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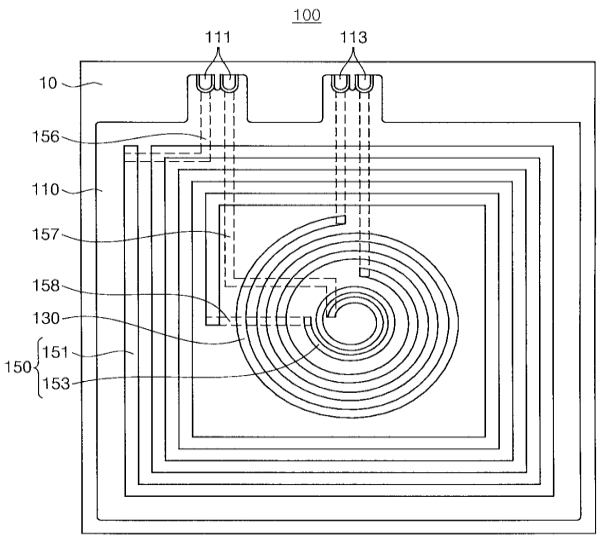
(54) Title of Invention **ANTENNA STRUCTURE FOR NEAR FIELD COMMUNICATION**

(57) Abstract

An antenna structure for near field communication comprises a base, a non-contact power receiving coil unit disposed in the center of the upper portion of the base and having a loop shape, and a loop antenna unit disposed on the upper portion of the base and having a first loop antenna pattern formed to surround by being spaced apart from the non-contact power receiving coil unit and a second loop antenna pattern electrically connected to the first loop antenna and formed in a loop of the non-contact power receiving coil unit.

Representative figure - Fig. 1



Scope of claims

Claim 1

An antenna structure for near field communication comprising a base;

a non-contact power receiving coil unit disposed in the center of the upper portion of the base and having a loop shape; and

a loop antenna unit disposed on the upper portion of the base and having a first loop antenna pattern formed to surround by being spaced apart from the non-contact power receiving coil unit and a second loop antenna pattern electrically connected to the first loop antenna and formed in a loop of the non-contact power receiving coil unit.

Claim 2

The antenna structure for near field communication of claim 1, wherein the loop antenna unit comprises

a flexible substrate having the first and second loop patterns formed on one surface thereof;

first connection lines formed on the other surface of the flexible substrate and electrically connecting the first and second loop antenna patterns to antenna pads, respectively; and

a second connection line formed on the other surface of the flexible substrate and electrically connecting the first and second loop antenna patterns to each other.

Claim 3

The antenna structure for near field communication of claim 1, wherein the first and second loop antenna patterns are capacitively coupled.

Claim 4

The antenna structure for near field communication of claim 1, wherein the first and second loop antenna patterns are at least one selected from the group consisting of conductive materials composed of copper, silver-coated copper, aluminum, and conductive carbon.

Claim 5

The antenna structure for near field communication of claim 1, wherein the base is made of ferrite or an electromagnetic wave absorbing material.

Specification

Technical field

[0001] The present invention relates to an antenna structure for near field communication. More particularly, the present invention relates to an antenna structure for near field communication capable of non-contact charging and near field communication by generating an induced electromotive force.

Background art

[0002] A power supply is required to operate various mobile communication terminals represented by a mobile phone and for this purpose, a battery needs to be installed, and a multi-use rechargeable battery is widely used instead of a single-use battery as the battery for mobile communication terminals.

[0003] Traditionally, the wired charging method has been widely used for charging batteries for mobile communication terminals, but wired charging not only limits mobility, which is the greatest advantage of a mobile communication terminal, but also has a problem in that the charging performance deteriorates due to aging of the charging terminal caused by repeated detachment.

[0004] A non-contact (wireless) charging method has been introduced for charging mobile phones, which is the representative mobile communication terminal. The principle of the most common non-contact charging is induced current, and according to this principle, when a mobile phone with a built-in secondary coil is placed on top of the primary coil installed in the non-contact charger, an induced electromotive force is generated in a frequency band of several hundred kHz (e.g., 300 kHz or less) between the primary and secondary coils, charging the battery of the mobile phone.

[0005] As such, to apply the non-contact charging to the mobile communication terminal, a coil capable of generating an induced electromotive force, that is, a loop antenna in the form of a spiral coil (hereinafter referred to as an antenna) is required.

[0006] In general, an antenna for non-contact charging is installed on the battery cover of a mobile phone and recently, as the charging circuit to which the antenna is connected became miniaturized and incorporated into the body of the mobile phone, only the antenna (unit) remains on the battery cover.

[0007] Meanwhile, separate from the environment of non-contact charging, the wireless environment of RFID (Radio Frequency Identification: wireless identification) is widely used in mobile communication terminals and for example, when an NFC chip that realizes Near Field Communication (NFC) is installed in a mobile phone, equipped with a non-contact smart card such as a USIM card, and brought nearby an external RF reader, the information of the USIM card of the mobile phone is read by the RF reader by near field communication and the necessary information is recorded, which realizes the equipped function (e.g. electronic money function) such as an electronic money function. In this case, the information exchange between the NFC chip and the RF reader is accomplished by supplying power for operating the USIM card by induced electromotive force at 13.56 MHz between the coil installed in the RF reader and the coil of the NFC chip installed in the mobile phone.

[0008] Furthermore, the NFC chip installed in mobile phones has been developed to function as an RFID reader as well to read the information recorded on an external RFID tag. When the NFC chip operates as an RF reader, the antenna (coil) connected to the NFC chip acts as a primary coil to transmit power, and an induced electromotive force is generated from the coil (antenna) installed on an external RFID tag, allowing wireless communication to be realized.

[0009] In other words, to apply the RFID system (NFC) to a mobile communication terminal, a loop antenna in the form of a spiral coil capable of generating an induced electromotive force is required. An antenna for NFC is also installed on the battery cover or battery.

[0010] As a result, to equip both a non-contact charging function and a near field wireless communication function in a mobile communication terminal represented by a mobile phone, two antennas (coils) for inducing an electromotive force to each are required. In this case, the recognition distance for near field communication may vary depending on the relative position between the antenna and the RFID tag. Therefore, there is a need for an antenna structure for near field communication capable of stably securing a recognition distance for near field communication regardless of the position between the antenna and the RFID tag.

Disclosure of invention

Problems to be solved

[0011] An object of the present invention is to provide an antenna structure for near field communication capable of securing a stable recognition distance regardless of the relative position between an antenna and an RFID tag.

Means to solve the problems

[0012] To achieve an object of the present invention, the antenna structure for near field communication according to embodiments of the present invention comprises a base, a non-contact power receiving coil unit disposed in the center of the upper portion of the base and having a loop shape, and a loop antenna unit disposed on the upper portion of the base and having a first loop antenna pattern formed to surround by being spaced apart from the non-contact power receiving coil unit and a second loop antenna pattern electrically connected to the first loop antenna and formed in a loop of the non-contact power receiving coil unit.

[0013] In one embodiment of the present invention, the loop antenna unit may comprise a flexible substrate having the first and second loop patterns formed on one surface thereof, first connection lines formed on the other surface of the flexible substrate and electrically connecting the first and second loop antenna patterns to pads for near field communication, respectively, and a second connection line formed on the other surface of the flexible substrate and electrically connecting the first and second loop antenna patterns to each other.

[0014] In one embodiment of the present invention, the first and second loop antenna patterns are capable of being capacitively coupled.

[0015] In one embodiment of the present invention, the first and second loop antenna patterns may comprise at least one from conductive materials composed of copper, silver-coated copper, aluminum, and conductive carbon.

[0016] In one embodiment of the present invention, the base may be composed of ferrite or an electromagnetic wave absorbing material.

Effect of invention

[0017] The antenna structure for near field communication according to embodiments of the present invention is capable of securing a stable recognition distance regardless of the relative position between the loop antenna unit and the RFID tag by comprising a loop antenna unit having a first loop antenna pattern formed to surround by being spaced apart from the non-contact power receiving coil unit and a second loop antenna pattern electrically connected to the first loop antenna and formed in a loop of the non-contact power receiving coil unit. In particular, even when the RFID tag is positioned in the loop of the non-contact power receiving coil unit, the antenna structure for near field communication can have a stable recognition distance with respect to the RFID tag.

[0018] Furthermore, as first and second loop antenna patterns are formed on one surface of the flexible substrate and a connection line for interconnecting the first and second loop antenna patterns is provided on the other surface of the flexible substrate, the first and second loop antenna patterns can be stably connected to each other.

[0019] Meanwhile, as the first and second loop antenna patterns are formed on one surface and the other surface of the flexible substrate, respectively, and the first and second loop antenna patterns form capacitive coupling with each other, the formation of a separate via contact can be omitted.

Brief description of figures

[0020] Fig. 1 is a plane view for describing an antenna structure for near field communication according to an embodiment of the present invention.

Fig. 2 is a cross-sectional view of the antenna structure for near field communication of Fig. 1.

Fig. 3 is a plane view for describing an example of a coupling relationship between the first and second loop antenna patterns of Fig. 1.

Descriptions of embodiments

[0021] Hereinafter, the present invention will be described in more detail with reference to the accompanying figures showing embodiments of the present invention. However, the present invention is not required to be configured as described in the embodiments described below and may be embodied in various other forms. The following embodiments are provided to sufficiently convey the scope of the present invention to a person with ordinary skill in the art of the present invention rather than being provided to ensure that the present invention can be wholly completed.

[0022] When one element is described as being disposed on or connected to another element or layer, said element may be directly disposed on or connected to said another element, and other elements or layers may be interposed therebetween. Alternatively, when one element is described as being directly disposed on or connected to another element, there cannot be another element between them. Terms, such as first, second, and third, may be used to describe various items, such as various elements, compositions, regions, layers, and/or portions, however said items will not be limited by these terms.

[0023] The terminology used below is only used for the purpose of describing specific embodiments and is not intended to limit the present invention. In addition, unless otherwise limited, all terms including technical and scientific terms have the same meaning as understood by a person with ordinary skill in the art of the present invention. Said terms, as those defined in ordinary dictionaries, will be interpreted to have meanings consistent with their meanings in the context of the relevant art and description of the present invention and will not be interpreted ideally or by overly outward intuition unless otherwise explicitly defined.

[0024] Embodiments of the present invention will be described with reference to cross-sectional diagrams, which are schematic diagrams of ideal embodiments of the present invention. Accordingly, changes from the shape of the diagrams, for example, manufacturing methods and/or tolerances, are to be expected. Therefore, embodiments of the present invention are not to be described as being limited to the specific shapes of the regions described by diagrams but include deviations in the shapes, and the regions described in the figures are entirely schematic and their shapes are not intended to describe the precise shape of the regions, nor are they intended to limit the scope of the present invention.

[0025] Fig. 1 is a plane view for describing an antenna structure for near field communication according to an embodiment of the present invention, and Fig. 2 is a cross-sectional view of the antenna structure for near field communication of Fig. 1.

[0026] Referring to Figs. 1 and 2, the antenna structure for near field communication (100) according to embodiments of the present invention comprises a base (110), a non-contact power receiving coil unit (130), and a loop antenna unit (150). The antenna structure for near field communication (100) is mounted on one surface of the battery (10), enabling non-contact charging of the battery (10) and, at the same time, near field communication for obtaining information from an external RFID tag or providing information to an RFID reader.

[0027] The base (110) may comprise a metal. As a result, the base (110) can block radio wave interference between a loop antenna pattern (150) formed on the upper portion thereof and a printed circuit board (not shown) disposed on the lower portion thereof. The base (110) may be made of, for example, a ferrite material.

[0028] The non-contact power receiving coil unit (130) is disposed on the upper portion of the base (110). In addition, the non-contact power receiving coil unit (130) is disposed on the center portion of the base (110). The non-contact power receiving coil unit (130) is a part of a WPC (wireless power charger) and is connected to charging terminals (113), which allows it to charge the battery (10) in a non-contact manner.

[0029] The non-contact power receiving coil unit (130) may have a loop shape. When the non-contact power receiving coil unit (130) is positioned on top of the primary coil installed in a non-contact charger (not shown), an induced electromotive force is generated in a frequency band of several hundred kHz (e.g., 300 kHz or less) between the coil unit (130) and the primary coil, making it possible to charge the battery (10) equipped with the antenna structure for near field communication (100).

[0030] The loop antenna unit (150) is disposed on the upper portion of the base (110). The loop antenna unit (150) enables near field communication between RFID tags. The loop antenna unit (150) is electrically connected to the terminals for near field communication (111).

[0031] The loop antenna unit (150) has a first loop antenna pattern (151) formed to surround by being spaced apart from the non-contact power receiving coil unit and a second loop antenna pattern (153) electrically connected to the first loop antenna (151) and formed in a loop of the non-contact power receiving coil unit (130). Therefore, while the first loop antenna pattern (151) enables near field communication with an RFID tag located in the A1 region adjacent to that location corresponding to the edge of the base (110), the second loop antenna pattern (153) can enable near field communication with an RFID tag adjacent to the location in the A2 region corresponding to the center portion of the base (110). Accordingly, the antenna structure (100) for near field communication can have a consistent recognition distance regardless of the relative position between the RFID tags.

[0032] In one embodiment of the present invention, the loop antenna unit (150) may further comprise a flexible substrate (155), first connection lines (156, 157), and a second connection line (158).

[0033] The flexible substrate (155) may be made of a flexible material. The flexible substrate (155) may comprise, for example, a heat-resistant polymer resin, that is, an ethylene-based resin or a polyimide-based resin. The first and second loop antenna patterns (151, 153) are formed on one surface of the flexible substrate (155).

[0034] The first connection lines (156, 157) are formed on the other surface of the flexible substrate (155). The first connection lines (155, 157) connect the first and second antenna patterns (151, 153) to pads for near field communication (111), respectively. In this case, the first connection lines (156, 157) may be connected to the first and second loop antenna patterns (151, 153) through contact vias (not shown) formed by penetrating the flexible substrate (155).

[0035] The second connection line (158) is formed on the other surface of the flexible substrate (155). The second connection line (158) interconnects the first and second loop antenna patterns (151, 153). The second connection line (158) can interconnect the first and second loop antenna patterns (151, 153) through contact vias (not shown) formed by penetrating the flexible substrate (155).

[0036] In one embodiment of the present invention, the first and second loop antenna patterns (151, 153) may be made of a conductive material, such as copper, silver-coated copper, aluminum, or conductive carbon.

[0037] Fig. 3 is a plane view for describing an example of a coupling relationship between the first and second loop antenna patterns of Fig. 1.

[0038] Referring to Fig. 3, the first and second loop antenna patterns (151, 153) may be interconnected through capacitive coupling. In other words, each of the first and second loop antenna patterns (151, 153) may be formed on different planes of the flexible substrate (155). Instead of being interconnected through a via contact as described above, the first and second loop antenna patterns (151, 153) are planarly overlapped and the overlapping area (152) corresponds to the effective area of the capacitive coupling. As a result, the first and second loop antenna patterns (151, 153) can be electrically connected to each other through capacitive coupling. Since a separate process for forming a via contact is omitted in this manner, the antenna structure for near field communication (100) comprising the first and second antenna patterns (151, 153) can be easily formed. In addition, the antenna structure for near field communication (100) can have a simpler structure.

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