(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
30 August 2018 (30.08.2018)

(10) International Publication Number
WO 2018/154446 A1

(51) International Patent Classification:
H04B 1/72 (2006.01) *G01S 13/00* (2006.01) *H01Q 5/00* (2015.01)

(21) International Application Number: PCT/IB2018/051047

(22) International Filing Date: 21 February 2018 (21.02.2018)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
201741006093 21 February 2017 (21.02.2017) IN

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,

(54) Title: MULTI-FREQUENCY RF SNIFFER PROBE

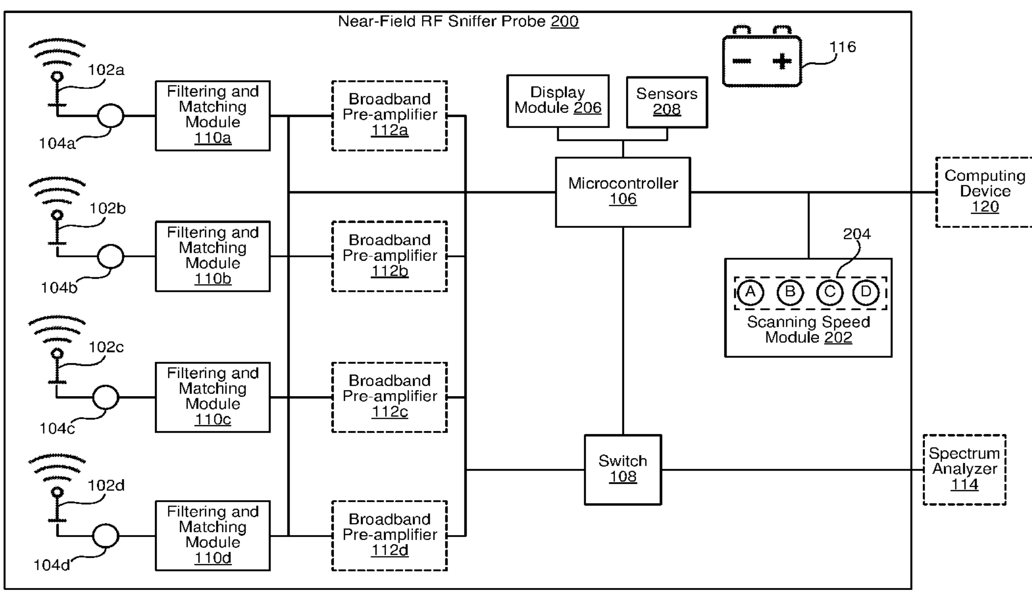

FIG. 2

(57) Abstract: This disclosure relates to a near-field Radio Frequency (RF) sniffer probe (100) for detecting multiple frequencies. The near-field RF sniffer probe (100) includes a plurality of antennas (102), such that, each of the plurality of antennas (102) is configured to detect a unique frequency band from a plurality of frequency bands. The near-field RF sniffer probe (100) further includes a microcontroller (106) communicatively coupled to the plurality of antennas (102). The microcontroller (106) selectively operates each of the plurality of antennas (102) to detect a frequency within an associated frequency band.

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TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:
— *as to the identity of the inventor (Rule 4.17(i))*
— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

Published:
— *with international search report (Art. 21(3))*
— *in black and white; the international application as filed contained color or greyscale and is available for download from PATENTSCOPE*

MULTI-FREQUENCY RF SNIFFER PROBE

Technical Field

This disclosure relates generally to Radio Frequency (RF) sniffer probes, and more particularly to a near-field RF sniffer probe for detecting multiple frequencies.

Background

For every radio device, radio designs are required to comply with Electromagnetic Compatibility (EMC) standards of a given region or country. Almost every country has a list of restricted frequency bands and a radio device should not disturb these restricted frequency bands with radio transmissions because of a poor RF design. Moreover, requirement of some other standards, which are concerned with emission time and maximum power levels that may potentially be harmful for humans and other living beings, also need to be satisfied and met. However, the list of such restricted frequency bands and necessary compliance requirements is considerably large.

In order to determine compliance of a radio device, an RF sniffer probe is used to measure electric fields and radio frequencies in an electronic circuit. The RF sniffer probe typically includes an antenna that detects electric fields and radio frequencies. The antenna detects a frequency which falls within a particular frequency band, such as, in Kilohertz (KHz), Megahertz (MHz), or Gigahertz (GHz) range. However, the antenna is tuned, such that, it detects a frequency of interest within the particular frequency band only.

In some conventional RF sniffer probes, the antennas may be changed every time frequencies in different frequency bands are required to be detected. Thus, the user has to attach a new antenna based on the frequency band of interest. The changing of antennas is performed manually, which consumes both manual effort and time. In some other conventional systems, very large RF detecting device are used to detect multiple frequencies, however, owing to the large size, it becomes difficult to detect electric fields in small circuits, such as, a Printed Circuit Board (PCB) Assembly.

SUMMARY

In one embodiment, a near-field Radio Frequency (RF) sniffer probe is described. The near-field RF sniffer probe includes a plurality of antennas, such that, each of the plurality of antennas is configured to detect a unique frequency band from a plurality of frequency bands. The near-field RF sniffer probe additionally include a microcontroller communicatively coupled to the plurality of antennas. The microcontroller selectively operates each of the plurality of antennas to detect a frequency within an associated frequency band.

In another embodiment, a near-field receiver for sniffing a plurality of frequency bands. The near-field receiver includes a plurality of antennas. Each of the plurality of antennas is configured to detect a unique frequency band from a plurality of frequency bands. A microcontroller selectively operates each of the plurality of antennas to detect at least one frequency in an associated frequency band.

In yet another embodiment, a RF sniffer probe includes a connecting module configured to receive a near-field receiver comprising a plurality of antennas. Each of the plurality of antennas is configured to detect a unique frequency band from a plurality of frequency bands. The RF sniffer probe further includes a microcontroller communicatively configured to selectively operate each of a plurality of antennas to detect a frequency within an associated frequency band.

It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention, as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute a part of this disclosure, illustrate exemplary embodiments and, together with the description, serve to explain the disclosed principles.

FIG. 1 illustrates a schematic diagram of a near-field Radio Frequency (RF) sniffer probe, in accordance with an embodiment;

FIG. 2 illustrates a schematic diagram of a near-field RF sniffer probe, in accordance with another embodiment; and

FIG. 3 illustrates a schematic diagram of a near-field receiver that may be attached to and detached from an RF sniffer probe, in accordance with an exemplary embodiment.

DETAILED DESCRIPTION

Exemplary embodiments are described with reference to the accompanying drawings. Wherever convenient, the same reference numbers are used throughout the drawings to refer to the same or like parts. While examples and features of disclosed principles are described herein, modifications, adaptations, and other implementations are possible without departing from the spirit and scope of the disclosed embodiments. It is intended that the following detailed description be considered as exemplary only, with the true scope and spirit being indicated by the following claims.

Referring now to FIG. 1, a schematic diagram of a near-field Radio Frequency (RF) sniffer probe 100 is illustrated, in accordance with an embodiment. The near-field RF sniffer probe 100 may be a system on chip arrangement. In an embodiment, the near-field RF sniffer probe 100 may be a hand-held device.

The near-field RF sniffer probe 100 may be used to detect frequencies within a plurality of frequency bands for a radio device in order to evaluate RF performance of the radio device. Evaluation of the RF performance may include determining interference with restricted frequency bands, spurious radio emissions, and harmful power levels. The range for the plurality of frequency bands may include, but is not limited to Hertz (Hz), Kilohertz (KHz), Megahertz, (MHz), Gigahertz (GHz), Petahertz (PHz), Terahertz (THz), and Exahertz (EHZ). By way of an example, the plurality of frequency bands, may include, but are not limited to 9KHz-MHz, 1MHz-30MHz, 30MHz-300MHz, and 300MHz-1GHz. The radio device scanned by the near-field RF sniffer probe 100 may include small size electronic circuits and electronic boards, for example, a Printed Circuit Board (PCB) Assembly.

In order to detect frequencies within the plurality of frequency bands, the near-field RF sniffer probe 100 includes an antenna 102a, an antenna 102b, an antenna 102c, and an antenna 102d, collectively referred to as a plurality of antennas 102. Each of the plurality of antennas 102 is configured to detect a unique frequency band from the plurality of frequency bands. In other words, a given antenna is tuned to detect frequencies only within a given frequency band.

As each of the plurality of antennas 102 scans a different frequency band, the near-field RF sniffer probe 100 may detect frequencies within any frequency band without any manual intervention during the process of frequency detection. The plurality of antennas 102 capture spikes/spurs/harmonic at respective tuned frequency bands. The type of antennas used for the plurality of antennas 102 may include, but are not limited to broadband antenna, frequency independent antennas, smart antennas, active antennas, and carbon nanotube antennas.

In order to affix or attach the plurality of antennas 102 to the near-field RF sniffer probe 100, a plurality of micro connectors 104 in the near-field RF sniffer probe 100 may cooperate with the plurality of antennas 102. The plurality of micro connectors 104 include a micro connector 104a, a micro connector 104b, a micro connector 104c, and a micro connector 104d. In an embodiment, each of the plurality of micro connectors 104 may receive an antenna from the plurality of antennas 102. By way of an example, the micro connector 104a receives the antenna 102a, the micro connector 104b receives the antenna 102b, the micro connector 104c receives the antenna 102c, and the micro connector 104d receives the antenna 102d. In other words, an antenna from the plurality of antennas 102 may be plugged into an associated micro connector from the plurality of micro connectors 104. Each of the plurality of micro connectors 104 may include a provision to facilitate the same.

Once an antenna is attached to the near-field sniffer probe 100, by way of being plugged into a micro connector, the antenna may later be detached from the micro controller without damaging the antenna. By way of an example, after the antenna 102a has been plugged into the micro controller 104a, the antenna 102a may later be detached without damaging the antenna 102a or the near-field sniffer probe 100. Thus, the plurality of micro connectors 104 enables attachment and detachment of the plurality of antennas 102 from the near-field sniffer probe 100.

In an embodiment, each of the plurality of micro connectors 104 additionally enable unrestricted orientations for each of the plurality of antennas 102, once received by the plurality of micro connectors 104. By way of an example, once the antenna 102b has been plugged into the micro connector 104b, the micro connector 104b may enable the antenna 102b to be rotated at various angles to detect frequencies in a device under test. The rotation may be controlled manually by a user. Alternatively, the rotation may be controller by an electronically controlled ball joint. In this case, a Micro-Electro Mechanical Systems (MEMS) motor may be affixed within the micro connector 104b.

The operation of the plurality of antennas 102 may be controller by a microcontroller 106, which is communicatively coupled to the plurality of antennas 102. The microcontroller 106 selectively operates each of the plurality of antennas 102 to detect a frequency within an associated frequency band. By way of an example, the antenna 102a may be operated to detect frequencies in the frequency band that the antenna 102a is tuned to detect. In order to operate an antenna from the plurality of antennas 102, the scanning functionality of the antenna may be activated by the microcontroller 106.

In an embodiment, the microcontroller 106 may control the operation of each of the plurality of antennas 102 through a switch 108 in the near-field RF sniffer probe 100. The switch 108 may be communicatively coupled to the microcontroller 106 and the plurality of antennas 102. It will be apparent to a person skilled in the art that the near-field RF sniffer probe 100 is not limited to the switch 108 and may include multiple such switches to operate more antennas. By way of an example, one switch (for example, the switch 108) may be used to operate a set of four antennas.

The switch 108 may enable the microcontroller 106 to operate each of the plurality of antennas 102 individually one after the other. The switch 108 may additionally enable the microcontroller 106 to operate each of the plurality of antennas 102 based on a predefined sequence, which may be configured and later modified by a user. By way of an example, the microcontroller 106 may operate the antennas 102a-102d, such that, the antenna 102a is operated first, followed by the antenna 102b, the antenna 102c, and the antenna 102d in a sequence. The sequence may be repeated each time operation of the antenna 102d culminates. It will be apparent to a person skilled in the art that the predefined sequence may keep on changing in every subsequent iteration. By way of an example, in the first iteration the sequence may be: 102a→102b→102c→102d and in the second iteration, the sequence may be 102b→102d→102a→102c.

Additionally, the microcontroller 106 may operate each of the plurality of antennas 102 after periodic time intervals, which may be configured and later modified by a user. By way of an example, the microcontroller 106 may operate each of the antennas 102a-102d for a period of two seconds each, after expiry of which, the microcontroller 106 may switch to the next antenna in the sequence through the switch 108. Thus, the microcontroller 106 may first start operating the antenna 102a, and after expiry of two seconds, may switch to the antenna 102b and so on till the antenna 102d is operated for two seconds.

Thereafter, the microcontroller 106 may switch back to the antenna 102a in order to repeat the sequence till the near-field RF sniffer probe 100 is switched on and is in operation. It will be apparent to a person skilled in the art that the periodic time intervals for operation of each of the plurality of antennas 102 may not be fixed and may be varied. By way of an example, the microcontroller 106 may operate the antenna 102a for three seconds and may switch to the antenna 102b thereafter, which may be operated for two seconds, followed by the antenna 102c for five seconds, and the antenna 102d for one second. In an embodiment, these periodic time intervals may be fixed based on a frequency band that an antenna is tuned to detect.

The periodic time intervals or the rate at which the switch 108 switches between the plurality of antennas 102 may be controller and varied through a scanning speed module. The scanning speed module controls frequency scanning speed for each of the plurality of antennas 102. This is further explained in detail in conjunction with FIG. 2.

In order to determine one or more frequencies detected by the plurality of antennas 102, one or more filtering and matching modules 110 are communicatively coupled to the plurality of antennas 102. In the current embodiment, a unique filtering and matching module is coupled to each of the plurality of antennas 102. Thus, a filtering and matching module 110a is communicatively coupled to the antenna 102a, a filtering and matching module 110b is communicatively coupled to the antenna 102b, a filtering and matching module 110c is communicatively coupled to the antenna 102c, and a filtering and matching module 110d is communicatively coupled to the antenna 102d. In an embodiment, the near-field RF sniffer probe 100 may include a single filtering and matching module that is coupled to each of the plurality of antennas 102. In another embodiment, each of the one or more filtering and matching modules 110 may be implemented as a separate filtering module and a separate matching module.

Each of the one or more filtering and matching modules 110 may match a frequency with an associated antenna from the plurality of antennas 102 and may additionally provide maximum power at the output. By way of an example, the filtering and matching module 110a may match a frequency with the antenna 102a and may provide maximum power at the output of the filtering and matching module 110a. In an exemplary embodiment, each of the plurality of antennas 102 may be matched to 50 ohms with a coupled filtering and matching module. By way of an example, the antenna 102d may be matched to 50 ohms with the filtering and matching module 110d.

Additionally, each of the one or more filtering and matching modules 110 may filter “Out of band” signals and spurious emissions. As a result, only the frequencies that are intended to be detected are left and passed on for further analysis. In an embodiment, a matching circuit within each of the one or more filtering and matching modules 110 may be active/passive or fixed/tunable. Similarly, a filter circuit within each of the one or more filtering and matching modules 110 may be fixed/tunable.

The signals that are received as an output from the one or more filtering and matching modules 110 may need amplification before being passed on for further analysis. To this end, the near-field RF sniffer probe 100 may include one or more broadband pre-amplifiers 112 that amplify output of the one or more filtering and matching modules 110. The one or more broadband pre-amplifiers 112 may be coupled to the microcontroller 106 and may include a broadband pre-amplifier 112a that may be coupled to the filtering and matching modules 110a, a broadband pre-amplifier 112b that may be coupled to the filtering and matching modules 110b, a broadband pre-amplifier 112c that may be coupled to the filtering and matching modules 110c, and a broadband pre-amplifier 112d that may be coupled to the filtering and matching modules 110d. The microcontroller 106 may control the amplification factor for the one or more broadband pre-amplifiers 112.

After amplification, information related to one or more detected frequencies may be sent through the switch 108 to a spectrum analyzer 114, via an interface (not shown in FIG. 1). The interface, for example, may be a coaxial cable. Alternatively, the interface may be a Fiber-Optic cable coupling for high frequency signals that are greater than 30GHz. The spectrum analyzer 114 may measure the one or more detected frequencies and may provide readings associated with the one or more detected frequencies. In an embodiment, the near-field RF sniffer probe 100, while in operation, is continuously connected to the spectrum analyzer 114.

In order to provide portability, the near-field RF sniffer probe 100 may include a battery 116, which may be rechargeable or replaceable. Alternatively, the near-field RF sniffer probe 100 may be directly connected to a power source by way of an adapter (not shown in FIG. 1). The battery 116 may provide power to each component within the near-field RF sniffer probe 100 in order to detect one or more frequencies in the plurality of frequency bands. The operation of the near-field RF sniffer probe 100 may be controlled by a button 118, which may be a push button or a switch, that may be activated to turn on the near-field RF sniffer probe 100 and may be deactivated to turn off the near-field RF sniffer probe 100. When the button 118 is activated, the microcontroller 106 may get activated from sleep and initiate operating the plurality of antennas 102. The button 118 may thus facilitate in conserving the battery 116 by activating the microcontroller 106 only when required. In an embodiment, the button 118 may be replaced with one or more sensors. This is explained in detail in conjunction with FIG. 2.

The near-field RF sniffer probe 100 may further include a memory (not shown in FIG. 1) coupled to the microcontroller 106. The memory may be used to store configuration data for the microcontroller 106 in order to operate the one or more filtering and matching modules 110, the one or more broadband Pre-amplifiers 112, the switch 108, the plurality of antennas 102, and the plurality of micro connectors 104. In an embodiment, the configuration data may be provided by a computing device 120 that may be communicatively coupled to the microcontroller 106 via an interface (not shown in FIG. 1). The configuration data may include, but is not limited to frequency scanning speeds, the plurality of key combinations, lock known antennas, probe calibration, or amplification factor. The computing device 102, for example, may include, but is not limited to a desktop, a laptop, a smart phone, or a tablet. A user may configure the near-field RF sniffer probe 100 through a Graphical User Interface (GUI) on the computing device 120. The interface, for example, may include, but is not limited to Universal Asynchronous Receiver-Transmitter (UART), Universal Serial Bus (USB), micro USB, or Ethernet.

Referring now to FIG. 2, a schematic diagram of a near-field RF sniffer probe 200 is illustrated, in accordance with another embodiment. In addition to the components and modules in the near-field RF sniffer probe 100, the near-field RF sniffer probe 200 may include a scanning speed module 202 that is communicatively coupled to the microcontroller 106. The scanning speed module 202 controls frequency scanning speed for each of the plurality of antennas 102. In other words, a user may interact with the scanning speed module 202 to control the time period for which each of the plurality of antennas 102 is to be operated in order to detect one or more frequencies in the plurality of frequency bands.

The scanning speed module 202 further includes a plurality of keys 204 (for example, Keys A, B, C, and D). There may be a plurality of key combinations for the plurality of keys 204. Each of the plurality of key combinations is associated with a predefined frequency scanning speed for one or more of the plurality of antennas 102. By way of an example, when only the key A is pressed, the microcontroller 106 may operate the plurality of antennas 102, such that, two seconds are spent for operating each of the plurality of antennas 102, before switching to a subsequent antenna in the sequence. Similarly, the key B may be linked with five seconds per antenna, the key C may be linked with 8 seconds per antenna, and the key D may be linked with 10 seconds per antenna. By way of another example, simultaneous pressing of two or more keys may result in addition, subtraction, or multiplication of the associated scanning speeds.

When the key A and the key B are pressed simultaneously, it may lead to multiplication of the associated scanning speeds.

In an embodiment, the plurality of keys 204 may also be used to determine the sequence in which the plurality of antennas 102 are to be operated. By way of an example, pressing the key A may indicate that the plurality of antenna 102 have to be operated in the following sequence: 102a→102b→102c→102d. Similarly, pressing the key B may indicate that the sequence is: 102a→102d→102b→102c and pressing the key C may indicate that only even numbered antenna are to be operated.

In order to indicate a currently active key combination from the plurality of key combinations, the near-field RF sniffer probe 200 may include a display module 206 that is communicatively coupled to the microcontroller 106. The display module 206 may include one of Light Emitting Diodes (LED) lights, a Liquid Crystal Diode (LCD) screen, or a touch screen. When the display module 206 includes one or more LED lights, the current frequency scanning speed or the currently active key combination may be indicated by blinking pattern of the one or more LED lights. Alternatively, when the display module 206 is an LCD screen, the current frequency scanning speed or the currently active key combination may be displayed on the LCD screen. Further, when the display module 206 is a touch screen, in addition to displaying the current frequency scanning speed, the display module 206 may also display a plurality of touch buttons, which can be activated by the user to activate one or more of the plurality of key combinations. In this case, the near-field RF sniffer probe 200 may not include the scanning speed module 202, as the display module 206 may perform functionality of the scanning speed module 202.

To further control the operation of the near-field RF sniffer probe 200, one or more sensors 208 may be used. The one or more sensors 208 may be communicatively coupled to the microcontroller 106 and may control activation and deactivation of the microcontroller 106. Examples of the one or more sensors 208 may include, but are not limited to one or more of proximity sensor, pressure sensor, or motion sensor. By way of an example, shaking the near-field RF sniffer probe 200 with a predefined intensity may activate a motion sensor in the near-field RF sniffer probe 200, which may further activate the microcontroller 106. In a similar manner, a subsequent shaking of the near-field RF sniffer probe 200 with the predefined intensity may deactivate the microcontroller 106. By way of another example, holding the near-field RF sniffer probe 200, such that, a hand of a user covers a proximity sensor, may activate the microcontroller 106. Releasing the hand may lead to deactivation of the microcontroller 106. The one or more sensors 208 may be used in addition to the button 118. Alternatively, the one or more sensors 208 may replace the button 118.

In addition to the near-field RF sniffer probe 100 and the near-field RF sniffer probe 200, another implementation of a near-field RF sniffer probe is illustrated in FIG. 3.

Referring now to FIG. 3, a schematic diagram of a near-field receiver 300 that may be attached to and detached from an RF sniffer probe 302 is illustrated, in accordance with an exemplary embodiment. Attaching the near-field receiver 300 with the RF sniffer probe 302 may result into one of the near-field RF sniffer probe 100 or the near-field RF sniffer probe 200.

The near-field receiver 300 includes the plurality of antennas 102 and the plurality of micro connectors 104. This has already been explained in detail in conjunction with FIG. 1. The near-field receiver 300 further includes a connecting module 304 that enables the near-field receiver 300 to attach with the RF sniffer probe 302. The connecting module 304 further enables detachment of the near-field receiver 300 from the RF sniffer probe 302, without damaging either the near-field receiver 300 or the RF sniffer probe 302.

Similarly, the RF sniffer probe 302 includes a connecting module 306 that is configured to receive the near-field receiver 300. Each of the connecting module 304 and the connecting module 306 cooperate with each other in order to form a near-field RF sniffer probe. The functionality of this near-field RF sniffer probe is same as that of the near-field RF sniffer probe 100 and the near-field RF sniffer probe 200. Once the connecting modules 304 and 306 are interlocked, a microcontroller 308 becomes aware of such connection and is activated. Thereafter, the microcontroller 308 is able to operate the plurality of antennas 102 through a switch 310. The plurality of antennas 102 are further able to communicate with a filtering and matching module 312, which is further coupled to a broadband pre-amplifier 314. After amplification in the broadband pre-amplifier 314, information related to one or more detected frequencies may be sent through the switch 108 to the spectrum analyzer 114, via an interface (not shown in FIG. 2). The RF sniffer probe 302 further includes a battery 316 and a button 318. The RF sniffer probe 302 may also be coupled to the computing device 120 via the microcontroller 308 in order to receive configuration data for the microcontroller 308. This has been explained in detail in conjunction with FIG. 1. Each of the components in the RF sniffer probe 302 have similar functionalities as the analogous components in the near-field RF sniffer probes 100 and 200. It will be apparent to a person skilled in the art that the RF sniffer probe 302 may include any component illustrated in the near-field RF sniffer probes 100 and 200.

A near-field RF sniffer probe thus provided is a low cost and compact hand-held device for radio engineers. The near-field RF sniffer probe includes multiple antennas, each of which is tuned to a unique frequency band. As a result, a wide range of frequency bands can be scanned by a single near-field RF sniffer probe. Moreover, the scanning and switching speed between the multiple antennas is also adjustable. The output of the near-field RF sniffer probe is integrated to a spectrum analyzer, resulting in real-time analysis of the detected frequencies. Additionally, the near-field RF sniffer probe may include optional active tuning for specific frequency bands and an optional pre-amplification to detect low power noise/signal. The near-field RF sniffer probe is battery operated and thus may have better floor noise. As a result of the above advantages, the near-field RF sniffer probe troubleshoots a radio device within three to four hours, when compared to three to four days taken by conventional RF sniffer probes.

The illustrated steps are set out to explain the exemplary embodiments shown, and it should be anticipated that ongoing technological development will change the manner in which particular functions are performed. These examples are presented herein for purposes of illustration, and not limitation. Alternatives (including equivalents, extensions, variations, deviations, etc., of those described herein) will be apparent to persons skilled in the relevant art(s) based on the teachings contained herein. Such alternatives fall within the scope and spirit of the disclosed embodiments.

It is intended that the disclosure and examples be considered as exemplary only, with a true scope and spirit of disclosed embodiments being indicated by the following claims.

We Claim:

1. A near-field Radio Frequency (RF) sniffer probe (100) comprising:

a plurality of antennas (102), wherein each of the plurality of antennas (102) is configured to detect a unique frequency band from a plurality of frequency bands; and

a microcontroller (106) communicatively coupled to the plurality of antennas (102), wherein the microcontroller (106) selectively operates each of the plurality of antennas (102) to detect a frequency within an associated frequency band.

2. The near-field RF sniffer probe (100) of claim 1, further comprising at least one filtering and matching module (110) communicatively coupled to the plurality of antennas (102) and the microcontroller (106), wherein the at least one filtering and matching module (110) matches a frequency band to an associated antenna from the plurality of antennas (102).

3. The near-field RF sniffer probe (100) of claim 2, wherein each of the plurality of antennas (102) is coupled to a unique filtering and matching module from the at least one filtering and matching module (110).

4. The near-field RF sniffer probe (100) of claim 1, further comprising at least one switch (108) communicatively coupled to the microcontroller (106) and the plurality of antennas (102), wherein the microcontroller (106) selectively operates each of the plurality of antennas (102) through the at least one switch (108).

5. The near-field RF sniffer probe (100) of claim 4, wherein the at least one switch (108) enables the microcontroller (106) to operate each of the plurality of antennas (102) individually.

6. The near-field RF sniffer probe (100) of claim 4, wherein the at least one switch (108) enables the microcontroller (106) to operate each of the plurality of antennas (102) after periodic time intervals in a predefined sequence.

7. The near-field RF sniffer probe (100) of claim 1, further comprising a scanning speed module (202) to control frequency scanning speed for each of the plurality of antennas (102).

8. The near-field RF sniffer probe (100) of claim 7, wherein the scanning speed module (202) comprises a plurality of keys (204), and wherein each of a plurality of key combinations for the plurality of keys (204) is associated with a predefined frequency scanning speed for at least one of the plurality of antennas (102).

9. The near-field RF sniffer probe (100) of claim 8, further comprising a display module (206) configured to indicate a currently active key combination from the plurality of key combinations.

10. The near-field RF sniffer probe (100) of claim 1, further comprising a plurality of micro connectors (104), wherein each of the plurality of micro connectors (104) cooperates with an antenna from the plurality of antennas (102).

11. The near-field RF sniffer probe (100) of claim 10, wherein a micro connector from the plurality of micro connectors (104) receives an antenna from the plurality of antennas (102), and wherein the micro connector enables unrestricted orientations for the antenna received by the micro connector.

12. The near-field RF sniffer probe (100) of claim 10, wherein a micro connector from the plurality of micro connectors (104) enables detachment of an antenna received by the micro connector.

13. The near-field RF sniffer probe (100) of claim 1, further comprising at least one sensor (208) for controlling activation and deactivation of the near-field RF sniffer probe (100).

14. The near-field RF sniffer probe (100) of claim 1, further comprising an interface to a spectrum analyzer (114), wherein the interface enables sending information related to at least one frequency detected by at least one of the plurality of antennas (102) to the spectrum analyzer (114) for further analysis.

15. A near-field receiver (300) for sniffing a plurality of frequency bands, the near-field receiver (300) comprising:

a plurality of antennas (102), wherein each of the plurality of antennas (102) is configured to detect a unique frequency band from a plurality of frequency bands, and wherein a microcontroller (308) selectively operates each of the plurality of antennas (102) to detect at least one frequency in an associated frequency band.

16. The near-field receiver (300) of claim 15, further comprising a connecting module (304) configured to:

attach the near-field receiver (300) to a Radio Frequency (RF) sniffer probe (302); and

detach the near-field receiver (300) from the RF sniffer probe (302).

17. The near-field receiver (300) of claim 15, further comprising a plurality of micro connectors (104), wherein each of the plurality of micro connectors (104) cooperates with an antenna from the plurality of antennas (102).

18. The near-field receiver (300) of claim 17, wherein each of the plurality of micro connectors (104) comprises a Micro-Electro Mechanical Systems (MEMS) motor to enable unrestricted orientations for an antenna received by a micro connector from the plurality of micro connectors (104).

19. A Radio Frequency (RF) sniffer probe (302) comprising:

a connecting module (306) configured to receive a near-field receiver (300) comprising a plurality of antennas (102), wherein each of the plurality of antennas (102) is configured to detect a unique frequency band from a plurality of frequency bands; and

a microcontroller (308) communicatively configured to selectively operate each of a plurality of antennas (102) to detect a frequency within an associated frequency band.

20. The RF sniffer probe (302) of claim 19, wherein the connecting module (306) is further configured to detach the near-field receiver (300) from the RF sniffer probe (302).

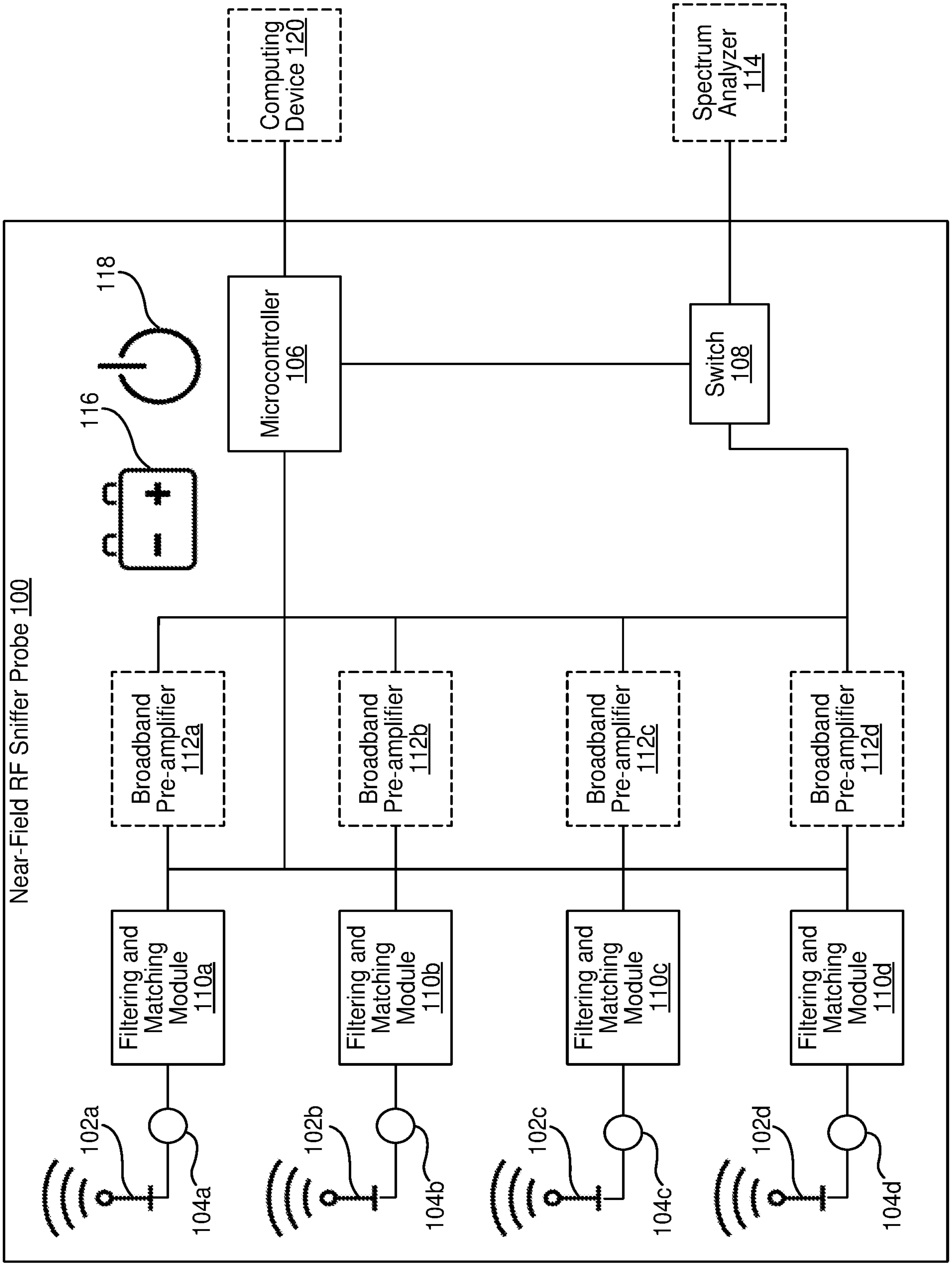
Computing Device 120
Spectrum Analyzer 114
Near-Field RF Sniffer Probe 100
116
118
Microcontroller 106
Switch 108
Broadband Pre-amplifier 112a
Broadband Pre-amplifier 112b
Broadband Pre-amplifier 112c
Broadband Pre-amplifier 112d
Filtering and Matching Module 110a
Filtering and Matching Module 110b
Filtering and Matching Module 110c
Filtering and Matching Module 110d
102a
102b
102c
102d
104a
104b
104c
104d

FIG. 1

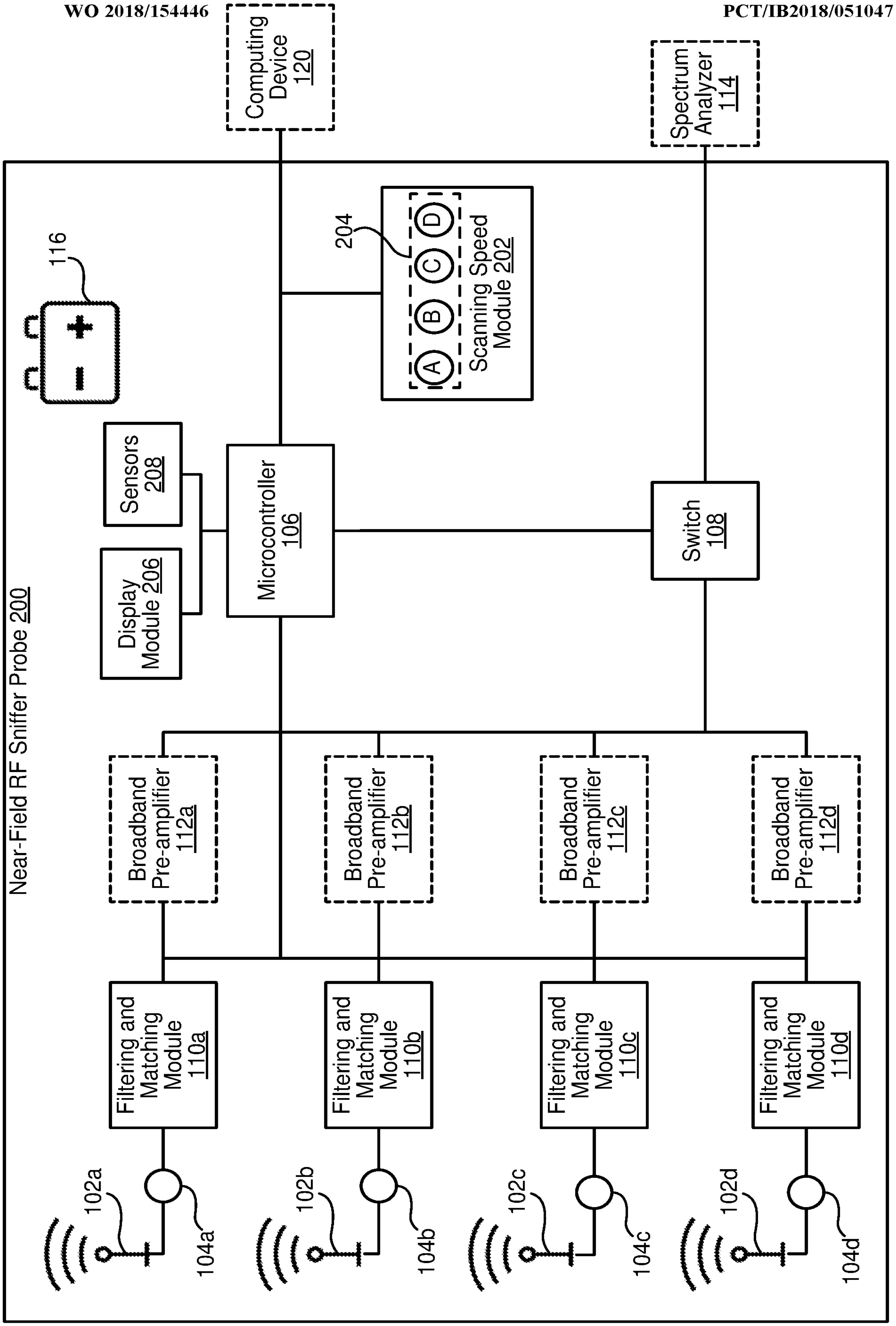
Computing Device 120
Spectrum Analyzer 114
Near-Field RF Sniffer Probe 200
116
204
A
B
C
D
Scanning Speed Module 202
Sensors 208
Display Module 206
Microcontroller 106
Switch 108
Broadband Pre-amplifier 112a
Broadband Pre-amplifier 112b
Broadband Pre-amplifier 112c
Broadband Pre-amplifier 112d
Filtering and Matching Module 110a
Filtering and Matching Module 110b
Filtering and Matching Module 110c
Filtering and Matching Module 110d
102a
102b
102c
102d
104a
104b
104c
104d

FIG. 2

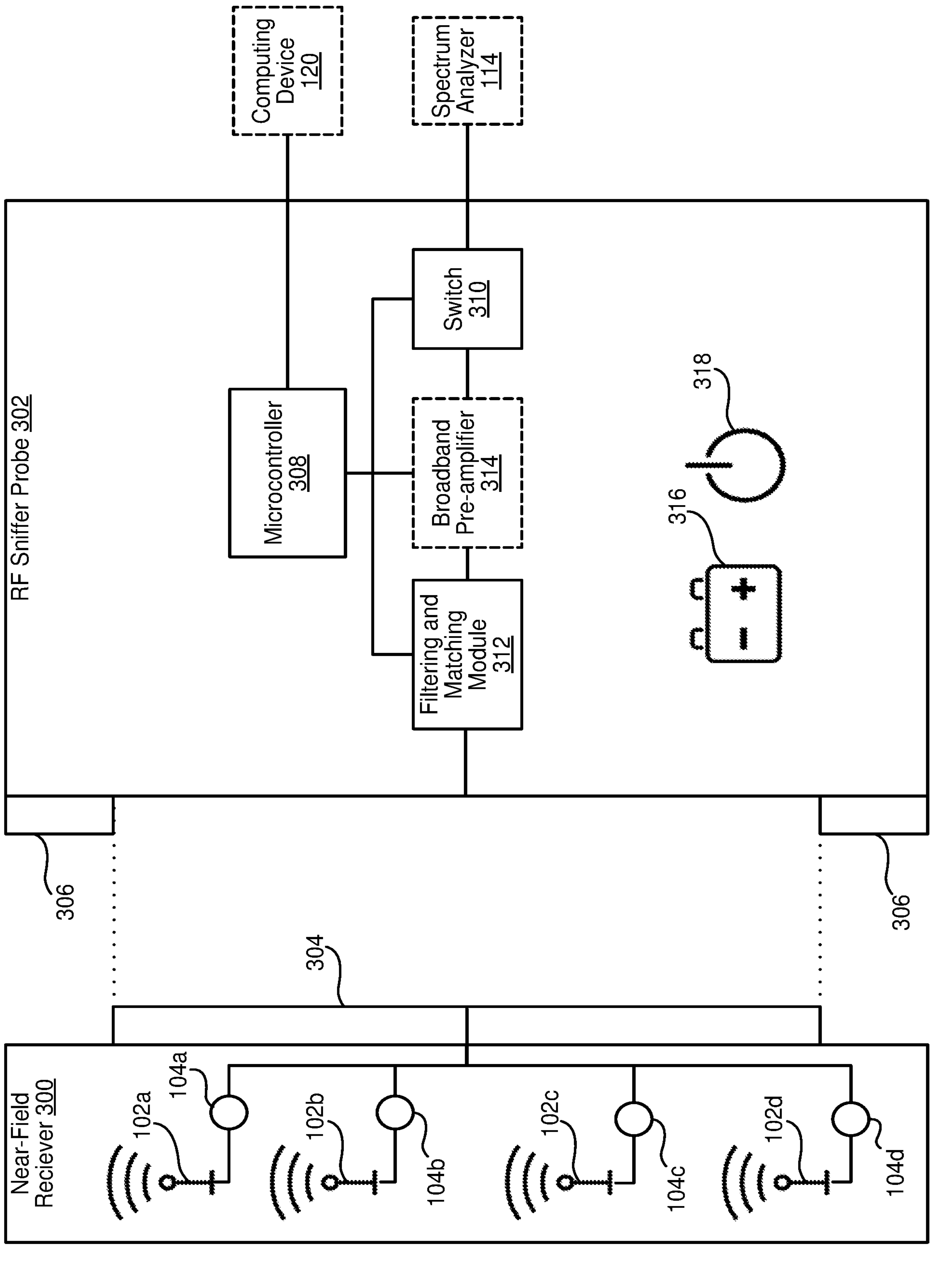
Computing Device 120
Spectrum Analyzer 114
RF Sniffer Probe 302
Microcontroller 308
Switch 310
Broadband Pre-amplifier 314
Filtering and Matching Module 312
318
316
306
306
304
Near-Field Reciever 300
102a
104a
102b
104b
102c
104c
102d
104d

FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2018/051047

A. CLASSIFICATION OF SUBJECT MATTER
H04B1/72,H01Q5/00,G01S13/00 Version=2018.01

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)

H04B, H01Q, G01S

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DATABASES:- PATSEER, IPO INTERNAL, TOTAL PATENT ONE
KEYWORDS:- PLURALITY, ANTENNAS, CONTROLLER, MULTI-FREQUENCIES

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US20160282462 A1 (BOEING CO(US)) 29 September 2016 (29-09-2016) ABSTRACT; FIGURES 3, 4; PARAGRAPHS [0033], [0044]	1-20
Y	WO2013155793 A1 (ZTE CORP(CN)) 24 October 2013 (24-10-2013) ABSTRACT; SUMMARY OF THE INVENTION, PARAGRAPHS 8-13; FIGURES 8, 9; DETAILED DESCRIPTION, PARAGRAPHS 15-19	1-20

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

* Special categories of cited documents:
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"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
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"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
16-04-2018	16-04-2018

Name and mailing address of the ISA/	Authorized officer
Indian Patent Office Plot No.32, Sector 14,Dwarka,New Delhi-110075 Facsimile No.	Saurabh Dwivedi Telephone No. +91-1125300200

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IB2018/051047

Citation	Pub.Date	Family	Pub.Date
US 20160282462 A1	29-09-2016	EP 3073574 A1	28-09-2016
		KR 1020160115714 A	06-10-2016
		CN 106019233 A	12-10-2016
		JP 2017038347 A	16-02-2017
		RU 2015154334 A	22-06-2017
WO 2013155793 A1	24-10-2013	CN 103378887 A	30-10-2013
		CN 103378887 B	25-08-2017