



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:  
**05.05.2010 Bulletin 2010/18**

(51) Int Cl.:  
**H01Q 1/24** (2006.01) **H01Q 5/00** (2006.01)  
**H01Q 7/00** (2006.01) **H01Q 9/42** (2006.01)  
**H01Q 9/04** (2006.01)

(21) Application number: **08167944.1**

(22) Date of filing: **30.10.2008**

(84) Designated Contracting States:  
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MT NL NO PL PT RO SE SI SK TR**  
Designated Extension States:  
**AL BA MK RS**

- **Südow, Mattias**  
**162 54 Vällingby (SE)**
- **Trossing, Martin**  
**187 32 Täby (SE)**
- **Bäckman, Johan**  
**187 64 Täby (SE)**
- **Erlandsson, Per**  
**117 34 Stockholm (SE)**

(71) Applicant: **Laird Technologies AB**  
**164 22 Kista (SE)**

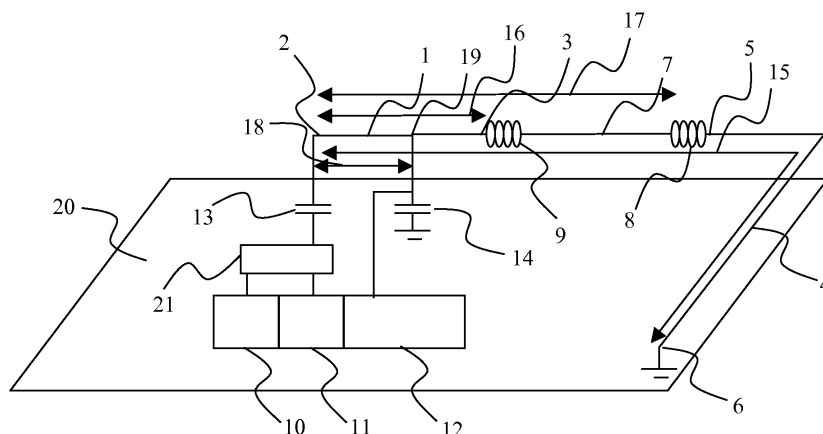
(74) Representative: **Fritzon, Rolf et al**  
**Kransell & Wennborg KB**  
**P.O. Box 27834**  
**115 93 Stockholm (SE)**

(72) Inventors:  
• **Kaikkonen, Andrei**  
**175 48 Järfälla (SE)**  
• **Lindberg, Peter**  
**752 29 Uppsala (SE)**

(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 configured for simultaneous multi frequency band operation. The antenna device comprises a first elongated radiating element (1,41), a second elongated radiating element (4,44), and first filtering means (8,47) arranged between the first and second elongated radiating elements, wherein the antenna device is configured for connection to a first receiver (10,49), a second receiver (11,50) and

a third receiver (12,48) at a first end thereof and is configured for connection to grounding at a second end thereof, opposite the first end of the antenna device, the first filtering means (8,47) is configured to block operating frequencies of the first and second receivers and to pass operating frequencies of the third receiver, and the antenna device is configured to effectively work as an IFA type antenna for the first and second receiver and to effectively work as a loop type antenna for the third receiver.



**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 plurality of operating frequency band.

### BACKGROUND

**[0002]** Internal antennas have been used for some time in portable radio communication devices. There are a number of advantages connected with using internal antennas compared to protruding antennas, of which can be mentioned that they are small and light, making them suitable for applications wherein size and weight are of importance, such as in mobile phones, PDA, portable computer or similar devices.

**[0003]** However, 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. This is especially true for antennas intended for use with radio signals of relatively low frequencies as the desired physical length of such antennas are large compared to antennas operating with relatively high frequencies.

**[0004]** 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.

**[0005]** 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 this solution is obviously not feasible.

**[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, Bluetooth, 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 provides for multi frequency band operation.

**[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 configured for simultaneous multi frequency band operation, wherein the antenna device comprises a first elongated radiating element, a second elongated radiating element, and first filtering means arranged between the first and second elongated radiating elements, wherein the antenna device is configured for connection to a first receiver, a second receiver and a third receiver at a first end thereof and is configured for connection to grounding at a second end thereof, opposite the first end of the antenna device, the first filtering means is configured to block operating frequencies of the first and second receivers and to pass operating frequencies of the third receiver, and the antenna device is configured to effectively work as an IFA type antenna for the first and second receiver and to effectively work as a loop type antenna for the third receiver, three different antennas are combined into one antenna.

**[0010]** Preferably the first receiver is a GPS receiver, the second receiver is a BT transceiver and the third receiver is a FM transceiver, whereby GPS and BT functionality are added to the FM antenna without essentially increasing available space in the portable radio communication device. By providing the radiating elements to together have a length configured for FM operation, the antenna device is based on the operation requiring most space.

**[0011]** To form the GPS and BT antennas as IFA type antennas the first filtering means is preferably configured to pass FM operating frequencies and to block GPS and BT operating frequencies.

**[0012]** Advantageously, the antenna device comprises a dielectric carrier supporting the first and second elongated radiating elements; preferably the dielectric carrier is part of the back cover of the portable radio communication device, whereby a cost efficient and robust installation of the antenna device is provided.

**[0013]** By preferably providing the first filtering means as a RF choke good quality blocking is achieved. By alternatively providing the first filtering means as a simple inductance a low cost blocking is achieved.

**[0014]** The antenna device preferably comprises a third elongated radiating element and second filtering means, wherein the first elongated radiating element has a first end and a second end, the second elongated radiating element has a first end and a second end, and the first end of the first elongated radiating element is

configured for connection to the first receiver and the second receiver, the second end of the first elongated radiating element is connected to the second filtering means, the first end of the second elongated radiating element is connected to the first filtering means, the second end of the second elongated radiating element is configured for the grounding, and the third elongated radiating element is connected between the first and second radiating elements, whereby the first and second receivers are individually easily configured as IFA type antennas.

**[0015]** The first elongated radiating element is preferably configured for connection to the third receiver at a connection point close to the first end of the first elongated radiating element, whereby a combo transceiver can be used for the first, second and third receivers.

**[0016]** By preferably connecting the connection point, close to the first end of the first elongated radiating element, to a third filtering means configured to ground operation for the first and second receivers, IFA type antennas are obtained.

**[0017]** Advantageously, the third filtering means is configured to also tune the third receiver.

**[0018]** Advantageously, the first end of the first elongated radiating element is connected to a second filtering means configured to block operation of the third receiver and to pass operation of the first and second receivers, which provides for the third receiver further being a transceiver.

**[0019]** The second end of the second elongated radiating element is preferably configured for connection to a fourth receiver, wherein the first filtering means also is configured to block operation of the fourth receiver.

**[0020]** By preferably configuring the second elongated element for the grounding at a connection point close to the second end of the second elongated element, an IFA type antenna is provided also for the fourth receiver.

**[0021]** By preferably further having fifth filtering means connected to the second end of the second elongated radiating element for connection to the first and fourth receivers, the first receiver can utilize two IFA type antennas of the antenna device.

**[0022]** Preferably, the first elongated radiating element has a first end and a second end, the second elongated radiating element has a first end and a second end, and the first end of the first elongated radiating element is configured for connection to the third receiver, the second end of the first elongated radiating element is connected to the first filtering means, the first end of the second elongated radiating element is connected to the first filtering means, and the second end of the second elongated radiating element is configured for the grounding, an antenna device provided with three simultaneous frequency band operation is achieved.

**[0023]** By preferably configuring the first elongated radiating element for connection to the first receiver and to the second receiver at a connection point close to the first end of the first elongated radiating element, a combo

transceiver can be used for the first, second and third receivers.

**[0024]** By advantageously providing the antenna device with second filtering means configured to block operation of the first and second receivers, IFA type antennas are achieved.

**[0025]** The connection point close to the first end of the first elongated radiating element is preferably connected to a third filtering means configured to block operation for the third receiver, which allow the third receiver to be a transceiver.

**[0026]** Advantageously, the third filtering means is connected to ground through fourth filtering means, to provide the IFA type antennas.

**[0027]** An antenna system for a portable radio communication device comprising an antenna device, the first, second and third receivers, is also provided.

**[0028]** Further, a portable radio communication device comprising an antenna system and a ground plane device, wherein the first and second elongated radiating elements are arranged over the ground plane device, is also provided.

**[0029]** Further preferred embodiments are defined in the dependent claims.

## BRIEF DESCRIPTION OF DRAWINGS

**[0030]** 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 of the present invention.

FIG. 4 is a schematic diagram showing a fourth embodiment of an antenna device of the present invention.

## DETAILED DESCRIPTION OF THE INVENTION

**[0031]** 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 de-

tails. 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.

**[0032]** 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 arranged 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.

**[0033]** 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.

**[0034]** The antenna device comprises a first elongated radiating element 1, having a first end 2 and a second end 3, a second radiating element 4, having a first end 5 and a second end 6, and a third radiating element 7. The antenna device further comprises first filtering means 8 connected between the third elongated radiating element 7 and the first end 5 of the second elongated radiating element 4, and a second filtering means 9 connected between the third elongated radiating element 7 and the second end 3 of the first elongated radiating element 1. The first end 2 of the first elongated radiating element 1 is connected to third filtering means 13, which in turn is connected to a GPS (Global Positioning System) receiver 10 and a BT (Bluetooth) transceiver 11. The second end 6 of the second elongated radiating element 4 is connected to ground. A FM transceiver 12 is connected to a point 19 of the first elongated radiating element 1 close to the first end 2 thereof. The connection point 19 is further connected to ground through fourth filtering means 14.

**[0035]** The first elongated radiating element 1 have a length 16 configured for BT operation, about 30 mm. The first and third elongated radiating elements 1 and 7 together with the second filtering means 9 have a length 17 configured for GPS operation, about 40 mm. The first, second and third elongated radiating elements 1, 4 and 7 together have a length 15 configured for FM operation, about 90 mm. The length 18 between the connection point 19 and the first end 2 of the first elongated radiating element 1 is configured for matching of the GPS receiver 10 and the BT transceiver 11, about 10 mm. The exemplary lengths given above are dependent on e.g. distance above a ground plane device 20, in this case based on the distance of about 6 mm and on filtering means values.

**[0036]** The second filtering means 9 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 parallel resonant circuit. The second filtering means 9 is in such a way configured to pass FM and GPS operation and to stop BT operation. The first

filtering means 8 is preferably provided as an RF choke, but could also be provided as a simple inductor, of about 30 nH, and could alternatively be provided as parallel resonant circuit. The first filtering means 8 is in such a way configured to pass FM operation and stop GPS operation. The third filtering means 13 is preferably provided as a capacitor of about 1 pF. By providing the third filtering means as a capacitor, a simple, low cost and efficient filtering means is achieved. The third filtering means 13 is in such a way configured to pass BT and GPS operation and to stop FM operation. The fourth filtering means 14 is preferably provided as a capacitor of about 30 pF. The fourth filtering means 14 is in such a way configured to tune the FM transceiver 12 and to ground BT and GPS operation. The antenna device is in such a way configured to simultaneously with FM frequencies operate at BT and GPS frequencies, wherein the BT antenna effectively works as an IFA type antenna, the GPS antenna effectively works as an IFA type antenna and the FM antenna effectively works as an loop type antenna.

**[0037]** 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.

**[0038]** 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 20 of the portable radio communication device. The antenna device thus effectively forms IFA type antennas for BT operation and GPS operation, and effectively forms a loop type antenna for FM operation.

**[0039]** The BT and GPS 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 configured to operate on their respective ground tone, which thereby minimizes their sensitivity to the environment.

**[0040]** Due to that the GPS receiver, the BT transceiver and the FM transceiver have feed points closely located on the first radiating element 1 they can be provided as a single module combo transceiver without long transmission lines.

**[0041]** The antenna device preferably comprises a BT/GPS duplex filter 21 between the third filtering means

13 and the BT transceiver and GPS receiver, respectively, which duplex filter 21 e.g. is implemented as a standard component or integrated on chips. Alternatively, the BT transceiver and GPS receiver are connected directly to the third filtering means 13.

**[0042]** An antenna system for the first embodiment of the antenna device comprises the antenna device, the filtering means and the receivers and transceivers.

**[0043]** A second embodiment of an antenna device according to the present invention is illustrated in Fig. 2.

**[0044]** The antenna device comprises a first elongated radiating element 1, having a first end 2 and a second end 3, a second radiating element 4, having a first end 5 and a second end 6, and a third radiating element 7. The antenna device further comprises first filtering means 8 connected between the third elongated radiating element 7 and the first end 5 of the second radiating element 4. The antenna device also comprises second filtering means 9 connected between the second end 3 of the first elongated radiating element 1 and the third radiating element 7. The first end 2 of the first elongated radiating element 1 is connected to second filtering means 13, which in turn is connected to a GPS receiver 10 and a BT transceiver 11. The second end 6 of the second elongated radiating element 4 is connected to a WCDMA (Wideband Code Division Multiple Access) Rx diversity receiver 22.

**[0045]** A ground connection is connected close to the second end 6 of the second elongated radiating element 4 at point 25. A FM transceiver 12 is connected to a point 19 of the first elongated radiating element 1 close to the first end 2 thereof. The connection point 19 is further connected to ground through fourth filtering means 14.

**[0046]** The first, second and third elongated radiating elements 1, 4 and 7 together have a length 15 configured for FM operation, about 90 mm. The first elongated radiating element 1 have a length 16 configured for BT operation, about 30 mm. The length 18 between the connection point 19 and the first end 2 of the first elongated radiating element 1 is configured for matching of the GPS receiver 10 and the BT transceiver 11, about 10 mm. The first and third elongated radiating elements 1 and 7 together with the second filtering means 9 have a length 17 configured for GPS operation, about 40 mm. The second elongated radiating element 4 has a length 23 configured for WCDMA Rx operation, about 35 mm. The length 24 between the connection point 25 and the second end 6 of the second elongated radiating element 4 is configured for matching of the WCDMA Rx receiver 22. The exemplary lengths given above are dependent on e.g. distance above a ground plane device 20, in this case based on the distance of about 6 mm and filtering means values.

**[0047]** The first filtering means 8 is preferably provided as an RF choke, but could also be provided as a simple inductor, of about 30 nH, and could alternatively be provided as parallel resonant circuit. The first filtering means 8 is in such a way configured to pass FM operation and

to stop GPS and WCDMA Rx operation, and thus also to stop BT operation. The second filtering means 9 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 parallel resonant circuit. The second filtering means 9 is in such a way configured to pass FM and GPS operation and to stop BT operation. The third filtering means 13 is preferably provided as a capacitor of about 1 pF. The third filtering means 13 is in such a way configured to pass BT and GPS operation and to stop FM operation. The fourth filtering means 14 is preferably provided as a capacitor of about 30 pF. The fourth filtering means 14 is in such a way configured to tune the FM transceiver 12 and to ground BT and GPS operation. The antenna device is in such a way configured to simultaneously with FM frequencies operate at BT, GPS and WCDMA Rx frequencies.

**[0048]** The first, second and third 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 radiating elements supported by a dielectric carrier the RF chokes are preferably mounted thereon. Further, the first, second and third radiating elements are alternatively self-supported, and the RF chokes are in this case preferably mounted on a printed wiring board 20 onto which the radiating elements are mounted on.

**[0049]** The antenna device preferably forms a half-loop radiating element for FM operation. The antenna device thus effectively forms IFA type antennas for BT, GPS and WCDMA Rx operation, and effectively forms a loop type antenna for FM operation.

**[0050]** The BT, GPS and WCDMA RX 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.

**[0051]** For configuration of the antenna device the second filtering means 9 is preferably positioned at the voltage maxima for the BT antenna, and the first filtering means 8 is preferably positioned at the voltage maxima for the GPS and WCDMA Rx antennas, respectively. All antennas are configured to operate on their respective ground tone, which thereby minimizes their sensitivity to the environment.

**[0052]** The antenna device preferably comprises a BT/GPS duplex filter 21 between the third filtering means 13 and the BT transceiver and GPS receiver, respectively, which duplex filter 21 e.g. is implemented as a standard component or integrated on chips. Alternatively, the BT transceiver and GPS receiver are e.g. connected directly to the third filtering means 13.

**[0053]** The feedings for BT, GPS and WCDMA Rx can be interchanged with maintained operability of the anten-

na device.

**[0054]** Due to that the GPS receiver, the BT transceiver and the FM transceiver have feed points closely located on the first radiating element 1 they can be provided as a single module combo transceiver without long transmission lines.

**[0055]** An antenna system for the second embodiment of the antenna device comprises the antenna device, the filtering means and the receivers and transceivers.

**[0056]** A third embodiment of an antenna device according to the present invention is illustrated in Fig. 3. The third embodiment of the antenna device is identical with the second embodiment of the antenna device described above apart from the following.

**[0057]** The antenna device comprises a fifth filtering means 26, preferably a capacitor of about 0.5 pF connected between the second end 6 of the second elongated radiating element 4 and the WCDMA Rx receiver 22. Further the GPS receiver 10 is connected also to the fifth filtering means 26. The second elongated radiating element 4 is thus utilized also for GPS operation, apart from WCDMA Rx operation. In this way a GPS receiver utilizing diversity reception is obtained by use of two existing different antenna elements.

**[0058]** The fifth filtering means 26 is preferably configured for WCDMA Rx receiver and GPS receiver matching.

**[0059]** A fourth embodiment of an antenna device according to the present invention is illustrated in Fig. 4.

**[0060]** The antenna device comprises a first elongated radiating element 41, having a first end 42 and a second end 43, and a second radiating element 44, having a first end 45 and a second end 46. The antenna device further comprises first filtering means 47 connected between the second end 43 of the first elongated radiating element 41 and the first end 45 of the second elongated radiating element 44. The first end 42 of the first elongated radiating element 1 is connected to second filtering means 59, which in turn is connected to a FM receiver 48. The second end 46 of the second elongated radiating element 44 is connected to ground. A GPS receiver 49 and a BT transceiver 50 are connected to a third filtering means 52, which in turn is connected to connection point 57 of the first elongated radiating element 41 between the first end 42 and second end 43 thereof. The GPS receiver 49 and the BT transceiver 50 are further connected to ground through fourth filtering means 53.

**[0061]** The first filtering means 47 is preferably provided as an RF choke, but could also be provided as a simple inductor, of about 30 nH, and could alternatively be provided as parallel resonant circuit. The first filtering means 47 is in such a way configured to pass FM operation and block BT and GPS operation. The second filtering means 59 is preferably provided as an inductor of about 30 nH. The second filtering means 59 is in such a way configured to block BT and GPS operation and to pass FM operation. The third filtering means 52 is preferably provided as a capacitor of about 1 pF. The third filtering means 52 is in

such a way configured to block FM operation and to pass BT and GPS operation. The fourth filtering means 53 is preferably provided as a distributed inductor of about 3 nH. The fourth filtering means 53 is in such a way configured to ground BT and GPS operation. The antenna device is in such a way configured to simultaneously with FM frequencies operate at BT and GPS frequencies.

**[0062]** The first and second 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 and second radiating elements supported by a dielectric carrier the RF choke is preferably mounted thereon. Further, the first and second radiating elements are alternatively self-supported, and the RF choke is in this case preferably mounted on a printed wiring board 58 onto which the radiating elements are mounted on.

**[0063]** The antenna device preferably forms a half-loop radiating element for FM operation. The antenna device effectively forms IFA type antennas for BT and GPS operation.

**[0064]** The BT and GPS antennas are effectively IFA antennas, which antennas 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 configured to operate on their respective ground tone, which thereby minimizes their sensitivity to the environment.

**[0065]** The antenna device preferably comprises a BT/GPS duplex filter 60 between the third filtering means 52 and the BT transceiver and GPS receiver, respectively, which duplex filter 60 e.g. is implemented as a standard component or integrated on chips. Alternatively, the BT transceiver and GPS receiver are e.g. connected directly to the third filtering means 52.

**[0066]** The length 54 between the first end 42 of the first elongated radiating element 41 and the second end 46 of the second radiating element 44 is configured for FM operation, about 70 mm.

**[0067]** The length between the duplex filter 60 and the second filtering means 59 is configured for BT operation, about 20 mm. The length between duplex filter 60 and the first filtering means 47 is configured for GPS operation, about 50 mm. The exemplary lengths given above are dependent on e.g. distance above a ground plane device 58, in this case based on the distance of about 5 mm and filtering means values.

**[0068]** An antenna system for the fourth embodiment of the antenna device comprises the antenna device, the filtering means and the receivers and transceivers.

**[0069]** 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 configured for simultaneous multi frequency band operation, **characterized in that** said antenna device comprises a first elongated radiating element (1; 41), a second elongated radiating element (4; 44), and first filtering means (8; 47) arranged between the first and second elongated radiating elements, wherein said antenna device is configured for connection to a first receiver (10; 49), a second receiver (11; 50) and a third receiver (12, 48) at a first end thereof and is configured for connection to grounding at a second end thereof, opposite said first end of said antenna device, said first filtering means (8; 47) is configured to block operating frequencies of said first and second receivers and to pass operating frequencies of said third receiver, and said antenna device is configured to effectively work as an IFA type antenna for said first and second receiver and to effectively work as a loop type antenna for said third receiver.
2. The antenna device as claimed in claim 1, wherein said first receiver is a GPS receiver, said second receiver is a BT transceiver and said third receiver is a FM transceiver.
3. The antenna device as claimed in claim 2, wherein said first filtering means (8; 47) is configured to pass FM operating frequencies and to block GPS and BT operating frequencies.
4. The antenna device according to any of claims 1-3, comprising a dielectric carrier supporting said first and second elongated radiating elements.
5. The antenna device according to claim 4, wherein said dielectric carrier is part of the back cover of the portable radio communication device.
6. The antenna device according to any of claims 1-5, wherein said first filtering means (8; 47) is a RF choke.
7. The antenna device according to any of claims 1-6, further comprising a third elongated radiating element (7) and second filtering means (9), wherein said first elongated radiating element (1) has a first end (2) and a second end (3), said second elongated radiating element (4) has a first end (5) and a second end (6), and said first end (2) of said first elongated radiating element (1) is configured for connection to said first receiver (10) and said second receiver (11), said second end (3) of said first elongated radiating element (1) is connected to said second filtering means (9), said first end (5) of said second elongated radiating element (4) is connected to said first filtering means (8), said second end (6) of said second elongated radiating element (4) is configured for said grounding, and said third elongated radiating element (7) is connected between said first and second radiating elements.
8. The antenna device according to claim 7, wherein said first elongated radiating element (1) is configured for connection to said third receiver (12) at a connection point (19) close to said first end (2) of said first elongated radiating element (1).
9. The antenna device according to claim 8, wherein said connection point (19) close to said first end (2) of said first elongated radiating element is connected to a third filtering means (14) configured to ground operation for said first and second receivers.
10. The antenna device according to claim 9, wherein said third filtering means (14) is configured to also tune said third receiver.
11. The antenna device according to any of claims 7-10, wherein said first end (2) of said first elongated radiating element (1) is connected to a second filtering means (13) configured to block operation of said third receiver and to pass operation of said first and second receivers.
12. The antenna device according to any of claims 7-11, wherein said second end (6) of said second elongated radiating element (4) is configured for connection to a fourth receiver (22), wherein said first filtering means (8) further is configured to block operation of said fourth receiver (22).
13. The antenna device according to claim 12, wherein said second elongated element (4) is configured for said grounding at a connection point (25) close to said second end (6) of said second elongated element (4).
14. The antenna device according to claim 12 or 13, comprising fifth filtering means (26) connected to said second end (6) of said second elongated radiating element (4) for connection to said first and fourth receivers.
15. The antenna device according to any of claims 1-6, wherein said first elongated radiating element (41) has a first end (42) and a second end (43), said second elongated radiating element (44) has a first end

(45) and a second end (46), and said first end (42) of said first elongated radiating element (41) is configured for connection to said third receiver (48), said second end (43) of said first elongated radiating element (41) is connected to said first filtering means (47), said first end (45) of said second elongated radiating element (44) is connected to said first filtering means (47), and said second end (46) of said second elongated radiating element (44) is configured for said grounding.

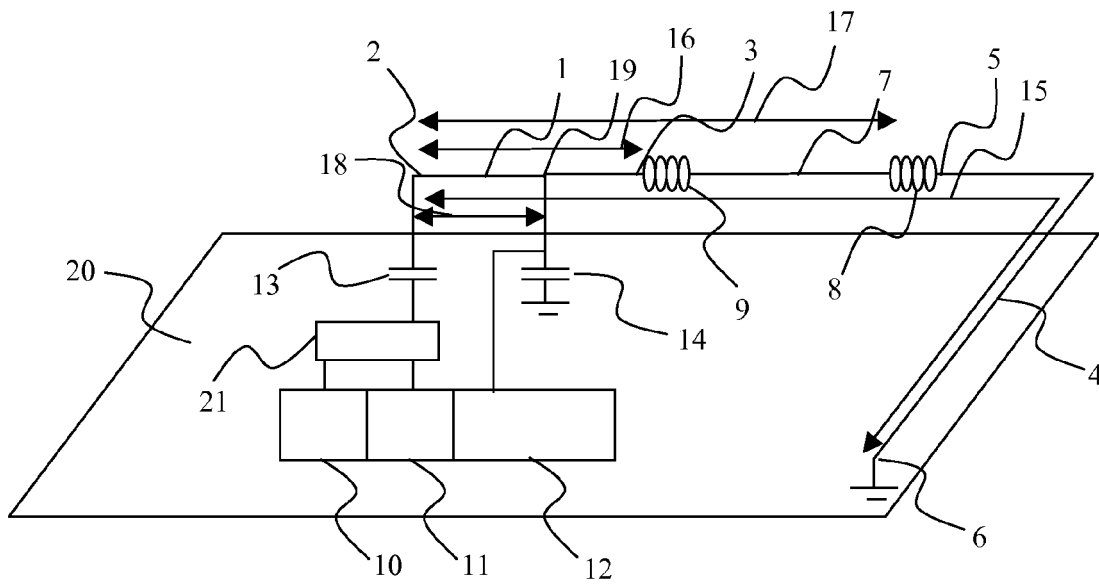
16. The antenna device according to claim 15, wherein said first elongated radiating element (1) is configured for connection to said first receiver (49) and to said second receiver (50) at a connection point (57) close to said first end (42) of said first elongated radiating element (41).
17. The antenna device according to claim 16, comprising second filtering means (59) configured to block operation of said first and second receivers.
18. The antenna device according to claim 16 or 17, wherein said connection point (47) close to said first end (42) of said first elongated radiating element is connected to a third filtering means (52) configured to block operation for said third receiver.
19. The antenna device according to claim 18, wherein said third filtering means (52) is connected to ground through fourth filtering means (53).
20. An antenna system for a portable radio communication device **characterized in that** it comprises an antenna device according to any previous claim and said first, second and third receivers.
21. A portable radio communication device, **characterized in that** it comprises an antenna system according to claim 20 and a ground plane device (20; 58), wherein said first (1; 41) and second (4; 44) elongated radiating elements are arranged over said ground plane device.

45

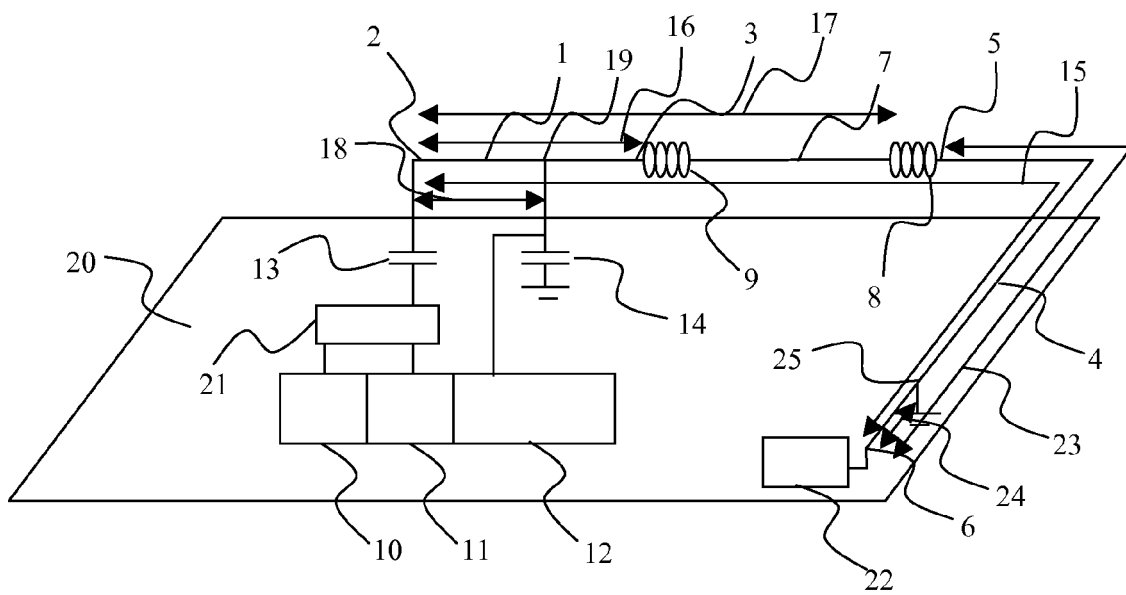
50

55

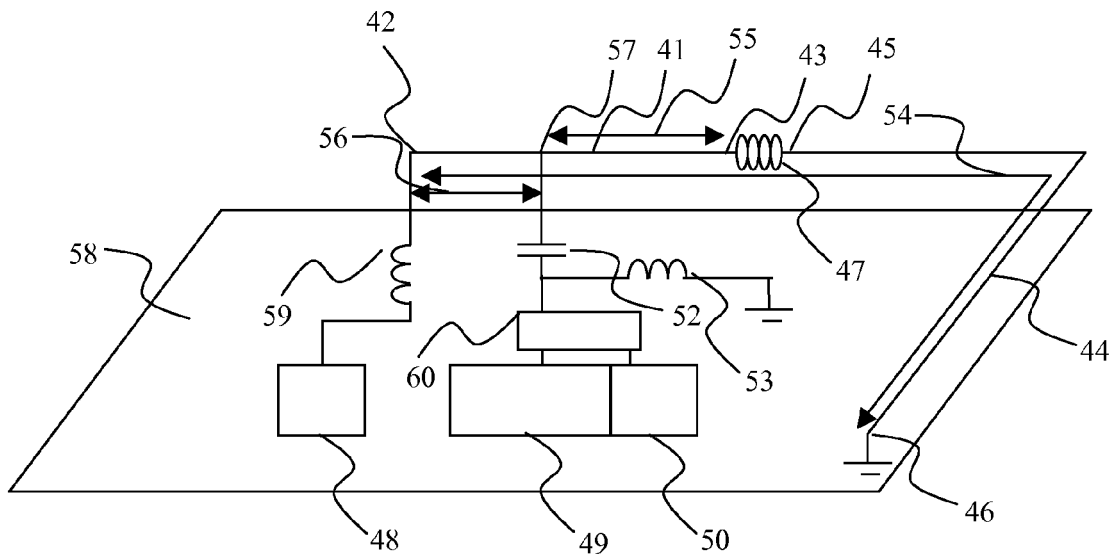
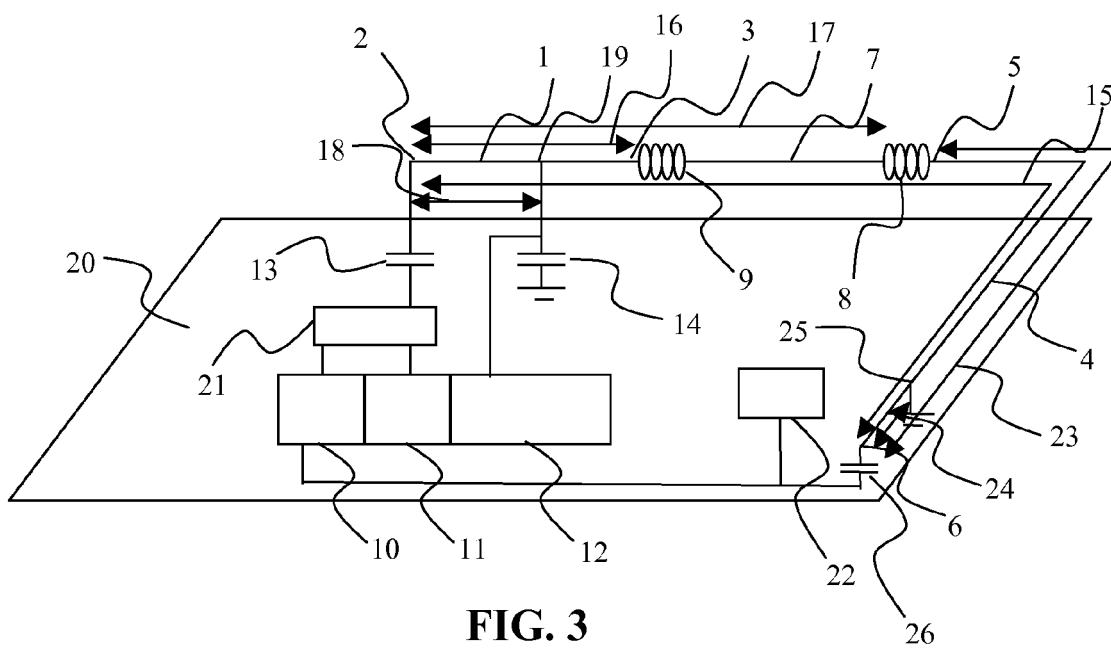




**FIG. 1**



**FIG. 2**





## EUROPEAN SEARCH REPORT

Application Number  
EP 08 16 7944

| DOCUMENTS CONSIDERED TO BE RELEVANT  |  |   |  |
|--|--|---|--|
| Category   | Citation of document with indication, where appropriate, of relevant passages  | Relevant to claim   | CLASSIFICATION OF THE APPLICATION (IPC)                          |
| Y  | US 6 204 819 B1 (HAYES GERARD JAMES [US]<br>ET AL) 20 March 2001 (2001-03-20)<br><br>* column 5, line 43 - column 7, line 52;<br>figures 4a-6b * | 1-11,<br>15-18,<br>20,21                                    | INV.<br>H01Q1/24<br>H01Q5/00<br>H01Q7/00<br>H01Q9/42<br>H01Q9/04 |
| Y  | US 2006/097918 A1 (OSHIYAMA TADASHI [JP]<br>ET AL) 11 May 2006 (2006-05-11)<br><br>* pages 3-5,; figures 1-4,9 *                                 | 1-11,<br>15-18,<br>20,21                                    |  |
| Y  | JP 11 251825 A (KENWOOD CORP)<br>17 September 1999 (1999-09-17)<br><br>* abstract *  | 1-11,<br>15-18,<br>20,21                                    |  |
| Y  | US 2004/041734 A1 (SHIOTSU SHINICHI [JP]<br>ET AL) 4 March 2004 (2004-03-04)<br><br>* figure 2 *   | 1-11,<br>15-18,<br>20,21                                    |  |
| A  | US 2007/069956 A1 (OZKAR METE [US])<br>29 March 2007 (2007-03-29)<br>* figure 2 *  |   | TECHNICAL FIELDS<br>SEARCHED (IPC)<br><br>H01Q                   |
| The present search report has been drawn up for all claims   |  |   |  |
| Place of search<br><b>Munich</b>   |  | Date of completion of the search<br><b>22 December 2008</b> | Examiner<br><b>Ribbe, Jonas</b>                                  |
| CATEGORY OF CITED DOCUMENTS<br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document<br>T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>& : member of the same patent family, corresponding document |  |   |  |

 1  
EPO FORM 1503 03.02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 08 16 7944

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
The members are as contained in the European Patent Office EDP file on  
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

22-12-2008

| Patent document<br>cited in search report |    | Publication<br>date | Patent family<br>member(s) |               | Publication<br>date |
|---|----|---------------------|----------------------------|---------------|---------------------|
| US 6204819                                | B1 | 20-03-2001          | AT                         | 273570 T      | 15-08-2004          |
|   |    |                     | AU                         | 5328001 A     | 03-12-2001          |
|   |    |                     | DE                         | 60104851 D1   | 16-09-2004          |
|   |    |                     | DE                         | 60104851 T2   | 05-01-2005          |
|   |    |                     | EP                         | 1295358 A1    | 26-03-2003          |
|   |    |                     | WO                         | 0191234 A1    | 29-11-2001          |
| -----                                     |    |                     |                            |               |                     |
| US 2006097918                             | A1 | 11-05-2006          | AU                         | 2003277639 A1 | 15-06-2004          |
|   |    |                     | CN                         | 1714471 A     | 28-12-2005          |
|   |    |                     | WO                         | 2004047223 A1 | 03-06-2004          |
|   |    |                     | KR                         | 20050086733 A | 30-08-2005          |
| -----                                     |    |                     |                            |               |                     |
| JP 11251825                               | A  | 17-09-1999          | JP                         | 3438016 B2    | 18-08-2003          |
| -----                                     |    |                     |                            |               |                     |
| US 2004041734                             | A1 | 04-03-2004          | JP                         | 2004096341 A  | 25-03-2004          |
| -----                                     |    |                     |                            |               |                     |
| US 2007069956                             | A1 | 29-03-2007          | CN                         | 101273493 A   | 24-09-2008          |
|   |    |                     | EP                         | 1932214 A1    | 18-06-2008          |
|   |    |                     | WO                         | 2007040639 A1 | 12-04-2007          |
| -----                                     |    |                     |                            |               |                     |