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(54) ELECTRONIC DEVICE FOR TUNING ANTENNA

(57) According to various embodiments, an electronic device may comprise: a slide frame for moving a first body from a first state to a second state; and a connection structure for electrically connecting the first body to a second body, wherein the first body includes an antenna and a first printed circuit board (PCB), the antenna is disposed in the first PCB, the second body includes a radio frequency (RF) module and a second PCB, and the RF module is disposed in the second PCB. The connection structure comprises: at least one antenna connection terminal disposed on the first PCB; and at least two RF connection terminals disposed on the second PCB, wherein the at least two RF connection terminals include a first RF connection terminal and a second RF connection terminal. The first body is electrically connected, in the first state, to the first RF connection terminal via the connection structure, and is electrically connected, in the second state, to the second RF connection terminal via the connection structure. The second PCB may include a first RF tuning circuit for the first RF connection terminal and a second RF tuning circuit for the second RF connection terminal.

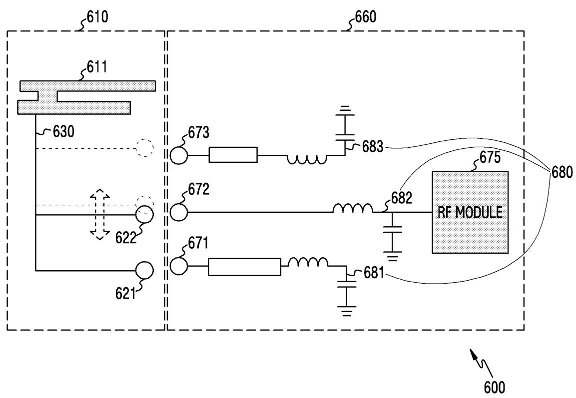

FIG.6

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Description

Technical Field

[0001] Various embodiments described below relate to an electronic device for antenna tuning.

Background Art

[0002] An electronic device can transmit a signal by using an antenna. To increase the efficiency of radiation performance, the tuning of a radio frequency (RF) circuit connected to the antenna is required. At this time, when a relative position between a body including the antenna and a body including an RF module is changed, a radiation characteristic of the antenna caused by the existing circuit devices can be changed.

Disclosure of Invention

Technical Problem

[0003] A problem is that it is difficult to optimize, by one tuning setting only, a radiation characteristic dependent on a physical position of each body. An electronic device of various embodiments can minimize an antenna performance difference dependent on a relative position change between a body including an antenna and a body including a radio frequency (RF) module, and optimize antenna performance in each position.

[0004] A technological solution the present document seeks to achieve is not limited to the above-mentioned technological solution, and other technological solutions not mentioned above would be able to be clearly understood by a person having ordinary skill in the art from the following statement.

Solution to Problem

[0005] According to various embodiments, an electronic device can include a first body including an antenna and a first printed circuit board (PCB), the antenna being disposed in the first PCB, a second body including a radio frequency (RF) module and a second PCB, the RF module being disposed in the second PCB, a slide frame for moving the first body from a first state to a second state, and a connection structure for electrically connecting the first body and the second body. The connection structure can include at least one antenna connection terminal disposed on the first PCB and at least two or more RF connection terminals disposed on the second PCB, and the at least two or more RF connection terminals can include a first RF connection terminal and a second RF connection terminal, and the first body can be electrically connected, in the first state, to the first RF connection terminal via the connection structure, and can be electrically connected, in the second state, to the second RF connection terminal via the connection structure, and the second PCB can include a first RF tuning circuit for the first RF connection terminal and a second RF tuning circuit for the second RF connection terminal.

Advantageous Effects of Invention

[0006] An electronic device of various embodiments can present optimal antenna performance in each position, by presenting an RF circuit for each relative position between detached bodies.

[0007] An effect obtainable from the present disclosure is not limited to the above-mentioned effects, and other effects not mentioned would be able to be apparently understood from the following statement by a person having ordinary skill in the art to which the present disclosure pertains.

Brief Description of Drawings

[0008]

FIG. 1 is a block diagram of an electronic device within a network environment according to various embodiments.

FIG. 2 is a block diagram of an electronic device in a network environment including a plurality of cellular networks according to various embodiments.

FIG. 3 illustrates an example of the type of an electronic device according to various embodiments.

FIG. 4A illustrates an example of a structure of a slide electronic device according to various embodiments.

FIG. 4B illustrates another example of a structure of a slide electronic device according to various embodiments.

FIG. 5 illustrates an example of connection between bodies according to various embodiments.

FIG. 6 illustrates an example of a circuit for connection between bodies according to various embodiments.

FIG. 7 illustrates an example of a contact structure for connection between bodies according to various embodiments.

FIG. 8A illustrates an example of antenna tuning in a contact structure according to various embodiments.

FIG. 8B illustrates an example of a circuit for antenna tuning according to various embodiments.

FIG. 9A illustrates another example of antenna tuning in a contact structure according to various embodiments.

FIG. 9B illustrates another example of a circuit for antenna tuning according to various embodiments.

FIG. 10A illustrates an example of a connection structure for maintaining connection between bodies according to various embodiments.

FIG. 10B illustrates another example of a connection structure for maintaining connection between bodies according to various embodiments.

FIG. 11 illustrates an example of a coupling structure that uses a capacitor according to various embodiments.

FIG. 12A illustrates an example of a coupling structure for maintaining connection between bodies according to various embodiments.

FIG. 12B illustrates another example of a coupling structure for maintaining connection between bodies according to various embodiments.

FIG. 12C illustrates a further example of a coupling structure for maintaining connection between bodies according to various embodiments.

FIG. 13 illustrates an example of connection between bodies that use a dielectric material according to various embodiments.

FIG. 14A illustrates an example of connection between bodies that use a dielectric material of a guide form according to various embodiments.

FIG. 14B illustrates an example of a section of a connection structure between bodies that use a dielectric material of a guide form according to various embodiments.

Best Mode for Carrying out the Invention

[0009] Terms used in the present disclosure are used just to explain a specific embodiment, and may not intend to limit the scope of another embodiment. The expression of a singular form can include the expression of a plural form unless otherwise dictating clearly in context. The terms used herein including the technological or scientific terms can have the same meanings as those generally understood by a person having ordinary skill in the art mentioned in the present disclosure. Of the terms used in the present disclosure, terms defined in a general dictionary can be interpreted as the same or similar meanings as the contextual meanings of a related technology, and are not interpreted as ideal or excessively formal meanings unless defined clearly in the present disclosure. According to cases, even the terms defined in the present disclosure cannot be construed as excluding embodiments of the present disclosure.

[0010] In various embodiments of the present disclosure described below, a hardware access method is explained as an example. However, various embodiments of the present disclosure include a technology which uses all of hardware and software, so various embodiments of the present disclosure do not exclude a software-based access method.

[0011] Below, the present disclosure relates to a device and method for antenna tuning in a wireless communication system. In detail, the present disclosure describes a technology for increasing the radiation performance of an antenna, by adaptively constructing a radio frequency (RF) circuit between the antenna and an RF module according to a relative position change of a body including the antenna and a body including the RF module in the wireless communication system.

[0012] Terms (e.g., an antenna element, an array antenna, an antenna module, and/or an antenna circuit) denoting an antenna used in the following description, terms (e.g., a structure body, a body, a moving part, and/or a fixing part) denoting a structure of an electronic device, terms (e.g., a conductive member, a conduction body, a conduction plate, a conductive plate, and/or a conductive element) denoting a conductor, terms (e.g., a contact device, a contact body, a contact member, a contact terminal, a connection terminal, a connection device, a connection body, a coupling terminal, and/or a coupling body) denoting a connection part between bodies, terms (e.g., an RF signal line, an RF path, an RF module, an antenna line, a ground circuit, and/or an RF circuit) denoting a circuit, etc. are exemplified for description convenience's sake. Accordingly, the present disclosure is not limited to the terms described below, and other terms having equivalent technological meanings can be used.

[0013] FIGS. 1 to 14B described below and various kinds of embodiments used to explain the principles of the present disclosure in this patent specification are by a method of only exemplification, and any scheme should not be construed as limiting the scope of the present disclosure. That the principles of the present disclosure can be implemented in an arbitrary properly configured system or device would be able to be understood by those skilled in the art. Also, with regard to a description of the drawings, similar reference symbols can be used to refer to similar or related constituent elements.

[0014] Fig. 1 is a block diagram illustrating an electronic device 101 in a network environment 100 according to various embodiments.

[0015] Referring to Fig. 1, the electronic device 101 in the network environment 100 may communicate with an electronic device 102 via a first network 198 (e.g., a short-range wireless communication network), or an electronic device 104 or a server 108 via a second network 199 (e.g., a long-range wireless communication network). According to an embodiment, the electronic device 101 may communicate with the electronic device 104 via the server 108. According to an embodiment, the electronic device 101 may include a processor 120, memory 130, an input device 150, a sound output device 155, a display device 160, an audio module 170, a sensor module 176, an interface 177, a haptic module 179, a camera module 180, a power management module 188, a battery 189, a communication module 190, a subscriber identification module(SIM) 196, or an antenna module 197. In some embodiments, at least one (e.g., the display device 160 or the camera module 180) of the components may be omitted from the electronic device 101, or one or more other components may be added in the electronic device 101. In some embodiments, some of the components may be implemented as single integrated circuitry. For example, the sensor module 176 (e.g., a fingerprint sensor, an iris sensor, or an illuminance sensor) may be implemented as embedded in the display device 160 (e.g., a display).

[0016] The processor 120 may execute, for example, software (e.g., a program 140) to control at least one other component (e.g., a hardware or software component) of the electronic device 101 coupled with the processor 120, and may perform various data processing or computation. According to one embodiment, as at least part of the data processing or computation, the processor 120 may load a command or data received from another component (e.g., the sensor module 176 or the communication module 190) in volatile memory 132, process the command or the data stored in the volatile memory 132, and store resulting data in non-volatile memory 134. According to an embodiment, the processor 120 may include a main processor 121 (e.g., a central processing unit (CPU) or an application processor (AP)), and an auxiliary processor 123 (e.g., a graphics processing unit (GPU), an image signal processor (ISP), a sensor hub processor, or a communication processor (CP)) that is operable independently from, or in conjunction with, the main processor 121. Additionally or alternatively, the auxiliary processor 123 may be adapted to consume less power than the main processor 121, or to be specific to a specified function. The auxiliary processor 123 may be implemented as separate from, or as part of the main processor 121.

[0017] The auxiliary processor 123 may control at least some of functions or states related to at least one component (e.g., the display device 160, the sensor module 176, or the communication module 190) among the components of the electronic device 101, instead of the main processor 121 while the main processor 121 is in an inactive (e.g., sleep) state, or together with the main processor 121 while the main processor 121 is in an active state (e.g., executing an application). According to an embodiment, the auxiliary processor 123 (e.g., an image signal processor or a communication processor) may be implemented as part of another component (e.g., the camera module 180 or the communication module 190) functionally related to the auxiliary processor 123.

[0018] The memory 130 may store various data used by at least one component (e.g., the processor 120 or the sensor module 176) of the electronic device 101. The various data may include, for example, software (e.g., the program 140) and input data or output data for a command related thererto. The memory 130 may include the volatile memory 132 or the non-volatile memory 134.

[0019] The program 140may be stored in the memory 130 as software, and may include, for example, an operating system (OS) 142, middleware 144, or an application 146.

[0020] The input device 150 may receive a command or data to be used by other component (e.g., the processor 120) of the electronic device 101, from the outside (e.g., a user) of the electronic device 101. The input device 150 may include, for example, a microphone, a mouse, a keyboard, or a digital pen (e.g., a stylus pen).

[0021] The sound output device 155 may output sound signals to the outside of the electronic device 101. The sound output device 155 may include, for example, a speaker or a receiver. The speaker may be used for general purposes, such as playing multimedia or playing record, and the receiver may be used for an incoming calls. According to an embodiment, the receiver may be implemented as separate from, or as part of the speaker.

[0022] The display device 160 may visually provide information to the outside (e.g., a user) of the electronic device 101. The display device 160 may include, for example, a display, a hologram device, or a projector and control circuitry to control a corresponding one of the display, hologram device, and projector. According to an embodiment, the display device 160 may include touch circuitry adapted to detect a touch, or sensor circuitry (e.g., a pressure sensor) adapted to measure the intensity of force incurred by the touch.

[0023] The audio module 170 may convert a sound into an electrical signal and vice versa. According to an embodiment, the audio module 170 may obtain the sound via the input device 150, or output the sound via the sound output device 155 or a headphone of an external electronic device (e.g., an electronic device 102) directly (e.g., wiredly) or wirelessly coupled with the electronic device 101.

[0024] The sensor module 176 may detect an operational state (e.g., power or temperature) of the electronic device 101 or an environmental state (e.g., a state of a user) external to the electronic device 101, and then generate an electrical signal or data value corresponding to the detected state. According to an embodiment, the sensor module 176 may include, for example, a gesture sensor, a gyro sensor, an atmospheric pressure sensor, a magnetic sensor, an acceleration sensor, a grip sensor, a proximity sensor, a color sensor, an infrared (IR) sensor, a biometric sensor, a temperature sensor, a humidity sensor, or an illuminance sensor.

[0025] The interface 177 may support one or more specified protocols to be used for the electronic device 101 to be coupled with the external electronic device (e.g., the electronic device 102) directly (e.g., wiredly) or wirelessly. According to an embodiment, the interface 177 may include, for example, a high definition multimedia interface (HDMI), a universal serial bus (USB) interface, a secure digital (SD) card interface, or an audio interface.

[0026] A connecting terminal 178 may include a connector via which the electronic device 101 may be physically connected with the external electronic device (e.g., the electronic device 102). According to an embodiment, the connecting terminal 178 may include, for example, a HDMI connector, a USB connector, a SD card connector, or an audio connector (e.g., a headphone connector).

[0027] The haptic module 179 may convert an electrical signal into a mechanical stimulus (e.g., a vibration or a movement) or electrical stimulus which may be recognized by a user via his tactile sensation or kinesthetic sensation. According to an embodiment, the haptic module 179 may include, for example, a motor, a piezoelectric element, or an electric stimulator.

[0028] The camera module 180 may capture a still image or moving images. According to an embodiment, the camera module 180 may include one or more lenses, image sensors, image signal processors, or flashes.

[0029] The power management module 188 may manage power supplied to the electronic device 101. According to one embodiment, the power management module 188 may be implemented as at least part of, for example, a power management integrated circuit (PMIC).

[0030] The battery 189 may supply power to at least one component of the electronic device 101. According to an embodiment, the battery 189 may include, for example, a primary cell which is not rechargeable, a secondary cell which is rechargeable, or a fuel cell.

[0031] The communication module 190 may support establishing a direct (e.g., wired) communication channel or a wireless communication channel between the electronic device 101 and the external electronic device (e.g., the electronic device 102, the electronic device 104, or the server 108) and performing communication via the established communication channel. The communication module 190 may include one or more communication processors that are operable independently from the processor 120 (e.g., the application processor (AP)) and supports a direct (e.g., wired) communication or a wireless communication. According to an embodiment, the communication module 190 may include a wireless communication module 192 (e.g., a cellular communication module, a short-range wireless communication module, or a global navigation satellite system (GNSS) communication module) or a wired communication module 194 (e.g., a local area network (LAN) communication module or a power line communication (PLC) module). A corresponding one of these communication modules may communicate with the external electronic device via the first network 198 (e.g., a short-range communication network, such as BluetoothTM, wireless-fidelity (Wi-Fi) direct, or infrared data association (IrDA)) or the second network 199 (e.g., a long-range communication network, such as a cellular network, the Internet, or a computer network (e.g., LAN or wide area network (WAN)). These various types of communication modules may be implemented as a single component (e.g., a single chip), or may be implemented as multi components (e.g., multi chips) separate from each other. The wireless communication module 192 may identify and authenticate the electronic device 101 in a communication network, such as the first network 198 or the second network 199, using subscriber information (e.g., international mobile subscriber identity (IMSI)) stored in the subscriber identification module 196.

[0032] The antenna module 197 may transmit or receive a signal or power to or from the outside (e.g., the external electronic device) of the electronic device 101. According to an embodiment, the antenna module 197 may include an antenna including a radiating element composed of a conductive material or a conductive pattern formed in or on a substrate (e.g., PCB). According to an embodiment, the antenna module 197 may include a plurality of antennas. In such a case, at least one antenna appropriate for a communication scheme used in the communication network, such as the first network 198 or the second network 199, may be selected, for example, by the communication module 190 (e.g., the wireless communication module 192) from the plurality of antennas. The signal or the power may then be transmitted or received between the communication module 190 and the external electronic device via the selected at least one antenna. According to an embodiment, another component (e.g., a radio frequency integrated circuit (RFIC)) other than the radiating element may be additionally formed as part of the antenna module 197.

[0033] At least some of the above-described components may be coupled mutually and communicate signals (e.g., commands or data) therebetween via an inter-peripheral communication scheme (e.g., a bus, general purpose input and output (GPIO), serial peripheral interface (SPI), or mobile industry processor interface (MIPI)).

[0034] According to an embodiment, commands or data may be transmitted or received between the electronic device 101 and the external electronic device 104 via the server 108 coupled with the second network 199. Each of the electronic devices 102 and 104 may be a device of a same type as, or a different type, from the electronic device 101. According to an embodiment, all or some of operations to be executed at the electronic device 101 may be executed at one or more of the external electronic devices 102, 104, or 108. For example, if the electronic device 101 should perform a function or a service automatically, or in response to a request from a user or another device, the electronic device 101, instead of, or in addition to, executing the function or the service, may request the one or more external electronic devices to perform at least part of the function or the service. The one or more external electronic devices receiving the request may perform the at least part of the function or the service requested, or an additional function or an additional service related to the request, and transfer an outcome of the performing to the electronic device 101. The electronic device 101 may provide the outcome, with or without further processing of the outcome, as at least part of a reply to the request. To that end, a cloud computing, distributed computing, or client-server computing technology may be used, for example.

[0035] FIG. 2 is a block diagram 200 illustrating an example electronic device 101 in a network environment including a plurality of cellular networks according to various embodiments.

[0036] Referring to FIG. 2, an electronic device 101 may include a first communication processor (e.g., including processing circuitry) 212, a second communication processor (e.g., including processing circuitry) 214, a first radio frequency integrated circuit (RFIC) 222, a second RFIC 224, a third RFIC 226, a fourth RFIC 228, a first radio frequency front end (RFFE) 232, a second RFFE 234, a first antenna module 242, a second antenna module 244, and an antenna 248. The electronic device 101 may further include a processor (e.g., including processing circuitry) 120 and a memory 130. The second network 199 may include a first cellular network 292 and a second cellular network 294. According to another embodiment, the electronic device may further include at least one of the parts shown in FIG. 1 and the second network 199 may further include at least one another network. According to an embodiment, the first communication processor 212, the second communication processor 214, the first RFIC 222, the second RFIC 224, the fourth RFIC 228, the first RFFE 232, and the second RFFE 234 may form at least a portion of a wireless communication module 192. According to another embodiment, the fourth RFIC 228 may be omitted or may be included as a portion of the third RFIC 226.

[0037] The first communication processor 212 can support establishment of a communication channel with a band to be used for wireless communication with the first cellular network 292 and legacy network communication through the established communication channel. According to various embodiments, the first cellular network may be a legacy network including a 2G, 3G, 4G, or Long-Term Evolution (LTE) network. The second communication processor 214 can support establishment of a communication channel corresponding to a designated band (e.g., about 6GHz ~ about 60GHz) of a band to be used for wireless communication with the second cellular network 294 and 5G network communication through the established communication channel. According to various embodiments, the second cellular network 294 may be a 5G network that is defined in 3GPP. Further, according to an embodiment, the first communication processor 212 or the second communication processor 214 can support establishment of a communication channel corresponding to another designated band (e.g., about 6GHz or less) of a band to be used for wireless communication with the second cellular network 294 and 5G network communication through the established communication channel. According to an embodiment, the first communication processor 212 and the second communication processor 214 may be implemented in a single chip or a single package. According to various embodiments, the first communication processor 212 or the second communication processor 214 may be disposed in a single chip or a single package together with the processor 120, the auxiliary processor 123, or the communication module 190. According to an embodiment, the first communication processor 212 and the second communication processor 214 is directly or indirectly connected by an interface (not shown), thereby being able to provide or receive data or control signal in one direction or two directions.

[0038] The first RFIC 222, in transmission, can converts a baseband signal generated by the first communication processor 212 into a radio frequency (RF) signal of about 700MHz to about 3GHz that is used for the first cellular network 292 (e.g., a legacy network). In reception, an RF signal can be obtained from the first cellular network 292 (e.g., a legacy network) through an antenna (e.g., the first antenna module 242) and can be preprocessed through an RFFE (e.g., the first RFFE 232). The first RFIC 222 can covert the preprocessed RF signal into a baseband signal so that the preprocessed RF signal can be processed by the first communication processor 212.

[0039] The second RFIC 224 can convert a baseband signal generated by the first communication processor 212 or the second communication processor 214 into an RF signal in a Sub6 band (e.g., about 6GHz or less) (hereafter, 5G Sub6 RF signal) that is used for the second cellular network 294 (e.g., a 5G network). In reception, a 5G Sub6 RF signal can be obtained from the second cellular network 294 (e.g., a 5G network) through an antenna (e.g., the second antenna module 244) and can be preprocessed through an RFFE (e.g., the second RFFE 234). The second RFIC 224 can convert the processed 5G Sub6 RF signal into a baseband signal so that the processed 5G Sub6 RF signal can be processed by a corresponding communication processor of the first communication processor 212 or the second communication processor 214.

[0040] The third RFIC 226 can convert a baseband signal generated by the second communication processor 214 into an RF signal in a 5G Above6 band (e.g., about 6GHz ~ about 60GHz) (hereafter, 5G Above6 RF signal) that is used for the second cellular network 294 (e.g., a 5G network). In reception, a 5G Above6 RF signal can be obtained from the second cellular network 294 (e.g., a 5G network) through an antenna (e.g., the antenna 248) and can be preprocessed through the third RFFE 236. The third RFIC 226 can covert the preprocessed 5G Above6 RF signal into a baseband signal so that the preprocessed 5G Above6 RF signal can be processed by the first communication processor 214. According to an embodiment, the third RFFE 236 may be provided as a portion of the third RFIC 226.

[0041] The electronic device 101, according to an embodiment, may include a fourth RFIC 228 separately from or as at least a portion of the third RFIC 226. In this case, the fourth RFIC 228 can convert a baseband signal generated by the second communication processor 214 into an RF signal in an intermediate frequency band (e.g., about 9GHz ~ about 11GHz) (hereafter, IF signal), and then transmit the IF signal to the third RFIC 226. The third RFIC 226 can convert the IF signal into a 5G Above6 RF signal. In reception, a 5G Above6 RF signal can be received from the second cellular network 294 (e.g., a 5G network) through an antenna (e.g., the antenna 248) and can be converted into an IF signal by the third RFIC 226. The fourth RFIC 228 can covert the IF signal into a baseband signal so that IF signal can be processed by the second communication processor 214.

[0042] According to an embodiment, the first RFIC 222 and the second RFIC 224 may be implemented as at least a portion of a single chip or a single package. According to an embodiment, the first RFFE 232 and the second RFFE 234 may be implemented as at least a portion of a single chip or a single package. According to an embodiment, at least one of the first antenna module 242 or the second antenna module 244 may be omitted, or may be combined with another antenna module and can process RF signals in a plurality of bands.

[0043] According to an embodiment, the third RFIC 226 and the antenna 248 may be disposed on a substrate, thereby being able to form a third antenna module 246. For example, the wireless communication module 192 or the processor 120 may be disposed on a first substrate (e.g., a main PCB). In this case, the third RFIC 226 may be disposed in a partial area (e.g., the bottom) and the antenna 248 may be disposed in another partial area (e.g., the top) of a second substrate (e.g., a sub PCB) that is different from the first substrate, thereby being able to form the third antenna module 246. By disposing the third RFIC 226 and the antenna 248 on the same substrate, it is possible to reduce the length of the transmission line therebetween. Accordingly, it is possible to reduce a loss (e.g., attenuation) of a signal in a high-frequency band (e.g., about 6GHz ~ about 60 GHz), for example, which is used for 5G network communication, due to a transmission line. Accordingly, the electronic device 101 can improve the quality and the speed of communication with the second cellular network 294 (e.g., 5G network).

[0044] According to an embodiment, the antenna 248 may be an antenna array including a plurality of antenna elements that can be used for beamforming. In this case, the third RFIC 226, for example, as a portion of the third RFFE 236, may include a plurality of phase shifters 238 corresponding to the antenna elements. In transmission, the phase shifters 238 can convert the phase of a 5G Above6 RF signal to be transmitted to the outside of the electronic device 101 (e.g., to a base station of a 5G network) through the respectively corresponding antenna elements. In reception, the phase shifters 238 can convert the phase of a 5G Above6 RF signal received from the outside through the respectively corresponding antenna element into the same or substantially the same phase. This enables transmission or reception through beamforming between the electronic device 101 and the outside.

[0045] The second cellular network 294 (e.g., a 5G network) may be operated independently from (e.g., Stand-Along (SA)) or connected and operated with (e.g., Non-Stand Along (NSA)) the first cellular network 292 (e.g., a legacy network). For example, there may be only an access network (e.g., a 5G radio access network (RAN) or a next generation RAN (NG RAN)) and there is no core network (e.g., a next generation core (NGC)) in a 5G network. In this case, the electronic device 101 can access the access network of the 5G network and then can access an external network (e.g., the internet) under control by the core network (e.g., an evolved packed core (EPC)) of the legacy network. Protocol information (e.g., LTE protocol information) for communication with a legacy network or protocol information (e.g., New Radio (NR) protocol information) for communication with a 5G network may be stored in the memory 230 and accessed by another part (e.g., the processor 120, the first communication processor 212, or the second communication processor 214).

[0046] FIG. 2 illustrates the plurality of cellular networks, but the electronic device 101 illustrated in FIG. 2 is just one example, and various embodiments of the present disclosure are not limited to this. According to various embodiments, the electronic device 101 can include the antenna for the first cellular network (e.g., LTE) or the second cellular network (e.g., NR, 6 GHz or less). According to various embodiments, the antenna can include a metal antenna.

[0047] The present disclosure relates to an electronic device including two or more bodies. That is, the electronic device can include a first body and a second body. The first body can include an antenna. The second body can include an RF module, and an RF circuit for connecting the RF module and the antenna. Below, an example of the electronic device that is based on the bodies is illustrated through FIG. 3.

[0048] FIG. 3 illustrates an example 300 of a type of an electronic device (e.g., the electronic device 101 of FIG. 1) according to various embodiments. The electronic device 101 can include two or more bodies. The type of the electronic device 101 can be a slide type.

[0049] Referring to FIG. 3, the electronic device 300 can include a first body 310, and a second body 360 disposed to overlap with the first body 310. According to various embodiments, the first body 310 can include an antenna for wireless communication. The second body 360 can include an RF module (e.g., an RFIC) for wireless communication and an RF circuit connected to the antenna. According to an embodiment, the first body 310 can include a display 325. The first body 310 can be located in a front surface of the electronic device 101, and the second body 360 can be located in a rear surface of the electronic device 101.

[0050] The first body 310 can be a structure which is movable (e.g., linear movement or curved movement) along one surface of the second body 360. For example, the first body 310 can be a structure in which linear movement 350 on an x axis is possible. Below, for description convenience's sake, a description is made in which a direction of decreasing an X coordinate on an x axis indicates that the first body 310 moves down, and a direction of increasing the X coordinate on the x axis indicates that the first body 310 moves up. The first body 310 can perform up/down movement on the x axis.

[0051] Two states can be defined according to the up/down movement of the first body 310. The two states can include a first state 300a and a second state 300b.

The first body can be denoted as a slide moving part. The second body can be denoted as a fixing part.

[0052] In the first state 300a, the first body 310 can at least partially overlap with the second body 360 when viewed from above a plane vertical to a z axis. The first state 300a can be defined as a state in which the first body 310 is overlapped, in the most region, with the second body 360. The first state 300a can be denoted as a slide-down state. In the second state 300b, the first body 310 can at least partially overlap with the second body 360 when viewed from above the plane vertical to the z axis. The second state 300b can be defined as a state in which the first body 310 is overlapped, in the least region, with the second body 360. The second state 300b can be denoted as a slide-up state. In accordance with an embodiment, the region overlapped in the second state 300b can be smaller than the region overlapped in the first state 300a.

[0053] According to various embodiments, a relative position relationship between the first body and the second body can become different in accordance with the movement of the first body. For example, a length of a transmission line between the antenna included in the first body and the RF circuit included in the second body can become different in accordance with the movement of the first body. Also, for example, a size of an overlapped region between the first body and the second body can become different in accordance with the movement of the first body. That is, the movement of the first body including the antenna can vary spatial characteristics between the first body including the antenna and the second body including the RF module. The movement of the first body can affect an electric field and/or magnetic field related with the antenna. Accordingly, the electronic device 101 of various embodiments can include a structure for presenting antenna performance optimized to each state.

[0054] In FIG. 3, a description has been made, as an example, for the slide type in which the first body 310 is opened in an x-axis direction with respect to the second body 360, but various embodiments of the present disclosure are not limited to this. A slide type in which the first body 310 is opened in a y-axis direction with respect to the second body 360 can be also understood as an embodiment of the present disclosure.

[0055] Also, in FIG. 3, a state between the bodies of the electronic device has been defined as one of two states, but the present disclosure is not limited to this. It is undoubted that three or more states can be defined according to the movement of the first body. An intermediate state can be defined as a third state besides when the first body is in the highest position or the lowest position.

[0056] Also, in FIG. 3, a description has been made for a slide-type structure as an example, but various embodiments of the present disclosure are applicable to a type of an electronic device which has two bodies detached and which has a plurality of physical forms according to a relative position between the two bodies as well as the slide type. For example, a tuning structure of various embodiments of the present disclosure can be applied even to an electronic device (e.g., a foldable electronic device including segmented bodies) of a type including a body different from a folded or reclinable body.

[0057] As described in FIG. 3, the present disclosure relates to an electronic device including two or more bodies. In detail, the present disclosure relates to a connection scheme between a first body including an antenna circuit including an antenna and a second body including a main circuit including an RF module and a processor, and antenna tuning of each connection scheme. Below, for description convenience's sake, a description is made in which the first body is denoted as a slide moving part and the second body is a fixing part, but various embodiments of the present disclosure are not limited to this. In accordance with an embodiment, the first body can be a fixing part, and the second body can be a slide moving part. That is, a front part including a display of the electronic device 101 can be fixed, and a rear part can perform up/down movement. In accordance with another embodiment, the first body and the second body all can be slide moving parts. That is, the first body and the second body all can perform the up/down movement as well.

[0058] The conventional slide-type electronic device has been implemented to, when connecting an antenna mounted in a slide moving part and an antenna circuit mounted in a fixing part, move connected portions along up/down movement of the slide moving part together, by using a coaxial cable or a flexible printed circuit board (FPCB). However, the up/down movement of the slide moving part can affect an electromagnetic field situation such as a relative variation, etc. with a dielectric material of the electronic device and/or a display. Also, a mounting space can be additionally required wherein the coaxial cable or the FPCB, etc. can move together with the slide moving part.

[0059] Various embodiments of the present disclosure can solve a problem caused by the insufficiency of a mounting space, by electrically connecting a body including an antenna and a body including an RF circuit through a direct contact scheme (below, a contact scheme) or a coupling scheme. However, although the connection between the two bodies is implemented in the contact scheme or the coupling scheme, when a relative position between the first body and the second body is changed, a relative distance between the antenna and the RF circuit becomes different and by this, a characteristic of an RF path forwarding a signal can become different. Also, a magnetic field formed due to conductive members disposed in the electronic device becomes different in accordance with the change of the physical position, and this affects antenna performance. Accordingly, the electronic device of various embodiments can construct each RF circuit for antenna tuning, in each state that is based on the relative position between the first body including the antenna and the second body including the RF circuit and the RF module. At contact or coupling, the RF circuit connected to the antenna is tuned individually according to the state (e.g., the slide-down state and/or the slide-up state) between the bodies, thereby optimizing the antenna performance according to the state between the bodies.

[0060] Below, in the present disclosure, antenna tuning can mean a circuit design for increasing antenna performance. The antenna performance can be affected by a frequency band at which communication is performed, device values within the RF circuit connected with the antenna, a length of a transmission line consisting of the RF circuit, and/or an arrangement between conductors. The antenna performance can include a resonance frequency provided through the antenna and the RF path, a signal gain obtained at a communication frequency band through the antenna, a standing wave ratio acquired through the antenna and the RF path, or a reflection coefficient. Also, optimized performance can be defined according to a standing wave ratio (SWR), a return loss or a resonance frequency. For example, the RF circuit connected with the antenna can operate as an impedance matching circuit at a communication frequency band. Through the impedance matching, the electronic device 101 can present high antenna performance (e.g., a low reflection coefficient, a low resonance error, and/or a high signal gain).

[0061] Below, the present disclosure distinguishes and describes a range of frequency bands by a low-frequency band (e.g., less than 1.3 GHz), a mid-frequency band (e.g., 1.3 GHz or more and less than 2.2 GHz), and a high-frequency band (e.g., 2.2 GHz or more), but various embodiments of the present disclosure are not limited to this. The high and low of the frequency band can be defined differently according to the performance of the antenna installed in the electronic device.

[0062] FIG. 4A illustrates an example (400) of a structure of a slide electronic device (e.g., the electronic device 101 of FIG. 1) according to various embodiments. The electronic device 101 can include a body for a full slide operation.

[0063] Referring to FIG. 4, the electronic device (e.g., the electronic device 101 of FIG. 1) can include a lower part 400a and an upper part 400b. The lower part 400a can mean a region located relatively below on a y axis, and the upper part 400b can mean a region located relatively above on the y axis.

[0064] The lower part 400a can include cellular antennas. In accordance with an embodiment, the lower part 400a can include at least one of a first cellular antenna 411, a second cellular antenna 412, and a third cellular antenna 413. The first cellular antenna 411 can support the transmission or reception of a signal of a low-frequency band (LB), a mid-frequency band (MB), and/or an ultra-high-frequency band (UHB). Also, as an example, the third cellular antenna 413 can support the transmission or reception of a signal of the mid-frequency band (MB) and a high-frequency band (HB). According to an embodiment, the first cellular antenna 411 can include a metal antenna segmentation structure.

[0065] The upper part 400b can include auxiliary antennas. In accordance with an embodiment, the upper part 400b can include a first auxiliary antenna 421, a second auxiliary antenna 422, a third auxiliary antenna 423, and a fourth auxiliary antenna 424. In accordance with another embodiment, the first auxiliary antenna 421 of the aforementioned embodiment can be replaced with a first auxiliary antenna 425 disposed at a side part instead of being disposed at an upper end of the upper part 400b. The first auxiliary antenna 421 or 425 can support the transmission or reception of a signal of a low-frequency band (LB) and an ultra-high-frequency band (UHB). The second auxiliary antenna 422 can support the transmission or reception of a signal of a mid-frequency band (MB) and a high-frequency band (HB). The third auxiliary antenna 423 can support the transmission or reception of a signal of the mid-frequency band (MB) and the high-frequency band (HB). The fourth auxiliary antenna 424 can support the transmission or reception of a signal of the ultra-high-frequency band (UHB).

[0066] The upper part 400b can include wireless local area network (WLAN) antennas. In accordance with an embodiment, the upper part 400b can include a first wireless LAN antenna 431 and a second wireless LAN antenna 432. The first wireless LAN antenna 431 can support the transmission or reception of a GPS signal and a wireless LAN (e.g., Wi-Fi) signal of 2.4 GHz or 5 GHz. The second wireless LAN antenna 432 can support the transmission or reception of a wireless LAN (e.g., Wi-Fi) signal of 2.4 GHz or 5 GHz.

[0067] The electronic device (e.g., the electronic device 101 of FIG. 1) can include two bodies distinguished as a top and bottom of a slide segment part 440. The two bodies can include a first body being a slide moving part and a second body being a fixing part. The electronic device 101 can include a slide frame 450 which provides a guide rail wherein the first body moves up/down on the second body. The slide frame 450 can present a direction for the slide movement of the first body. To move the first body up/down on the y axis with criterion of the slide segment part 440, the electronic device 101 can include a motor 460 for slide driving.

[0068] The electronic device (e.g., the electronic device 101 of FIG. 1) of various embodiments can include the first body which is located in the upper part 400b. The first body can include at least one antenna disposed in the upper part 400b. In detail, antennas can be mounted on a PCB of the first body. As the first body moves along the slide frame, a distance between the antenna of the first body and an RF module of the electronic device 101 can become different.

[0069] FIG. 4B illustrates another example 480 of a structure of a slide electronic device (e.g., the electronic device 101 of FIG. 1) according to various embodiments. The electronic device 101 can include a body for a pop-up slide operation. A description being the same or similar to that of the example 400 of the structure of FIG. 4A can be omitted.

[0070] Referring to FIG. 4B, the electronic device (e.g., the electronic device 101 of FIG. 1) can include two bodies distinguished as a top and bottom of a slide segment part 485. The two bodies can include a first body being a slide moving part and a second body being a fixing part. For example, the electronic device can include a first body of which a slide operation is possible in a manner in which a partial region of an apparatus such as a camera region disposed in the upper part of the electronic device rises up.

[0071] As in FIG. 4A, the electronic device can include a slide frame 490 for guiding a direction of a slide operation of the first body. The first body can move up or move down on the y axis along the slide frame 490. That is, the slide frame 490 can be constructed to present a guide rail in a y-axis direction on the drawing.

[0072] FIG. 4A and FIG. 4B illustrate a structure of a slide-type electronic device. In accordance with a slide form, a position of a slide segment part, and an antenna mounting structure, can be changed. Also, as a disposition of an antenna mounted in a structure for a slide operation is changed, the setting of a tuning circuit for presenting optimized performance of the antenna can become different. According to various embodiments, the tuning circuit for presenting the optimized performance of the antenna can be set on the basis of at least one of a slide type, a state between bodies dependent on a slide operation, a position of a segment part, a disposition of the antenna, and/or a position. Below, through FIG. 5 to FIG. 9B, a connection structure between bodies based on a slide operation and a tuning circuit design way based on each connection are described.

[0073] FIG. 5 illustrates an example 500 of connection between bodies according to various embodiments. In the present disclosure, a connection structure between the bodies can include a structure (below, a contact structure) of directly connecting through a contact of each body and a conductive member or a structure of electrically connecting through a conductive plate of each body. Below, FIG. 5 describes a contact structure as an example, but this is only an example and does not limit embodiments of the present disclosure.

[0074] Referring to FIG. 5, an electronic device (e.g., the electronic device 101 of FIG. 1) can include a first body 510 and a second body 560. A description is made, as an example, for a situation in which the first body 510 is a moving part of the slide electronic device, and the second body 560 is a fixing part of the slide electronic device.

[0075] The first body 510 can include a first printed circuit board (PCB) 520. The first body 510 can include an antenna (not shown) disposed in the first PCB 520. The antenna can be electrically connected to the first PCB 520. The first body 510 can include a circuit (below, an antenna connection circuit) which is constructed in the first PCB 520 and is connected with the antenna. The first body 510 can include a first antenna connection terminal 521 and a second antenna connection terminal 522 for connection of the antenna and the second body 560. Here, the antenna connection terminal can mean a conductive member for connecting the antenna with another body. The first PCB 520 can include the first antenna connection terminal 521 and the second antenna connection terminal 522. In accordance with various embodiments, the antenna connection terminal can be connected with a conductive member for connection with another body.

[0076] The second body 560 can include a second PCB 570. The second body 560 can include an RF module (not shown) disposed in the second PCB 570. For example, the RF module can be implemented by an RFIC. The second body 560 can include a circuit (below, an RF circuit) which is disposed in the second PCB 570 and is connected with the RF module or the ground (GND). The RF circuit can include at least one tuning circuit. The tuning circuit can be a matching circuit connected with the ground or a circuit connected with the RF module. The second body 560 can include a first RF connection terminal 571, a second RF connection terminal 572, and a third RF connection terminal 573 for connection of the RF circuit and the first body 510. Here, the RF connection terminal can mean a conductive member for connecting the RF module with another body. The second PCB 570 can include the first RF connection terminal 571, the second RF connection terminal 572, and the third RF connection terminal 573.

[0077] A first state 500a can be a state in which the first body is located relatively below on a y axis. The first state 500a can be denoted as a slide-down or closed state. In the first state 500a, the first antenna connection terminal 521 can be electrically connected with the first RF connection terminal 571. According to an embodiment, the first antenna connection terminal 521 can come in physical contact with the first RF connection terminal 571 through a conductive contact member. As the conductive contact member is physically connected between the first antenna connection terminal 521 and the first RF connection terminal 571, an electrical RF path can be provided. According to another embodiment, the first antenna connection terminal 521 can be coupled with the first RF connection terminal 571 through a capacitor. Owing to charging charges of the capacitor, an electrical RF path can be provided between the first antenna connection terminal 521 and the first RF connection terminal 571. Like the first antenna connection terminal 521 and the first RF connection terminal 571, the second antenna connection terminal 522 can be electrically connected with the second RF connection terminal 572.

[0078] A second state 500b can be a state in which the first body is located relatively above on the y axis. The second state 500b can be denoted as a slide-up or open state. In the second state 500b, the first antenna connection terminal 521 can be electrically connected with the second RF connection terminal 572. According to an embodiment, the first antenna connection terminal 521 can come in physical contact with the second RF connection terminal 572 through a conductive contact member. As the conductive contact member is physically connected between the first antenna connection terminal 521 and the second RF connection terminal 572, an electrical RF path can be provided. According to another embodiment, the first antenna connection terminal 521 can be coupled with the second RF connection terminal 572 through a capacitor. Owing to charging charges of the capacitor, an electrical RF path can be provided between the first antenna connection terminal 521 and the second RF connection terminal 572. Like the first antenna connection terminal 521 and the second RF connection terminal 572, the second antenna connection terminal 522 can be electrically connected with the third RF connection terminal 573.

[0079] As the first body 510 moves from down to up, the electronic device 101 can change from the first state 500a to the second state 500b. As the electronic device 101 changes from the first state 500a to the second state 500b, the RF connection terminal connected to each antenna connection terminal can become different. In accordance with an embodiment, the antenna connection terminal can be connected with the RF connection terminal through a contact structure. As the first body 510 moves from down to up, the first antenna connection terminal 521 can, as in a contact scheme 545, be detached from the first RF connection terminal 571 located relatively below on the y axis, and be connected to the second RF connection terminal 572 located relatively above on the y axis.

[0080] The second body 560 can include an RF circuit. The RF circuit can include an RF circuit construction connected with the first body 510 in the first state 500a and an RF circuit construction connected with the second body 560 in the second state 500b. For example, the RF circuit disposed in the second PCB 570 can include a first tuning circuit including the first RF connection terminal 571, a second tuning circuit including the second RF connection terminal 572, and a third tuning circuit including the third RF connection terminal 573. At this time, the first tuning circuit can include devices for antenna tuning in the first state 500a, because an RF path is formed by connecting with the antenna connection circuit of the first body 510 only in a slide-down state that is the first state 500a. The third tuning circuit can include devices for antenna tuning in the second state 500b, because an RF path is formed by connecting with the antenna connection circuit of the first body 510 only in a slide-up state that is the second state 500b.

[0081] Like this, the second body 560 of various embodiments can include an RF circuit differently constructed according to a position of the first body 510, by differently constructing an RF connection terminal connected with a communication path according to the movement of the first body 510. A tuning circuit corresponding to each RF connection terminal of the second body 560 consists of devices presenting optimal antenna performance in each state, whereby the electronic device can present high antenna performance although the position of the first body becomes different.

[0082] Below, FIG. 6 illustrates an example of a circuit construction of each body for presenting optimal antenna performance.

[0083] FIG. 6 illustrates an example 600 of a circuit for connection between bodies according to various embodiments. FIG. 6 is a circuit diagram expressing a connection between the first body 510 and the second body 560 of FIG. 5. A first body 610 and a second body 660 can correspond to each of the first body 510 and the second body 560 of FIG. 5. A description is made for a situation in which the first body 610 is a moving part of a slide electronic device, and the second body 660 is a fixing part of the slide electronic device. Below, a description of the same or similar construction as that of FIG. 5 can be omitted.

[0084] The electronic device (e.g., the electronic device 101 of FIG. 1) can include a connection part for signal forwarding between the first body 610 and the second body 660 in each of a slide-up state and a slide-down state. The electronic device 101 can include a tuning part for optimizing antenna performance in each of the slide-up state and the slide-down state.

[0085] Referring to FIG. 6, the first body 610 can include an antenna 611. The antenna 611 can be electrically connected to a first PCB (e.g., the first PCB 520 of FIG. 5). The first body 610 can include an antenna connection circuit 630 disposed in the first PCB. The first body 610 can include a first antenna connection terminal 621 and a second antenna connection terminal 622 for connection of the antenna connection circuit and the second body 660.

[0086] The second body 660 can include an RF module 675. For example, the RF module 675 can be implemented by an RFIC. The second body 660 can include a circuit (below, an RF circuit) 680 which is disposed in the second PCB (e.g., the second PCB 570 of FIG. 5) and is connected with the RF module or the ground (GND). The second body 660 can include a first RF connection terminal 671, a second RF connection terminal 672, and a third RF connection terminal 673 for connection of the RF circuit and the first body 610. In accordance with an embodiment, the RF circuit 680 can include a tuning circuit that is based on each RF circuit terminal. The RF circuit 680 can include a first tuning circuit 681 connected with the first RF connection terminal 671, a second tuning circuit 682 connected with the second RF connection terminal 672, and a third tuning circuit 683 connected with the third RF connection terminal 673.

[0087] On the other hand, the tuning circuit constructed to each RF connection terminal is just an example, and the present disclosure is not limited to this. The RF circuit 680 can include one tuning circuit for a plurality of RF connection terminals. For example, the RF circuit 680 can include a tuning circuit for the first RF connection terminal 671 and the second RF connection terminal 672 and another tuning circuit for the third RF connection terminal 673. For another example, the RF circuit 680 can include a tuning circuit for the first RF connection terminal 671 and another tuning circuit for the second RF connection terminal 672 and the third RF connection terminal 673.

[0088] According to various embodiments, the electronic device 101 can include a connection structure in which the RF connection terminals of the second body 660 connected with the antenna connection terminals (e.g., the first antenna connection terminal 621 and the second antenna connection terminal 622) of the first body 610 become different according to the up/down movement of the first body 610. For example, the electronic device 101 can include the first RF connection terminal 671 of the second body 660, the second RF connection terminal 672 disposed relatively higher on a y axis than the first RF connection terminal 671, and the third RF connection terminal 673 disposed relatively higher on the y axis than the second RF connection terminal 672. Here, the y axis means an axis of a slide movement direction. In a slide-down state, the first antenna connection terminal 621 can be connected to the first RF connection terminal 671. In the slide-down state, the second antenna connection terminal 622 can be connected to the second RF connection terminal 672. Thereafter, in the slide-up state, the first antenna connection terminal 621 can be connected to the second RF connection terminal 672. Also, the second antenna connection terminal 622 can be connected to the third RF connection terminal 673.

[0089] According to various embodiments, the electronic device 101 can include the RF circuit 680 which includes a different RF circuit construction in each state. The electronic device 101 can include a connection structure which is constructed wherein the RF connection terminals connected with the first body 610 become different in each of the slide-up state and the slide-down state. As the RF connection terminals become different, a construction of an RF path formed from the antenna to the RF module through connection of an antenna circuit of the first body 610 and an RF circuit of the second body 660 can become different.

[0090] In the RF circuit 680 of various embodiments, a tuning circuit for an RF terminal coming in contact with or electrically connected with the first body 610 in each state (e.g., slide-up or slide-down) can be individually constructed. As an example, the RF circuit 680 including the first tuning circuit 681 and the second tuning circuit 682 for the sake of optimization of antenna performance in the slide-down state can be designed. Also, as an example, the RF circuit 680 including the second tuning circuit 682 and the third tuning circuit 683 for the sake of optimization of antenna performance in the slide-up state can be designed. The electronic device 101 can include the first body 610, the second body 660, and a connection structure which form mutually different RF paths in each of the slide-up state and the slide-down state.

[0091] FIG. 7 illustrates an example 700 of a contact structure for connection between bodies according to various embodiments.

[0092] Referring to FIG. 7, the electronic device (e.g., the electronic device 101 of FIG. 1) can include a first body 710 and a second body 760. The first body 710 can be a moving part of a slide electronic device (e.g., the electronic device 101 of FIG. 1), and the second body 760 can be a fixing part of the slide electronic device. A cross section 700a exemplifies a contact structure including terminals for connection between the first body 710 and the second body 760, and the other cross section 700b exemplifies internal terminals of each body.

[0093] The first body 710 can include a first PCB 720. The first body 710 can include an antenna 711 disposed in the first PCB 720. The first body 710 can include a first antenna connection terminal 721 and/or a second antenna connection terminal 722 which are disposed on the first PCB 720 and are connected with the antenna 711. Each antenna connection terminal can be a conductive member.

[0094] The second body 760 can include a second PCB 770. The second body 760 can include an RF module which is disposed in the second PCB 770. The second body 760 can include a contact pad which is disposed on the second PCB 770. The contact pad can include a first RF connection terminal 771, a second RF connection terminal 772, and/or a third RF connection terminal 773 which are connected with the RF module or the ground (GND) on the second PCB 770.

[0095] According to various embodiments, referring to the cross section 700a, the first antenna connection terminal 721 can be physically attached to a contact member 745. The contact member 745 can be a conductive member. The contact member 745 can come in physical contact with the first RF connection terminal 771 of the second body 760. In accordance with the physical contact of the conductive members, an RF path can be formed from the antenna 711 of the first body 710 to an RF module (not shown) of the second body 760.

[0096] To transmit a signal over a wireless channel through the antenna or receive a signal over the wireless channel, a path for forwarding an RF signal can be required. The RF signal can be forwarded through a physically contacted contact structure.

[0097] The electronic device of various embodiments can, referring to another cross section 700a, can include a contact structure which moves up/down when the first body 710 moves up/down. The contact structure can include the antenna connection terminal (e.g., the first antenna connection terminal 721 and/or the second antenna connection terminal 722) of the first body 710, the RF connection terminal (e.g., the first RF connection terminal 771, the second RF connection terminal 772, and the third RF connection terminal 773) of the second body 760, and the contact member 745. Through the contact structure including the contact member 745, the electronic device 101 can be connected, without a coaxial cable or FPCB for connection between the antenna of the first body 710 and the RF circuit of the second body 760.

[0098] FIG. 8A illustrates an example 800 of antenna tuning in a contact structure according to various embodiments. The contact structure can mean a structure of connecting two bodies, by physically contacting a contact member having conductivity between the antenna connection terminal of the first body and the RF connection terminal of the second body as in FIG. 7.

[0099] Referring to FIG. 8A, an electronic device (e.g., the electronic device 101 of FIG. 1) can include a first body 810 and a second body 860. A description is made, as an example, for a situation in which the first body 810 is a moving part of the slide electronic device 101, and the second body 860 is a fixing part of the slide electronic device.

[0100] The first body 810 can include a first PCB 820. The first body 810 can include an antenna 811 which is disposed in the first PCB 820. The first body 810 can include an antenna connection circuit which is constructed in the first PCB 820. The antenna 811 can be connected with a first antenna connection terminal 821 and a second antenna connection terminal 822 through the antenna connection circuit. The first antenna connection terminal 821 and the second antenna connection terminal 822 can be disposed in the first body 810 through the antenna connection circuit.

[0101] The second body 860 can include a second PCB 870. The second body 860 can include an RF module (e.g., an RFIC) 875 which is disposed in the second PCB 870. The second body 860 can construct an RFIC circuit in the second PCB. The ground can be connected with a first RF connection terminal 871 and a third RF connection terminal 873 through the RF circuit. The RF module 875 can be connected with a second RF connection terminal 872 through the RF circuit. The first RF connection terminal 871, the second RF connection terminal 872, and the third RF connection terminal 873 can be disposed in the second body 860 through the RF circuit.

[0102] Referring to a cross section 800a, the electronic device can be in a slide-down state. The first antenna connection terminal 821 can come in physical contact with a first contact member 845a. The second antenna connection terminal 822 can come in physical contact with a second contact member 845b. The first contact member 845a can come in physical contact with the first RF connection terminal 871. The second contact member 845b can come in physical contact with the second RF connection terminal 872. To become a slide-up state, the first body 810 can move to the right on an x axis. In the slide-up state, the first contact member 845a can come in physical contact with the second RF connection terminal 872. The second contact member 845b can come in physical contact with the third RF connection terminal 873. Through each contact member, the antenna connection terminal and the RF connection terminal can be electrically connected. An RF path for forwarding a signal from the antenna 811 to the RF module 875 or from the RF module 875 to the antenna 811 can be formed.

[0103] Referring to an internal circuit diagram 800b, the second body 860 can include a tuning circuit corresponding to each RF connection terminal. The first RF connection terminal 871 can be connected to a first tuning circuit 881. The first tuning circuit 881 can be connected with the ground. The first tuning circuit 881 can include a transmission line having a first length, an inductor, and/or a capacitor. The second RF connection terminal 872 can be connected to a second tuning circuit 882. The second tuning circuit can be connected to the RF module 875. The second tuning circuit 882 can include an inductor and a capacitor. The third RF connection terminal 873 can be connected to a third tuning circuit 883. The third tuning circuit 883 can be connected with the ground. The third tuning circuit 883 can include a transmission line having a second length, an inductor, and/or a capacitor.

[0104] In various embodiments, the first RF tuning circuit 881 can include at least one of a first capacitor, a first resistor, a first inductor, or a first chip (e.g., a compensation circuit), and the second RF tuning circuit 882 can include at least one of a second capacitor, a second resistor, a second inductor, or a second chip (e.g., a compensation circuit). Here, at least one of the first capacitor, the first resistor, the first inductor, and/or the first chip can have a value of maximizing a standing wave ratio related to the first antenna in the first state, and at least one of the second capacitor, the second resistor, the second inductor, and/or the second chip can have a value of maximizing a standing wave ratio related to the second antenna in the second state.

[0105] In the slide-down state, the third tuning circuit 883 can be inactivated, because only the first RF connection terminal 871 and the second RF connection terminal 872 are each connected with the first body 810 through the first contact member 845a and the second contact member 845b. According to various embodiments, the electronic device can optimize antenna performance in the slide-down state, through a design of the first tuning circuit 881 and the second tuning circuit 882. According to various embodiments, a design of the tuning circuit for optimizing the antenna performance can include at least one of a circuit design of decreasing a reflection coefficient or return loss of an antenna stage, a circuit design of increasing a signal gain forwarded through an antenna, and/or a design of an impedance matching circuit corresponding to impedance of the antenna stage. The third tuning circuit 883 may not affect a tuning circuit design for minimizing the return loss for the antenna in the slide-down state. In accordance with an embodiment, a value of a capacitor of the tuning circuit for the optimization and a value of an inductor can be predetermined values (e.g., experimental values).

[0106] In the slide-up state, the first tuning circuit 881 can be inactivated, because only the second RF connection terminal 872 and the third RF connection terminal 873 are each connected with the first body 810 through the first contact member 845a and the second contact member 845b. According to various embodiments, the electronic device can optimize the antenna performance, in the slide-up state, through a design of the second tuning circuit 882 and the third tuning circuit 883. The first tuning circuit 881 may not affect a tuning circuit design for minimizing a return loss for the antenna in the slide-up state. In accordance with an embodiment, a value of a capacitor of the tuning circuit for the optimization and a value of an inductor can be predetermined values (e.g., experimental values).

[0107] According to various embodiments, a line length from the antenna 811 to the second body 860 can become different according to the slide movement of the first body 810. In response to the antenna 811 moving up on a y axis in the internal circuit diagram 800b, a distance between the second body 860 and the antenna 811 can increase. That is, a length of a transmission line for forwarding an RF signal from the second body 860 to the antenna 811 can increase. Contrariwise, in response to the antenna 811 moving down on the y axis, the distance between the second body 860 and the antenna 811 can decrease. That is, the length of the transmission line for forwarding the RF signal from the second body 860 to the antenna 811 can decrease. Because the antenna 811 is one, it can be required to compensate for the length of the transmission line being varied in each state, for the sake of a tuning circuit construction of optimizing the performance of the antenna 811.

[0108] According to an embodiment, a transmission line of the first tuning circuit 881 activated in the slide-down state can be constructed to be longer than a transmission line of the third tuning circuit 883 activated in the slide-up state, in order to compensate for a transmission line of a short length between the antenna 811 and the second body 860. In other words, the electronic device 101 can include the first tuning circuit 881 including the transmission line having the first length, and the third tuning circuit 883 including the transmission line having the second length shorter than the first length. Also, in accordance with another embodiment, because an environment (interference) around the antenna in the slide-up state and the slide-down state is different, a circuit further adding a compensation device for the slide-down state can be constructed. That is, the tuning circuit of various embodiments of the present disclosure can constantly maintain, by a desired frequency, a resonance frequency which is varied as a length of an antenna becomes different electrically, and can be also used to optimize a characteristic variation which can occur due to peripheral apparatuses according to the slide-up state or the slide-down state.

[0109] FIG. 8B illustrates an example 850 of a circuit for antenna tuning according to various embodiments. FIG. 8B is a circuit diagram expressing connection between the first body 810 and the second body 860 of FIG. 8A. The first body 810 and the second body 860 can correspond to each of the first body 610 and the second body 860 of FIG. 6. A description is made for a situation in which the first body 810 is a moving part of a slide electronic device, and the second body 860 is a fixing part of the slide electronic device. Below, a description of the same or similar construction as that of FIG. 6 can be omitted.

[0110] Referring to FIG. 8B, the first body 810 can include the antenna 811. The first body 810 can include the first antenna connection terminal 821 and the second antenna connection terminal 822. The first body 810 can include the antenna connection circuit 830 for connecting the antenna 811 and each antenna connection terminal. The antenna connection circuit can be a 2-terminal structure.

[0111] The second body 860 can include the RF module 875. For example, the RF module 875 can be implemented by an RFIC. The second body 860 can include the first RF connection terminal 871, the second RF connection terminal 872, and the third RF connection terminal 873. The second body 860 can include an RF circuit 880 for electrical connection between the RF module 875 and the RF connection terminal. Each RF connection terminal can be connected with the RF module 875 or the ground. The RF circuit 880 can include a tuning circuit that is based on each RF circuit terminal. The RF circuit 880 can include the first tuning circuit 881 connected with the first RF connection terminal 871, the second tuning circuit 882 connected with the second RF connection terminal 872, and the third tuning circuit 883 connected with the third RF connection terminal 873. That is, the RF circuit 880 can be a 3-terminal structure.

[0112] According to various embodiments, the electronic device (e.g., the electronic device 101 of FIG. 1) can include the RF circuit 880 which, in the slide-down state, is connected with the first antenna connection terminal 821 through the first RF connection terminal 871 and is connected with the second antenna connection terminal 822 through the second RF connection terminal 872. At this time, the connection between the first antenna connection terminal 821 and the first RF connection terminal 871 is carried out only in the slide-down state, so the first tuning circuit 881 connected to the first RF connection terminal 871 can be designed based on optimization setting for the slide-down state. The first tuning circuit 881 can include a transmission line and a passive element (e.g., a resistor, an inductor, and a capacitor). Values of the length of the transmission line and the passive element can be values determined for the optimization setting of the slide-down state. The optimization setting can include at least one of circuit setting for increasing a gain of the antenna 811, circuit setting for decreasing a return loss, and circuit setting for presenting a low resonance error in a corresponding frequency band. That is, in the optimization setting, the first tuning circuit 881 can operate as an impedance matching circuit for RF paths constructed in the slide-down state.

[0113] According to various embodiments, in the slide-down state, the third tuning circuit 883 can be inactivated.

In accordance with an embodiment, in the slide-down state, the third tuning circuit 883 can operate as an open circuit or connect with a termination resistor, in order not to affect the tuning circuit design.

[0114] The electronic device can include the RF circuit 880 in which, in the slide-up state, the first antenna connection terminal 821 and the second RF connection terminal 872 are connected and the second antenna connection terminal 822 and the third RF connection terminal 873 are connected. At this time, the connection between the second antenna connection terminal 822 and the third RF connection terminal 873 is carried out only in the slide-up state, so the third tuning circuit 883 connected to the third RF connection terminal 873 can be designed based on optimization setting for the slide-up state. The third tuning circuit 883 can include a transmission line and a passive element (e.g., a resistor, an inductor, and a capacitor). Values of the length of the transmission line and the passive element can be values determined for the optimization setting of the slide-up state.

[0115] According to various embodiments, in the slide-up state, the first tuning circuit 881 can be inactivated. In accordance with an embodiment, in the slide-up state, the first tuning circuit 881 can operate as an open circuit or connect with a termination resistor, in order not to affect the tuning circuit design.

[0116] According to various embodiments, the electronic device (e.g., the electronic device 101 of FIG. 1) can include the second body 860 which includes the third tuning circuit 883 having a transmission line of a shorter length than that of the first tuning circuit 881. A physical distance between the antenna 811 and the second body 860 in the slide-up state can be longer than a physical distance between the antenna 811 and the second body 860 in the slide-down state. The length of the transmission line of the third tuning circuit 883 is constructed shorter than the length of the transmission line of the first tuning circuit 881, whereby an antenna radiation characteristic based on a length of an RF path which increases in the slide-up state compared to the slide-down state can be compensated.

[0117] The connection structure of FIG. 8A to FIG. 8B connects the first body 810 and the second body 860 and presents a tuning circuit of each connection state, by using the antenna connection circuit 830 of the 2-terminal structure and the RF circuit 880 of the 3-terminal structure. However, the antenna connection circuit 830 of the 2-terminal structure or the RF circuit 880 of the 3-terminal structure is just an example for description, and various embodiments of the present disclosure are not limited to this. Below, as an alternative example, embodiments of the connection structure which uses the antenna connection circuit of the 1-terminal structure and the RF circuit of the 2-terminal structure are described through FIG. 9A to FIG. 9B.

[0118] FIG. 9A illustrates another example 900 of antenna tuning in a contact structure according to various embodiments. The contact structure can mean a structure of connecting two bodies, by physically contacting a contact member having conductivity between an antenna connection terminal of a first body and an RF connection terminal of a second body as in FIG. 7.

[0119] Referring to FIG. 9A, the electronic device (e.g., the electronic device 101 of FIG. 1) can include a first body 910 and a second body 960. A description is made, as an example, for a situation in which the first body 910 is a moving part of the slide electronic device 101 and the second body 960 is a fixing part of the slide electronic device.

[0120] The first body 910 can include a first PCB 920. The first body 910 can include an antenna 911 disposed in the first PCB 920. The first body 910 can include an antenna connection circuit constructed in the first PCB 920. The antenna 911 can be connected with a first antenna connection terminal 921 through the antenna connection circuit. The first antenna connection terminal 921 can be disposed in the first body 910 through the antenna connection circuit.

[0121] The second body 960 can include a second PCB 970. The second body 960 can include an RF module (e.g., an RFIC) 975 disposed in the second PCB 970. The second body 960 can construct an RF circuit in the second PCB. A first RF connection terminal 971 and a second RF connection terminal 972 can be connected with the ground through the RF circuit. Also, the first RF connection terminal 971 and the second RF connection terminal 972 can be connected with the RF module 975 through the RF circuit. The first RF connection terminal 971 and the second RF connection terminal 972 can be disposed in the second body 960 through the RF circuit.

[0122] Referring to a cross section 900a, the electronic device can be in a slide-down state. The first antenna connection terminal 921 can come in physical contact with a first contact member 945a and a second contact member 945b. The first contact member 945a and the second contact member 945b can come in physical contact with the first RF connection terminal 971. To become a slide-up state, the first body 910 can move to the right on an x axis. In the slide-up state, the first contact member 945a and the second contact member 945b can come in physical contact with the second RF connection terminal 972. Through each contact member, the antenna connection terminal and the RF connection terminal can be electrically connected. An RF path for forwarding a signal from the antenna 911 to the RF module 975 or from the RF module 975 to the antenna 911 can be formed.

[0123] The first antenna connection terminal 921 of various embodiments is connected with two contact members, whereby connection between the first body 910 and the second body 960 can be maintained even during slide movement. A detailed description is made through FIG. 10B.

[0124] Referring to an internal circuit diagram 900b, the second body 960 can include a tuning circuit corresponding to each RF connection terminal. The first RF connection terminal 971 can be connected to a first tuning circuit 981. The first tuning circuit 981 can be connected with the ground and the RF module 975. The first tuning circuit 981 can include a transmission line having a first length, an inductor, and/or a capacitor. The second RF connection terminal 972 can be connected to a second tuning circuit 982. The second tuning circuit can be connected with the ground and the RF module 975. The second tuning circuit 982 can include a transmission line having a second length, an inductor, and/or a capacitor.

[0125] In the slide-down state, the second tuning circuit 982 can be inactivated, because only the first RF connection terminal 971 is connected with the first body 910 through the first contact member 945a and the second contact member 945b. According to various embodiments, the electronic device can optimize antenna performance, in the slide-down state, through a design of the first tuning circuit 981. According to various embodiments, a design of the tuning circuit for optimizing the antenna performance can include at least one of a circuit design of decreasing a reflection coefficient or return loss of an antenna stage, a circuit design of increasing a signal gain forwarded through an antenna, and/or a design of an impedance matching circuit corresponding to impedance of the antenna stage. The second tuning circuit 982 may not affect a tuning circuit design for minimizing the return loss for the antenna in the slide-down state. In accordance with an embodiment, a value of a capacitor of a tuning circuit for the optimization and a value of an inductor can be predetermined values (e.g., experimental values).

[0126] In the slide-up state, the first tuning circuit 981 can be inactivated, because only the second RF connection terminal 972 is connected with the first body 910 through the first contact member 945a and the second contact member 945b. According to various embodiments, the electronic device can optimize antenna performance, in the slide-down state, through the design of the second tuning circuit 982. The first tuning circuit 981 may not affect a tuning circuit design for minimizing the return loss for the antenna in the slide-up state. In accordance with an embodiment, a value of a capacitor of the tuning circuit for the optimization and a value of an inductor can be predetermined values (e.g., experimental values).

[0127] According to various embodiments, a line length from the antenna 911 to the second body 960 can become different according to the slide movement of the first body 910. As mentioned in FIG. 8A, because a length between the antenna 911 and the second body 960 in the slide-up state is formed longer than a length in the slide-down state, an RF circuit including the first tuning circuit 981 including a transmission line longer than a transmission line of the second tuning circuit 982 can be disposed in the second body 960.

[0128] FIG. 9B illustrates another example of a circuit for antenna tuning according to various embodiments. FIG. 9B is a circuit diagram expressing connection between the first body 910 and the second body 960 of FIG. 9A. The first body 910 and the second body 960 can correspond to each of the first body 610 and the second body 960 of FIG. 6. A description is made for a situation in which the first body 910 is a moving part of a slide electronic device and the second body 960 is a fixing part of the slide electronic device. Below, a description of the same or similar construction as that of FIG. 6 can be omitted.

[0129] Referring to FIG. 9B, the first body 910 can include the antenna 911. The first body 910 can include the first antenna connection terminal 921. The first body 910 can include an antenna connection circuit 930 for connecting the antenna 911 and the first antenna connection terminal 921. The antenna connection circuit can be a 1-terminal structure.

[0130] The second body 960 can include the RF module 975. For example, the RF module 975 can be implemented by an RFIC. The second body 960 can include the first RF connection terminal 971 and the second RF connection terminal 972. The second body 960 can include an RF circuit 980 for electrical connection between the RF module 975 and the RF connection terminal. Each RF connection terminal can be connected with the RF module or the ground. The RF circuit 980 can include a tuning circuit that is based on each RF circuit terminal. The RF circuit 980 can include the first tuning circuit 981 connected with the first RF connection terminal 971 and the second tuning circuit 982 connected with the second RF connection terminal 972. That is, the RF circuit 980 can be a 2-terminal structure.

[0131] According to various embodiments, the electronic device (e.g., the electronic device 101 of FIG. 1) can include the RF circuit 980 which, in the slide-down state, is connected with the first antenna connection terminal 921 through the first RF connection terminal 971. At this time, the connection between the first antenna connection terminal 921 and the first RF connection terminal 971 is carried out only in the slide-down state, so the first tuning circuit 981 connected to the first RF connection terminal 971 can be designed based on optimization setting for the slide-down state. The first tuning circuit 981 can include a transmission line and a passive element (e.g., a resistor, an inductor, and a capacitor). Values of a length of the transmission line and the passive element can be values determined for the optimization setting of the slide-down state. The optimization setting can include at least one of circuit setting for increasing a gain of the antenna 911, circuit setting for decreasing a return loss, and/or circuit setting for presenting a low resonance error in a corresponding frequency band. That is, in the optimization setting, the first tuning circuit 981 can operate as an impedance matching circuit for RF paths constructed in the slide-down state.

[0132] According to various embodiments, in the slide-down state, the second tuning circuit 982 can be inactivated. In accordance with an embodiment, in the slide-down state, the second tuning circuit 982 can operate as an open circuit or connect with a termination resistor, in order not to affect the tuning circuit design.

[0133] The electronic device can include the RF circuit 880 which, in the slide-up state, is connected with the first antenna connection terminal 921 through the second RF connection terminal 972. At this time, the connection between the first antenna connection terminal 921 and the second RF connection terminal 972 is carried out only in the slide-up state, so the second tuning circuit 982 connected to the second RF connection terminal 972 can be designed based on the optimization setting for the slide-up state. The second tuning circuit 982 can include a transmission line and a passive element (e.g., a resistor, an inductor, and a capacitor). Values of the length of the transmission line and the passive element can be values determined for the optimization setting of the slide-up state.

[0134] According to various embodiments, in the slide-up state, the first tuning circuit 981 can be inactivated. In accordance with an embodiment, in the slide-up state, the first tuning circuit 981 can operate as an open circuit or connect with a termination resistor, in order not to affect the tuning circuit design.

[0135] According to various embodiments, the electronic device can include the second body 960 which includes the second tuning circuit 982 having a transmission line of a shorter length than that of the first tuning circuit 981. Because a length of a physical line between the antenna 911 and the second body 960 in the slide-up state is formed longer than a length of a physical line between the antenna 911 and the second body 960 in the slide-down state, the length of the transmission line of the second tuning circuit 982 can be implemented to be shorter than the length of the transmission line of the first tuning circuit 981. Accordingly to this, an antenna radiation characteristic based on a length of an RF path which increases in the slide-up state compared to the slide-down state can be compensated.

[0136] FIG. 10A illustrates an example 1000a, 1000b, or 1000c of a connection structure for maintaining connection between bodies according to various embodiments. In embodiments of FIG. 10A, a description is made, as an example, for a connection structure consisting of three RF connection terminals as in FIGS. 8A to 8B.

[0137] Referring to FIG. 10A, the electronic device (e.g., the electronic device 101 of FIG. 1) can include the first body 810 and the second body 860. The first body 810 can include an antenna. The second body 860 can include an RF circuit. The first body 810 can include the first antenna connection terminal 821 and the second antenna connection terminal 822. The second body 860 can include the first RF connection terminal 871, the second RF connection terminal 872, and the third RF connection terminal 873. The electronic device can include a connection part. The connection part can include the first contact member 845a and the second contact member 845b. The first contact member 845a can be attached to the first antenna connection terminal 821. The second contact member 845b can be attached to the second antenna connection terminal 822.

[0138] The electronic device of various embodiments can include a connection structure of maintaining connection between the first body 810 and the second body 860, by connecting even any one of the antenna connection terminals with the RF circuit. In the present disclosure, the connection structure can include the antenna connection terminal disposed on the first PCB of the first body, the contact member connected to the antenna connection terminal, and the RF connection terminal physically attached to the contact member and disposed on the second PCB of the second body.

[0139] The electronic device of various embodiments can include a connection structure of maintaining a contact between the first contact member 845a and the second body 860 when the second contact member 845b is contact detached from the second body 860. Also, the electronic device 101 of various embodiments can include a connection structure of maintaining a contact between the second contact member 845b and the second body 860 when the first contact member 845a is contact detached from the second body 860.

[0140] According to various embodiments, the electronic device can include a connection part for forming a difference between a time at which one contact member is detached from the second body 860 and a time at which the other contact member is detached from the second body 860. For example, the electronic device 101 can include a structure of, when the first body 810 slides and moves, maintaining a connection of the second contact member 845b to the second RF connection terminal 872 during a duration from a time point at which the first contact member 845a is contact detached from the first RF connection terminal 871 to a time point of contacting with the second RF connection terminal 872. Also, for example, the electronic device 101 can include a structure of, when the first body 810 slides and moves, maintaining a connection of the first contact member 845a to the second RF connection terminal 872 during a duration from a time point at which the second contact member 845b is contact detached from the second RF connection terminal 872 to a time point of contacting with the third RF connection terminal 873.

[0141] The first state 1000a can be a slide-down state. In the first state 1000a, the first contact member 845a can be connected with the first RF connection terminal 871. The second contact member 845b can be connected with the second RF connection terminal 872.

[0142] The second state 1000b can be a state of being moving from the slide-down state to a slide-up state. That is, the second state 1000b represents a situation in which the first body 810 more moves to the right ((+) x-axis direction) in the first state 1000a. Connection between the first body 810 and the second body 860 can be maintained through a structure of maintaining a connection of the second contact member 845b to the second RF connection terminal 872 although the first contact member 845a is detached from the first RF connection terminal

871. The electronic device 101 can include a connection structure of maintaining a contact of the second contact member 845b to the second RF connection terminal 872 until the first contact member 845a is connected to the second RF connection terminal 872.

[0143] The third state 1000c can be the slide-up state. That is, the third state 1000c is a situation in which the first body 810 more moves to the right ((+) x-axis direction) in the second state 1000b. Connection between the first body 810 and the second body 860 can be maintained through a structure of maintaining a connection of the first contact member 845a to the second RF connection terminal 872 although the second contact member 845b is detached from the second RF connection terminal 872. The electronic device 101 can include a connection structure of maintaining a contact of the first contact member 845a to the second RF connection terminal 872 until the second contact member 845b is connected to the third RF connection terminal 873.

[0144] The electronic device of various embodiments can include the second body 860 consisting of three RF terminals. One of the three RF terminals can include an RF terminal having a different length of a contact region. A length of a region (below, a contact region) for contact with a contact member can be implemented to be greater than those of RF connection terminals of both ends. Here, the length of the contact region can be a length corresponding to a slide movement direction (e.g., an x axis).

[0145] According to various embodiments, a time (below, a contact movement time) at which contact members each is detached from and attached to the second body 860 may not overlap with each other through a connection structure having a different length of a contact region between RF connection terminals. In detail, a time point at which the first contact member 845a connected to the first antenna connection terminal 821 of the first body 810 is detached from the second body 960 (e.g., a time point of being detached from the first RF connection terminal 871) to a time point of being again attached to the second body 860 (e.g., a time point of contacting with the second RF connection terminal 872) may not overlap, on a time axis, with a time point at which the second contact member 845b is detached from the second body 860 (e.g., a time point of being detached from the second RF connection terminal 872) to a time point of being again attached to the second body 860 (e.g., a time point of contacting with the third RF connection terminal 873).

[0146] According to various embodiments, the electronic device can include a connection structure in which a time point of releasing a contact of each contact member with the second body 860 is not overlapped, whereby a contact of the first body 810 and the second body 860 is maintained irrespective of the slide movement of the first body 810.

[0147] FIG. 10B illustrates another example 1050a, 1050b, or 1050c of a connection structure for maintaining connection between bodies according to various embodiments. In embodiments of FIG. 10B, a description is made, as an example, for a connection structure consisting of two RF connection terminals as in FIGS. 9A to 9B.

[0148] Referring to FIG. 10B, the electronic device (e.g., the electronic device 101 of FIG. 1) can include the first body 910 and the second body 960. The first body 910 can include an antenna. The second body 960 can include an RF circuit. The first body 910 can include the first antenna connection terminal 921. The second body 960 can include the first RF connection terminal 971 and the second RF connection terminal 972. The electronic device 101 can include a connection part. The connection part can include the first contact member 945a and the second contact member 945b. The first contact member 945a can be attached to the first antenna connection terminal 921. Even the second contact member 945b can be attached to the first antenna connection terminal 921.

[0149] The electronic device of various embodiments can include a connection structure in which the first contact member 945a maintains a contact with the second body 960 when the second contact member 945b is contact detached from the second body 960. Also, the electronic device 101 of various embodiments can include a connection structure in which the second contact member 945b maintains a contact with the second body 960 when the first contact member 945a is contact detached from the second body 960.

[0150] According to various embodiments, the electronic device can include a connection part forming a difference between a time at which one contact member is detached from the second body 960 and a time at which the other contact member is detached from the second body 960. For example, the electronic device 101 can include a structure in which, when the first body 910 slides and moves, the first contact member 945a maintains a connection to the first RF connection terminal 971 during a duration from a time point at which the second contact member 945b is contact detached from the first RF connection terminal 971 to a time point of contacting with the second RF connection terminal 972. Also, for example, the electronic device can include a structure in which, when the first body 810 slides and moves, the second contact member 945b maintains a connection to the second RF connection terminal 972 during a duration from a time point at which the first contact member 945a is contact detached from the first RF connection terminal 971 to a time point of contacting with the second RF connection terminal 972.

[0151] The first state 1050a can be a slide-down state. In the first state 1050a, the first contact member 945a and the second contact member 945b all can be connected with the first RF connection terminal 971.

[0152] The second state 1050b can be a state of being moving from the slide-down state to a slide-up state. That is, the second state 1050b represents a situation in which the first body 910 more moves to the right ((+) x-axis direction) in the first state 1050a. The first contact member 945a can be connected with the first RF connection terminal 971, and the second contact member 945b can be connected with the second RF connection terminal 972. Connection between the first body 910 and the second body 960 can be maintained through a structure in which the first contact member 945a maintains a connection to the first RF connection terminal 971 although the second contact member 945b is detached from the first RF connection terminal 971. As an example, when a change is made from the slide-down to the slide-up or from the slide-up to the slide-down state in a call state, connection between the antenna and the RF module is maintained, whereby a call drop due to a complete short circuit can be prevented and safety can be secured.

[0153] The third state 1050c can be the slide-up state. That is, the third state 1050c is a situation in which the first body 910 more moves to the right ((+) x-axis direction) in the second state 1050b. Connection between the first body 910 and the second body 960 can be maintained through a structure in which the first contact member 945a maintains a connection to the first RF connection terminal 921 although the first contact member 945a is detached from the first RF connection terminal 921.

[0154] The electronic device of various embodiments can include the second body 960 consisting of two RF terminals having a different length of a contact region. As the lengths of the contact regions of the respective RF connection terminals are different, a time (i.e., a contact movement time) at which the contact members each is detached from and attached to the second body 960 may not overlap with each other. In detail, a time point at which the first contact member 945a connected to the first antenna connection terminal 921 of the first body 910 is detached from the second body 960 (e.g., a time point of being detached from the first RF connection terminal 971) to a time point of being again attached to the second body 960 (e.g., a time point of contacting with the second RF connection terminal 972) may not overlap, on a time axis, with a time point at which the second contact member 945b is detached from the second body 960 (e.g., a time point of being detached from the first RF connection terminal 971) to a time point of being again attached to the second body 960 (e.g., a time point of contacting with the second RF connection terminal 972).

[0155] According to various embodiments, the electronic device can include a connection structure in which a time point of releasing a contact of each contact member with the second body 960 is not overlapped, whereby a contact of the first body 810 and the second body 960 is maintained irrespective of slide movement.

[0156] In FIG. 10A and FIG. 10B, a description has been made for embodiments of a structure for preventing a complete cutoff phenomenon between the antenna and the RF circuit in course of a slide operation process wherein a time point of releasing a contact between contact members is not overlapped with each other.

[0157] In FIG. 10A and FIG. 10B, a description has been made for two contact members as an example, but the present disclosure is not limited to this. The electronic device 101 of various embodiments can include three or more contact members. For the sake of connection maintenance between the first body and the second body, it can include a connection structure which is designed not to provide a region where a time (below, a contact movement time) of being detached from the first body of each contact member and being again connected to the second body is all overlapped (in other words, a region where a contact movement time of all contact members is overlapped). It is because a complete cutoff between the first body and the second body occurs when the contact movement time of all the contact members are at least partially overlapped.

[0158] Through FIG. 10A and FIG. 10B, a description has been made for a way for maintaining connection during slide movement in a connection part of a contact scheme, through an RF connection terminal disposed in middle of which a length of a contact region is longer than that of another RF connection terminal. However, in the present disclosure, the connection part for maintaining the connection can be implemented in another scheme other than the length of the contact region of the RF connection terminal. In accordance with an embodiment, the electronic device 101 can include a connection structure having a structure in which at least one antenna connection terminal always comes in contact with the RF connection terminal, because a distance between the first antenna connection terminal 821 and the second antenna connection terminal 822 is constructed longer than a length of each RF connection terminal.

[0159] In FIG. 10A to FIG. 10B, a description has been made in which the first body and the second body are connected through a contact member including a conductive member, but a form of the contact member can be constructed in various schemes. The electronic device of various embodiments can include a contact member having a rolling structure. To reduce abrasion due to a repetition of an operation of being contact detached from and being again attached to the second body (or the first body), the contact member can have a form for rolling. The form for rolling can include a form of a cylinder or sphere which is rotatable according to slide movement. Also, although the first body slides and moves, a contact movement time of a first contact member of a rolling form may not overlap with a contact movement time of a second contact member of a rolling form, in order to maintain connection between the first body and the second body.

[0160] FIG. 11 illustrates an example 1100 of a coupling structure that uses a capacitor according to various embodiments. Coupling can mean a phenomenon in which alternating-current signal energy is mutually forwarded electrically or magnetically between independent spaces or lines. Unlike the connection structure through the contact between the first body and the second body described in FIG. 8A to FIG. 10B, a description is made, together with FIG. 11, for embodiments of a structure for electrically connecting the first body and the second body through the coupling although the first body and the second body are not contacted.

[0161] Referring to FIG. 11, the electronic device (e.g., the electronic device 101 of FIG. 1) can include a first body 1110 and a second body 1160. A description is made, as an example, for a situation in which the first body 1110 is a moving part of the slide electronic device 101, and the second body 1160 is a fixing part of the slide electronic device.

[0162] The first body 1110 can include a first PCB 1120. The first body 1110 can include an antenna 1111 disposed in the first PCB 1120. The first body 1110 can include an antenna connection circuit constructed in the first PCB 1120. The antenna 1111 can be connected with a first antenna connection terminal 1121 and a second antenna connection terminal 1122 through the antenna connection circuit. The first antenna connection terminal 1121 and the second antenna connection terminal 1122 can be disposed in the first body 1110 through the antenna connection circuit.

[0163] The second body 1160 can include a second PCB 1170. The second body 1160 can include an RF module (e.g., an RFIC) 1175 which is disposed in the second PCB 1170. The second body 1160 can construct an RF circuit in the second PCB. The ground can be connected with a first RF connection terminal 1171 and a third RF connection terminal 1173 through the RF circuit. The RF module 1175 can be connected with a second RF connection terminal 1172 through the RF circuit. The first RF connection terminal 1171, the second RF connection terminal 1172, and the third RF connection terminal 1173 can be disposed in the second body 1160 through the RF circuit.

[0164] Referring to a cross section 1100a, the electronic device can be in a slide-down state. The first antenna connection terminal 1121 can include a conductive plate. The second antenna connection terminal 1122 can include a conductive plate. Likely, the first RF connection terminal 1171, the second RF connection terminal 1172, and the third RF connection terminal 1173 each can include a conductive plate. The electronic device can include a connection structure in which two or more conductive plates form a space, whereby charging is made with electric charges. For example, the electronic device 101 can include a connection structure 1145a presenting an equivalent circuit such as inserting a capacitor between the first body 1110 and the second body 1160, by charging with electric charges between the conductive plate of the first antenna connection terminal 1121 and the conductive plate of the first RF connection terminal 1171. Also, for example, the electronic device can include a connection structure 1145b presenting an equivalent circuit such as inserting a capacitor between the first body 1110 and the second body 1160, by charging with electric charges between the conductive plate of the second antenna connection terminal 1122 and the conductive plate of the second RF connection terminal 1172.

[0165] To become a slide-up state, the first body 1110 can move to the right on an x axis. The electronic device can include a structure in which RF connection between the first body 1110 and the second body 1160 is shorted although the conductive plates are not symmetric exactly. According to various embodiments, the electronic device can include a connection structure including conductive plates presenting a greater capacitor value than a reference value. The reference value can be determined on the basis of a space formed between the respective conductive plates, a size of an area of the conductive plate, a permittivity, and/or a distance between the first body and the second body.

[0166] The electronic device can include a connection structure in which, even in the slide-up state, two or more conductive plates form a space, whereby charging is made with electric charges. For example, the electronic device 101 can include a connection structure 1145c presenting an equivalent circuit such as inserting a capacitor between the first body 1110 and the second body 1160, by charging with electric charges between the conductive plate of the first antenna connection terminal 1121 and the conductive plate of the first RF connection terminal 1172. Also, for example, the electronic device 101 can include a connection structure 1145d presenting an equivalent circuit such as inserting a capacitor between the first body 1110 and the second body 1160, by charging with electric charges between the conductive plate of the second antenna connection terminal 1122 and the conductive plate of the second RF connection terminal 1173.

[0167] Referring to an internal circuit diagram 1100b, the second body 1160 can include a tuning circuit corresponding to each RF connection terminal. A first tuning circuit 1181, a second tuning circuit 1182, and a third tuning circuit 1183 can correspond to the first tuning circuit 881, the second tuning circuit 882, and the third tuning circuit 883 of FIG. 8, respectively. A design of the tuning circuit corresponding to each of the slide-down state and the slide-up state is the same as those of FIG. 8A and FIG. 8B, and a description can be omitted.

[0168] The description has been made, as an example, for the connection structure in which the electronic device couples the first body and the second body, by forming capacitance through the conductive plates included in each antenna connection terminal or each RF terminal. The antenna connection terminals and the RF connection terminals exemplified in FIG. 11 are just exemplification for coupling, and various embodiments of the present disclosure may not be limited to the construction shown in FIG. 11. For example, the first body can be connected with one antenna connection terminal, and the two bodies can be connected with three antenna connection terminals. For another example, the first body can be connected with one antenna connection terminal, and the two bodies can be connected with two antenna connection terminals. Below, a description is made, through FIG. 12A to FIG. 12C, for a way for maintaining connection at slide movement that is based on each coupling-based connection structure.

[0169] FIG. 12A illustrates an example 1200a of a coupling structure for maintaining connection between bodies according to various embodiments. An RF circuit can include three RF terminals and a tuning circuit connected with each RF terminal.

[0170] Referring to FIG. 12A, an electronic device (e.g., the electronic device 101 of FIG. 1) can include a first body 1210. The first body 1210 can include a first PCB 1220 and an antenna disposed in the first PCB 1220. Also, the electronic device can include a second body 1260. The second body 1260 can include a second PCB 1270 and an RF module disposed in the second PCB 1270. Also, the electronic device can include a first coupling structure connecting the first body and the second body.

[0171] The first coupling structure of various embodiments can include a first antenna connection terminal 1211 and a second antenna connection terminal 1212 which are connected with the first body 1210. Each antenna connection terminal can include a conductive plate. The first coupling structure of various embodiments can include a first RF connection terminal 1221, a second RF connection terminal 1222, and a third RF connection terminal 1223 which are connected with the second body 1260. Each RF connection terminal can include a conductive plate.

[0172] The first body 1210 of various embodiments can move along one surface of the second body 1260. For example, a position of the first body 1210 can, by a slide-up operation, change from a first state 1201a to a third state 1203a via a second state 1202a. For another example, the position of the first body 1210 can, by a slide-down operation, change from the third state 1203a to the first state 1201a via the second state 1202a.

[0173] The first state 1201a can be a slide-down state. In the first state 1201a, the conductive plate of the first antenna connection terminal 1211 can at least partially overlap with the conductive plate of the first RF connection terminal 1221, when viewed from above a plane vertical to a y axis. For example, the conductive plate of the first antenna connection terminal 1211 can be disposed in a position which is symmetric to the conductive plate of the first RF connection terminal 1221. The conductive plate of the second antenna connection terminal 1212 can be disposed in a position which is symmetric to the conductive plate of the second RF connection terminal 1222. As the two conductive plates form a symmetric plane, electric charges can charge between the two conductive plates. The electronic device 101 can include a structure in which the first body 1210 and the second body 1260 are electrically connected through capacitance formed between the first body 1210 and the second body 1260.

[0174] The second state 1202a can be a state of being moving from the slide-down state to the slide-up state. That is, the second state 1202a represents a situation in which the first body 1210 more moves to the right ((+) x-axis direction) in the first state 1201a. The first antenna connection terminal 1211 and the second antenna connection terminal 1212 can move to the right ((+) x-axis direction) in accordance with the movement of the first body 1210.

[0175] Although the conductive plate of the first antenna connection terminal 1211 is spaced a predetermined distance apart from the conductive plate of the first RF connection terminal 1221, electrical connection between the first body 1210 and the second body 1260 can be maintained, as the conductive plate of the first antenna connection terminal 1211 gets close, within a predetermined distance, to the conductive plate of the second RF connection terminal 1222. Likely, although connection is broken as the conductive plate of the second antenna connection terminal 1212 is spaced a predetermined distance apart from the conductive plate of the second RF connection terminal 1222, the electrical connection between the first body 1210 and the second body 1260 can be maintained, as the conductive plate of the second antenna connection terminal 1212 gets close, within a predetermined distance, to the conductive plate of the third RF connection terminal 1223.

[0176] The electronic device of various embodiments can include a first coupling structure which is constructed wherein, although slide movement is performed, the first antenna connection terminal 1211 and the second antenna connection terminal 1212 are connected with at least one of the first RF connection terminal 1221, the second RF connection terminal 1222, and the third RF connection terminal 1223. Each connection terminal can include a conductive plate. The first coupling structure can be determined based on at least one of an area of the conductive plate of each terminal, a spaced distance between the antenna connection terminals, a spaced distance between the RF connection terminals, a distance between the conductive plate of the antenna connection terminal and the conductive plate of the RF connection terminal, or a dielectric material located between the conductive plates.

[0177] On the other hand, because two conductive plates operate as a capacitor in view of an RF circuit, capacitance formed between the two conductive plates affects antenna performance. The electronic device 101 of various embodiments can include a connection structure for maintaining capacitance within a predetermined error range for the sake of maintaining the same circuit performance in a slide movement state as well as a slide-up state and a slide-down state. For example, although a region where the conductive plate of the first antenna connection terminal 1211 is overlapped, on a plane vertical with a y axis, with the conductive plate of the first RF connection terminal 1221 is decreased, capacitance can be maintained within a predetermined range, as a region overlapped, on the plane, with the conductive plate of the second RF connection terminal 1222 is increased.

[0178] The third state 1203a can be a slide-up state. That is, the third state 1203a is a situation in which the first body 1210 more moves to the right ((+) x-axis direction) in the second state 1202a. In the third state 1203a, the conductive plate of the first antenna connection terminal 1211 can at least partially overlap with the conductive plate of the second RF connection terminal 1222, when viewed from above the plane vertical to the y axis. For example, the conductive plate of the first antenna connection terminal 1211 can be disposed in a position which is symmetric to the conductive plate of the second RF connection terminal 1222. The conductive plate of the second antenna connection terminal 1212 can be disposed in a position which is symmetric to the conductive plate of the third RF connection terminal 1223. As the two conductive plates form a symmetric plane, charging can be made with electric charges between the two conductive plates. The electronic device can include a structure in which the first body 1210 and the second body 1260 are electrically connected through capacitance formed between the first body 1210 and the second body 1260.

[0179] FIG. 12B illustrates another example 1200b of a coupling structure for maintaining connection between bodies according to various embodiments. An RF circuit can include three RF terminals and a tuning circuit connected with each RF terminal.

[0180] Referring to FIG. 12B, an electronic device (e.g., the electronic device 101 of FIG. 1) can include a first body 1210. The first body 1210 can include a first PCB 1220 and an antenna disposed in the first PCB 1220. Also, the electronic device 101 can include a second body 1260. The second body 1260 can include a second PCB 1270 and an RF module disposed in the second PCB 1270. Also, the electronic device 101 can include a second coupling structure connecting the first body and the second body.

[0181] The second coupling structure of various embodiments can include a first antenna connection terminal 1241 connected with the first body 1210. Unlike the first coupling structure of FIG. 12A, the first body 1210 can include one antenna connection terminal. The first antenna connection terminal 1241 can include a conductive plate. The conductive plate of the first antenna connection terminal 1241 can have a greater area than the conductive plate of each antenna connection terminal of FIG. 12A. The conductive plate of the greater area can present a greater capacitance value. The second coupling structure of various embodiments can include a first RF connection terminal 1251, a second RF connection terminal 1252, and a third RF connection terminal 1253 which are connected with the second body 1260. Each RF connection terminal can include a conductive plate.

[0182] The first body 1210 of various embodiments can move along one surface of the second body 1260. For example, a position of the first body 1210 can, by a slide-up operation, change from a first state 1201b to a third state 1203b via a second state 1202b. For another example, the position of the first body 1210 can, by a slide-down operation, change from the third state 1203b to the first state 1200b via the second state 1202b.

[0183] The first state 1201b can be a slide-down state. In the first state 1201b, the conductive plate of the first antenna connection terminal 1241 can be at least partially overlapped with at least one of the first RF connection terminal 1251, the second RF connection terminal 1252, and the third RF connection terminal 1253, when viewed from above a plane vertical to a y axis. For example, the conductive plate of the first antenna connection terminal 1241 can be disposed in a position which is symmetric to the conductive plate of the first RF connection terminal 1251 and the conductive plate of the second RF connection terminal 1252. As the conductive plate of the first antenna connection terminal 1241 forms a symmetric plane with the two conductive plates, an equivalent circuit including two capacitors can be formed. The electronic device can include a structure in which the first body 1210 and the second body 1260 are electrically connected through the equivalent circuit including the capacitor formed between the first body 1210 and the second body 1260.

[0184] The second state 1202b can be a state of being moving from the slide-down state to a slide-up state. That is, the second state 1202b represents a situation in which the first body 1210 more moves to the right ((+) x-axis direction) in the first state 1201b. The first antenna connection terminal 1241 can move to the right ((+) x-axis direction) in accordance with the movement of the first body 1210.

[0185] Although the conductive plate of the first antenna connection terminal 1241 is spaced a predetermined distance apart from the conductive plate of the first RF connection terminal 1251, electrical connection between the first body 1210 and the second body 1260 can be maintained, as the conductive plate of the first antenna connection terminal 1241 maintains a predetermined distance from the conductive plate of the second RF connection terminal 1252. When viewed from above the plane vertical to the y axis, the conductive plate of the second RF connection terminal 1252 can be completely overlapped with the conductive plate of the first antenna connection terminal 1241. The electronic device of various embodiments can include a coupling structure in which the overlapping of the conductive plate is maintained according to slide movement. That is, although the first body 1210 moves, the electrical connection between the first body 1210 and the second body 1260 can be maintained.

[0186] The electronic device of various embodiments can include the second coupling structure which is constructed wherein, although the slide movement is performed, the first antenna connection terminal 1241 is connected with at least one of the first RF connection terminal 1251, the second RF connection terminal 1252, and the third RF connection terminal 1253. Each connection terminal can include a conductive plate. The second coupling structure can be determined based on at least one of an area of the conductive plate of the antenna connection terminal, an area of the conductive plate of each

RF connection terminal, a distance between the conductive plate of the antenna connection terminal and the conductive plate of the RF connection terminal, a spaced distance between the RF connection terminals, or a dielectric material located between the conductive plates.

[0187] The third state 1203b can be the slide-up state. That is, the third state 1203b is a situation in which the first body 1210 more moves to the right ((+) x-axis direction) in the second state 1202b. In the third state 1203b, the conductive plate of the first antenna connection terminal 1241 can at least partially overlap with the conductive plate of the second RF connection terminal 1252 and the conductive plate of the third RF connection terminal 1253, when viewed from above the plane vertical to the y axis. For example, the conductive plate of the first antenna connection terminal 1241 can be disposed in a position which is symmetric to the conductive plate of the first RF connection terminal 1252 and the conductive plate of the third RF connection terminal 1253. An equivalent circuit including two capacitors can be formed. The electronic device can include a structure in which the first body 1210 and the second body 1260 are electrically connected through a capacitor formed between the first body 1210 and the second body 1260.

[0188] FIG. 12C illustrates a further example 1200c of a coupling structure for maintaining connection between bodies according to various embodiments. An RF circuit can include two RF terminals and a tuning circuit connected with each RF terminal.

[0189] Referring to FIG. 12C, an electronic device (e.g., the electronic device 101 of FIG. 1) can include a first body 1210. The first body 1210 can include a first PCB 1220 and an antenna disposed in the first PCB 1220. Also, the electronic device can include a second body 1260. The second body 1260 can include a second PCB 1270 and an RF module disposed in the second PCB 1270. Also, the electronic device 101 can include a third coupling structure connecting the first body and the second body.

[0190] The third coupling structure of various embodiments can include a first antenna connection terminal 1271 connected with the first body 1210. Unlike the first coupling structure of FIG. 12A, the first body 1210 can include one antenna connection terminal. The first antenna connection terminal 1271 can include a conductive plate. The conductive plate of the first antenna connection terminal 1271 can have a greater area than the conductive plate of each antenna connection terminal of FIG. 12A. The conductive plate of the greater area can present a greater capacitance value. The third coupling structure of various embodiments can include a first RF connection terminal 1281 and a second RF connection terminal 1282 which are connected with the second body 1260. Unlike the second coupling structure of FIG. 12B, the second body 1260 can include two RF connection terminals. Each RF connection terminal can include a conductive plate.

[0191] The first body 1210 of various embodiments can move along one surface of the second body 1260. For example, a position of the first body 1210 can, by a slide-up operation, change from a first state 1201c to a third state 1203c via a second state 1202c. For another example, the position of the first body 1210 can, by a slide-down operation, change from the third state 1203c to the first state 1201c via the second state 1202c.

[0192] The first state 1201c can be a slide-down state. In the first state 1201c, the conductive plate of the first antenna connection terminal 1271 can at least partially overlap with the first RF connection terminal 1251, when viewed from above a plane vertical to a y axis. For example, the conductive plate of the first antenna connection terminal 1271 can be disposed in a position which is symmetric to the conductive plate of the first RF connection terminal 1281. As the conductive plate of the first antenna connection terminal 1271 forms a symmetric plane with the conductive plate of the first RF connection terminal 1281, an equivalent circuit including a capacitor can be formed. The electronic device can include a structure in which the first body 1210 and the second body 1260 are electrically connected through the equivalent circuit including the capacitor formed between the first body 1210 and the second body 1260.

[0193] The second state 1202c can be a state of being moving from the slide-down state to a slide-up state. That is, the second state 1202b represents a situation in which the first body 1210 more moves to the right ((+) x-axis direction) in the first state 1201b. The first antenna connection terminal 1271 can move to the right ((+) x-axis direction) in accordance with the movement of the first body 1210. Although the conductive plate of the first antenna connection terminal 1271 is spaced a predetermined distance apart from the conductive plate of the first RF connection terminal 1281, an equivalent circuit including a capacitor within a predetermined range can be formed, as it gets close, within a predetermined distance, to the conductive plate of the second RF connection terminal 1282. An equivalent circuit including one capacitor to maximum two capacitors can be formed. Through a connection structure including the equivalent circuit, electrical connection between the first body 1210 and the second body 1260 can be maintained.

[0194] The third state 1203c can be the slide-up state. That is, the third state 1203c is a situation in which the first body 1210 more moves to the right ((+) x-axis direction) in the second state 1202c. In the third state 1203c, the conductive plate of the first antenna connection terminal 1271 can at least partially overlap with the conductive plate of the second RF connection terminal 1282, when viewed from above a plane vertical to a y axis. For example, the conductive plate of the first antenna connection terminal 1271 can be disposed in a position which is symmetric to the conductive plate of the second RF connection terminal 1282. As the two conductive plates become symmetric, a connection part of the electronic device can include a circuit including a capacitor. The electronic device can include a structure in which the first body 1210 and the second body 1260 are electrically connected through a capacitor formed between the first body 1210 and the second body 1260.

[0195] FIG. 13 illustrates an example 1300 of connection between bodies that use a dielectric material according to various embodiments. A coupling structure for connection between the bodies is similar with the coupling structure of FIG. 7 and thus, a description of the same or similar construction can be omitted.

[0196] Referring to FIG. 13, as illustrated in a first cross section 1300a, an electronic device (e.g., the electronic device 101 of FIG. 1) can include a first body 1310 and a second body 1360. A description is made, as an example, for a situation in which the first body 1310 is a moving part of the slide electronic device, and the second body 1360 is a fixing part of the slide electronic device. The first body 1310 can include a first PCB 1320. The first body 1310 can be connected with a first antenna connection terminal 1321 and a second antenna connection terminal 1322 through an antenna connection circuit disposed in the first PCB 1320. The first antenna connection terminal 1321 and the second antenna connection terminal 1322 can be disposed in the first body 1310 through the antenna connection circuit. The second body 1360 can include a second PCB 1370. The second body 1360 can be connected with a first RF connection terminal 1371, a second RF connection terminal 1372, and a third RF connection terminal 1373 through an RF connection circuit disposed in the second PCB 1370. The electronic device of various embodiments can include a dielectric material 1350 disposed between each antenna connection terminal and each RF connection terminal. Through the dielectric material 1350, electrical connection between the first body 1310 and the second body 1360 can be maintained.

[0197] The electronic device 101 can include a connection structure for connecting the first body 1310 and the second body 1360. The connection structure can include each antenna connection terminal, each RF connection terminal, and the dielectric material 1350. Referring to a second cross section 1300b, the dielectric material 1350 can be connected with each antenna connection terminal and each RF connection terminal. The dielectric material, an insulator having a polarity in an electric field, can include an insulation substance. As a permittivity of the dielectric material is higher, a length of a line can be shorter, and this can make it possible to implement a small circuit. According to various embodiments, the electronic device 101 can include a coupling structure of a reduced size, by disposing a dielectric material having a higher permittivity than air between the first body 1310 and the second body 1360.

[0198] Referring to an internal circuit diagram 1300c, the first RF connection terminal 1371, the second RF connection terminal 1372, and the third RF connection terminal 1373 can come in contact with the dielectric material 1350. The dielectric material 1350 can come in contact with the first antenna connection terminal 1321 and the second antenna connection terminal 1322. The first antenna connection terminal 1321 and the second antenna connection terminal 1322 can be connected with the antenna 1311. The second body 1360 can include a tuning circuit corresponding to each RF terminal. The first RF connection terminal 1371 can be connected to the ground through a first tuning circuit. The second RF connection terminal 1372 can be connected to an RFIC 1375 through a second tuning circuit. The third RF connection terminal 1373 can be connected to the ground through a third tuning circuit. In accordance with an embodiment, the first tuning circuit and the second tuning circuit can be a circuit for impedance matching of an antenna in a slide-down state. In accordance with an embodiment, the second tuning circuit and the third tuning circuit can be a circuit for impedance matching of the antenna in the slide-up state.

[0199] FIG. 14A illustrates an example 1400 of connection between bodies that use a dielectric material of a guide form according to various embodiments. The bodies can include a first body including an antenna and a second body including an RF module.

[0200] Referring to FIG. 14A, an electronic device (e.g., the electronic device 101 of FIG. 1) can include a first PCB 1420 of a first body and a second PCB 1470 of a second body. The electronic device can include a coupling structure for connection between the first body and the second body. The coupling structure of various embodiments can include a first antenna connection terminal 1421 disposed in the first PCB 1420, a first RF connection terminal 1471 and a second RF connection terminal 1472 which are disposed in the second PCB 1470, and/or a dielectric material 1450. The coupling structure can be a laminate structure of forming a layer in an up to down direction on a z axis in order of the first PCB 1420, the first antenna connection terminal 1421, the dielectric material 1450, the first RF connection terminal 1471, and/or the second PCB 1470.

[0201] The dielectric material 1450 of various embodiments can be a guide form. Here, the guide form means a form for guiding a direction in which the first body being a moving part of the slide electronic device 101 moves. For example, as in a first cross section 1400a and a second cross section 1400b, the first PCB 1420 can move left and right. The first PCB 1420 can be included in the first body and move together. The dielectric material 1450 can be a form of guiding wherein the first PCB 1420 moves left and right. The dielectric material 1450 of various embodiments can be disposed in a form of surrounding a surface of the first antenna connection terminal 1421 to guide the first body (i.e., the first PCB 1420).

[0202] FIG. 14B illustrates an example 1401 of a section of a connection structure between bodies that use a dielectric material of a guide form according to various embodiments. FIG. 14B is a cross section of the laminate structure of FIG. 14A, viewed from above a plane vertical to a movement direction of a first PCB 1420.

[0203] Referring to FIG. 14B, the dielectric material

1450 can be disposed between the first PCB 1420 and the second PCB 1470 in order to surround surfaces of the first antenna connection terminal 1421. In accordance with the movement of the first body 1410, even the first antenna connection terminal 1421 attached to the first PCB 1420 of the first body 1410 can move together. The dielectric material 1450 can be disposed in a form of guiding a movement direction of the first antenna connection terminal 1421. The dielectric material of the guide form can minimize a problem in which a coupling space is not maintained constantly due to an external pressure or a looseness between a slide moving part and a fixing part. By disposing the dielectric material in the form of surrounding the surfaces of the first antenna connection terminal 1421 disposed on the first PCB 1420 of the first body 1410, a shake in a direction vertical to a slide direction can be reduced. In other words, the electronic device 101 can decrease the performance deterioration of an antenna tuning circuit connected to each RF connection terminal, by minimizing a variability of an antenna characteristic due to capacitance change, through a guide along a movement direction of the slide moving part, i.e., the first body 1410.

[0204] In accordance with various embodiments, the first antenna connection terminal 1421 can include a conductive member. The first RF connection terminal 1471 and the second RF connection terminal 1472 each can include a conductive member. For example, the conductive member can be a stainless use steel (SUS).

[0205] A connection structure of an electronic device (e.g., the electronic device 101 of FIG. 1) of various embodiments can include a combining body 1490 in which the dielectric material 1450 of the guide form and the SUS 1471 are combined. The combining body 1490 can be disposed on the second PCB 1470 of the second body 1460. For example, the combining body 1490 can be mounted on a surface of the second PCB 1470. A device mounted on the surface can be denoted as a surface-mounted device (SMD). The SUS 1421 can be mounted even on a surface of the first PCB 1420 of the first body 1410. By implementing a coupling connection structure through a capacitor structure of SUS 1421 - dielectric material 1450 - SUS 1471, the combining body 1490 can complement a left/right shake at up/down movement of a slide. By minimizing a move due to the slide movement, the electronic device can forward a more robust signal.

[0206] The electronic device 101 of various embodiments can decrease a space of a connection structure including a conductive plate, by increasing capacitance through a connection structure including a dielectric material. For example, as a permittivity of the dielectric material becomes higher, an area of the conductive plate for presenting the same capacitance value is reduced, so the connection structure including the high permittivity can be advantageous for securing lots of mounting space.

[0207] According to various embodiments, an electronic device (e.g., the electronic device 101 of FIG. 1) can include a first body (e.g., the first body 510 of FIG. 5) including an antenna (e.g., the antenna module 192 of FIG. 1) and a first printed circuit board (PCB) (e.g., the first PCB 520 of FIG. 5), the antenna being disposed in the first PCB, a second body (e.g., the second body 560 of FIG. 5) including a radio frequency (RF) module (e.g., the RF module 675 of FIG. 6) and a second PCB (e.g., the second PCB 570 of FIG. 5), the RF module being disposed in the second PCB, a slide frame for moving the first body from a first state (e.g., the first state 500a of FIG. 5) to a second state (e.g., the second state 500b of FIG. 5), and a connection structure for electrically connecting the first body and the second body. The connection structure can include at least one antenna connection terminal disposed on the first PCB and at least two or more RF connection terminals disposed on the second PCB. The at least two or more RF connection terminals can include a first RF connection terminal (e.g., the first RF connection terminal 671 of FIG. 6, the first RF connection terminal 871 of FIGS. 8A and 8B, and/or the first RF connection terminal 971 of FIG. 9A and 9B) and a second RF connection terminal (e.g., the third RF connection terminal 673 of FIG. 6, the third RF connection terminal 873 of FIGS. 8A and 8B, and/or the second RF connection terminal 972 of FIGS. 9A and 9B). The first body can be electrically connected, in the first state, to the first RF connection terminal via the connection structure, and can be electrically connected, in the second state, to the second RF connection terminal via the connection structure. The second PCB can include a first RF tuning circuit (e.g., the first RF tuning circuit 681 of FIG. 6 and/or the first RF tuning circuit 881 of FIG. 8) for the first RF connection terminal and a second RF tuning circuit (e.g., the third tuning circuit 683 of FIG. 6 and/or the third tuning circuit 883 of FIG. 8) for the second RF connection terminal.

[0208] According to various embodiments, the at least one antenna connection terminal can include a first antenna connection terminal (e.g., the first antenna connection terminal 621 of FIG. 6 and/or the first antenna connection terminal 821 of FIGS. 8A and 8B) and a second antenna connection terminal (e.g., the second antenna connection terminal 622 of FIG. 6 and/or the second antenna connection terminal 822 of FIGS. 8A and 8B). The connection structure can include a first conductive member (e.g., the first contact member 845a of FIG. 8A) coming in contact with the first antenna connection terminal and a second conductive member (e.g., the second contact member of FIG. 845b of FIG. 8A) coming in contact with the second antenna connection terminal.

[0209] According to various embodiments, in the electronic device, the at least two or more RF connection terminals can further include a third RF connection terminal (e.g., the second RF connection terminal 672 of FIG. 6 and/or the second RF connection terminal 872 of FIGS. 8A and 8B), and the first conductive member can be disposed to be connectable to the first RF connection terminal or the third RF connection terminal, and the second conductive member can be disposed to be connectable to the second RF connection terminal or the third RF connection terminal.

[0210] According to various embodiments, the first conductive member can be disposed to be detached from the first RF connection terminal and be connected to the third RF connection terminal, when the first body moves from the first state to the second state, and the second conductive member can be disposed to be detached from the third RF connection terminal and be connected to the second RF connection terminal, when the first body moves from the first state to the second state.

[0211] According to various embodiments, the connection structure can include a structure in which the first antenna connection terminal, the second antenna connection terminal, the first RF connection terminal, the second RF connection terminal, and the third RF connection terminal are disposed wherein a first duration between a time point at which the first conductive member is detached from the first RF connection terminal and a time point of being connected to the third RF connection terminal is not overlapped with a second duration between a time point at which the second conductive member is detached from the third RF connection terminal and a time point of being connected to the second RF connection terminal.

[0212] According to various embodiments, the at least one antenna connection terminal can include a first antenna connection terminal (e.g., the first antenna connection terminal 921 of FIGS. 9A and 9B), and the connection structure can include a first conductive member (e.g., the first contact member 945a of FIG. 9A) and a second conductive member (e.g., the second contact member 945b of FIG. 9A) which come in contact with the first antenna connection terminal.

[0213] According to various embodiments, the first conductive member can be disposed to be detached from the first RF connection terminal and be connected to the second RF connection terminal, when the first body moves from the first state to the second state, and the second conductive member can be disposed to be detached from the second RF connection terminal and be connected to the third RF connection terminal, when the first body moves from the first state to the second state.

[0214] According to various embodiments, the connection structure can include a structure in which the first antenna connection terminal, the first RF connection terminal, and the second RF connection terminal are disposed wherein a first duration between a time point at which the first conductive member is detached from the first RF connection terminal and a time point of being connected to the second RF connection terminal is not overlapped with a second duration between a time point at which the second conductive member is detached from the first RF connection terminal and a time point of being connected to the second RF connection terminal.

[0215] According to various embodiments, the connection structure can include a rolling-structure conductive member which comes in contact with at least one of the at least one antenna connection terminal and the at least two or more RF connection terminals.

[0216] According to various embodiments, the connection structure can further include a dielectric material (e.g., the dielectric material 1450 of FIG. 14) disposed between the first PCB and the second PCB, and the dielectric material can be disposed to guide a path through which the first body moves from the first state to the second state.

[0217] According to various embodiments, the dielectric material can be disposed to surround at least two or more surfaces of the conductive member surface-mounted on the first PCB, and the dielectric material can come in contact with the conductive member surface-mounted on the second PCB.

[0218] According to various embodiments, the connection structure can include a connection body including a first stainless use steel (SUS) surface-mounted on the first PCB, the dielectric material, and a second SUS surface-mounted on the second PCB.

[0219] According to various embodiments, the dielectric material can include a dielectric material having a higher permittivity than air.

[0220] According to various embodiments, the at least one antenna connection terminal each can include a first conductive plate, and the at least two or more RF connection terminals each can include a second conductive plate.

[0221] According to various embodiments, the first RF connection terminal can include a first conductive plate, and the second RF connection terminal can include a second conductive plate, and the at least one antenna connection terminal can include at least one conductive plate, and the at least one conductive plate can be disposed to be charged with electric charges with at least one of the first conductive plate or the second conductive plate.

[0222] According to various embodiments, the at least two or more RF connection terminals can further include a third RF connection terminal, and the third RF connection terminal can include a third conductive plate, and the at least one conductive plate can be disposed to be charged with electric charges with at least one of the first conductive plate, the second conductive plate, and the third conductive plate.

[0223] According to various embodiments, the first RF tuning circuit can include at least one of a first capacitor, a first resistor, or a first inductor, and the second RF tuning circuit can include at least one of a second capacitor, a second resistor, or a second inductor, and at least one of the first capacitor, the first resistor, or the first inductor can have a value of maximizing a standing wave ratio related to the first antenna in the first state, and at least one of the second capacitor, the second resistor, or the second inductor can have a value of maximizing a standing wave ratio related to the second antenna in the second state.

[0224] According to various embodiments, the first RF tuning circuit and the second RF tuning circuit can be connected to the RF module through the second PCB.

[0225] According to various embodiments, the at least two or more RF connection terminals can further include a third RF connection terminal, and the second PCB can include a third RF tuning circuit for the third RF connection terminal, and the first RF tuning circuit and the second RF tuning circuit can be connected to the ground, and the third RF tuning circuit can be connected to the RF module.

[0226] According to various embodiments, the first body can correspond to a moving part of a slide electronic device, and the second body can correspond to a fixing part of the slide electronic device, and the first state can be a slide-down state, and the second state can be a slide-up state.

[0227] As described above, an electronic device of various embodiments of the present disclosure can include a first body, a second body, and a connection structure for connecting the first body and the second body. The connection structure can include a contact structure for connecting the first body and the second body through a physical contact, or a coupling structure that uses a conductive plate to form an equivalent circuit including a capacitor.

[0228] The connection structure includes, instead of including a coaxial cable and an FPCB, a contact structure or coupling structure occupying a relatively small area, thereby being capable of more securing a mounting space in the electronic device. This can bring an advantage of a mounting space in a miniaturized mobile electronic device. Also, by performing individual antenna tuning in each slide state and maintaining connection during slide movement, the electronic device of various embodiments of the present disclosure can guarantee optimal antenna performance and at the same time, present a real-time service (e.g., a phone call) in a stable state.

[0229] In the present disclosure, to determine whether a specific condition is fulfilled, the expression of equal to or more than or equal to or less than has been used, but this is merely a statement for expressing one example and does not exclude a statement of exceeding or less than (or within). A condition stated as 'equal to or more than' can be replaced with 'exceeding', and a condition stated as 'equal to or less than' can be replaced with 'less than', and a condition stated as 'equal to or more than and less than' can be replaced with 'exceeding and equal to or less than'.

[0230] Methods of embodiments mentioned in the claims or specification of the present disclosure can be implemented in the form of hardware, software, or a combination of hardware and software.

[0231] In response to being implemented by software, a computer-readable storage media storing one or more programs (software modules) can be presented. The one or more programs stored in the computer-readable storage media are configured to be executable by one or more processors within an electronic device. The one or more programs include instructions for enabling the electronic device to execute the methods of the embodiments stated in the claims or specification of the present disclosure.

[0232] These programs (i.e., software modules and/or software) can be stored in a random access memory (RAM), a non-volatile memory including a flash memory, a read only memory (ROM), an electrically erasable programmable ROM (EEPROM), a magnetic disc storage device, a compact disc - ROM (CD-ROM), digital versatile discs (DVDs), an optical storage device of another form, and/or a magnetic cassette. Or, the programs can be stored in a memory that is constructed in combination of some, or all, of them. Also, each constructed memory can be included in the plural as well.

[0233] Also, the program can be stored in an attachable storage device that can access via a communication network such as Internet, an intranet, a local area network (LAN), a wireless LAN (WLAN) or a storage area network (SAN), or a communication network constructed in combination of them. This storage device can access a device performing an embodiment of the present disclosure via an external port. Also, a separate storage device on the communication network can access the device performing the embodiment of the present disclosure as well.

[0234] In the aforementioned concrete embodiments of the present disclosure, a constituent element included in the disclosure has been expressed in a singular form or a plural form according to a proposed concrete embodiment. But, the expression of the singular form or plural form is selected suitable to a given situation for description convenience's sake, and the present disclosure is not limited to singular or plural constituent elements. Even if a constituent element is expressed in the plural form, the constituent element can be constructed in the singular form, or even if a constituent element is expressed in the singular form, the constituent element can be constructed in the plural form.

[0235] On the other hand, in a detailed description of the present disclosure, a concrete embodiment has been described, but it is undoubted that various modifications are available without departing from the scope of the present disclosure. Therefore, the scope of the present disclosure should not be limited to and defined by the described embodiment and should be defined by not only claims stated later but also equivalents to these claims.

Claims

1. An electronic device comprising:

a first body comprising an antenna and a first printed circuit board (PCB), the antenna being disposed in the first PCB;

a second body comprising a radio frequency (RF) module and a second PCB, the RF module

being disposed in the second PCB;
a slide frame for moving the first body from a first state to a second state; and
a connection structure for electrically connecting the first body and the second body,
wherein the connection structure comprises at least one antenna connection terminal disposed on the first PCB and at least two or more RF connection terminals disposed on the second PCB,
the at least two or more RF connection terminals comprise a first RF connection terminal and a second RF connection terminal,
the first body is electrically connected, in the first state, to the first RF connection terminal via the connection structure, and is electrically connected, in the second state, to the second RF connection terminal via the connection structure, and
the second PCB comprises a first RF tuning circuit for the first RF connection terminal and a second RF tuning circuit for the second RF connection terminal.

2. The electronic device of claim 1, wherein the at least one antenna connection terminal comprises a first antenna connection terminal and a second antenna connection terminal, and
the connection structure comprises a first conductive member coming in contact with the first antenna connection terminal and a second conductive member coming in contact with the second antenna connection terminal.

3. The electronic device of claim 2, wherein the at least two or more RF connection terminals further comprise a third RF connection terminal,

the first conductive member is disposed to be connectable to the first RF connection terminal or the third RF connection terminal, and
the second conductive member is disposed to be connectable to the second RF connection terminal or the third RF connection terminal.

4. The electronic device of claim 3, wherein the first conductive member is disposed to be detached from the first RF connection terminal and be connected to the third RF connection terminal, when the first body moves from the first state to the second state, and
the second conductive member is disposed to be detached from the third RF connection terminal and be connected to the second RF connection terminal, when the first body moves from the first state to the second state.

5. The electronic device of claim 1, wherein the at least one antenna connection terminal comprises a first antenna connection terminal, and
the connection structure comprises a first conductive member and a second conductive member which come in contact with the first antenna connection terminal.

6. The electronic device of claim 5, wherein the first conductive member is disposed to be detached from the first RF connection terminal and be connected to the second RF connection terminal, when the first body moves from the first state to the second state and
the second conductive member is disposed to be detached from the second RF connection terminal and be connected to the third RF connection terminal, when the first body moves from the first state to the second state.

7. The electronic device of claim 1, wherein the connection structure comprises a rolling-structure conductive member which comes in contact with at least one of the at least one antenna connection terminal and the at least two or more RF connection terminals.

8. The electronic device of claim 1, wherein the connection structure further comprises a dielectric material disposed between the first PCB and the second PCB, and
the dielectric material is disposed to guide a path through which the first body moves from the first state to the second state.

9. The electronic device of claim 8, wherein the connection structure comprises a connection body comprising:

a first stainless use steel (SUS) surface-mounted on the first PCB;
the dielectric material; and
a second SUS surface-mounted on the second PCB.

10. The electronic device of claim 1, wherein the at least one antenna connection terminal each comprises a first conductive plate, and
the at least two or more RF connection terminals each comprise a second conductive plate.

11. The electronic device of claim 1, wherein the first RF connection terminal comprises a first conductive plate,

the second RF connection terminal comprises a second conductive plate,
the at least one antenna connection terminal comprises at least one conductive plate, and
the at least one conductive plate is disposed to

be charged with electric charges with at least one of the first conductive plate or the second conductive plate.

12. The electronic device of claim 11, wherein the at least two or more RF connection terminals further comprise a third RF connection terminal,

the third RF connection terminal comprises a third conductive plate, and
the at least one conductive plate is disposed to be charged with electric charges with at least one of the first conductive plate, the second conductive plate, and the third conductive plate.

13. The electronic device of claim 1, wherein the first RF tuning circuit comprises at least one of a first capacitor, a first resistor, or a first inductor,

the second RF tuning circuit comprises at least one of a second capacitor, a second resistor, or a second inductor,
at least one of the first capacitor, the first resistor, or the first inductor has a value of maximizing a standing wave ratio related to the first antenna in the first state, and
at least one of the second capacitor, the second resistor, or the second inductor has a value of maximizing a standing wave ratio related to the second antenna in the second state.

14. The electronic device of claim 13, wherein the first RF tuning circuit and the second RF tuning circuit are connected to the RF module through the second PCB.

15. The electronic device of claim 13, wherein the at least two or more RF connection terminals further comprise a third RF connection terminal,

the second PCB comprises a third RF tuning circuit for the third RF connection terminal,
the first RF tuning circuit and the second RF tuning circuit are connected to the ground, and
the third RF tuning circuit is connected to the RF module.

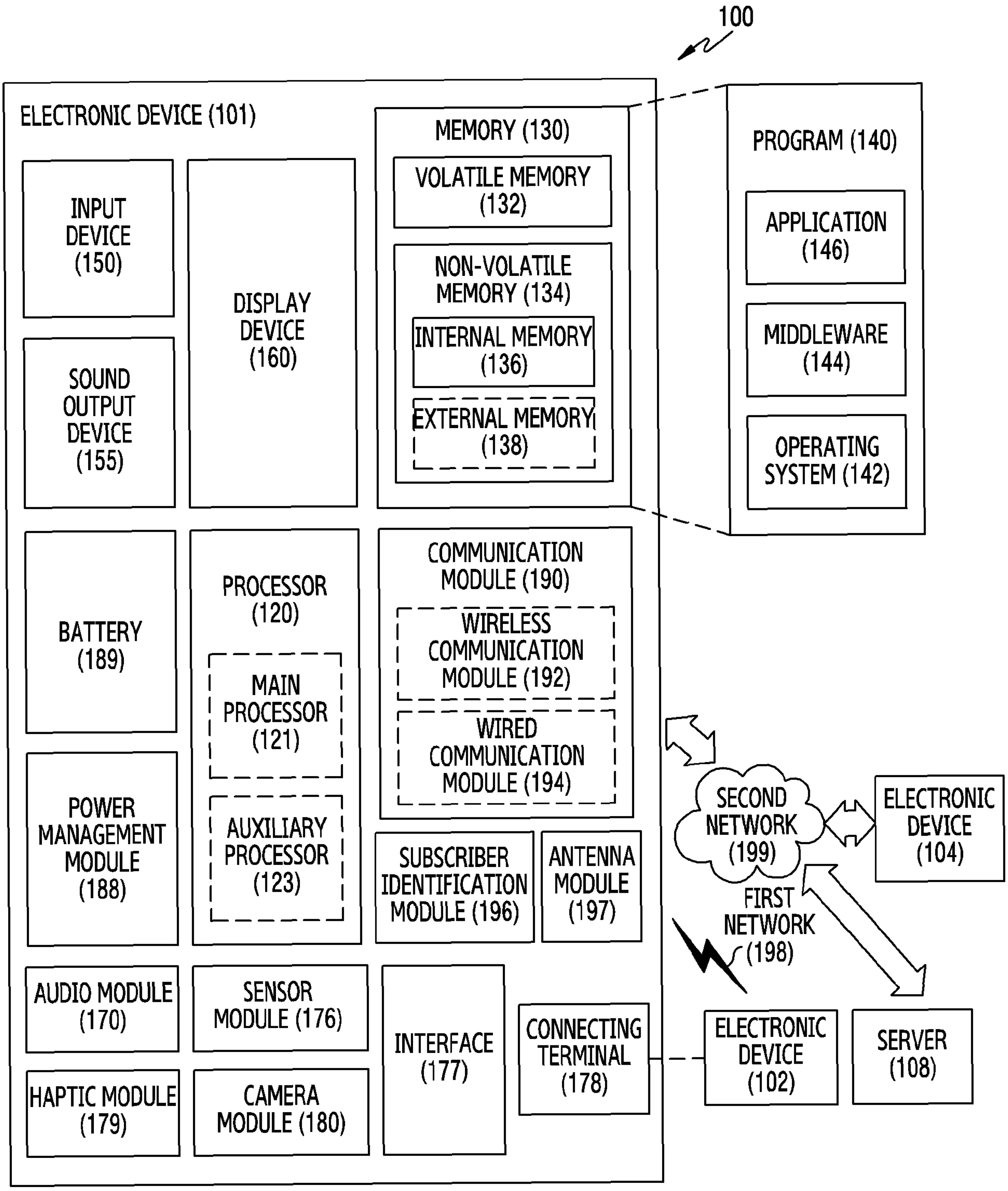

100
ELECTRONIC DEVICE (101)
INPUT DEVICE (150)
DISPLAY DEVICE (160)
MEMORY (130)
VOLATILE MEMORY (132)
NON-VOLATILE MEMORY (134)
INTERNAL MEMORY (136)
EXTERNAL MEMORY (138)
PROGRAM (140)
APPLICATION (146)
MIDDLEWARE (144)
OPERATING SYSTEM (142)
SOUND OUTPUT DEVICE (155)
BATTERY (189)
PROCESSOR (120)
MAIN PROCESSOR (121)
AUXILIARY PROCESSOR (123)
COMMUNICATION MODULE (190)
WIRELESS COMMUNICATION MODULE (192)
WIRED COMMUNICATION MODULE (194)
POWER MANAGEMENT MODULE (188)
SUBSCRIBER IDENTIFICATION MODULE (196)
ANTENNA MODULE (197)
SECOND NETWORK (199)
ELECTRONIC DEVICE (104)
FIRST NETWORK (198)
AUDIO MODULE (170)
SENSOR MODULE (176)
INTERFACE (177)
CONNECTING TERMINAL (178)
ELECTRONIC DEVICE (102)
SERVER (108)
HAPTIC MODULE (179)
CAMERA MODULE (180)

FIG.1

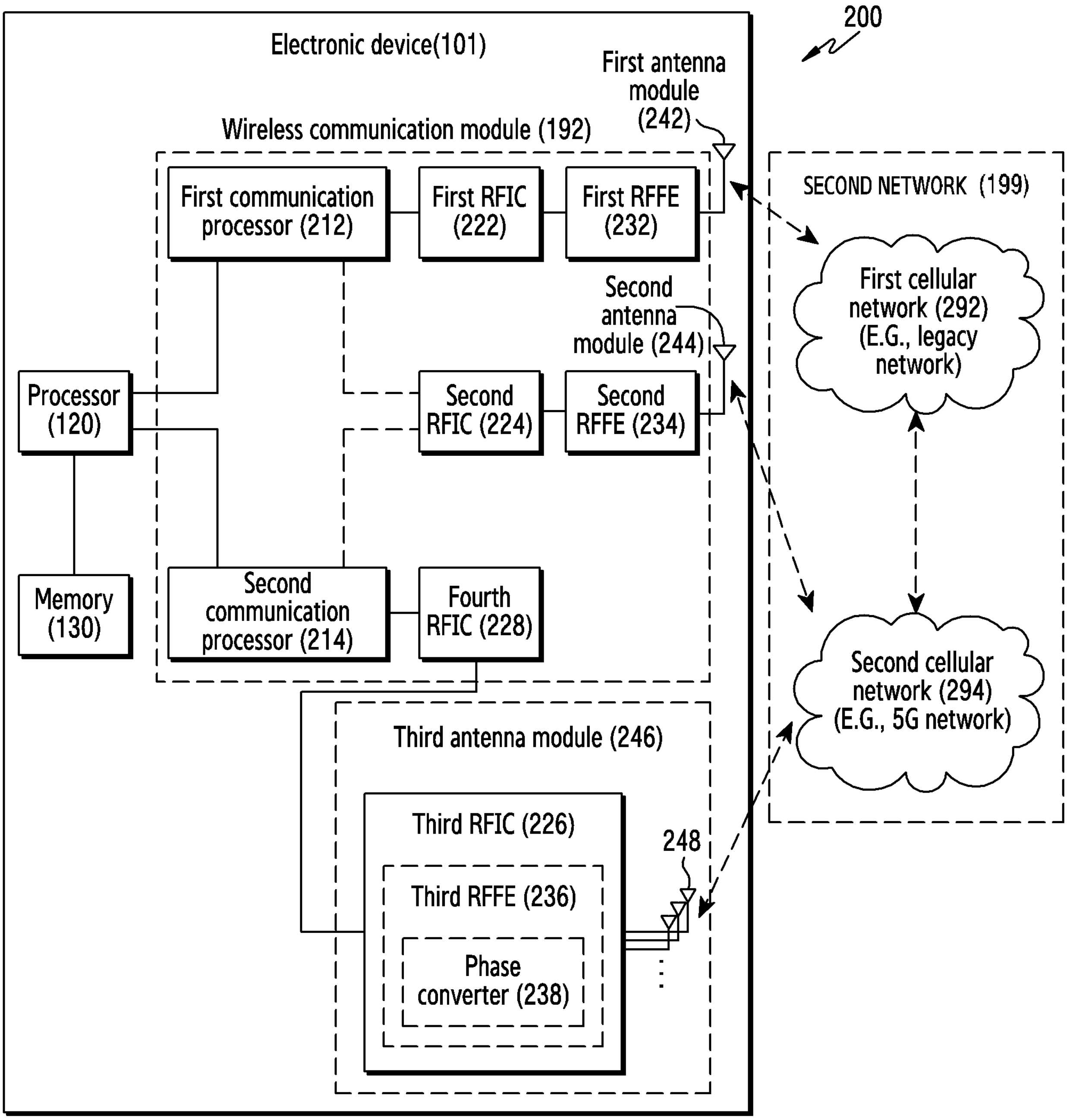

200
Electronic device(101)
First antenna module (242)
Wireless communication module (192)
First communication processor (212)
First RFIC (222)
First RFFE (232)
Second antenna module (244)
Processor (120)
Second RFIC (224)
Second RFFE (234)
Memory (130)
Second communication processor (214)
Fourth RFIC (228)
Third antenna module (246)
Third RFIC (226)
Third RFFE (236)
Phase converter (238)
248
SECOND NETWORK (199)
First cellular network (292) (E.G., legacy network)
Second cellular network (294) (E.G., 5G network)

FIG.2

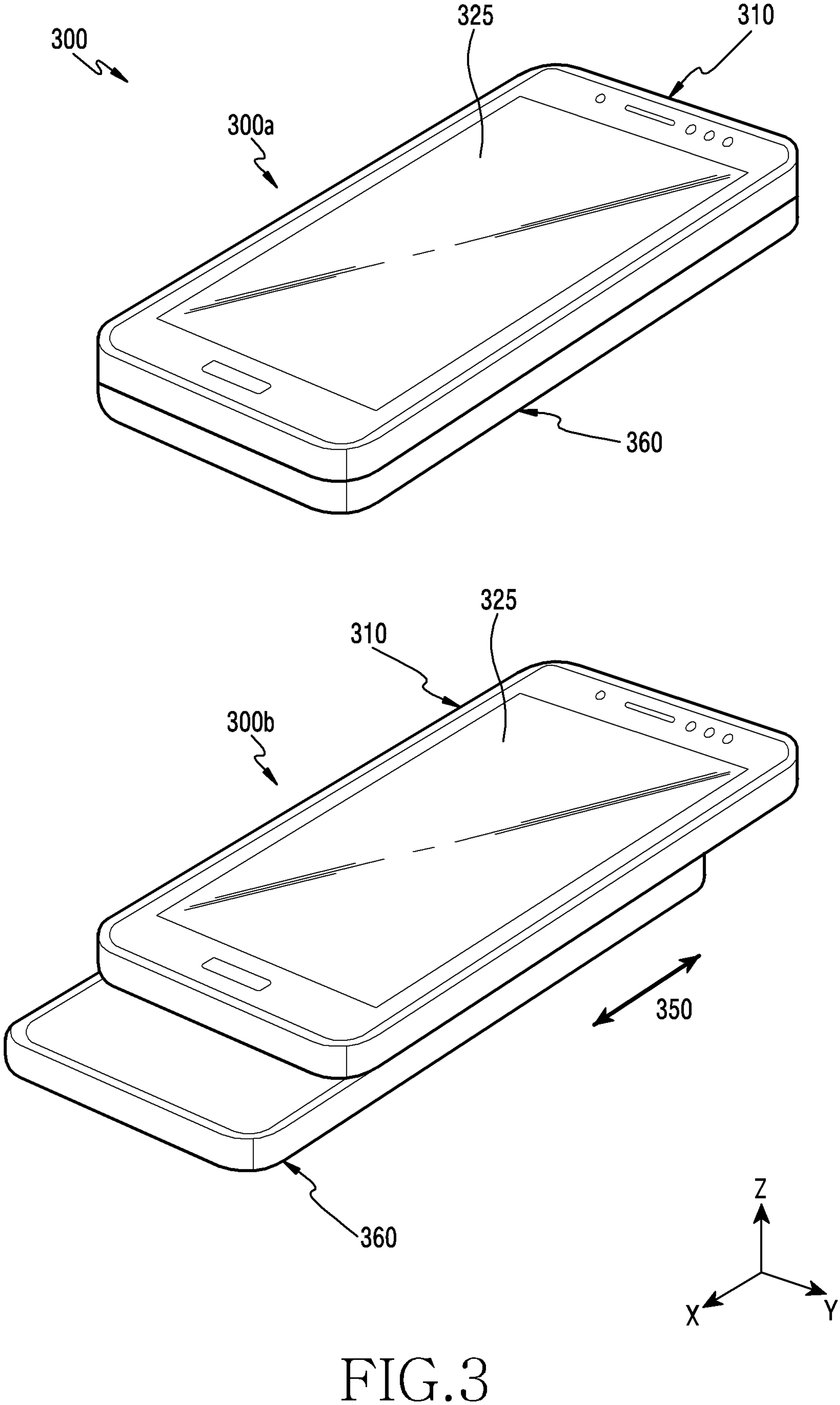


FIG.3

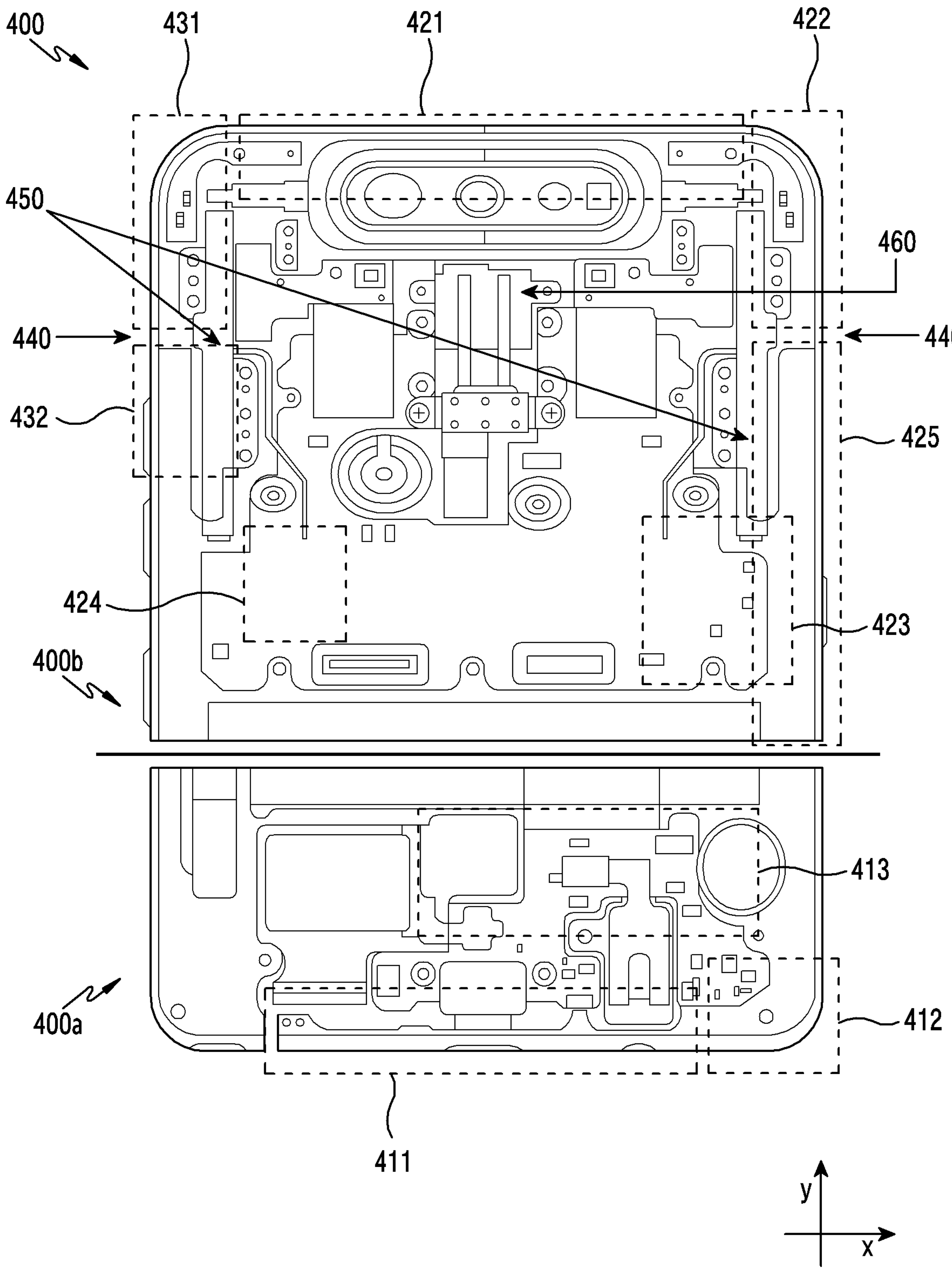

400
431
421
422
450
460
440
440
432
425
424
423
400b
413
412
400a
411
y
x

FIG.4A

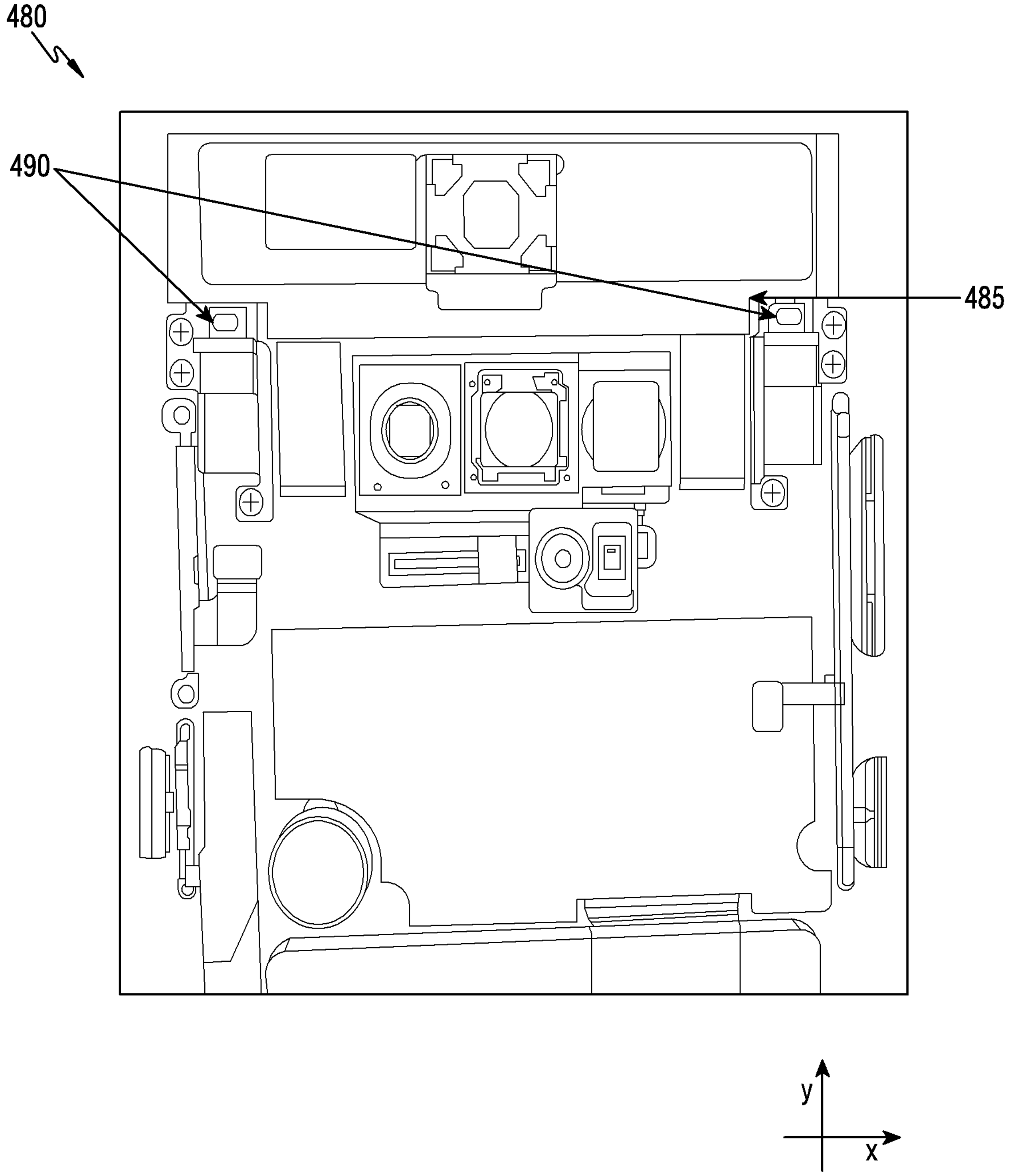


FIG.4B

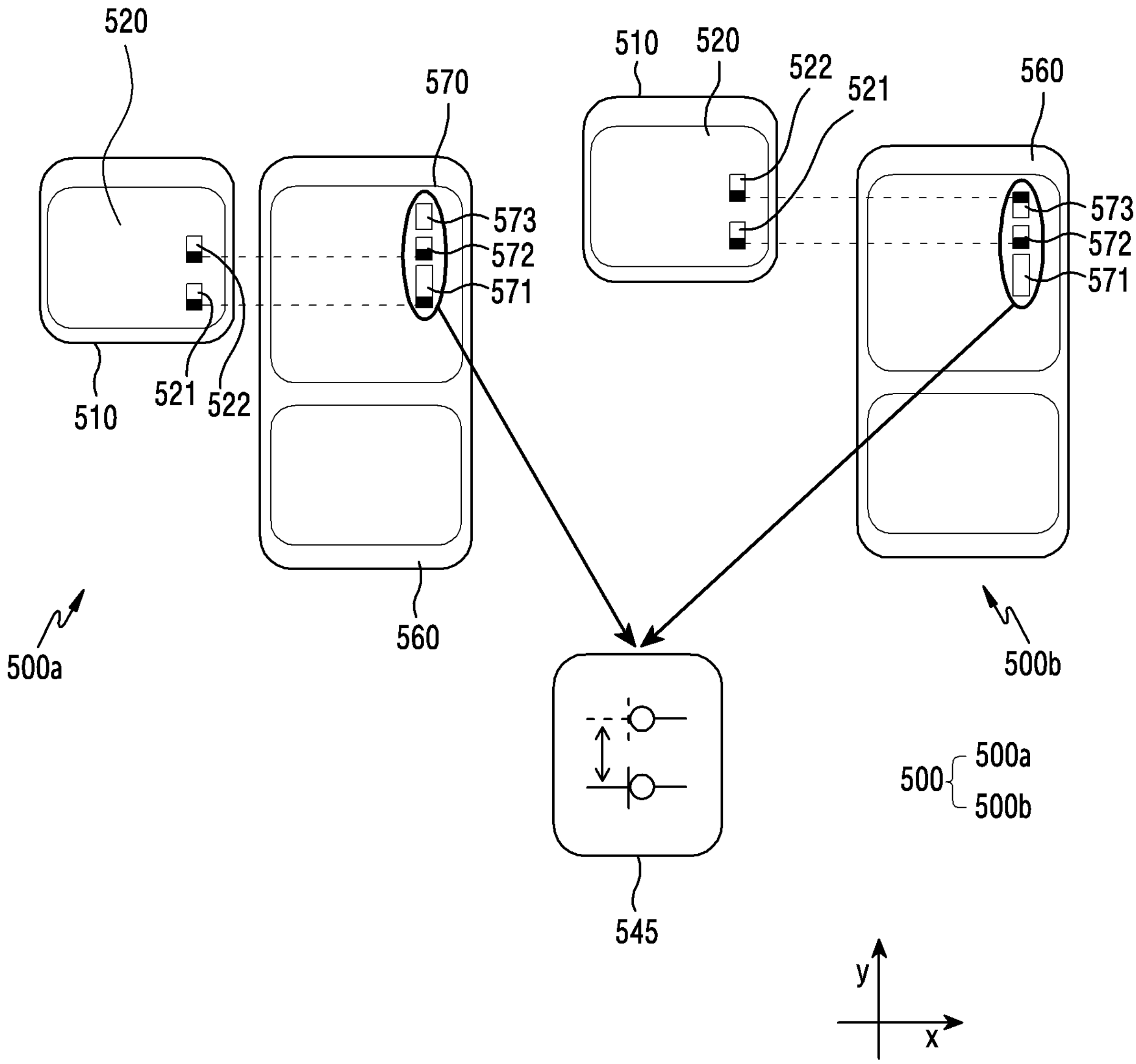

520
570
510
520
522
521
560
573
572
571
573
572
571
510
521
522
560
500a
500b
545
500
500a
500b
y
x

FIG.5

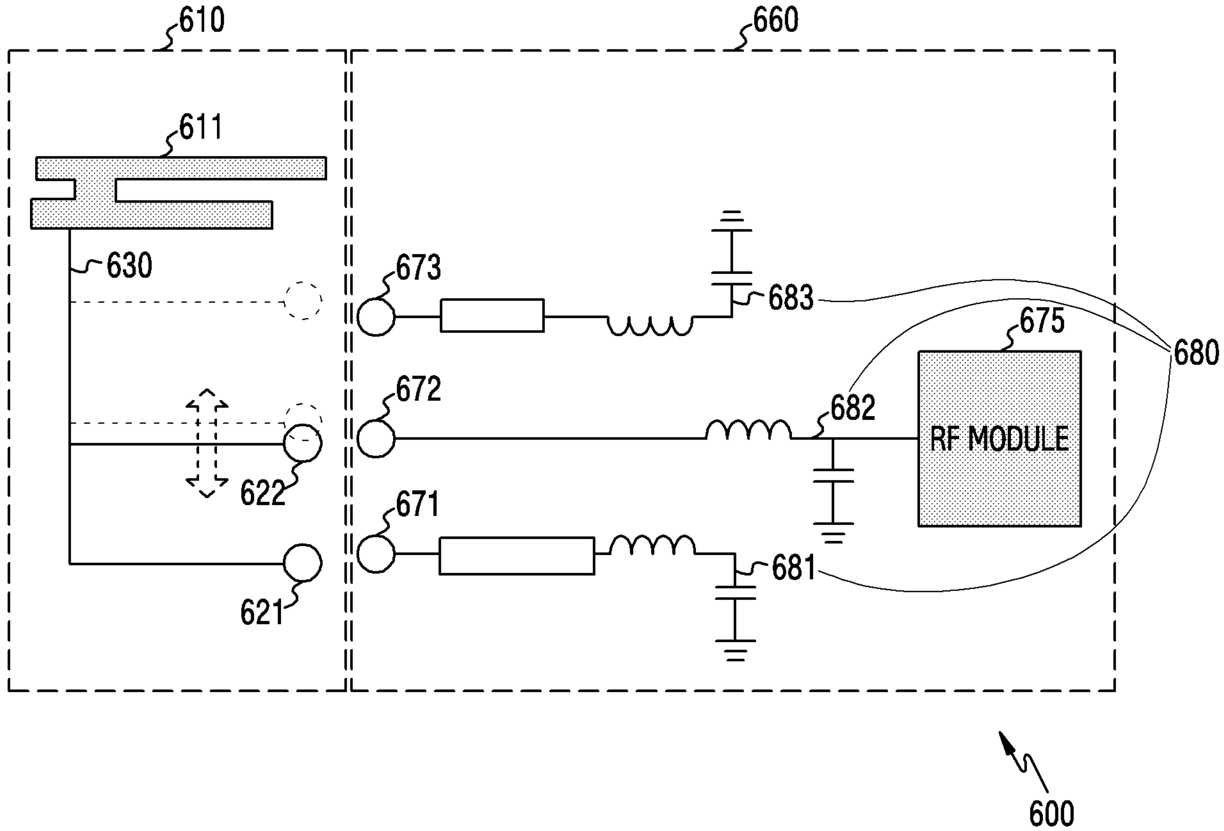

610
660
611
630
673
683
675
680
672
682
RF MODULE
622
671
681
621
600

FIG.6

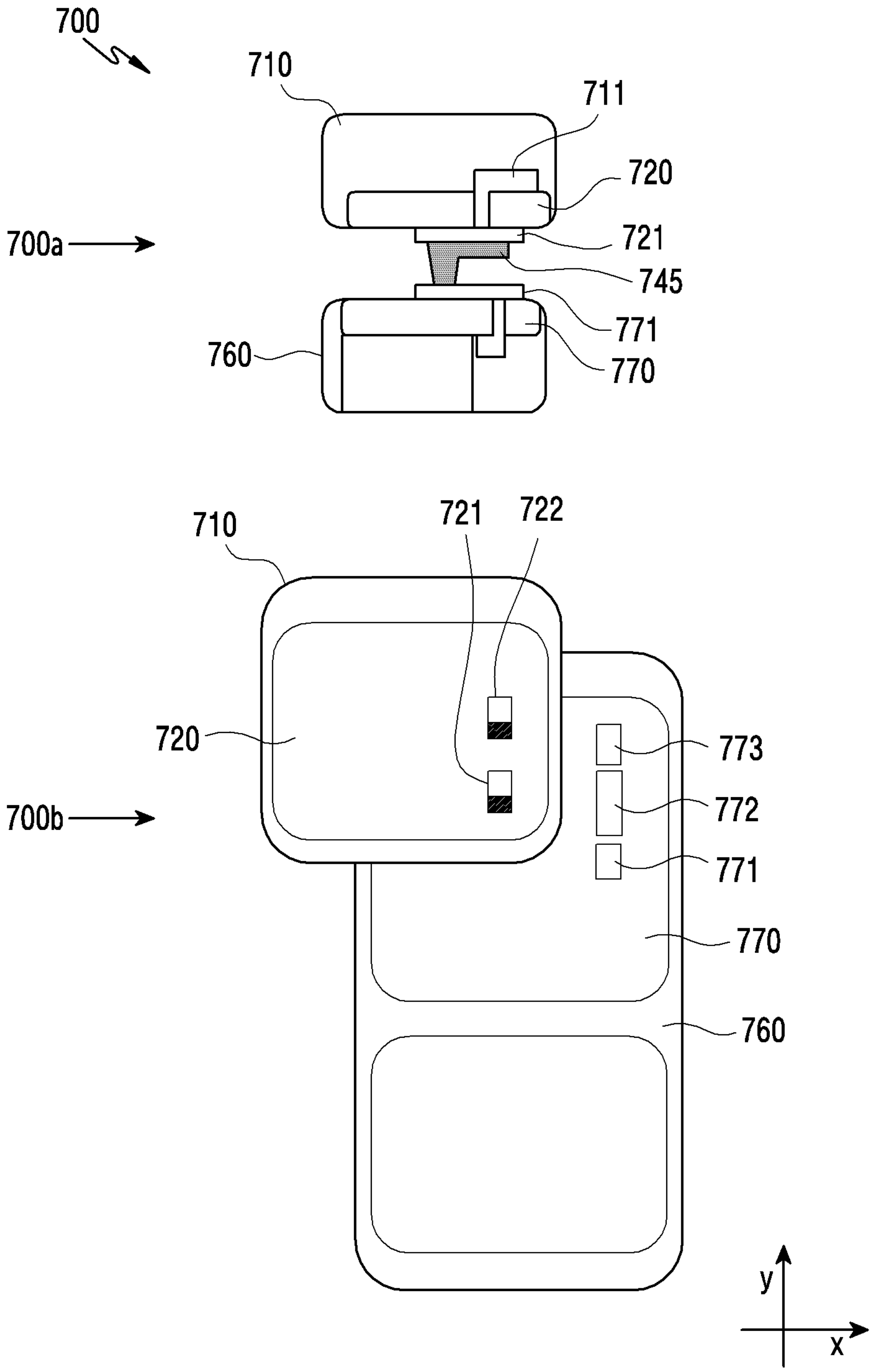

700
710
711
720
700a
721
745
771
760
770
710
721
722
720
700b
773
772
771
770
760
y
x

FIG.7

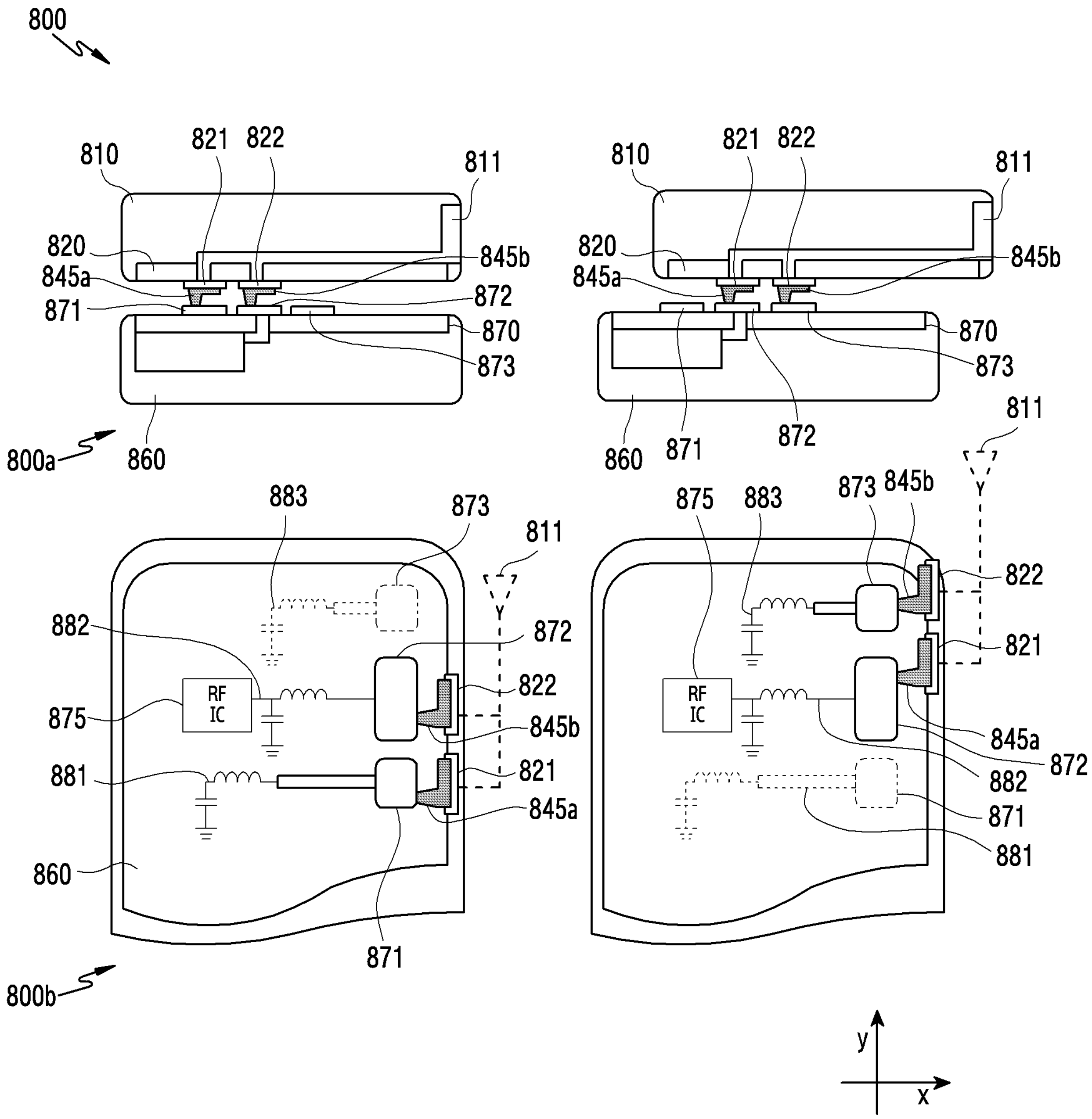

800
810
821
822
811
820
845b
845a
872
871
870
873
800a
860
810
821
822
811
820
845b
845a
870
873
860
871
872
811
883
873
811
882
872
875
RF
IC
822
845b
881
821
845a
860
871
800b
875
883
873
845b
822
821
RF
IC
845a
872
882
871
881
y
x

FIG.8A

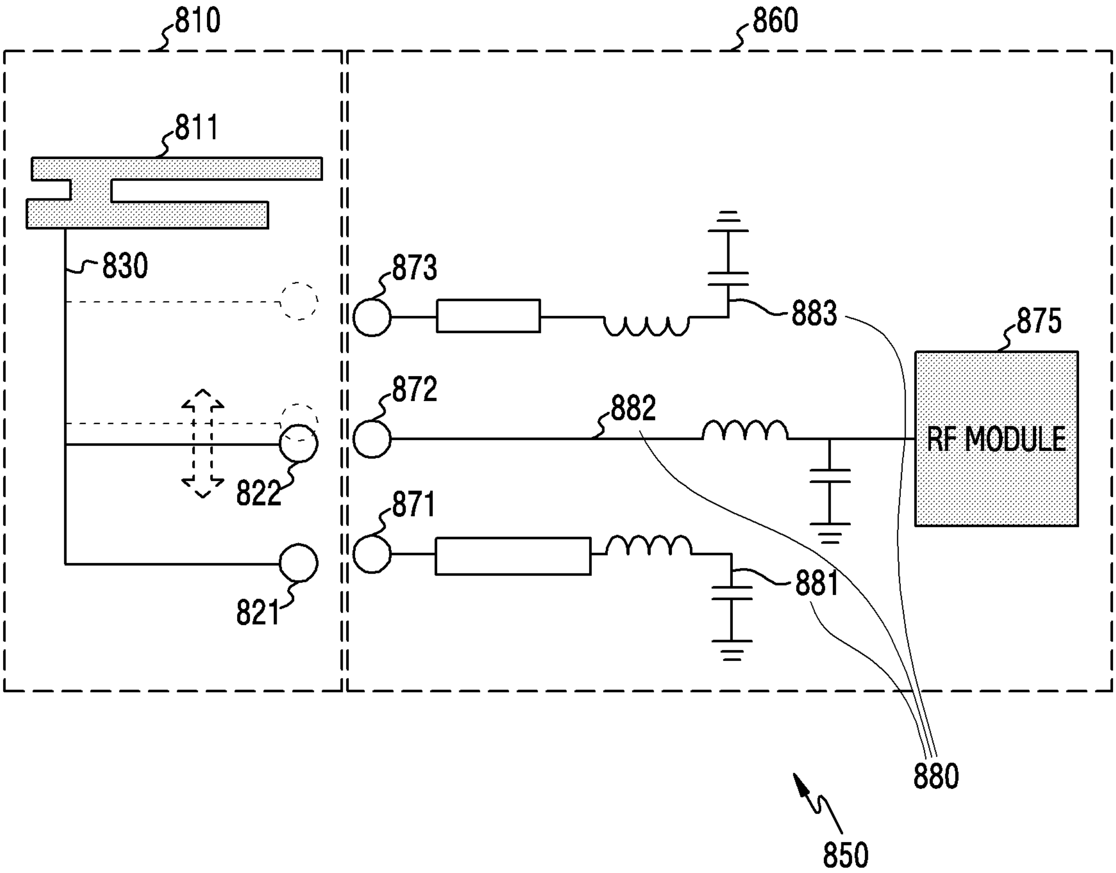

810
860
811
830
873
883
875
872
882
RF MODULE
822
871
881
821
880
850

FIG.8B

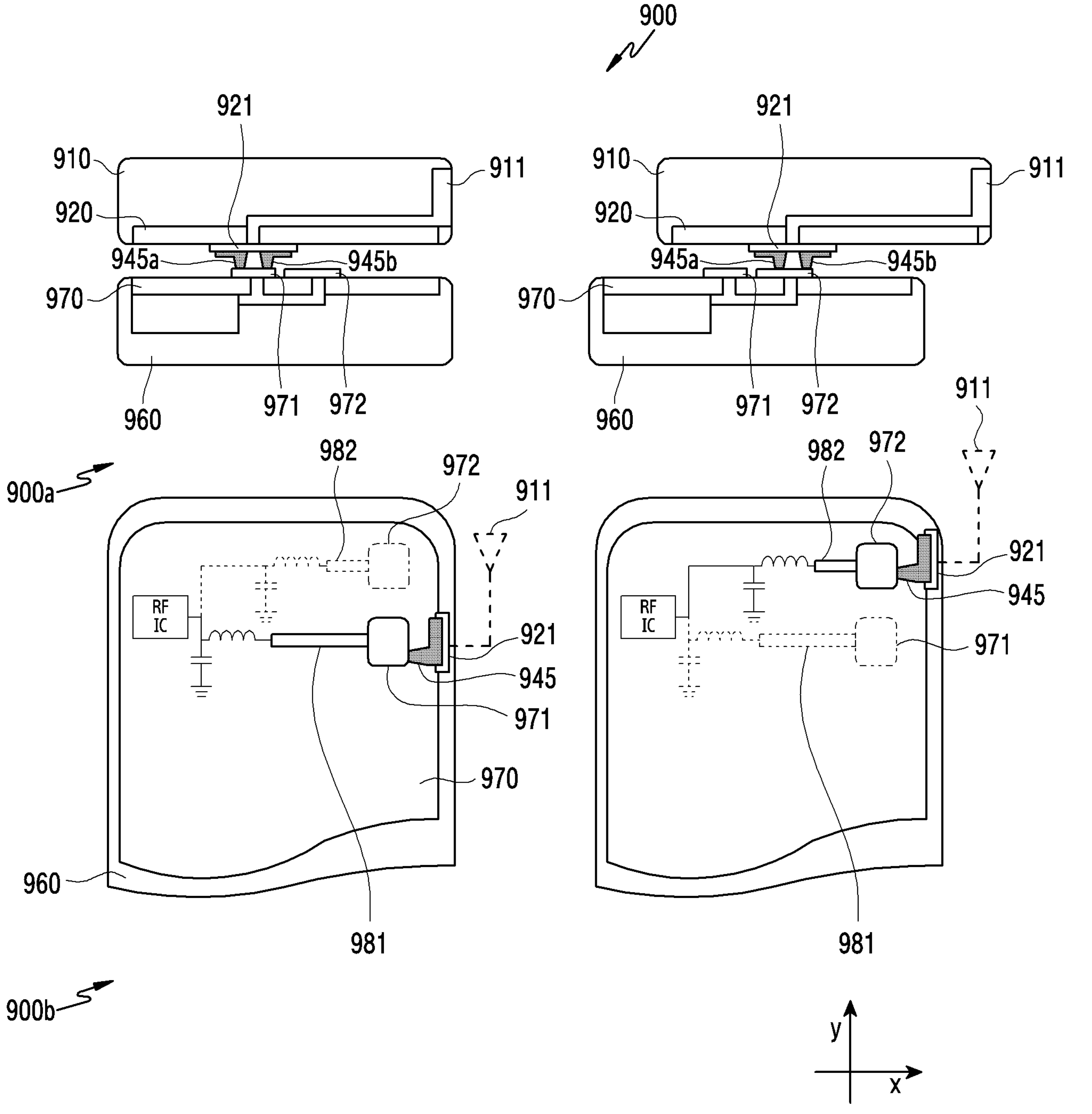

900
921
910
911
920
945a
945b
970
960
971
972
900a
982
972
911
RF IC
921
945
971
970
960
981
900b
y
x

FIG.9A

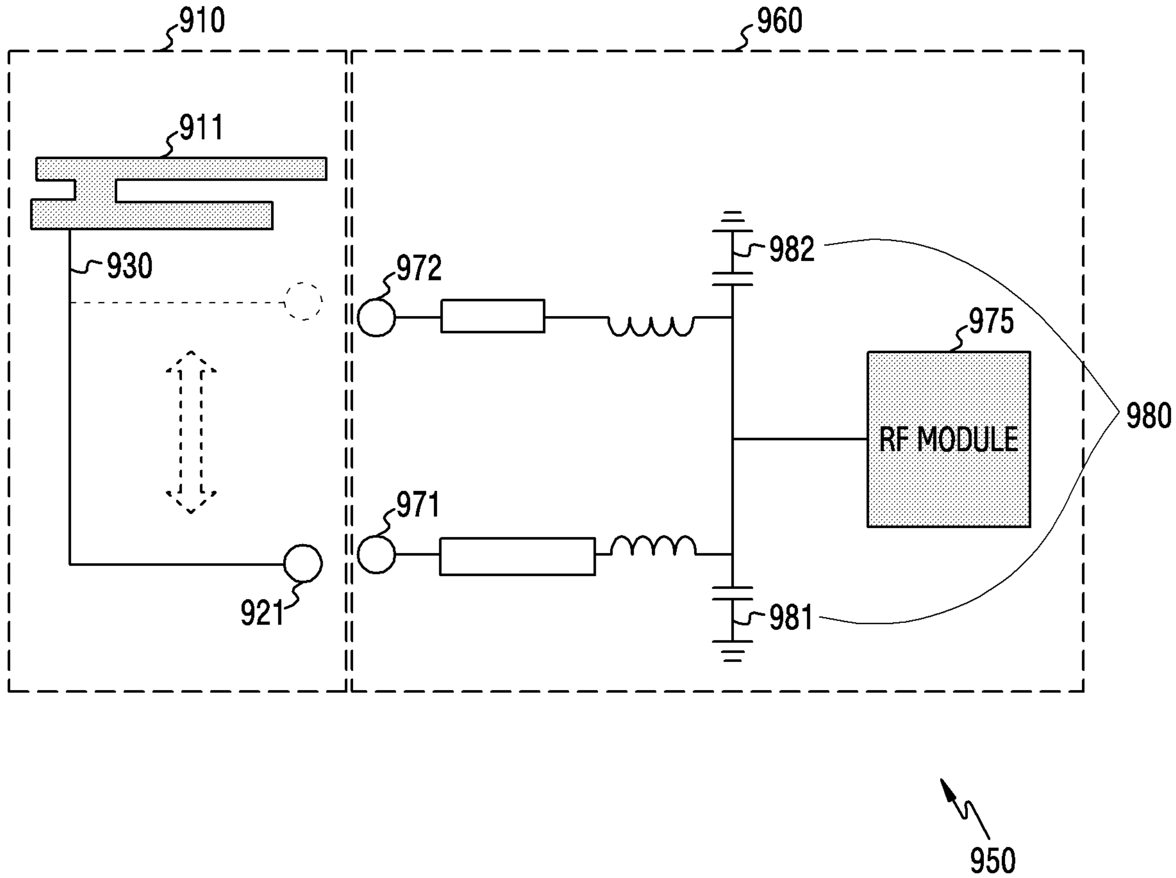


FIG.9B

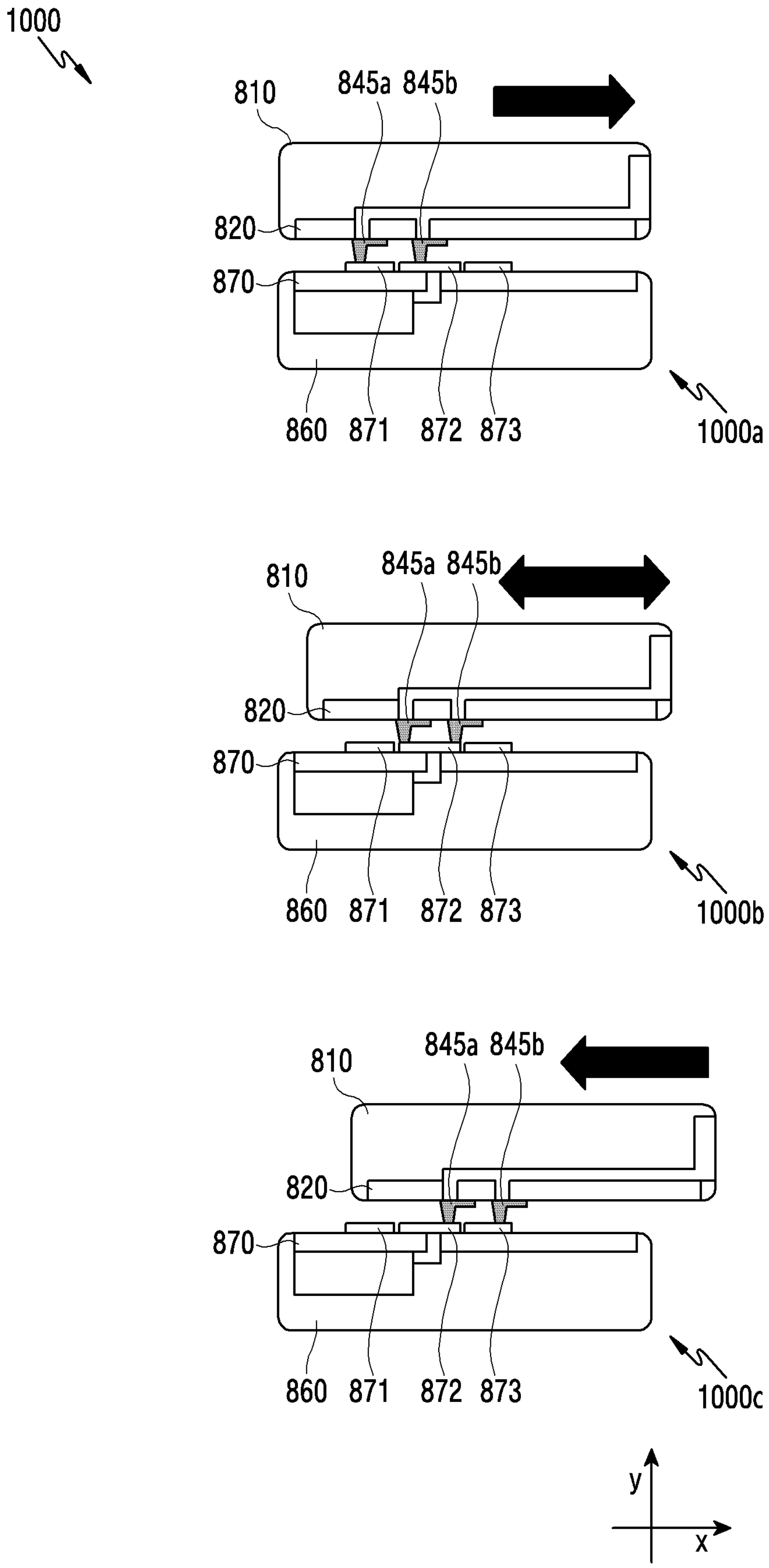

1000
810
845a 845b
820
870
860 871 872 873
1000a
810
845a 845b
820
870
860 871 872 873
1000b
810
845a 845b
820
870
860 871 872 873
1000c
y
x

FIG.10A

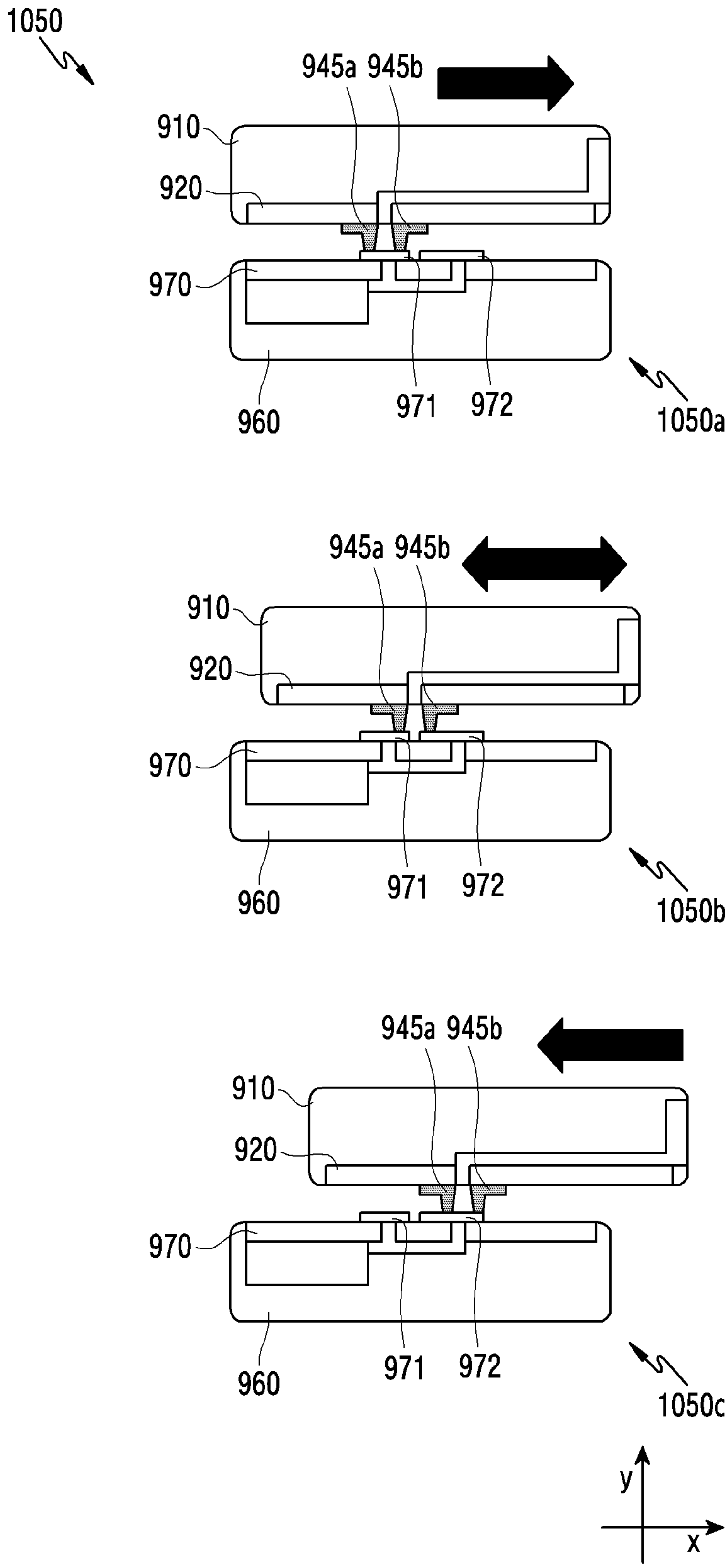

1050
945a 945b
910
920
970
960
971
972
1050a
945a 945b
910
920
970
960
971
972
1050b
945a 945b
910
920
970
960
971
972
1050c
y
x

FIG.10B

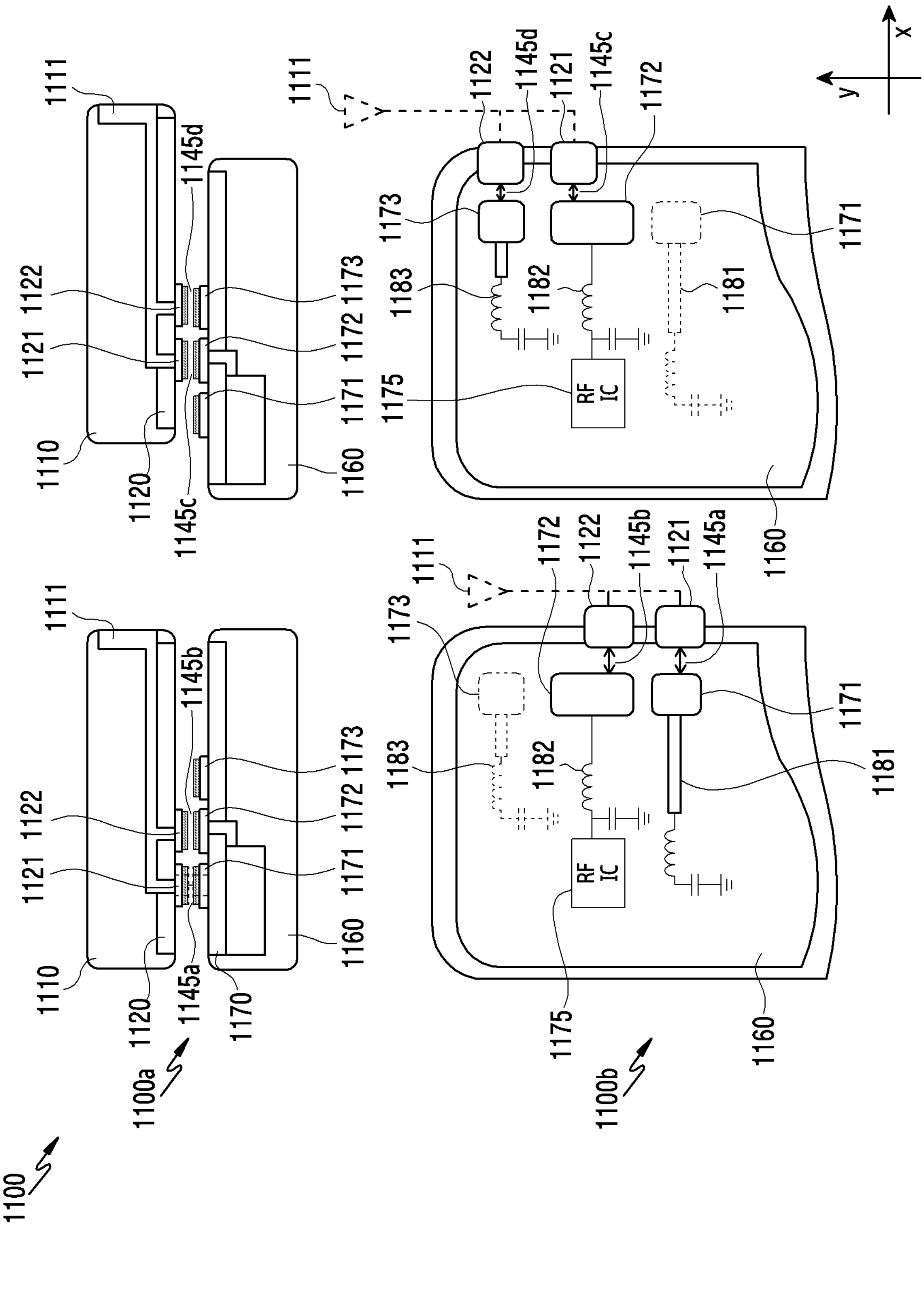
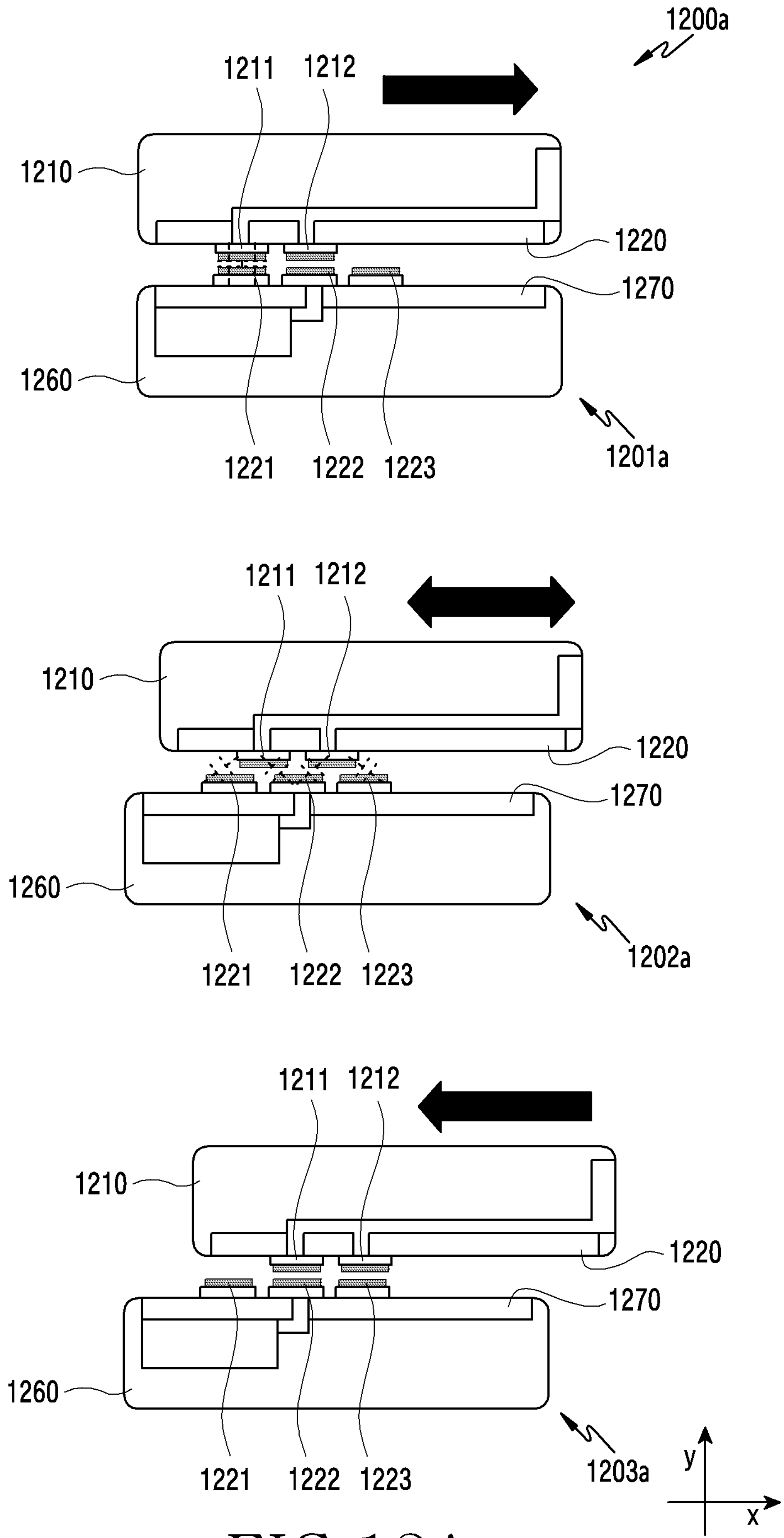

1100
1100a
1100b
1110
1111
1120
1121
1122
1145a
1145b
1145c
1145d
1160
1170
1171
1172
1173
1175
1181
1182
1183
RF IC
x
y

FIG.11


1200a
1211
1212
1210
1220
1270
1260
1221
1222
1223
1201a
1211
1212
1210
1220
1270
1260
1221
1222
1223
1202a
1211
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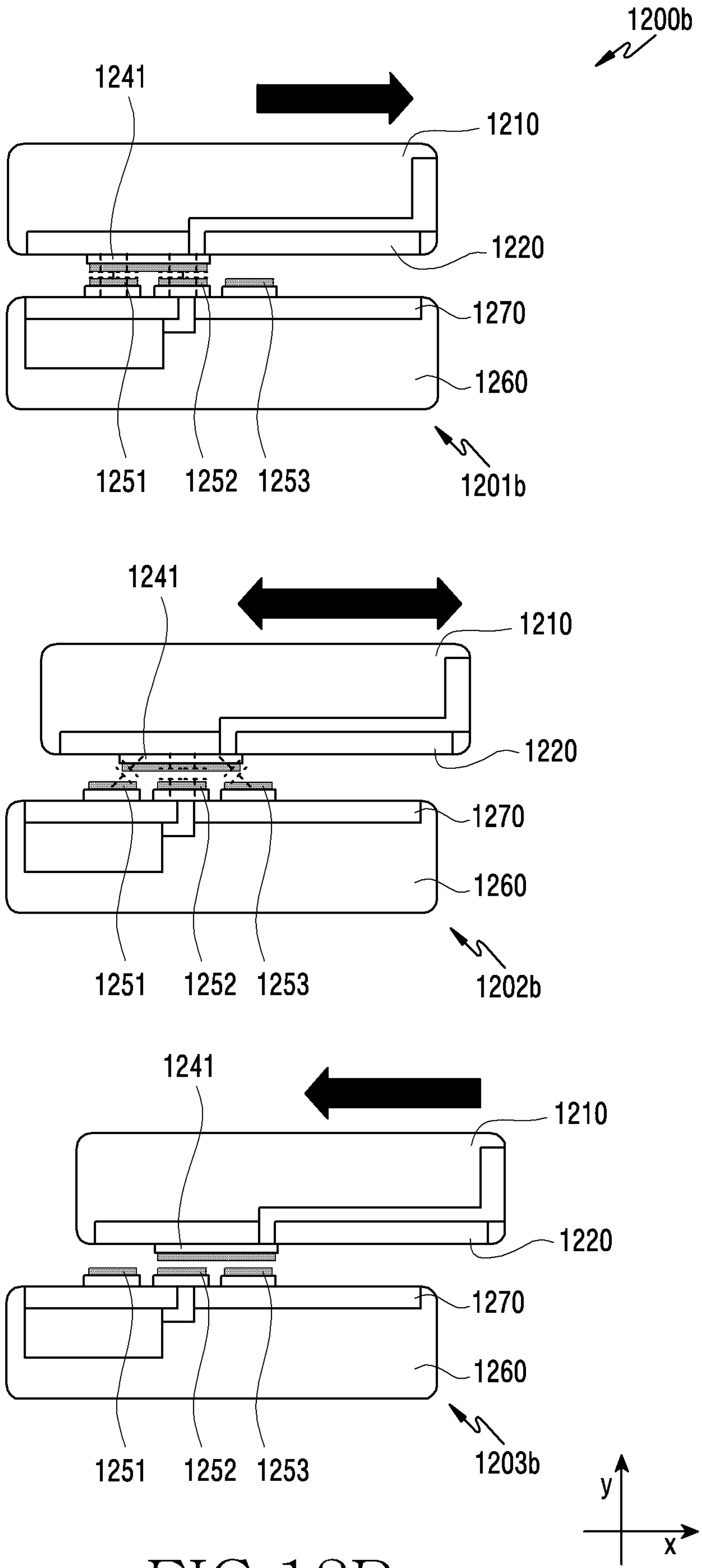
1210
1220
1270
1260
1221
1222
1223
1203a
y
x

FIG.12A


1200b
1241
1210
1220
1270
1260
1251
1252
1253
1201b
1241
1210
1220
1270
1260
1251
1252
1253
1202b
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1210
1220
1270
1260
1251
1252
1253
1203b
y
x

FIG.12B

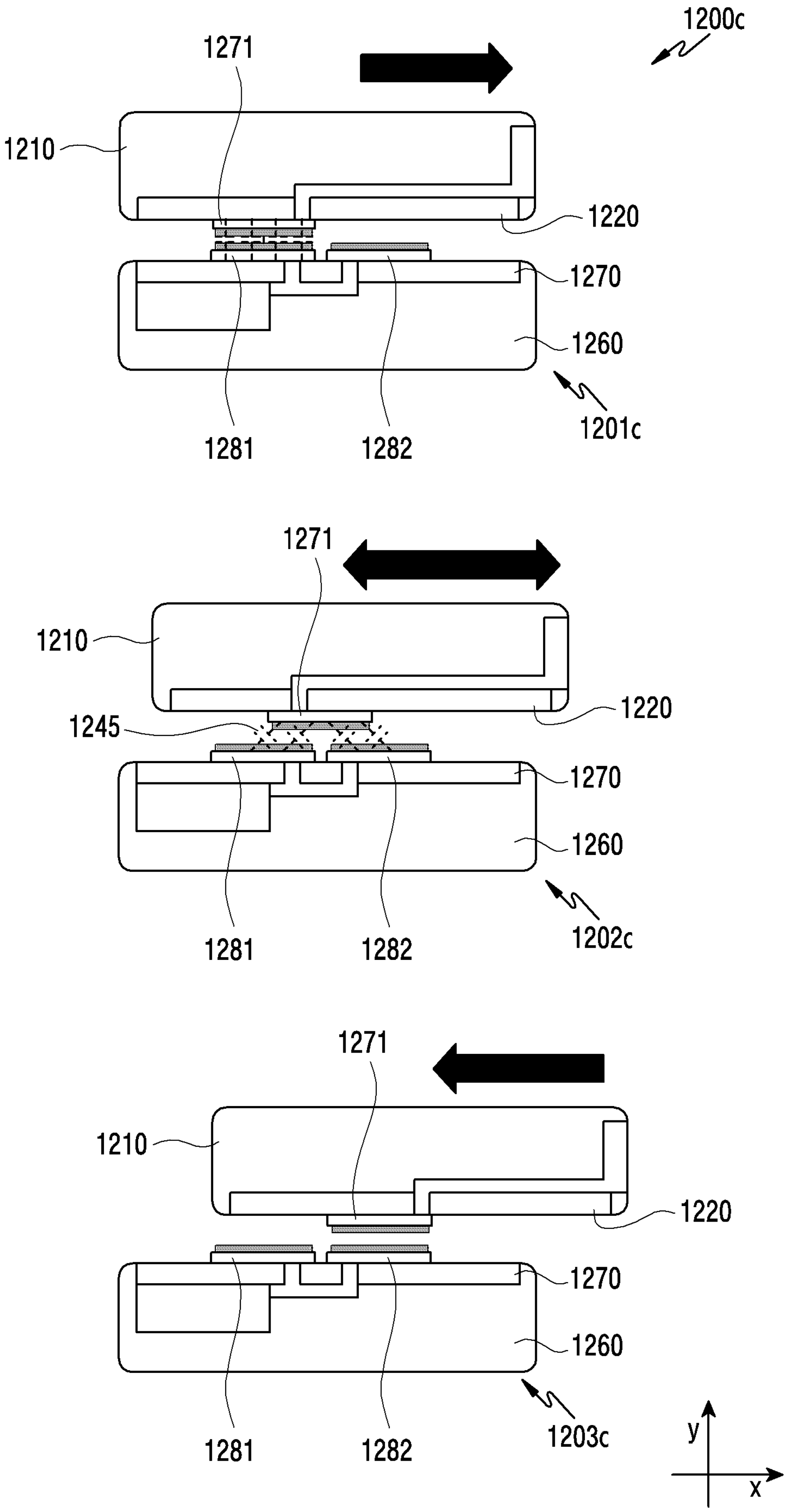
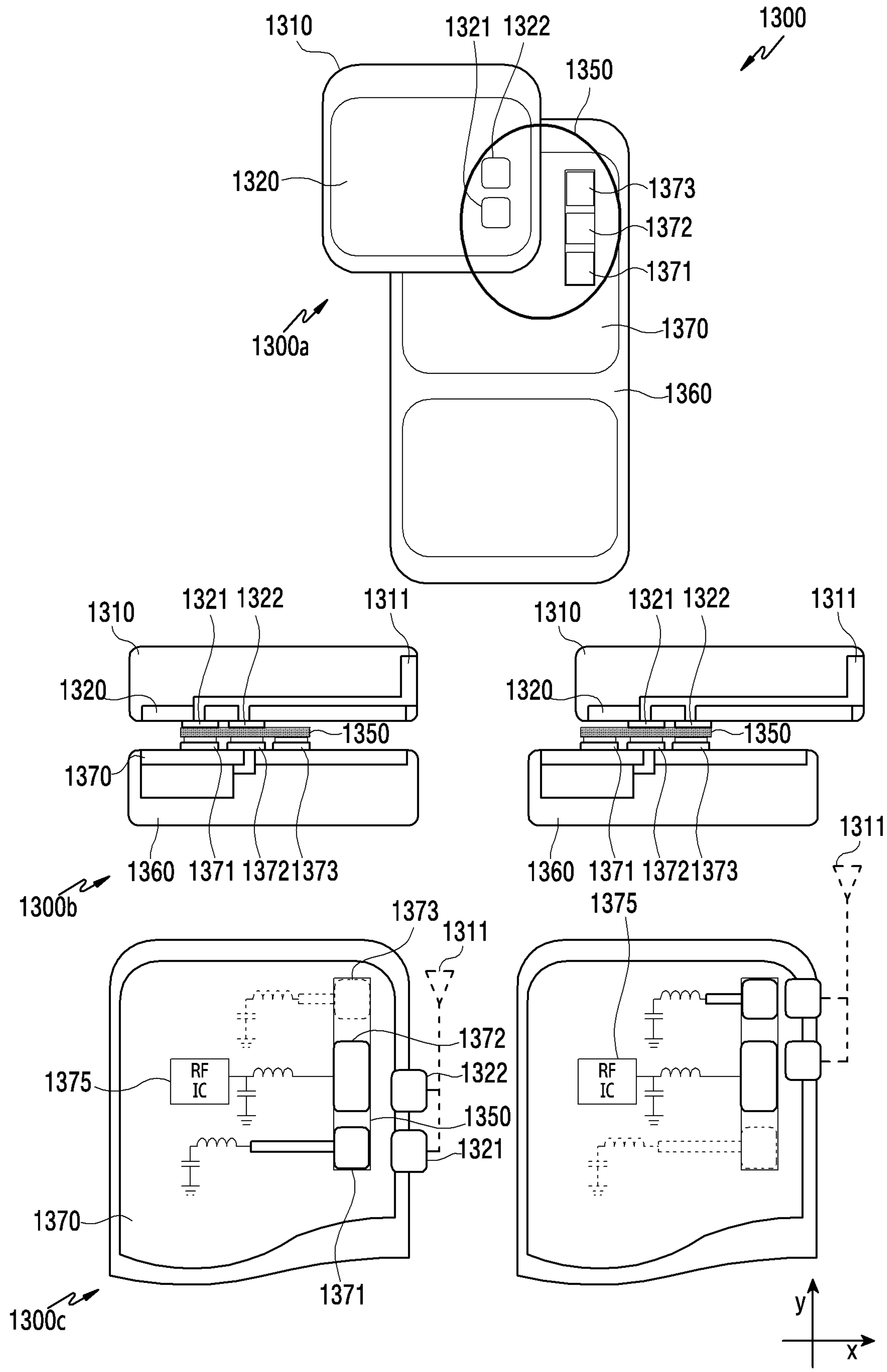

1200c
1271
1210
1220
1270
1260
1281
1282
1201c
1271
1210
1245
1220
1270
1260
1281
1282
1202c
1271
1210
1220
1270
1260
1281
1282
1203c
y
x

FIG.12C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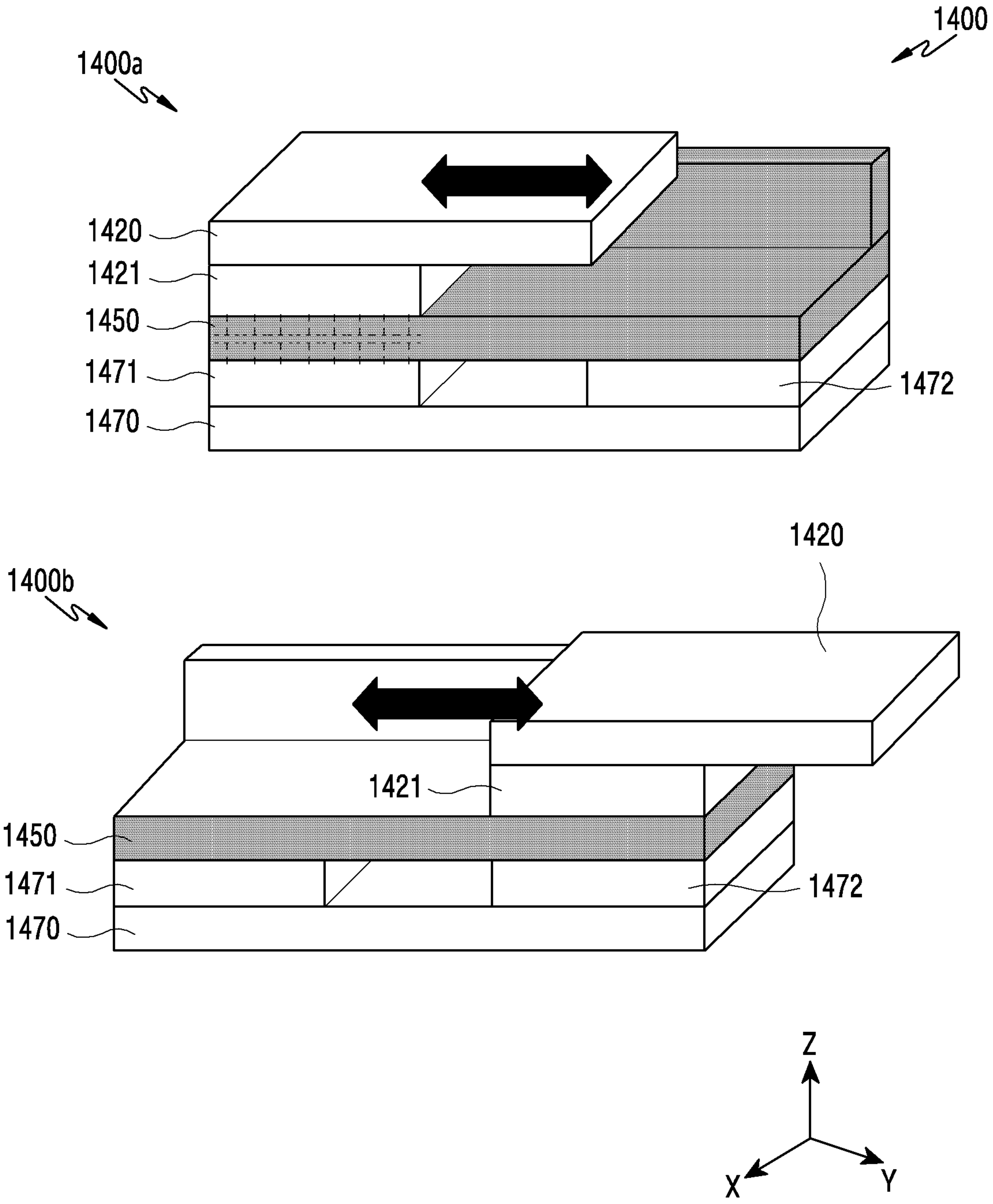
1310
1321 1322
1350
1320
1373
1372
1371
1370
1360
1300a
1310
1321 1322
1311
1320
1350
1370
1360 1371 13721373
1300b
1310
1321 1322
1311
1320
1350
1360 1371 13721373
1311
1373
1311
1372
1375
RF IC
1322
1350
1321
1370
1371
1300c
1375
RF IC
y
x

FIG.13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1400a
1420
1421
1450
1471
1470
1472
1400b
1420
1421
1450
1471
1470
1472
Z
X
Y

FIG.14A

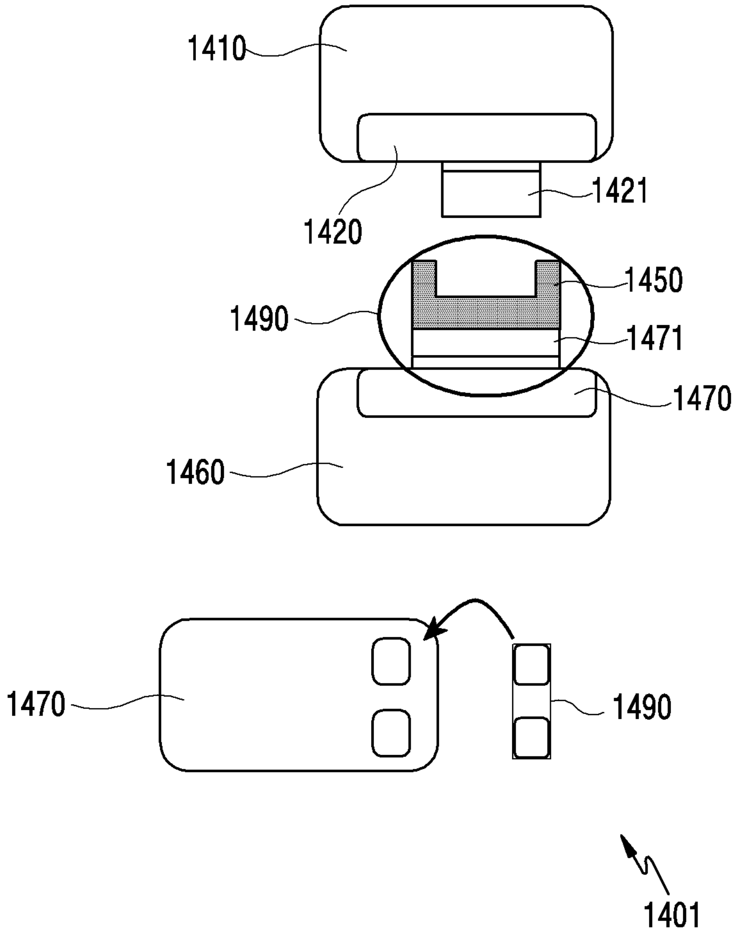

FIG.14B

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2020/007200

A. CLASSIFICATION OF SUBJECT MATTER

H01Q 1/38(2006.01)i, H01Q 1/24(2006.01)i, H01R 12/57(2011.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H01Q 1/38; H01L 33/48; H01Q 1/24; H01Q 3/24; H01Q 9/04; H01R 12/77; H04B 1/40; H01R 12/57

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models: IPC as above
Japanese utility models and applications for utility models: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS (KIPO internal) & Keywords: antenna, PCB, moving, connecting terminal, tuning

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 2007-201918 A (MITSUBISHI ELECTRIC CORP.) 09 August 2007 See paragraphs [0010]-[0022], claim 1 and figures 1-3.	1-6,8-10,13-15 7,11-12
Y	KR 10-2017-0051588 A (LG DISPLAY CO., LTD.) 12 May 2017 See paragraph [0028] and figures 1-5.	7
Y	KR 10-0598357 B1 (LG ELECTRONICS INC. et al.) 06 July 2006 See paragraph [0034] and figures 1-5.	11-12
A	KR 10-2005-0007751 A (PANTECH&CURITEL COMMUNICATIONS, INC.) 21 January 2005 See claim 1 and figures 3-6.	1-15
A	US 2017-0025763 A1 (BLACKBERRY LIMITED) 26 January 2017 See claim 1 and figures 1-6.	1-15

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 SEPTEMBER 2020 (18.09.2020)	**18 SEPTEMBER 2020 (18.09.2020)**
Name and mailing address of the ISA/KR Korean Intellectual Property Office Government Complex Daejeon Building 4, 189, Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea Facsimile No. +82-42-481-8578	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2020/007200

Patent document cited in search report	Publication date	Patent family member	Publication date
JP 2007-201918 A	09/08/2007	None	
KR 10-2017-0051588 A	12/05/2017	None	
KR 10-0598357 B1	06/07/2006	None	
KR 10-2005-0007751 A	21/01/2005	None	
US 2017-0025763 A1	26/01/2017	EP 2722996 A1	23/04/2014
		EP 2722996 B1	17/12/2014
		US 2014-0113679 A1	24/04/2014
		US 9496901 B2	15/11/2016
		US 9793610 B2	17/10/2017

Form PCT/ISA/210 (patent family annex) (January 2015)