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(54) **An antenna device, an antenna system and a portable radio communication device comprising such an antenna device**

(57) The present invention relates to an antenna device for a portable radio communication device, wherein the antenna device comprises an elongated radiating el-

ement (1) configured to, in a first state, work as an electric resonant monopole antenna and to, in a second state, work as a magnetic resonant half-loop antenna.

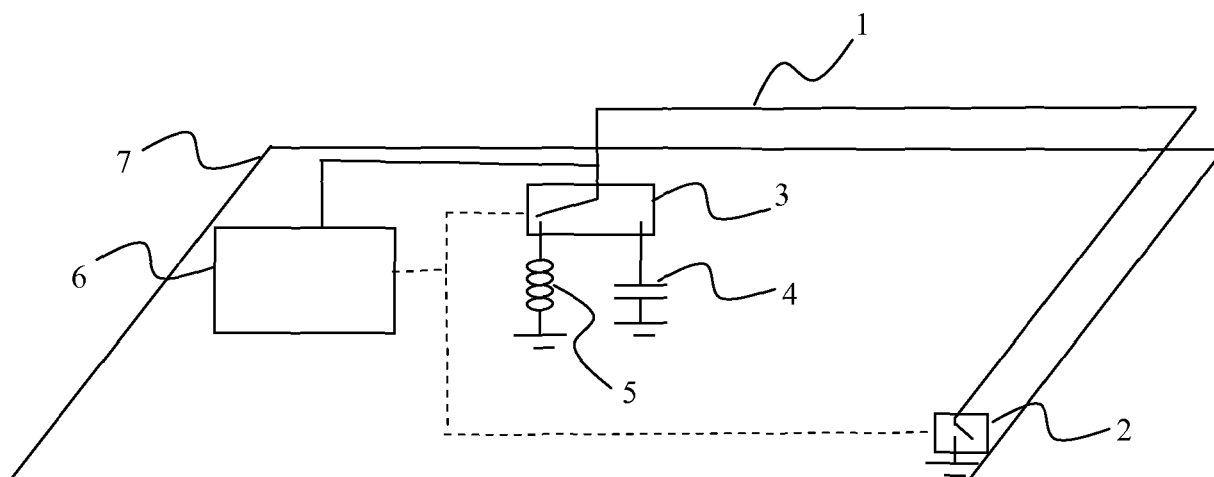


FIG. 1

Description

FIELD OF INVENTION

[0001] The present invention relates generally to antenna devices and more particularly to an antenna device for use in a portable radio communication device providing a diversity function.

BACKGROUND

[0002] The application of internal antennas in a mobile phone puts some constraints on the configuration of the radiating element of the antenna. In particular, in a portable radio communication device the space for an internal antenna device is limited. These constraints may make it difficult to find a configuration of the antenna device that provides for desired use.

[0003] One specific application operating in a relatively low frequency band is the FM radio application. The FM operating band is defined as frequencies between 88-108 MHz in most of the world and frequencies between 76-90 MHz in Japan. Prior art conventional antenna configurations, such as loop antennas or monopole antennas, fitted within the casing of a portable radio communication device will result in unsatisfactory operation in that the antenna either has too bad performance over a sufficiently wide frequency band or sufficient performance over a too narrow frequency band.

[0004] Instead, a conventional FM antenna for portable radio communication devices is usually provided in the headset wire connected to the communication device. This configuration with a relatively long wire permits an antenna length that is sufficient also for low frequency applications. However, if no external antenna is permitted due to design choices, this solution is obviously not feasible.

[0005] The interaction between antenna, telephone body and close-by environment, such as e.g. the user himself, will become more important as the wireless terminals become smaller and smaller. It is thus a formidable task to manufacture such compact and versatile terminals, which exhibit good antenna performance under a variety of conditions.

[0006] Further, a portable radio communication device is today many times provided with frequency operational coverage for other frequency bands than FM, such as GSM900, GSM1800, GPS, BT, WLAN, WCDMA and GPS. A portable radio communication device has limited space and it is thus desirable to, if possible, add multiple functionality to an antenna device.

SUMMARY OF THE INVENTION

[0007] An object of the present invention is to provide an antenna device for a portable radio communication device, which efficiently utilizes available space of the portable radio communication device and is adaptable

to varying communication environment.

[0008] This object, among others, is according to the present invention attained by an antenna device, an antenna system and a portable radio communication device, respectively, as defined by the appended claims.

[0009] By providing an antenna device for a portable radio communication device, wherein the antenna device comprises an elongated radiating element, first switching means connected between a first end of the elongated radiating element and ground, and second switching means connected between a second end of the elongated radiating element, opposite the first end thereof, and first filtering means and second filtering means, wherein the first switching means is configured to connect the elongated radiating element to ground when the second switching means is configured to connect the elongated radiating element to the first filtering means, and the first filtering means is configured to disconnect the elongated radiating element from ground when the second switching means is configured to connect the elongated radiating element to the second filtering means, an antenna device able to work as an electric resonant antenna and as a magnetic resonant antenna with a single radiating element is provided.

[0010] Preferably the second end of the elongated radiating element is configured to be connected to a FM receiver.

[0011] Preferably, the antenna device is further configured for simultaneous multi frequency band operation wherein four different antennas are combined into one antenna device providing simultaneous operation with good isolation between all antennas as well as good performance for all antennas.

[0012] The configuration of the antenna device is preferably such that it effectively works as a monopole antenna for BT, GPS and WCDMA Rx operating frequencies, respectively, and as a magnetic resonant antenna for FM operating frequencies in a default mode, and effectively work as an electric resonant monopole antenna for FM operating frequencies in a diversity mode.

[0013] By preferably supporting the first, second and third elongated radiating elements on a dielectric carrier a cost efficient and robust installation of the antenna device is provided. Advantageously the dielectric carrier is part of the back cover of the portable radio communication device.

[0014] Preferably the first, second, fifth, seventh and eighth filtering means are provided as RF chokes, whereby good quality blocking is achieved, and the third, fourth and sixth filtering means are preferably provided as capacitors, whereby low cost blocking is achieved. By alternatively providing the first, second, fifth, seventh and eighth filtering means as a simple inductances low cost blocking is achieved.

[0015] By preferably connecting the third filtering means to the second elongated radiating element close to the second filtering means and configuring the second and third filtering means together to block GPS operating

frequencies, in order to improve isolation between BT and GPS operation. Alternatively, the third filtering means is connected to the second elongated radiating element close to the first filtering means and the first and third filtering means are together configured to block GPS operating frequencies.

[0016] Further preferred embodiments are defined in the dependent claims.

BRIEF DESCRIPTION OF DRAWINGS

[0017] The present invention will become more fully understood from the detailed description of embodiments given below and the accompanying figures, which are given by way of illustration only, and thus, are not limitative of the present invention, wherein:

FIG. 1 is a schematic diagram showing a first embodiment of an antenna device according to the present invention.

FIG. 2 is a schematic diagram showing a second embodiment of an antenna device of the present invention.

FIG. 3 is a schematic diagram showing a third embodiment of an antenna device according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0018] In the following description, for purpose of explanation and not limitation, specific details are set forth, such as particular techniques and applications in order to provide a thorough understanding of the present invention. However, it will be apparent for a person skilled in the art that the present invention may be practiced in other embodiments that depart from these specific details. In other instances, detailed description of well-known methods and apparatuses are omitted so as not to obscure the description of the present invention with unnecessary details.

[0019] In the following description and claims, the term radiating element is used. It is to be understood that this term is intended to cover electrically conductive elements configured for receiving and/or transmitting radio signals. Further the term IFA type antenna is also used, which is to be understood as a radiating element comprising feeding and grounding points in one end thereof and the other end being open. Also, the term loop type antenna is used, which is to be understood as an antenna having an effective radiating structure of essentially a loop. The term a magnetic resonant antenna is to be understood as a radiator of magnetic nature made resonant with a matching component for FM frequencies. The term an electric resonant monopole antenna is to be understood as a radiator of electric nature made resonant with a matching component for FM frequencies.

[0020] An antenna device for a portable radio communication device according to a first embodiment of the present invention will now be described with reference to Fig. 1.

5 [0021] The antenna device comprises an elongated radiating element 1, first switching means 2 and second switching means 3. The first switching means 2 is connected to a first end of the elongated radiating element 1 and to ground, and the second switching means 3 is connected to a second end of the elongated radiating element 1, opposite the first end thereof, to first filtering means 4 and to second filtering means 5.

10 [0022] The first filtering means 4 is connected between the second filtering means 3 and ground. The first filtering means 4 is capacitive, and is in a simple form provided as a capacitor of about 30 pF. The second filtering means 5 is connected between the second filtering means 3 and ground. The second filtering means 5 is inductive, and is in a simple form provided as an inductor of about 470 nH.

20 [0023] The second end of the elongated radiating element 1 is also connected to a FM receiver 6. The elongated radiating element 1 is preferably positioned over a printed wiring board 7 of the portable radio communication device, providing a ground plane for the elongated radiating element 1.

25 [0024] The elongated radiating element 1 is configured to provide a diversity function for the FM receiver 6, working as an electric resonant monopole antenna in a first state, diversity mode, and working as a magnetic resonant half-loop antenna in a second state, default mode.

30 [0025] In the first state the first switching means 2 disconnects the first end of the elongated radiating element 1 from ground, making the first end of the elongated radiating element 1 being open ended. In the first state the second switching means 3 connects the second end of the elongated radiating element 1 to the second filtering means 5, which tunes the elongated radiating element 1 to FM frequencies.

35 [0026] In the second state the first switching means 2 connects the first end of the elongated radiating element 1 to ground, and the second switching means 3 connects the second end of the elongated radiating element 1 to the first filtering means 4, which tunes the elongated radiating element 1 to FM frequencies.

40 [0027] Further, a high impedance amplifier, together with associated components, such as ESD protection components, is preferably provided between the FM receiver 6 and the elongated radiating element 1.

45 [0028] The FM receiver 6 preferably selects which state to work the FM antenna in, based on signal quality. The FM receiver 6 utilizes one or more of the following diversity functions. A user interaction diversity, wherein a user close to or holding the portable radio communication device affects an electric resonant monopole antenna more than a magnetic resonant half-loop antenna. An EMI diversity, wherein EMI (electromagnetic interference) or other environmental noise is dominated by either

a electronic or magnetic component. A pattern diversity, wherein the reception pattern is likely not equally strong in different directions of the FM antenna. A polarization diversity, wherein reception polarization is likely not equally strong in different polarizations of the FM antenna.

[0029] The FM antenna and the FM receiver together make up an antenna system. The antenna system preferably comprises a FM transceiver instead of a FM receiver, providing the same diversity function for FM reception as with only a FM receiver. The state of the FM antenna for FM transmission is preferably based on which state provides the highest gain during design of the FM antenna and the portable radio communication device.

[0030] The processing technique for the diversity function could e.g. use switching and selecting.

[0031] An antenna device for a portable radio communication device according to a second embodiment of the present invention will now be described with reference to Fig. 2.

[0032] The antenna device comprises a first elongated radiating element 10, a second elongated radiating element 11, and a third elongated radiating element 12. The antenna device further comprises first filtering means 13 connected between a first end of the first elongated radiating element 10 and a first end of the second elongated radiating element 11, and second filtering means 14 connected between a second end of the second elongated radiating element 11, opposite the first end thereof, and a first end of the third elongated radiating element 12. The second radiating element 12 is connected to ground through third filtering means 15.

[0033] A second end of the first elongated radiating element 10, opposite the first end thereof, is connected to fourth filtering means 16, which in turn is connected to a BT (Bluetooth) transceiver 17 and first switching means 18. The first switching means 18 is also connected to ground through eighth filtering means 32, which serves as a matching component for the BT transceiver.

[0034] A second end of the third elongated radiating element 12, opposite the first end thereof, is connected to a WCDMA (Wideband Code Division Multiple Access) Rx receiver 19, preferably a diversity receiver, and a GPS receiver 20. The WCDMA receiver 19 and GPS receiver 20 are preferably connected through a WCDMA/GPS diplexer 21, which diplex filter 21 e.g. is implemented as a standard component or integrated on chips. Additionally, a matching network 22 is preferably provided between the diplex filter 21 and the second end of the third radiating element 12, for matching of the WCDMA receiver 19. The matching network 22 is preferably a capacitor of about 0.5 pF.

[0035] A FM transceiver 23 is connected to fifth filtering means 24, which in turn is connected to the first elongated radiating element 10 close to the second end thereof, and to second switching means 25. The second switching means 25 is further connected to ground through sixth

filtering means 26 and seventh filtering means 27, respectively.

[0036] Third switching means 28 is connected between ground and the third radiating element 12 close to the second end thereof.

[0037] In a first state, default mode, of the antenna device the first switching means 18 disconnects the BT transceiver from the eighth filtering means 32, the second switching means 25 connects the first elongated radiating element 10 to the sixth filtering means 26, and the third filtering means 28 connects the third elongated radiating element 12 to ground. In this way the FM receiver 23 exhibits a magnetic resonant loop structure, and the BT, GPS and WCDMA receivers exhibit a monopole structure.

[0038] In a second state, diversity mode, of the antenna device the first switching means 18 connects the BT transceiver to the eighth filtering means 32, the second switching means 25 connects the first elongated radiating element 10 to the seventh filtering means 27, and the third filtering means 28 disconnects the third elongated radiating element 12 from ground. In this way the FM receiver 23 exhibits an electric resonant monopole structure, and the BT transceiver 17 still exhibits a monopole structure, but the GPS receiver 20 and the WCDMA receiver 19 do no longer work in the diversity mode.

[0039] The first, second and third elongated radiating elements 10, 11 and 12 together have a length 29 configured for FM operation, about 110 mm. The first elongated radiating element 10 have a length 30 configured for BT operation, about 35 mm. The length between the connection point of the second switching means 25 on the first elongated radiating element 10 and the second end thereof is configured for matching of the BT transceiver 19, about 10 mm. The third elongated radiating element 12 has a length 31 configured for WCDMA Rx operation, about 35 mm. The length 32 for GPS operation is preferably about 70 mm. The length between the connection point of the third switching means 28 on the third elongated radiating element 12 and the second end thereof is configured for matching of the WCDMA Rx receiver 19, and is typically about 10 mm. The first filtering means 13 and the third filtering means 15 are together configured for blocking of GPS operation, and the length there between is about 5 mm. The exemplary lengths given above are dependent on e.g. distance above a ground plane device 7, in this case based on the distance of about 6 mm and filtering means values.

[0040] The first filtering means 13 is preferably provided as an RF choke, but could also be provided as a simple inductor, of about 20 nH, and could alternatively be provided as a parallel resonant circuit. The first filtering means 13 is in such a way configured to pass FM operation and to block BT operation. The second filtering means 14 is preferably provided as an RF choke, but could also be provided as a simple inductor, of about 15 nH, and could alternatively be provided as a parallel resonant circuit. The second filtering means 14 is in such a

way configured to pass FM and GPS operation and to block WCDMA operation. The third filtering means 15 is preferably provided as a capacitor of about 5 pF. The first and third filtering means 13 and 15 are in such a way configured to block GPS operation.

[0041] The fourth filtering means 16 is preferably provided as a capacitor of about 1 pF. The fourth filtering means 16 is in such a way configured to pass BT operation and to block FM operation. The fifth filtering means 24 is preferably provided as an inductor of about 56 nH. The fifth filtering means 24 is in such a way configured as a low pass filter for FM frequencies, and thus blocks e.g. BT operating frequencies. The antenna device is in such a way configured to simultaneously with FM frequencies operate at BT, GPS and WCDMA Rx frequencies.

[0042] In the default mode the antenna device thus exhibits a ground and feed point near the second end of the first elongated radiating element and an open end in first end of the first elongated radiating element, for BT frequencies. In the default mode the antenna device also exhibits a ground and feed point in the second end of the third elongated radiating element and an open end in the combined first and third filtering means, for GPS frequencies. In the default mode the antenna device further exhibits a ground and feed point in the second end of the third elongated radiating element and an open end in the second filtering means, for WCDMA frequencies. In the default mode the antenna device also exhibits a loop structure from the fifth filtering means to grounding near the second end of the third elongated radiating element 12, for FM frequencies. The antenna device needs no diplexer for implementing FM frequencies. The isolation between all antennas is good, as well as the performance of all antennas, for such an antenna device.

[0043] The first, second and third elongated radiating elements are preferably planar elements supported by a dielectric carrier, such as radiating portions on a dielectric flexible film supported by a carrier. The dielectric carrier is preferably a portion of the back cover of the portable radio communication device. Alternatively the dielectric carrier is e.g. a portion of the middle deck the portable radio communication device. With the first, second and third elongated radiating elements supported by a dielectric carrier the RF choke is preferably mounted thereon. Further, the first, second and third elongated radiating elements are alternatively self-supported, and the RF choke is in this case preferably mounted on a printed wiring board onto which the radiating elements are mounted on.

[0044] The antenna device preferably forms a half-loop radiating element for FM operation. A half-loop antenna is a virtual loop antenna, by being provided over a ground plane device 7 of the portable radio communication device. The second end of the first elongated radiating element 10 and the second end of the third elongated radiating element 12 protrudes out of the feed and ground for the FM loop structure, but these parts are seen

as open-ended stubs protruding from a loop, by the FM transceiver, which stubs affect FM operation very little.

[0045] The BT, GPS and WCDMA antennas utilize parts of the FM antenna, which antennas thus are added to an originally configured active FM antenna without essentially increasing utilization of available space in the portable radio communication device. All antennas are preferably configured to operate on their respective ground tone, which thereby minimizes their sensitivity to the environment.

[0046] Due to that the BT transceiver and the FM transceiver have feed points closely located on the first elongated radiating element 10 they can be provided as a single module combo transceiver without long transmission lines.

[0047] For configuration of the antenna device the first filtering means 13 is preferably positioned at the voltage maxima for the BT antenna, the second filtering means 14 is preferably positioned at the voltage maxima for the WCDMA antenna, and the third filtering means 15 is preferably positioned at the current maxima for the GPS antenna, respectively.

[0048] An antenna system for the first embodiment of the antenna device preferably comprises the antenna device, the switching means, the filtering means and the receivers and transceivers.

[0049] A third embodiment of an antenna device for a portable radio communication device according to the present invention is illustrated in Fig. 3. The main difference between the second embodiment and the third embodiment is that the GPS receiver is connected to the first elongated radiating element instead of the third elongated radiating element.

[0050] The antenna device comprises a first elongated radiating element 10, a second elongated radiating element 11, and a third elongated radiating element 12. The antenna device further comprises first filtering means 13 connected between a first end of the first elongated radiating element 10 and a first end of the second elongated radiating element 11, and second filtering means 14 connected between a second end of the second elongated radiating element 11, opposite the first end thereof, and a first end of the third elongated radiating element 12. The second radiating element 12 is connected to ground through third filtering means 15.

[0051] A second end of the first elongated radiating element 10, opposite the first end thereof, is connected to fourth filtering means 16, which in turn is connected to a BT (Bluetooth) transceiver 17, a GPS receiver 20, preferably connected through a BT/GPS diplexer 33, and first switching means 18. The first switching means 18 is also connected to ground through eighth filtering means 32. The diplex filter 33 is e.g. implemented as a standard component or integrated on chips.

[0052] A second end of the third elongated radiating element 12, opposite the first end thereof, is connected to a WCDMA (Wideband Code Division Multiple Access) Rx receiver 19, preferably a diversity receiver, Addition-

ally, a matching network 22 is preferably provided between the WCDMA receiver 19 and the second end of the third radiating element 12, for matching of the WCDMA receiver 19. The matching network 22 is preferably a capacitor of about 0.5 pF.

[0053] A FM transceiver 23 is connected to fifth filtering means 24, which in turn is connected to the first elongated radiating element 10 close to the second end thereof, and to second switching means 25. The second switching means 25 is further connected to ground through sixth filtering means 26 and seventh filtering means 27, respectively.

[0054] Third switching means 28 is connected between ground and the third radiating element 12 close to the second end thereof.

[0055] In a first state, default mode, of the antenna device the first switching means 18 disconnects the fourth filtering means 16 from the eighth filtering means 32, the second switching means 25 connects the first elongated radiating element 10 to the sixth filtering means 26, and the third filtering means 28 connects the third elongated radiating element 12 to ground. In this way the FM receiver 23 exhibits a magnetic resonant loop structure, and the BT, GPS and WCDMA receivers exhibit an monopole structure.

[0056] In a second state, diversity mode, of the antenna device the first switching means 18 connects the fourth filtering means 16 to the eighth filtering means 32, the second switching means 25 connects the first elongated radiating element 10 to the seventh filtering means 27, and the third filtering means 28 disconnects the third elongated radiating element 12 from ground. In this way the FM receiver 23 exhibits an electric resonant monopole structure, and the BT transceiver 17 still exhibits a monopole structure, but the GPS receiver 20 and the WCDMA receiver 19 do no longer work in the diversity mode.

[0057] The first, second and third elongated radiating elements 10, 11 and 12 together have a length 29 configured for FM operation, about 110 mm. The first elongated radiating element 10 have a length 30 configured for BT operation, about 35 mm. The length between the connection point of the second switching means 25 on the first elongated radiating element 10 and the second end thereof is configured for matching of the BT transceiver 19, about 10 mm. The third elongated radiating element 12 has a length 31 configured for WCDMA Rx operation, about 35 mm. The length 32 for GPS operation is preferably about 70 mm. The length between the connection point of the third switching means 28 on the third elongated radiating element 12 and the second end thereof is configured for matching of the WCDMA Rx receiver 19, and is typically about 10 mm. The second filtering means 13 and the third filtering means 15 are together configured for blocking of GPS operation, and the length there between is about 5 mm. The exemplary lengths given above are dependent on e.g. distance above a ground plane device 7, in this case based on the distance of about 6 mm and filtering means values.

[0058] The first filtering means 13 is preferably provided as an RF choke, but could also be provided as a simple inductor, of about 20 nH, and could alternatively be provided as a parallel resonant circuit. The first filtering means 13 is in such a way configured to pass FM and GPS operation and to block BT operation. The second filtering means 14 is preferably provided as an RF choke, but could also be provided as a simple inductor, of about 15 nH, and could alternatively be provided as a parallel resonant circuit. The second filtering means 14 is in such a way configured to pass FM operation and to block WCDMA operation. The third filtering means 15 is preferably provided as a capacitor of about 5 pF. The second and third filtering means 13 and 15 are in such a way configured to block GPS operation.

[0059] The fourth filtering means 16 is preferably provided as a capacitor of about 1 pF. The fourth filtering means 16 is in such a way configured to pass BT operation and to block FM operation. The fifth filtering means 24 is preferably provided as an inductor of about 56 nH. The fifth filtering means 24 is in such a way configured as a low pass filter for FM frequencies, and thus blocks e.g. BT operating frequencies. The antenna device is in such a way configured to simultaneously with FM frequencies operate at BT, GPS and WCDMA Rx frequencies.

[0060] Due to that the BT transceiver, the FM transceiver and the GPS receiver have feed points closely located on the first elongated radiating element 10 they can be provided as a single module combo transceiver without long transmission lines.

[0061] For configuration of the antenna device the first filtering means 13 is preferably positioned at the voltage maxima for the BT antenna, the second filtering means 14 is preferably positioned at the voltage maxima for the WCDMA antenna, and the third filtering means 15 is preferably positioned at the current maxima for the GPS antenna, respectively.

[0062] It will be obvious that the present invention may be varied in a plurality of ways. Such variations are not to be regarded as departure from the scope of the present invention as defined by the appended claims. All such variations as would be obvious for a person skilled in the art are intended to be included within the scope of the present invention as defined by the appended claims.

Claims

1. An antenna device for a portable radio communication device, **characterized in that** said antenna device comprises an elongated radiating element (1), first switching means (2) connected between a first end of said elongated radiating element and ground, and second switching means (3) connected between a second end of said elongated radiating element, opposite said first end thereof, and first filtering means (4) and second filtering

- means (5),
 wherein said first switching means (2) is configured to be connected to ground when said second switching means (3) is connected to said first filtering means (4), and said first filtering means (2) is configured to be disconnected from ground when said second switching means (3) is connected to said second filtering means (5).
2. The antenna device according to claim 1, wherein said second end of said elongated radiating element (1) is configured to be connected to a FM receiver.
 3. The antenna device according to claim 1 or 2, wherein said first filtering means (4) is capacitive and said second filtering means (5) is inductive.
 4. An antenna device for a portable radio communication device, **characterized in that** said antenna device comprises an elongated radiating element (1) configured to, in a first state, work as an electric resonant monopole antenna and to, in a second state, work as a magnetic resonant half-loop antenna.
 5. The antenna device according to claim 4, wherein said elongated radiating element (1) is configured to provide diversity function for FM reception.
 6. The antenna device according to claim 5, wherein said elongated radiating element (1) is configured to provide diversity function for BT reception.
 7. The antenna device according to any of claims 4-6, comprising first switching means (2) connected between a first end of said elongated radiating element and ground, and second switching means (3) connected between a second end of said elongated radiating element, opposite said first end thereof, and first filtering means (4) and second filtering means (5),
 wherein said first switching means (2) is configured to be connected to ground when said second switching means (3) is connected to said first filtering means (4), and said first filtering means (2) is configured to be disconnected from ground when said second switching means (3) is connected to said second filtering means (5).
 8. The antenna device according to any of claims 4-7, wherein said first filtering means (4) is capacitive and said second filtering means (5) is inductive.
 9. An antenna device for a portable radio communication device, **characterized in that** said antenna device comprises a first elongated radiating element (10), a second elongated radiating element (11), a third elongated radiating element (12), first filtering means (13), second filtering means (14), third filtering means (15), fourth filtering means (16), fifth filtering means (24), sixth filtering means (26), seventh filtering means (27), eighth filtering means (32), first switching means (18), second switching means (25), and third switching means (28),
 wherein said first filtering means (13) is connected between a first end of said first elongated radiating element (10) and a first end of said second elongated radiating element (11), said second filtering means (14) is connected between a second end of said second elongated radiating element (11), opposite the first end thereof, and a first end of said third elongated radiating element (12), said third filtering means (14) is connected between said second elongated radiating element (11) and ground, said fourth filtering means (16) is connected between a second end of said first elongated radiating element (10), opposite the first end thereof, and said first switching means (18), said fifth filtering means (24) is connected to said first elongated radiating element (10) and to said second switching means (25), said sixth filtering means (26) is connected between said second switching means (25) and ground, said seventh filtering means (27) is connected between said second filtering means (25) and ground, said eighth filtering means (32) is connected between said first switching means (18) and ground, said third switching means (28) is connected between said third elongated radiating element (12) and ground, and
 wherein, in a first state, said first switching means (18) is configured to disconnect said fourth filtering means (16) from said eighth filtering means (32), said second switching means (25) is configured to connect said first elongated radiating element (10) to said sixth filtering means (26), and said third switching means (28) is configured to connect said third filtering means (12) to ground and in a second state said first switching means (18) is configured to connect said fourth filtering means (16) to said eighth filtering means (32), said second switching means (25) is configured to connect said first elongated radiating element (10) to said seventh filtering means (27), and said third switching means (28) is configured to disconnect said third filtering means (12) from ground.
 10. The antenna device according to claim 9, wherein said first and second filtering means (13, 14) each is a RF choke.
 11. The antenna device according to claim 10, wherein said third filtering means (15) is connected to said second elongated radiating element (11) close to said second filtering means (14) and said second and third filtering means (14, 15) are together configured to block GPS operating frequencies.

12. The antenna device according to claim 10, wherein said third filtering means (115) is connected to said second elongated radiating element (11) close to said first filtering means (13) and said first and third filtering means (13, 15) are together configured to block GPS operating frequencies. 5
13. An antenna system for a portable radio communication device **characterized in that** it comprises an antenna device according to any previous claim and a FM receiver. 10
14. A portable radio communication device, **characterized in that** it comprises an antenna system according to claim 13, and a ground plane device (7), wherein said elongated radiating elements are arranged over said ground plane device. 15

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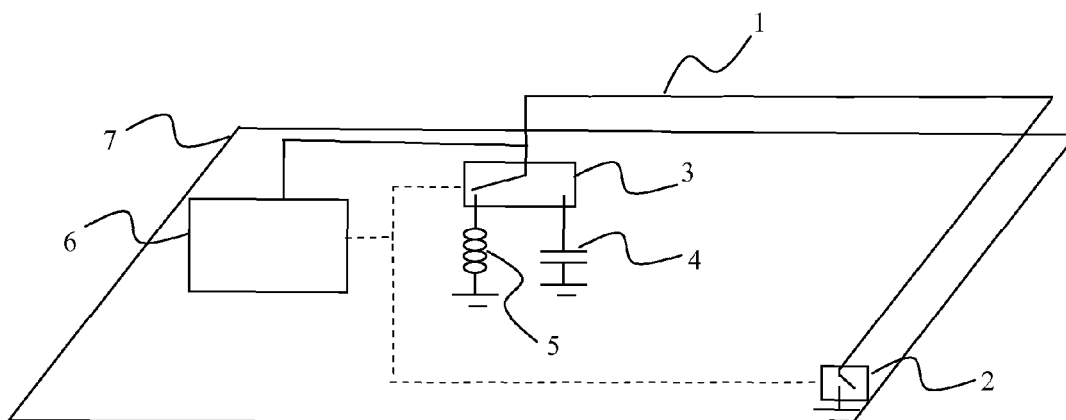


FIG. 1

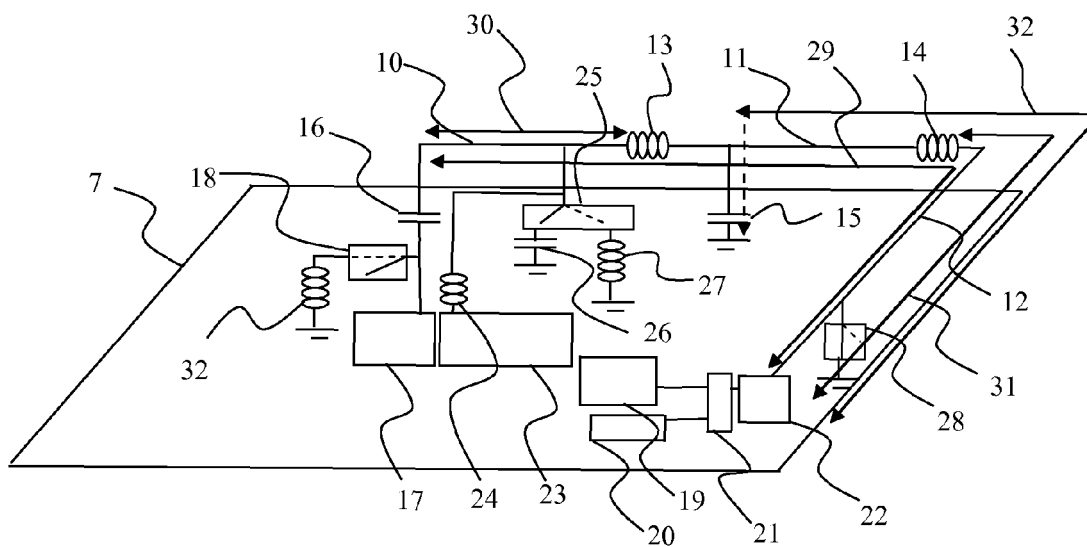


FIG. 2

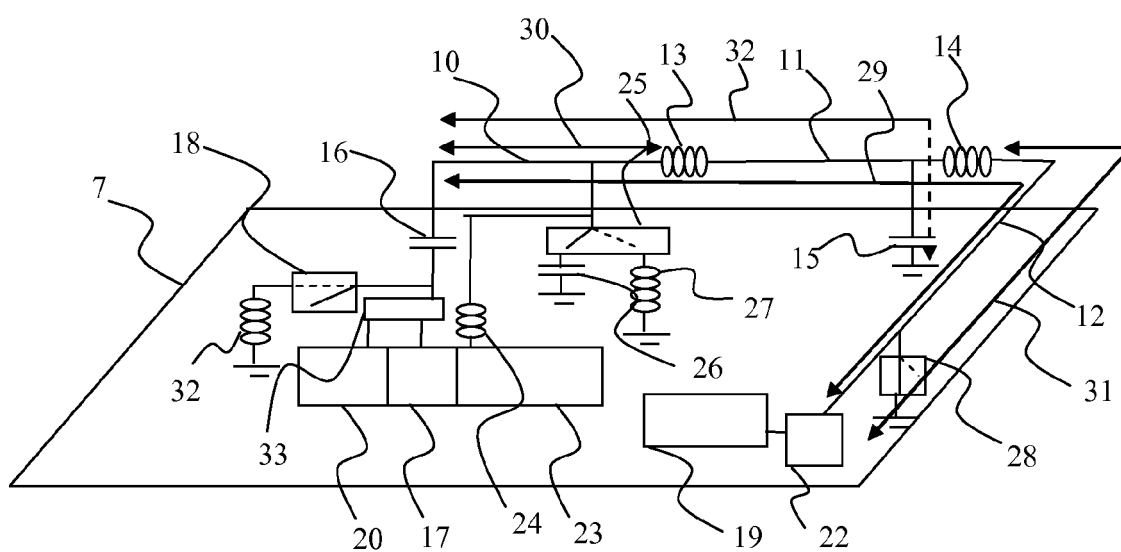


FIG. 3



EUROPEAN SEARCH REPORT

Application Number
EP 09 15 2694

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			TECHNICAL FIELDS SEARCHED (IPC)
			H01Q
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 29 May 2009	Examiner Ribbe, Jonas
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