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(73) Applicant: 000006231 Murata Manufacturing Co., Ltd. 1-10-1, Higashikotari, Nagaokakyo City, Kyoto
(74) Agent: 100117260 Masaya FUKUNAGA, Patent Attorney
(72) Inventor: Shinji GOMA Murata Manufacturing Co., Ltd. 1-10-1, Higashikotari, Nagaokakyo City, Kyoto
(72) Inventor: Kazuya KATO Murata Manufacturing Co., Ltd. 1-10-1, Higashikotari, Nagaokakyo City, Kyoto
(72) Inventor: Yutaka NONOGAKI Murata Manufacturing Co., Ltd. 1-10-1, Higashikotari, Nagaokakyo City, Kyoto

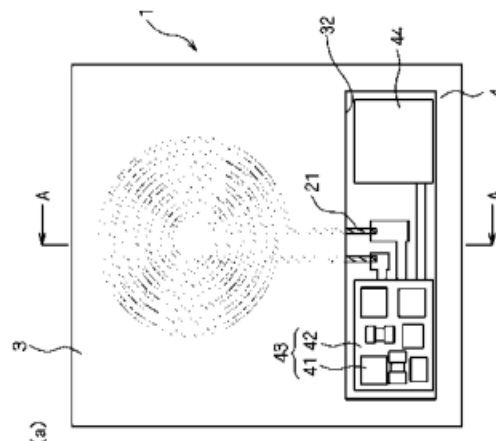
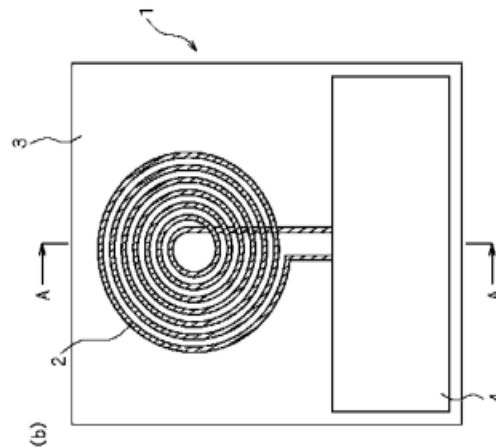
(54) [Title of the Invention] Coil Module and Electronic Device Equipped With Same

(57) [Abstract]

[Problem] The present invention provides a coil module that can be made thin and compact, and an electronic device equipped with the coil module.

[Solution] A coil module 1 according to the present invention is equipped with a flat plate-shaped coil 2, a circuit substrate 4 that is electrically connected to the coil 2 and that has a plurality of electronic components mounted thereon that controls the electric power that is transmitted by the coil 2, and a flat plate-shaped resin structural body 3 comprising a magnetic material. The coil 2 is incorporated so as to be offset towards one surface of the resin structural body 3, the circuit substrate 4 is disposed horizontally with respect to the coil 2, and at least a portion of the circuit substrate 4 is incorporated within the resin structural body 3.

[Selected Drawing] FIG. 1



[CLAIMS]

[Claim 1]

A coil module, characterized by being equipped with
a flat plate-shaped coil;

- 5 a circuit substrate that is electrically connected to the coil and that has a plurality of electronic components mounted thereon that controls the electric power that is transmitted by the coil; and
a flat plate-shaped resin structural body comprising a magnetic material, and in that
the coil is incorporated so as to be offset towards one surface side of the resin structural body; and
the circuit substrate is disposed horizontally with respect to the coil, with at least a portion of the circuit substrate
10 being incorporated within the resin structural body.

[Claim 2]

The coil module as set forth in claim 1, characterized in that a portion of the coil is exposed to the exterior on a surface side of the resin structural body.

[Claim 3]

- 15 The coil module as set forth in claim 1 or 2, characterized in that a portion of the circuit substrate is exposed to the exterior on a surface side of the resin structural body.

[Claim 4]

- The coil module as set forth in any one of claims 1 to 3, characterized in that the resin structural body is provided with an opening portion in the region of the circuit substrate where the plurality of electronic components has been
20 mounted.

[Claim 5]

The coil module as set forth in claim 4, characterized in that the resin structural body is equipped with a sealing material that covers the opening portion.

[Claim 6]

- 25 The coil module as set forth in any one of claims 1 to 5, characterized in that the circuit substrate is provided with a connector for connecting to the exterior.

[Claim 7]

The coil module as set forth in any one of claims 1 to 6, characterized in that the plurality of electronic components is mounted on the circuit substrate, and is electrically connected to terminals formed on the circuit substrate.

- 30 [Claim 8]

The coil module as set forth in any one of claims 1 to 7, characterized in that
the coil module is further provided with a sub-circuit substrate that is electrically connected to terminals formed on the circuit substrate, and

- 35 the plurality of electronic components is electrically connected to terminals formed on the sub-circuit substrate, and is mounted on the circuit substrate via the sub-circuit substrate.

[Claim 9]

The coil module as set forth in any one of claims 1 to 8, characterized in that the circuit substrate has a recessed portion in the horizontal direction, and the coil and the circuit substrate are disposed such that the recessed portion of the circuit substrate and a portion of the coil overlap.

- 40 [Claim 10]

An electronic device equipped with the coil module as set forth in any one of claims 1 to 9.

[Detailed Description of the Invention]

[Technical Field]

[0001]

- 45 The present invention relates to coil modules and to electronic devices equipped with coil modules, and in particular, to a coil module for contactless electric power transmission and an electronic device equipped with this coil module.

[Prior Art]

[0002]

Electronic devices such as communication equipment that gets charged by transmitting electric power in a contactless manner have been developed in recent years. In order to transmit power in a contactless manner between electronic devices, it is necessary to install a coil module for contactless power transmission in both the electronic device on the power transmitting side and in the electronic device on the power receiving side. For example, Patent Document 1 discloses a coil module in which a coil and a plurality of electronic components that controls the power to be transmitted are mounted on a circuit substrate. Further, Patent Document 2 discloses a coil module in which a circuit substrate on which a plurality of electronic components that controls the power to be transmitted has been mounted is stacked on a coil.

[Prior Art Documents]

10 [Patent Documents]

[0003]

[Patent Document 1] Japanese Unexamined Patent Application Publication No. Hei 07-335443

[Patent Document 2] Japanese Unexamined Patent Application Publication No. 2005-260122

[Summary of the Invention]

15 [Problem to be Solved by the Invention]

[0004]

Further, in recent years, due to advances in the size and weight reduction of electronic devices, it has also become necessary to make the coils provided in electronic devices smaller and lighter. However, since the ability of coil modules to transmit power decreases with the diameter of the coil, there has been a limit to how small the diameter of the coil can be made. Therefore, it is important to reduce the size of the coil module by reducing its thickness while maintaining its ability to transmit power.

20 [0005]

For example, in the coil module disclosed in Patent Document 1, the coil is mounted on the circuit substrate and the coil module cannot be made thinner than the combined thickness of the coil and the circuit substrate. Further, in the coil module disclosed in Patent Document 2, the circuit substrate on which a plurality of electronic components has been mounted is stacked on the coil, and the coil module cannot be made thinner than the combined thickness of the coil and the circuit substrate on which the plurality of electronic components has been mounted.

25 [0006]

The present invention, devised in light of the above situation, has for its objects to provide a coil module that can be made thin and compact while maintaining electric power transmission capability, and to provide an electronic device equipped with this coil module.

30 [Means for Solving the Problem]

[0007]

A coil module relating to a first invention for achieving the above object is equipped with a flat plate-shaped coil; a circuit substrate that is electrically connected to the coil and that has a plurality of electronic components mounted thereon that controls the electric power that is transmitted by the coil; and a flat plate-shaped resin structural body comprising a magnetic material, with the coil being incorporated so as to be offset towards one surface side of the resin structural body; and the circuit substrate being disposed horizontally with respect to the coil with at least a portion of the circuit substrate being incorporated within the resin structural body.

40 [0008]

In the coil module relating to a second invention, a portion of the coil in the first invention is exposed to the exterior on a surface side of the resin structural body.

[0009]

45 In the coil module relating to a third invention, a portion of the circuit substrate in the first or second invention is exposed to the exterior on a surface side of the resin structural body.

[0010]

Further, in the coil module relating to a fourth invention, the resin structural body in any one of the first to third inventions is provided with an opening portion in the region of the circuit substrate where the plurality of the electronic components has been mounted.

50 [0011]

[0012]

Further, in the coil module relating to a sixth invention, the circuit substrate in any one of the first to fifth inventions is provided with a connector for connecting to the exterior.

[0013]

- 5 Further, in the coil module relating to a seventh invention, the plurality of electronic components in any one of the first to sixth inventions is mounted on the circuit substrate and is electrically connected to terminals formed on the circuit substrate.

[0014]

- 10 Further, in the coil module relating to an eighth invention, the coil module in any of the first to seventh inventions is further provided with a sub-circuit substrate that is electrically connected to terminals formed on the circuit substrate, and the plurality of electronic components is electrically connected to terminals formed on the sub-circuit substrate and is mounted on the circuit substrate via the sub-circuit substrate.

[0015]

- 15 Further, in the coil module relating to a ninth invention, the circuit substrate in any one of the first to eighth inventions has a recessed portion in the horizontal direction, and the coil and the circuit substrate are disposed such that the recessed portion of the circuit substrate and a portion of the coil overlap.

[0016]

Further, the electronic device as set forth in the tenth invention is equipped with the coil module of any one of the first to ninth inventions.

- 20 [0017]

- In the first invention, in a coil module equipped with a flat plate-shaped coil, a circuit substrate that is electrically connected to the coil and that has a plurality of electronic components mounted thereon that controls the electric power that is transmitted by the coil, and a flat plate-shaped resin structural body comprising a magnetic material, since the coil is incorporated so as to be offset towards one side of the resin structural body, the circuit substrate is disposed horizontally with respect to the coil, and at least a portion of the circuit substrate is incorporated within the resin structural body, it is possible to make the coil module thin and compact while ensuring the necessary coil diameter and maintaining the electric power transfer capability thereof without the coil and the circuit substrate overlapping.

[0018]

- 30 In the second invention, since a portion of the coil is exposed to the exterior on a surface side of the resin structural body in which the coil has been incorporated, it is possible to transmit electric power efficiently by transmitting electric power from the surface side of the resin structural body on which the coil is exposed.

[0019]

- 35 In the third invention, since a portion of the circuit substrate is exposed to the exterior on a surface side of the resin structural body in which the coil is incorporated in an offset manner, it is possible to make the coil module thinner and more compact by placing one surface side of the coil and one surface side of the circuit substrate on the same plane.

[0020]

- 40 In the fourth invention, since an opening portion has been provided in the resin structural body in the region of the circuit substrate whereupon the plurality of the electronic components has been mounted, it is possible to prevent the phenomenon (of solder flash) whereby the solder that connects the electronic components and the circuit substrate heats up re-melts during the process of forming the resin structural body, and seeps out into minute gaps causing short circuiting of the electronic components. In addition, since the plurality of electronic components is enclosed by a wall formed by the opening portion of the resin structural body containing a magnetic material, it becomes possible to reduce the effect of electromagnetic waves from the coil on the plurality of electronic components, and to achieve stable operation.

- 45 [0021]

In the fifth invention, since the resin structural body is equipped with a sealing material that covers the opening portion, it is possible to reduce the effect of electromagnetic waves from the coil affecting the plurality of electronic components via the opening portion of the resin structural body, and to achieve stable operation of the electronic components.

[0022]

- 50 In the sixth invention, since the circuit substrate is provided with a connector for connecting to the exterior, mounting

In the seventh invention, since the plurality of electronic components is electrically connected to terminals formed on the circuit substrate and is mounted on the circuit substrate, it is possible to reduce the height of the circuit substrate on which the plurality of electronic components is mounted, thereby making the coil module thinner and more compact.
[0024]

5 In the eighth invention, since a sub-circuit substrate that is electrically connected to terminals formed on the circuit substrate is further provided and the plurality of electronic components is electrically connected to terminals formed on the sub-circuit substrate and mounted on the circuit substrate via the sub-circuit substrate, the configuration of the plurality of electronic components mounted on the circuit substrate can be changed simply by changing the sub-circuit substrate.

10 [0025]

In the ninth invention, since the circuit substrate has a recessed portion in the horizontal direction, and since the coil and circuit substrate are arranged so that the recessed portion of the circuit substrate overlaps with a portion of the coil, it is possible to shorten the combined length of the coil and the circuit substrate arranged in the horizontal direction, and to make the coil module compact.

15 [0026]

In the tenth invention, since the coil module of any one of the first through ninth inventions is provided, it is possible to make the electronic device itself thinner and smaller by making the coil module thinner and smaller.

[Effect of the Invention]

[0027]

20 In the coil module of the present invention, which is equipped with a flat plate-shaped coil, a circuit substrate on which a plurality of electronic components is mounted, and a flat resin structural body containing a magnetic material, since the coil is incorporated in a manner offset towards one surface of the resin structural body, the circuit substrate is disposed horizontally with respect to the coil, and at least a portion of the circuit substrate is incorporated within the resin structural body, the coil module can be made thinner and smaller while securing the required coil diameter and
25 maintaining the ability to transmit power without the coil and circuit substrate overlapping.

[Brief Description of the Drawings]

[0028]

[FIG. 1] A plan view of a coil module according to Embodiment 1 of the present invention.

[FIG. 1] An A-A cross-sectional view of the coil module shown in FIG. 1.

30 [FIG. 3] A schematic diagram descriptive of the method of manufacturing a coil module according to Embodiment 1 of the present invention.

[FIG. 4] A plan view showing the configuration of a coil module according to Embodiment 2 of the present invention.

[FIG. 5] A B-B cross-sectional view of the coil module shown in FIG. 4.

[FIG. 6] A plan view of a coil module according to Embodiment 3 of the present invention.

35 [FIG. 7] A plan view of a coil module according to Embodiment 4 of the present invention.

[FIG. 8] A plan view showing another configuration of a coil module according to Embodiment 4 of the present invention.

[FIG. 9] A plan view showing the configuration of a coil module according to Embodiment 5 of the present invention.

40 [FIG. 10] A schematic diagram descriptive of the configuration of an electronic device according to Embodiment 6 of the present invention.

[Modes of Carrying Out the Invention]

[0029]

The coil module and the electronic device equipped with this coil module are specifically described below in embodiments of the present invention with reference to the drawings. The following embodiments are not intended to
45 limit the invention described in the claims, and it bears repeating that not all combinations of characteristic matters described in the embodiments are essential to the means for solving the problems.

[0030]

Although the coil modules relating to the embodiments of the present invention consist of coil modules used in electronic devices on the power transmitting side and coil modules used in electronic devices on the power receiving
50 side, in the following description, which of these types of coil module is being described shall be immaterial unless

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