that in FIG. **1**A, a distal end of the power contacts **130**, **140** (i.e. the lateral side **133**, **143** arranged at the bottom in FIG. **1**A) is exposed from the molded body **120**. It is however also possible that the molded body **120** covers this lateral side **133**, **143** as well.

[0046] FIG. **4** shows a perspective view of a further molded power semiconductor module **400** which may be similar or identical to the molded power semiconductor module **100**, except for the differences described in the following.

[0047] The molded power semiconductor module **400** comprises the first and second power contacts **130**, **140** and it further comprises a third power contact **160**. The third power contact **160** may be arranged laterally next to the second power contact **140** at the same lateral side **123** of the molded body **120**. The power contacts **130**, **140** and **160** may e.g. be coplanar with each other. The protrusion part **120'**

may be configured to support all three power contacts **130**, **140** and **160** as explained further above.

[0048] According to an example, the first and third power contacts **130**, **160** are configured to carry a positive supply voltage and the second power contact **140** is configured to carry a negative supply voltage. According to another example, it is the other way around.

[0049] The molded power semiconductor module **400** may further comprise a fourth power contact **170**. The fourth power contact **170** may be arranged at a lateral side **123** of the molded body **120** that is opposite to the lateral side **123** which comprises the first, second and third power contacts **130**, **140** and **160**. The fourth power contact **170** may for example be configured as a phase contact of the molded power semiconductor module **400**.

[0050] According to an example, the fourth power contact **170** is not supported by a protrusion part **120'** of the molded body **120**. In other words, both the first and the second side of the fourth power contact **170** are exposed from the molded body **120**. However, it is also possible that the fourth power contact **170** is supported by a protrusion part **120'**, similar to the first, second and third power contacts **130**, **140** and **160**.

[0051] The molded power semiconductor module **400** may further comprise one or more control or sensing contacts **180**. The control or sensing contact (s) **180** may for example be arranged at the first side **121** of the molded body **120**. The control or sensing contacts **180** may essentially be arranged in a vertical direction with respect to an orientation of the power contacts **130-170**. The control or sensing contacts **180** may be configured to provide control signals for controlling the power semiconductor die(s) **110** of the molded power semiconductor module **400** and/or to output sensing signals, e.g. for temperature sensing. According to an example, the control or sensing contacts **180** comprise pins, e.g. press fit pins.

[0052] FIG. **5** shows a plan view of a further molded power semiconductor module **500** which may be similar or identical to the molded power semiconductor modules **100** or **400**, except for the differences described in the following.

[0053] In particular, the molded power semiconductor module **500** also comprises one or more testing contacts **190** exposed from the molded body **120**. The one or more testing contacts **190** are configured to provide electrical connections to top side electrodes of the one or more power semiconductor dies **110** for electrical testing.

[0054] The top side electrodes are those electrodes of the power semiconductor die (s) **110** that face towards the first side **121** of the molded body **120**. After the molded body **120** has been formed, the top side electrodes may be inaccessible from the outside. By providing the testing contacts **190** which are coupled to the top side electrodes, an electrical functionality test of the top side electrodes can be performed.

[0055] According to an example, one or more of the testing contacts **190** are arranged coplanar with the power contacts **130**, **140** and **160**. As shown in FIG. **5**, a testing contact **190** may be arranged in a cutout area of a power contact (the second power contact **140** in FIG. **5**). The power contacts **130-170** and the testing contacts **190** may for example be parts of the same leadframe.

[0056] FIG. **6** is a flow chart of a method **600** for fabricating a molded power semiconductor module. The method **600** may for example be used to fabricate the molded power semiconductor modules **100**, **400** and **500**.

[0057] The method **600** comprises at **601** a process of providing one or more power semiconductor dies, at **602** a process of electrically coupling a first and a second power contact to the one or more power semiconductor dies, the first and second power contacts each comprising a first and an opposite second side, and at **603** a process of at least partially encapsulating the one or more power semiconductor dies with a molded body, wherein the molded body has a first side, an opposite second side and lateral sides connecting the first and second sides, such that the first and second power contacts are arranged at a first one of the lateral sides of the molded body, wherein the first sides of the first and second power contacts each comprise an exposed part exposed from the molded body, and wherein the second sides of the first and second power contacts comprise a part that is arranged vertically below an outline of the respective exposed part of the first side and that is at least partially covered by a protrusion part of the molded body, wherein the vertical direction is perpendicular to the first and second sides of the power contacts.

[0058] In the following, the molded power semiconductor module as well as the method for fabricating a molded power semiconductor module are further explained using specific examples.

[0059] Example 1 is a molded power semiconductor module, comprising: one or more power semiconductor dies, a molded body at least partially encapsulating the one or more power semiconductor dies, the molded body having a first side, an opposite second side and lateral sides connecting the first and second sides, a first and a second power contact arranged laterally next to each other at a first one of the lateral sides of the molded body and electrically coupled to the one or more power semiconductor dies, the first and second power contacts each comprising a first and an opposite second side, wherein the first sides of the first and second power contacts each comprise an exposed part exposed from the molded body, and wherein the second sides of the first and second power contacts comprise a part that is arranged vertically below an outline of the respective exposed part of the first side and that is at least partially covered by a protrusion part o the molded body, wherein the vertical direction is perpendicular to the first and second sides of the power contacts.

[0060] Example 2 is the molded power semiconductor module of example 1, wherein the first and second power contacts also comprise lateral sides connecting the first and second sides, wherein a lateral side of the first power contact is arranged opposite lateral side of the second power contact, and wherein the molded body completely shields the opposite lateral sides from one another such that a creepage distance between the first and second power contacts is increased.

[0061] Example 3 is the molded power semiconductor module of one of the preceding examples, wherein the first power contact is configured to carry a positive supply voltage and the second power contact is configured to carry a negative supply voltage.

[0062] Example 4 is the molded power semiconductor module of one of the preceding examples, wherein the protrusion part is configured to support the respective one of the first and second power contacts against a mechanical

force of IN or more pressing down onto the first side of the respective one of the first and second power contacts.

[0063] Example 5 is the molded power semiconductor module of one of the preceding examples, wherein a thickness of the protrusion part of the molded body is 1 mm or more, the thickness being measured perpendicular to the first and second sides of the power contacts.

[0064] Example 6 is the molded power semiconductor module of one of the preceding examples, further comprising: at least one further power contact arranged at a second one of the lateral sides of the molded body, wherein the at least one further power contact is configured as a phase contact of the molded power semiconductor module.

[0065] Example 7 is the molded power semiconductor module of one of the preceding examples, further comprising: testing contacts exposed from the molded body and configured to provide electrical connections to top side electrodes of the one or more power semiconductor dies for electrical testing, wherein the power contacts and the testing contacts are leadframe parts.

[0066] Example 8 is the molded power semiconductor module of one of the preceding examples, further comprising: control or sensing contacts exposed from the first side of the molded body.

[0067] Example 9 is the molded power semiconductor module of one of the preceding examples, wherein the first and second power contacts are coplanar.

[0068] Example 10 is the molded power semiconductor module of one of the preceding examples, wherein the molded body also at least partially covers an edge portion of the first side of the first and second power contacts.

[0069] Example 11 is the molded power semiconductor module of one of the preceding examples, wherein the second side of the molded body is configured to be arranged over a heatsink.

[0070] Example 12 is a method for fabricating a molded power semiconductor module, the method comprising: providing one or more power semiconductor dies, electrically coupling a first and a second power contact to the one or more power semiconductor dies, the first and second power contacts each comprising a first and an opposite second side, and at least partially encapsulating the one or more power semiconductor dies with a molded body, wherein the molded body has a first side, an opposite second side and lateral sides connecting the first and second sides, such that the first and second power contacts are arranged at a first one of the lateral sides of the molded body, wherein the first sides of the first and second power contacts each comprise an exposed part exposed from the molded body, and wherein the second sides of the first and second power contacts comprise a part that is arranged vertically below an outline of the respective exposed part of the first side and that is at least partially covered by a protrusion part of the molded body, wherein the vertical direction is perpendicular to the first and second sides of the power contacts.

[0071] Example 13 is the method of example 12, wherein the protrusion part is configured to support the respective one of the first and second power contacts against a mechanical force of 1N or more pressing down onto the first side of the respective one of the first and second power contacts.

[0072] Example 14 is an apparatus with means for performing the method according to example 12 or 13.

[0073] While the disclosure has been illustrated and described with respect to one or more implementations, alterations and/or modifications may be made to the illustrated examples without departing from the spirit and scope of the appended claims. In particular regard to the various functions performed by the above described components or structures (assemblies, devices, circuits, systems, etc.), the terms (including a reference to a "means") used to describe such components are intended to correspond, unless otherwise indicated, to any component or structure which performs the specified function of the described component (e.g., that is functionally equivalent), even though riot structurally equivalent to the disclosed structure which performs the function in the herein illustrated exemplary implementations of the disclosure.

What is claimed is:

1. A molded power semiconductor module, comprising:

one or more power semiconductor dies;

a molded body at least partially encapsulating the one or more power semiconductor dies, the molded body having a first side, an opposite second side, and lateral sides connecting the first and second sides; and

a first and a second power contact arranged laterally next to each other at a first one of the lateral sides of the molded body and electrically coupled to the one or more power semiconductor dies, the first and second power contacts each comprising a first and an opposite second side,

wherein the first sides of the first and second power contacts each comprise an exposed part exposed from the molded body,

wherein the second sides of the first and second power contacts each comprise a part that is arranged in a vertical direction below an outline of the respective exposed part of the first side and fiat is at least partially covered by a protrusion part of the molded body,

wherein the vertical direction is perpendicular to the first and second sides of the first and second power contacts.

2. The molded power semiconductor module of claim **1**, wherein the first and second power contacts further comprise lateral sides connecting the first and second sides, wherein a lateral side of the first power contact is arranged opposite a lateral side of the second power contact, and wherein the molded body completely shields the opposite lateral sides from one another such that a creepage distance between the first and second power contacts is increased.

3. The molded power semiconductor module of claim **1**, wherein the first power contact is configured to carry a positive supply voltage and the second power contact is configured to carry a negative supply voltage.

4. The molded power semiconductor module of claim **1**, wherein the protrusion part of the molded body is configured to support the respective one of the first and second power contacts against a mechanical force of 1N or more pressing down onto the first side of the respective one of the first and second power contacts.

5. The molded power semiconductor module of claim **1**, wherein a thickness of the protrusion part of the molded body is 1 mm or more, the thickness being measured perpendicular to the first and second sides of the power contacts.

6. The molded power semiconductor module of claim **1**, further comprising:

at least one further power contact arranged ac a second one of the lateral sides of the molded body,

wherein the at least one further power contact is configured as a phase contact of the molded power semiconductor module.

7. The molded power semiconductor module of claim **1**, further comprising:

testing contacts exposed from the molded body and configured to provide electrical connections to top side electrodes of the one or more power semiconductor dies for electrical testing,

wherein the first and second power contacts and the testing contacts are leadframe parts.

8. The molded power semiconductor module of claim **1**, further comprising:

control or sensing contacts exposed from the first side of the molded body.

9. The molded cower semiconductor claim **1**, wherein the first and second power contacts are coplanar.

10. The molded power semiconductor module of claim **1**, wherein the molded body at least partially covers an edge portion of the first side of the first and second power contacts.

11. The molded power semiconductor module of claim **1**, wherein the second side of the molded body is configured to be arranged over a heatsink.

12. A method for fabricating a molded power semiconductor module, the method comprising:

providing one or more power semiconductor dies;

electrically coupling a first and a second power contact to the one or more power semiconductor dies, the first and second power contacts each comprising a first and an opposite second side; and

at least partially encapsulating the one or more power semiconductor dies with a molded body,

wherein the molded body has a first side, an opposite second side, and lateral sides connecting the first and second sides, such that the first and second power contacts are arranged at a first one of the lateral sides of the molded body,

wherein the first sides of the first and second power contacts each comprise an exposed part exposed from the molded body,

wherein the second sides of the first and second power contacts each comprise a part that as arranged in a vertical direction below an outline of the respective exposed part of the first side and that is at least partially covered by a protrusion part of the molded body,

wherein the vertical direction is perpendicular to the first and second sides of the power contacts.

13. The method of claim **12**, wherein the protrusion part of the molded body is configured to support the respective one of the first and second power contacts against a mechanical force of 1N or more pressing down onto the first side of the respective one of the first and second power contacts.

* * * * *