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(54) **ELECTRONIC PACKAGE STRUCTURE**

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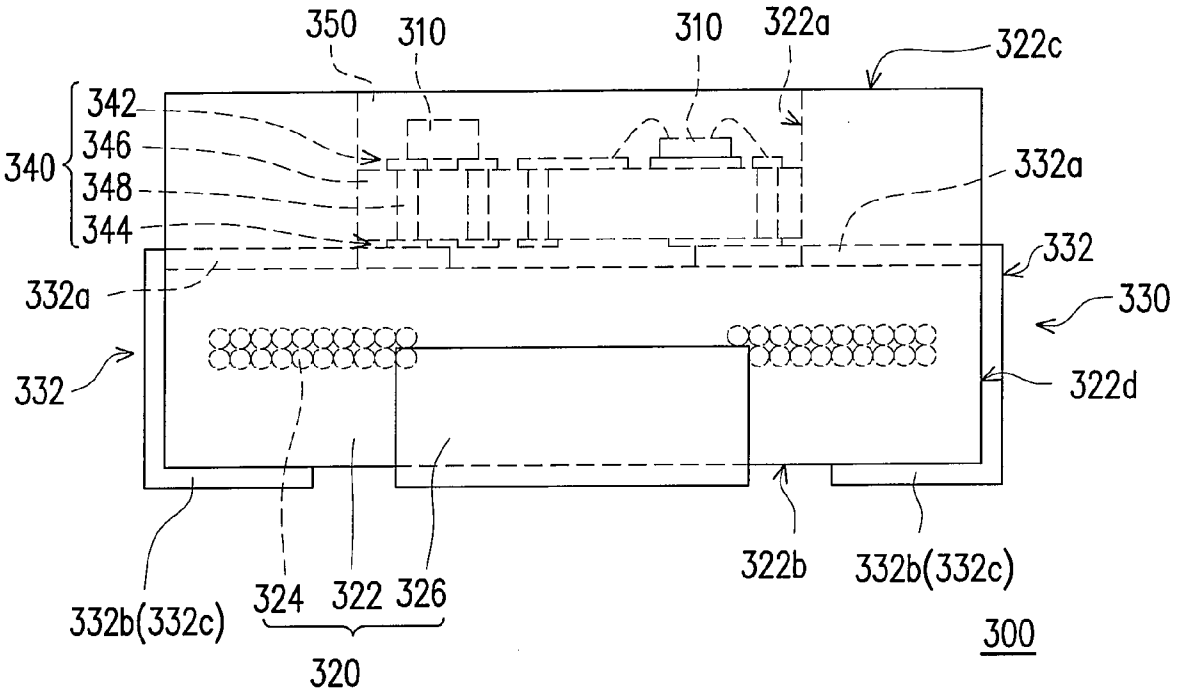
(57) **ABSTRACT**

An electronic package structure including at least one first electronic element, a second electronic element and a lead frame is provided. The second electronic element includes a body having a cavity. The first electronic element is disposed in the cavity. The lead frame has a plurality of leads. Each of the leads has a first end and a second end. The first end of at least one of the leads extends to the cavity to electrically connect the first electronic element.



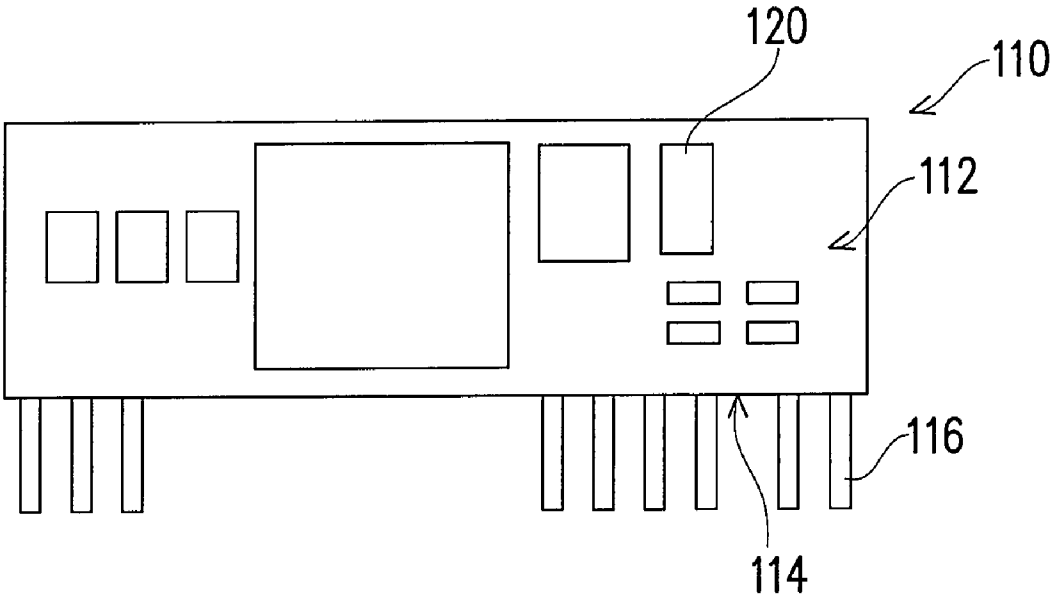


FIG. 1 (PRIOR ART)

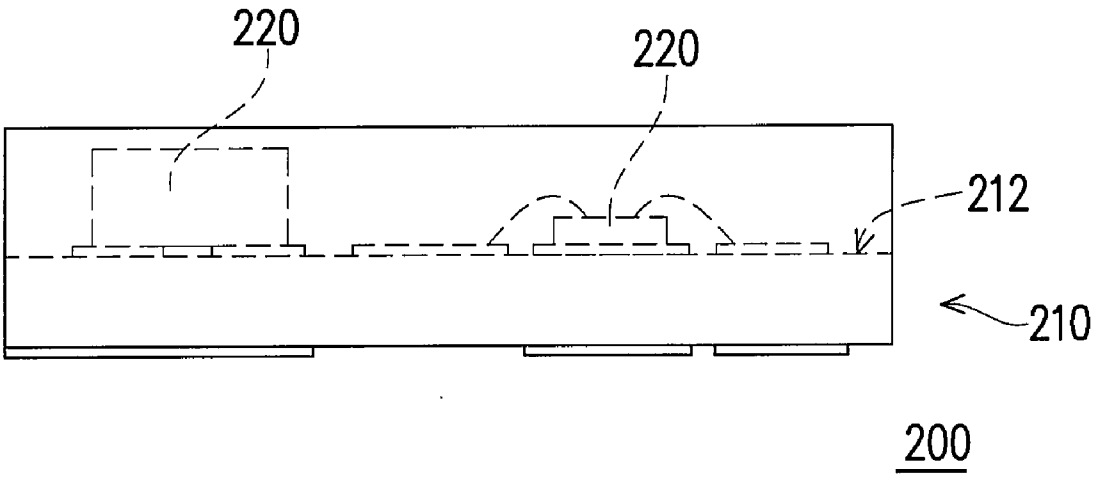


FIG. 2 (PRIOR ART)

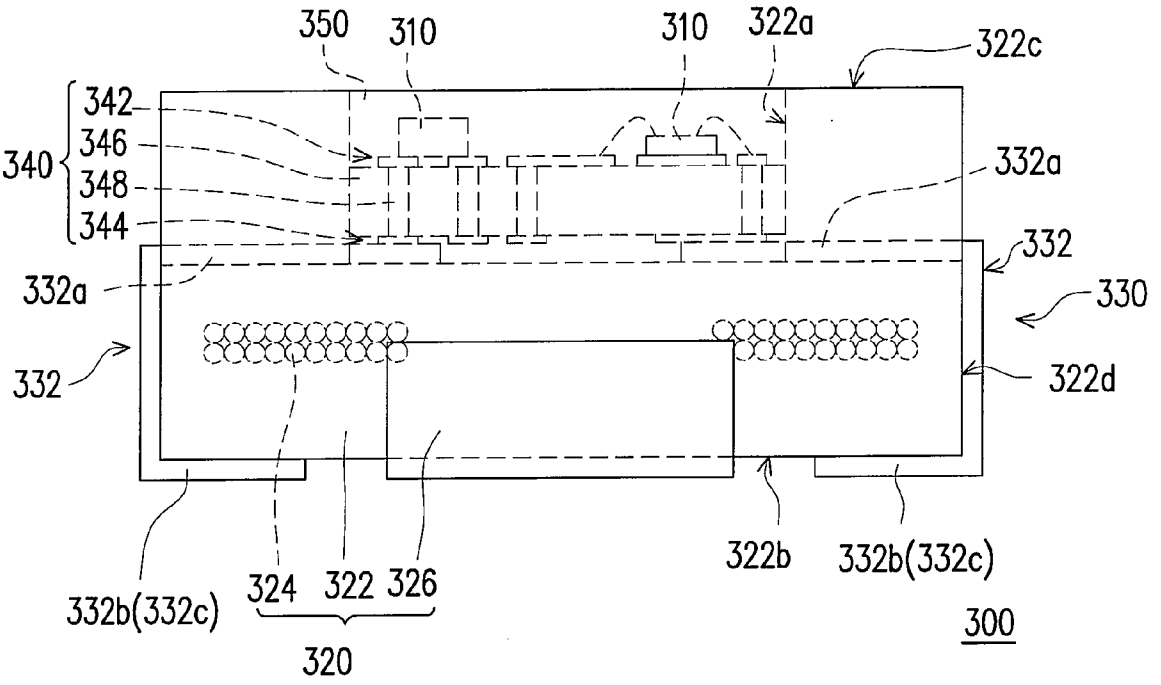

350
310
310
322a
322c
342
346
348
344
340
332a
332a
332
330
332
322d
322b
332b(332c)
332b(332c)
324
322
326
320
300

FIG. 3A

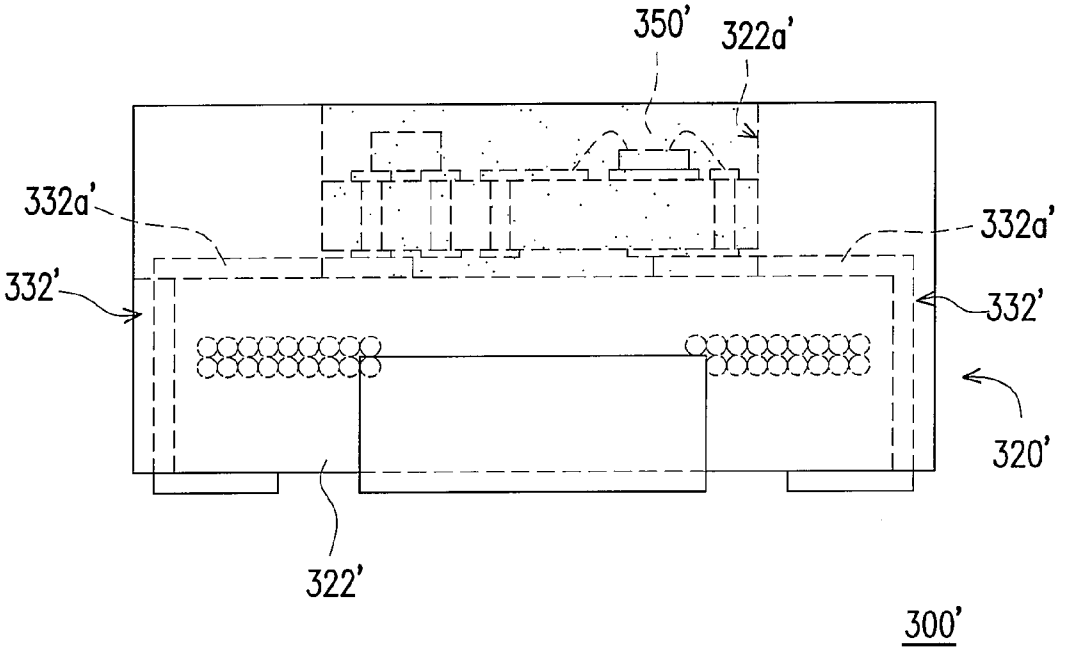

350'
322a'
332a'
332a'
332'
332'
320'
322'
300'

FIG. 3B

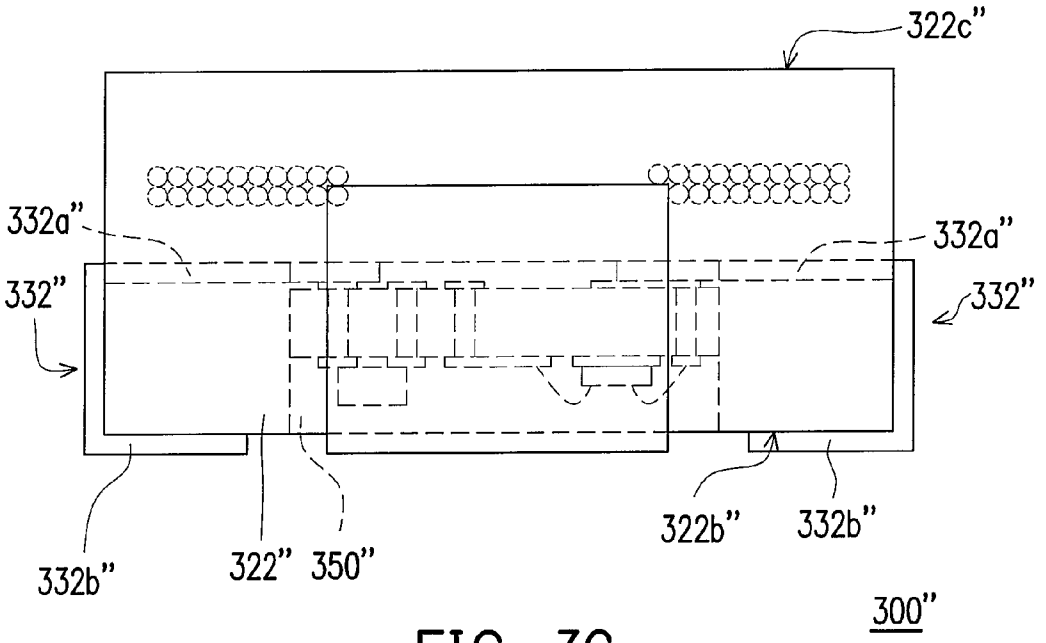

322c"
332a"
332a"
332"
332"
322b"
332b"
332b"
322"
350"
300"

FIG. 3C

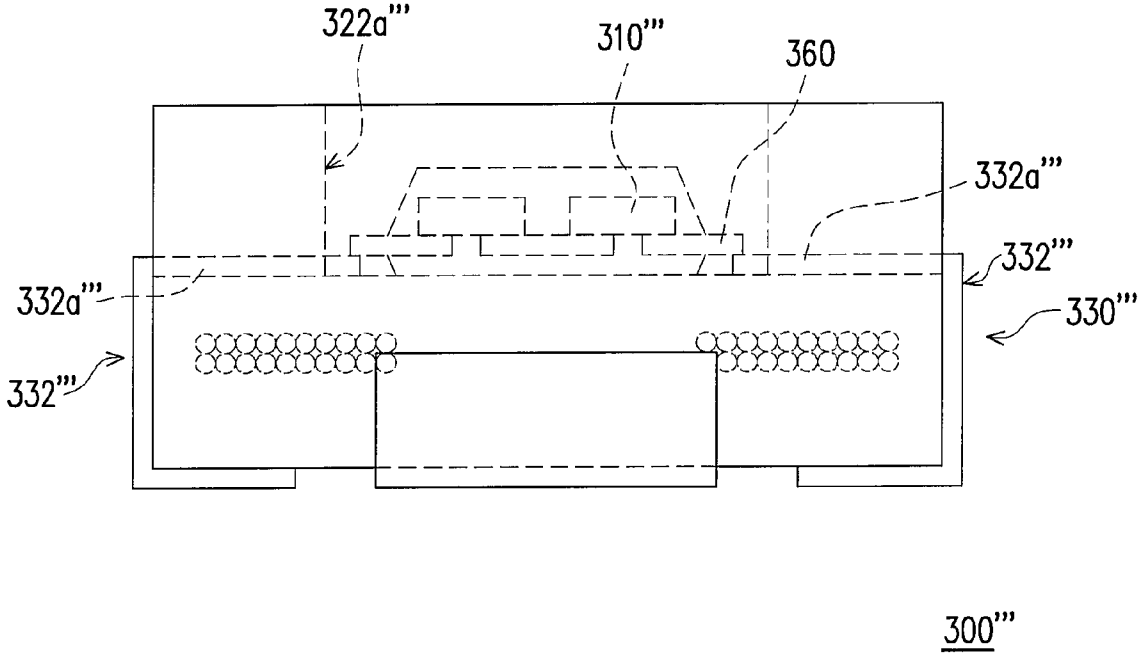

322a'''
310'''
360
332a'''
332'''
332a'''
330'''
332'''
300'''

FIG. 3D

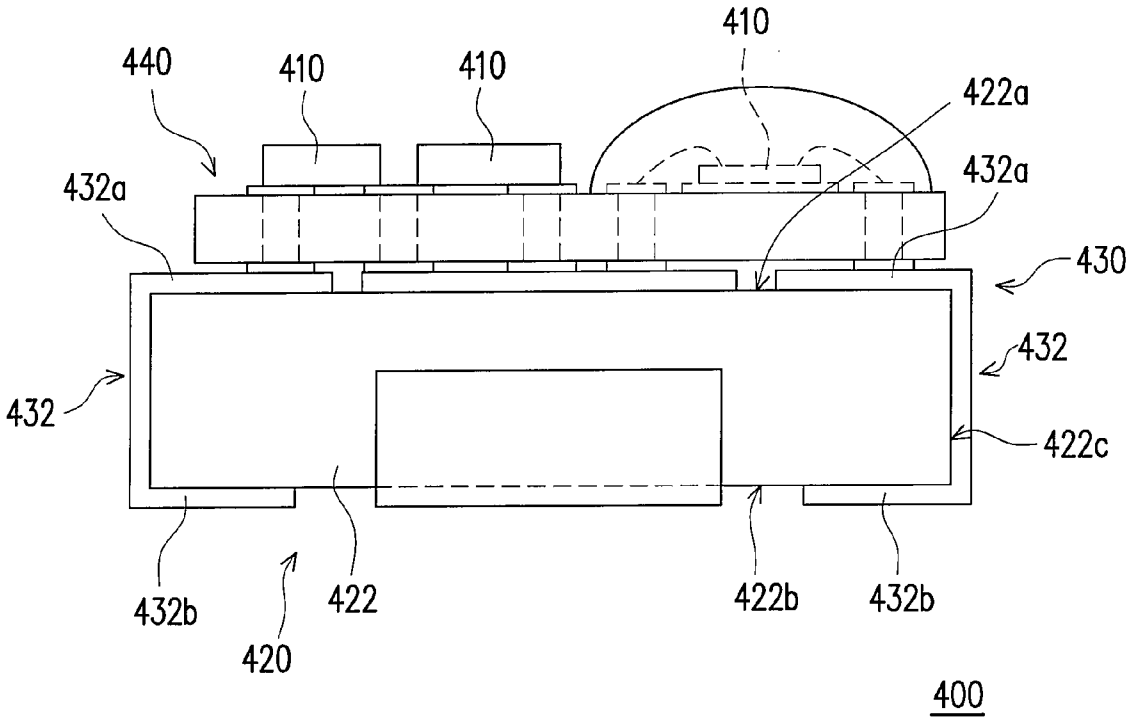

410
440
410
410
422a
432a
432a
430
432
432
422c
432b
420
422
422b
432b
400

FIG. 4A

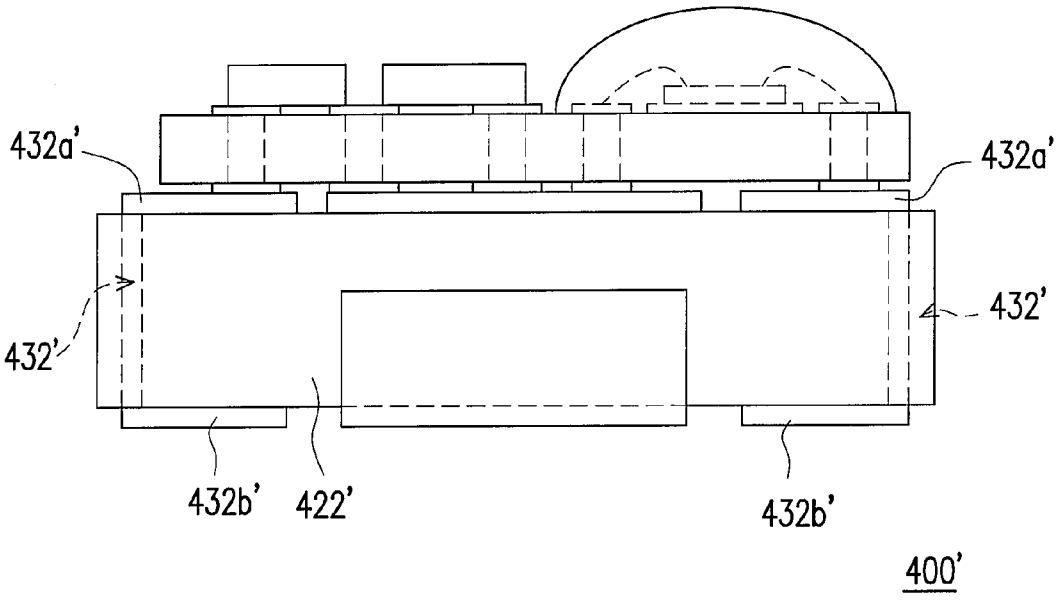
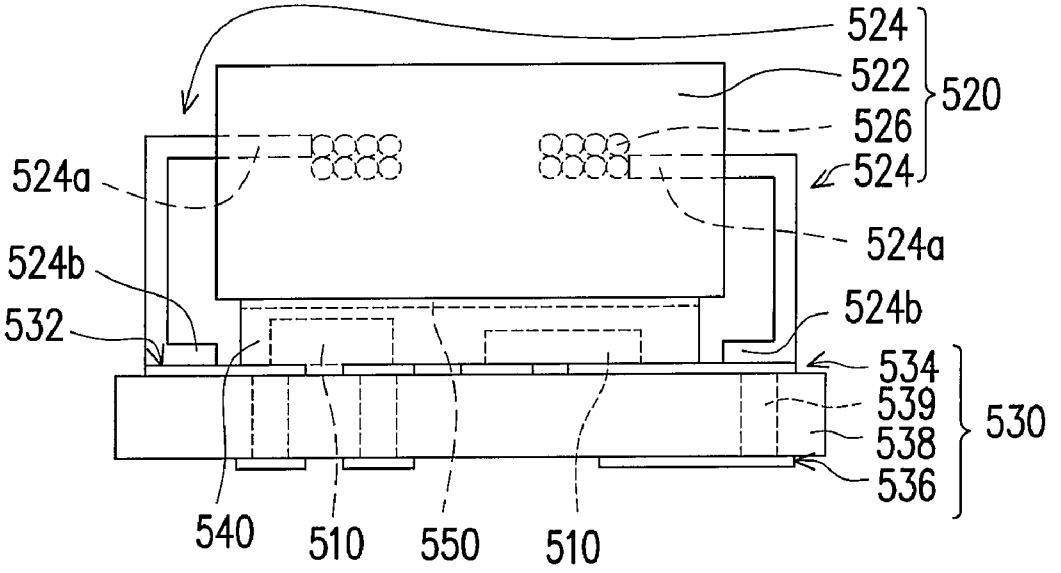
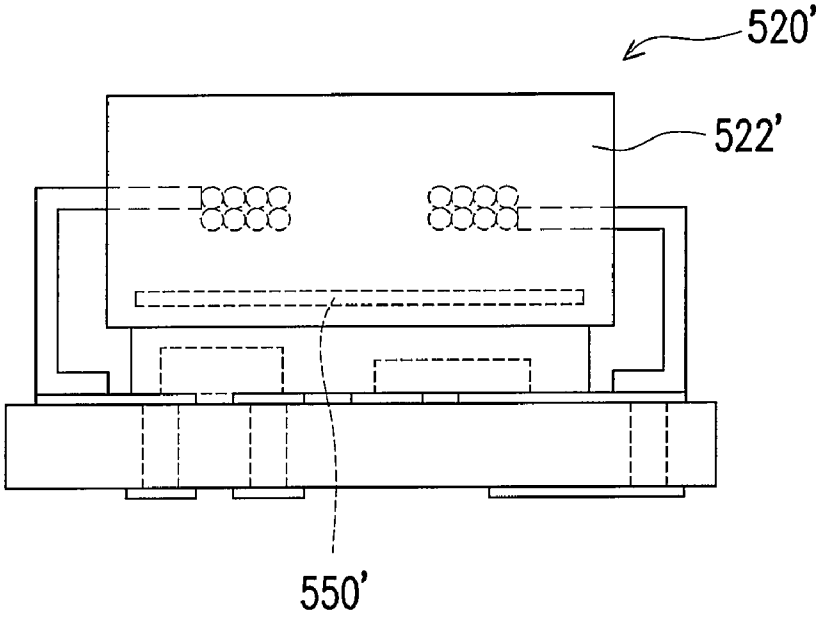

432a'
432a'
432'
432'
432b'
422'
432b'
400'

FIG. 4B



500

FIG. 5A



500'

FIG. 5B

ELECTRONIC PACKAGE STRUCTURE

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the priority benefit of Taiwan application serial no. 97105555, filed on Feb. 18, 2008. The entirety of the above-mentioned patent application is hereby incorporated by reference herein and made a part of specification.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a package structure. More particularly, the present invention relates to an electronic package structure.

[0004] 2. Description of Related Art

[0005] Electronic package structures are formed by complicated package processes. Different electronic package structures have different electrical performances and capacities of heat dissipation, and therefore a designer may select an electronic package structure with a desired electrical performance and capacity of heat dissipation according to a design requirement.

[0006] FIG. **1** is a schematic diagram of a conventional electronic package structure. Referring to FIG. **1**, the conventional electronic package structure **100** includes a printed circuit board (PCB) **110** and a plurality of electronic elements **120**. The electronic elements **120** are disposed on a surface **112** of the PCB **110** and electrically connected to the PCB **110**. The PCB **110** has a plurality of pins **116** extending out from another surface **114** of the PCB **110** to be electrically connected to an electronic device, for example, a motherboard (not shown).

[0007] FIG. **2** is a schematic diagram of another conventional electronic package structure. Referring to FIG. **2**, the conventional electronic package structure **200** includes a circuit substrate **210** and a plurality of electronic elements **220**. The electronic elements **220** are disposed on a surface **212** of the circuit substrate **210**, and electrically connected to the circuit substrate **210** via a wire bonding technology, a flip-chip bonding technology or a surface mount technology. Moreover, the conventional electronic package structure **200** may be electrically connected to an electronic device, for example, a motherboard (not shown), via a solder paste or a plurality of solder balls (not shown).

[0008] It should be noted that the electronic elements **120** of the conventional electronic package structure **100** are all disposed on the surface **112** of the PCB **110**, and the electronic elements **220** of the conventional electronic package structure **200** are all disposed on the surface **212** of the circuit substrate **210**. Therefore, in the conventional electronic package structures **100** and **200**, spatial utilization of the PCB **110** and the circuit substrate **210** is relatively low, and sizes of the conventional electronic package structures **100** and **200** are relatively great.

SUMMARY OF THE INVENTION

[0009] In accordance with the present invention, an electronic package structure can achieve a relatively high utilization of an internal space thereof, so that a size of the electronic package structure can be reduced.

[0010] In one embodiment of the present invention, an electronic package structure includes at least a first electronic element, a second electronic element and a first lead frame. The second electronic element includes a body having a cavity. The first electronic element is disposed in the cavity. The lead frame has a plurality of leads. Each of the leads has a first end and a second end, and the first end of at least one of the leads extends to the cavity to electrically connect the first electronic element.

[0011] In one embodiment of the present invention, an electronic package structure includes at least one first electronic element, a second electronic element and a lead frame. The second electronic element includes a body having a first surface. The lead frame has a plurality of leads. Each of the leads has a first end and a second end. The first ends are disposed on the first surface, and the first electronic element is disposed on the first surface and electrically connected to at least one of the leads.

[0012] In one embodiment, an electronic package structure includes a circuit substrate, at least one first electronic element and a second electronic element. The circuit substrate has a first surface. The first electronic element is disposed on the first surface of the circuit substrate and electrically connected to the circuit substrate. The second electronic element is disposed above the first surface of the circuit substrate and includes a body and a plurality of leads. Each of the leads has a first end and second end, and the second end of each of the leads extends out from the body to electrically connect the circuit substrate. The first electronic element is located among the body of the second electronic element, the first surface of the circuit substrate and the leads.

[0013] In the above embodiments of the present invention, since the first electronic element can be disposed in the cavity of the second electronic element or on the second electronic element, or the second electronic element can be stacked on the first electronic element, compared to the conventional electronic package structures, utilization of an internal space of the electronic package structure is relatively high.

[0014] In order to make the aforementioned and other objects, features and advantages of the present invention comprehensible, a preferred embodiment accompanied with figures is described in detail below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] FIG. **1** is a schematic diagram of a conventional electronic package structure.

[0016] FIG. **2** is a schematic diagram of another conventional electronic package structure.

[0017] FIG. **3**A is a schematic diagram of an electronic package structure according to a first embodiment of the present invention.

[0018] FIG. **3**B is a schematic diagram of another electronic package structure according to the first embodiment of the present invention.

[0019] FIG. **3**C is a schematic diagram of another electronic package structure according to the first embodiment of the present invention.

[0020] FIG. **3**D is a schematic diagram of still another electronic package structure according to the first embodiment of the present invention.

[0021] FIG. **4**A is a schematic diagram of an electronic package structure according to a second embodiment of the present invention.

[0022] FIG. **4**B is a schematic diagram of another electronic package structure according to the second embodiment of the present invention.

[0023] FIG. **5**A is a schematic diagram of an electronic package structure according to a third embodiment of the present invention.

[0024] FIG. **5**B is a schematic diagram of another electronic package structure according to the third embodiment of the present invention.

DESCRIPTION OF EMBODIMENTS

First Embodiment

[0025] FIG. **3**A is a schematic diagram of an electronic package structure according to a first embodiment of the present invention. Referring to FIG. **3**A, the electronic package structure **300** includes at least one first electronic element **310** (two first electronic elements are illustrated in FIG. **3**A), a second electronic element **320** and a first lead frame **330**. The electronic package structure **300** is generally applied to a voltage regulator module, a network adapter, a graphics processing unit, a DC/DC converter or a point-of-load (POL) converter. Each of the first electronic elements **310** can be a logical control element, a driving element or a passive element. The passive element can be a capacitor, an inductor with lesser inductance, or a resistor. Each of the first electronic elements **310** can also be a power element, such as a metal-oxide-semiconductor field effect transistor (MOSFET), an insulated gate bipolar transistor (IGBT) or a diode.

[0026] The second electronic element **320** includes a body **322** having a cavity **322***a*. The first electronic elements **310** are disposed in the cavity **322***a*. In the embodiment, the body **322** of the second electronic element **320** has a first surface **322***b*, a second surface **322***c* opposite to the first surface **322***b* and a side surface **322***d*. The cavity **322***a* sinks in a direction from the second surface **322***c* towards the first surface **322***b*. The side surface **322***d* connects the first surface **322***b* and the second surface **322***c*. Besides, the second electronic element **320** can be an energy-storage element used for storing electric energy. In detail, the second electronic element **320** further includes a coil **324** and a plurality of first external electrodes **326**. The coil **324** is disposed within the body **322**. The first external electrodes **326** are respectively connected to two opposite ends of the coil **324**, and extend outside the body **322** to locate on the first surface **322***b* and the side surface **322***d*. The body **322** comprising a magnetic body encloses the coil **324**. The second electronic element **320** can be an inductive element with a greater inductance and a greater size than the first electronic elements **310**.

[0027] The first lead frame **330** has a plurality of leads **332**. Each of the leads **332** has a first end **332***a* and a second end **332***b*, and the first end **332***a* of each of the leads **332** can be embedded in the body **322** and extends to the cavity **322***a* for electrically connecting to the first electronic elements **310**. The second end **332***b* of each of the leads **332** is disposed on the first surface **322***b* of the body **322** to form a second external electrode **332***c*, and a part of each of the leads **332** connecting the first end **332***a* and the second end **332***b* is disposed on the side surface **322***d* of the body **322**.

[0028] In the present embodiment, the electronic package structure **300** further includes a circuit substrate **340** and an insulating encapsulant **350**. The circuit substrate **340** is disposed in the cavity **322***a* of the body **322**. The first electronic elements **310** can be disposed on the circuit substrate **340** and electrically connected to the circuit substrate **340**. The circuit substrate **340** is electrically connected to the first end **332***a* of each of the leads **332** extending to the cavity **322***a*. The first electronic elements **310** may be electrically connected to the circuit substrate **340** via a wire bonding technology, a flip-chip bonding technology or a surface mount technology. The circuit substrate **340** has a first circuit layer **342**, a second circuit layer **344**, a dielectric layer **346** disposed between the first circuit layer **342** and the second circuit layer **344**, and at least a conductive channel **348**. The first electronic elements **310** are disposed on the first circuit layer **342**, and the conductive channel **348** penetrates the dielectric layer **346** for electrically connecting the first circuit layer **342** and the second circuit layer **344**. It should be noted that the circuit board **340** of the electronic package structure **300** may be omitted according to a design requirement of a designer, though it is not illustrated.

[0029] Moreover, the insulating encapsulant **350** is disposed in the cavity **322***a* and encapsulates the first electronic elements **310** and the circuit substrate **340** for protecting the first electronic elements **310** and the circuit substrate **340**, and enhancing a whole mechanical strength of the electronic package structure **300**.

[0030] Since the first electronic elements **310** and the circuit substrate **340** are disposed in the cavity **322***a* of the second electronic element **320**, compared to a conventional electronic package structures of FIG. **1** and FIG. **2**, utilization of an internal space of the electronic package structure **300** is relatively high, and the first electronic elements **310** and the circuit substrate **340** can be protected by the cavity **322***a*. Besides, since the insulating encapsulant **350** is disposed in the cavity **322***a*, material of the insulating encapsulant **350** can be directly filled into the cavity **322***a* without aiding of extra mold during formation of the insulating encapsulant **350**.

[0031] FIG. **3**B is a schematic diagram of another electronic package structure according to the first embodiment of the present invention. Referring to FIG. **3**A and FIG. **3**B, a difference between the electronic package structure **300'** and the electronic package structure **300** is that a part of each lead **332'** connecting a first end **332***a'* and a second end **332***b'* penetrates a body **322'**. Besides, the insulating encapsulant **350** of the electronic package structure **300** is different from a magnetic encapsulant **350'** of the electronic package structure **300'**. The magnetic encapsulant **350'** is disposed in a cavity **322***a'* of the body **322'**. Therefore, if a second electronic element **320'** is an inductive element, an inductive characteristic of the second electronic element **320'** influenced by the cavity **322'** then can be compensated by the magnetic encapsulant **350'**. It should be noted that a part of each of the leads **332** connecting the first end **332***a* and the second end **332***b* may also penetrate the body **322** according to a design requirement, though it is not illustrated.

[0032] FIG. **3**C is a schematic diagram of another electronic package structure according to the first embodiment of the present invention. Referring to FIG. **3**A and FIG. **3**C, a difference between the electronic package structure **300"** and the electronic package structure **300** is that a cavity **322***a"* of a body **322"** sinks in a direction from a first surface **322***b"* towards a second surface **322***c"*. It should be noted that an insulating encapsulant **350"** can be substituted by a magnetic encapsulant according to a design requirement, and a part of each lead **332"** connecting a first end **332***a"* and a second end **332***b"* may also penetrate the body **322"** according to a design requirement, though it is not illustrated.

[0033] FIG. **3**D is a schematic diagram of still another electronic package structure according to the first embodi-

ment of the present invention. Referring to FIG. **3**A and FIG. **3**D, a second lead frame **360** is applied in the electronic package structure **300'''** for substituting the circuit substrate **340** of the electronic package structure **300** according to a design requirement. A plurality of first electronic elements **310'''** are disposed on the second lead frame **360** and electrically connected to the second lead frame **360**. The second lead frame **360** is electrically connected to a first end **332***a'''* of each lead **332'''** of a first lead frame **330'''** that extends to a cavity **322***a'''*.

Second Embodiment

[0034] FIG. **4**A is a schematic diagram of an electronic package structure according to a second embodiment of the present invention. Referring to FIG. **4**A and FIG. **3**A, a difference between the electronic package structure **400** of the second embodiment and the electronic package structure **300** of the first embodiment is that a body **422** of a second electronic element **420** does not have the cavity **322***a*. In detail, a first end **432***a* of each lead **432** of a lead frame **430** is disposed on a first surface **422***a* of a body **422**, and a plurality of first electronic elements **410** are disposed on the first surface **422***a* and electrically connected to the leads **432**. Moreover, a second end **432***b* of each of the leads **432** is disposed on a second surface **422***b* of the body **422** opposite to the first surface **422***a*, and a part of each of the leads **432** connecting the first end **432***a* and the second end **432***b* is disposed on a side surface **422***c* of the body **422**.

[0035] Furthermore, a circuit substrate **440** is disposed on the first surface **422***a* and electrically connected to the leads **432**, and the first electronic elements **410** are disposed on the circuit substrate **440** and electrically connected to the circuit substrate **440**. It should be noted that the circuit substrate **440** of the electronic package structure **400** may be omitted according to a design requirement of the designer, or the circuit substrate **440** may be substituted by a lead frame, though it is not illustrated.

[0036] FIG. **4**B is a schematic diagram of another electronic package structure according to the second embodiment of the present invention. Referring to FIG. **4**A and FIG. **4**B, a difference between the electronic package structure **400'** and the electronic package structure **400** is that a part of each lead **432'** connecting a first end **432***a'* and a second end **432***b'* penetrates a body **422'**.

Third Embodiment

[0037] FIG. **5**A is a schematic diagram of an electronic package structure according to a third embodiment of the present invention. Referring to FIG. **5**A, in the electronic package structure **500** of the present embodiment, a plurality of first electronic elements **510** are disposed on a first surface **532** of a circuit substrate **530** and electrically connected to the circuit substrate **530**. A second electronic element **520** is disposed above the first surface **532** of the circuit substrate **530**. The first electronic elements **510** are located between a body **522** of the second electronic element **520** and the first surface **532** of the circuit substrate **530**, and the first electronic elements **510** are located between leads **524** of the second electronic element **520**. In other words, in the present embodiment, the second electronic element **520** covers the first electronic elements **510**. Besides, an insulating encapsulant **540** is disposed between the second electronic element **520** and the circuit substrate **530** and encapsulating the first electronic elements **510** for protecting the first electronic elements **510** and enhancing a whole mechanical strength of the electronic package structure **500**. Moreover, the circuit substrate **530** may further include at least a conductive channel **539**, and each of the conductive channels **539** penetrates a dielectric layer **538** for electrically connecting a first circuit layer **534** and a second circuit layer **536**. At least one of the conductive channels **539** (for example, the two conductive channels **539** located at a left side of FIG. **5**A) is located below at least one of the first electronic elements **510** (for example, the first electronic element **510** located at the left side of FIG. **5**A), so that heat generated by the first electronic element **510** located at the left side may be quickly transmitted to where is outside the electronic package structure **500** via the two conductive channels **539** located at the left side. A second end **524**b of each of the leads **524** of the second electronic element **520** extends out from the body **522** to electrically connect the circuit substrate **530**. The second electronic element **520** may be an inductive element including a coil **526**. The body **522** which is a magnetic wrap wraps the coil **526**, and a first end **524***a* of each of the leads **524** is connected to one of two opposite ends of the coil **526**.

[0038] It should be noted that the electronic package structure **500** further includes an electromagnetic-interference-shielding element (EMI-shielding element) **550** covering the first electronic elements **510**. In the present embodiment, the EMI-shielding element **550** is disposed on the body **522** of the second electronic element **520**, and is located between the body **522** of the second electronic element **520** and the circuit substrate **530**. Therefore, during operation of the electronic package structure **500**, it may be reduced by means of the EMI-shielding element **550** that electrical signals transmitted in the circuit substrate **530** is interfered by a magnetic force generated by the second electronic element **520** which functions as an inductive element.

[0039] FIG. **5**B is a schematic diagram of another electronic package structure according to the third embodiment of the present invention. Referring to FIG. **5**A and FIG. **5**B, a difference between the electronic package structure **500'** and the electronic package structure **500** is that an EMI-shielding element **550'** of the electronic package structure **500'** is disposed in a cavity **522'** of a second electronic element **520'**.

[0040] In summary, in the aforementioned embodiments of the present invention, since the first electronic elements can be disposed in the cavity of the second electronic element or can be disposed on the second electronic element, or the second electronic element can be stacked on the first electronic elements, compared to the conventional electronic package structures, utilization of an internal space of the electronic package structure is relatively high, so that a size of the electronic package structure can be reduced.

[0041] It will be apparent to those skilled in the art that various modifications and variations can be made to the structure of the present invention without departing from the scope or spirit of the invention. In view of the foregoing, it is intended that the present invention cover modifications and variations of this invention provided they fall within the scope of the following claims and their equivalents.

What is claimed is:

1. An electronic package structure, comprising:

at least one first electronic element;

a second electronic element, comprising a body having a cavity, wherein the first electronic element is disposed in the cavity; and

a first lead frame, having a plurality of leads, wherein each of the leads has a first end and second end, and the first end of at least one of the leads extends to the cavity for electrically connecting to the first electronic element.

2. The electronic package structure as claimed in claim **1**, further comprising a circuit substrate disposed in the cavity, wherein the first electronic element is disposed on the circuit substrate and electrically connected to the circuit substrate, and the circuit substrate is electrically connected to the first end of the lead extending to the cavity.

3. The electronic package structure as claimed in claim **1**, wherein the body has a first surface and a second surface opposite to the first surface, the cavity sinks in a direction from the first surface towards the second surface, and the second end of each of the leads is disposed on the first surface.

4. The electronic package structure as claimed in claim **1**, wherein the body has a first surface and a second surface opposite to the first surface, the cavity sinks in a direction from the second surface towards the first surface, and the second end of each of the leads is disposed on the first surface.

5. The electronic package structure as claimed in claim **1**, wherein the body has a first surface, a second surface opposite to the first surface and a side surface, the side surface connects the first surface and the second surface, and a part of each of the leads connecting the first end and the second end is disposed on the side surface.

6. The electronic package structure as claimed in claim **1**, wherein a part of each of the leads connecting the first end and the second end penetrates the body.

7. The electronic package structure as claimed in claim **1**, wherein the first end of each of the leads is embedded in the body.

8. The electronic package structure as claimed in claim **1**, further comprising an insulating encapsulant disposed in the cavity and encapsulating the first electronic element.

9. The electronic package structure as claimed in claim **1**, wherein the second electronic element is an inductive element further comprising a coil, and the body is a magnetic body enclosing the coil.

10. The electronic package structure as claimed in claim **9**, further comprising a magnetic encapsulant disposed in the cavity and encapsulating the first electronic element.

11. The electronic package structure as claimed in claim **1**, wherein the first electronic element is a control element or a power element, the second electronic element is an energy-storage element, and the size of the second electronic element is greater than the first electronic element.

12. The electronic package structure as claimed in claim **1**, wherein the second electronic element further comprises a plurality of first external electrodes disposed on a first surface of the body, and the second end of each of the leads is disposed on the first surface to form a second external electrode.

13. The electronic package structure as claimed in claim **1**, further comprising a second lead frame disposed in the cavity, wherein the first electronic element is disposed on the second lead frame and electrically connected to the second lead frame, and the second lead frame is electrically connected to the first end of the lead extending to the cavity.

* * * * *