

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

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
12 August 2010 (12.08.2010)

(10) International Publication Number
WO 2010/090573 A1

(51) International Patent Classification:
H01Q 1/38 (2006.01) *H01Q 9/04* (2006.01)

(21) International Application Number:
PCT/SE2010/000020

(22) International Filing Date:
28 January 2010 (28.01.2010)

(25) Filing Language: Swedish

(26) Publication Language: English

(30) Priority Data:
0900132-2 4 February 2009 (04.02.2009) SE

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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, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, 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.

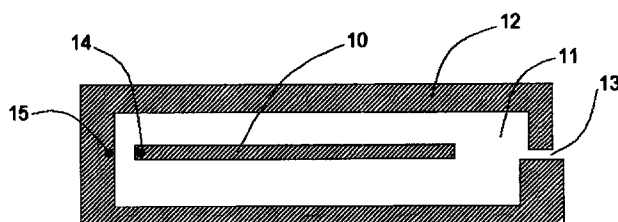
(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: ANTENNA

Figure 1



(57) Abstract: Present invention consists of an antenna with at least one antenna element out of electrically conductive material essentially located within an inner area surrounded of electrically conductive material that has a slot into the inner area.



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Technical field

The present invention concerns an antenna including surrounding electrically conductive material and a slot.

5 State of the art and background of the invention

The purpose of an antenna is to convert wire bound signals to electromagnetic signals propagating in the ambient media. The design of the antenna determines the properties of this
10 conversion. The requirements of a wireless communications system determine the requirements of the antenna and by that what type of antenna to be used.

It is common that antennas needs to be mounted on both
15 metallic and none metallic objects. To eliminating the needs of selecting antenna depending of the backing is metallic or non metallic, it is desirable that the same antenna operate at both cases. It is also desirable that the antenna operates at several frequency bands. It is also important that the antenna
20 isn't big, but its size shall be minimized having sufficient performance for the communication system.

Since antennas shall be able to be placed both on metallic and non metallic material, it is common that the antenna contain
25 an integrated ground plane. By that the antenna always will have metallic material in the vicinity making it operate at both cases. Common antennas intended to be mounted on ground plane are F-antennas and planar F-antennas. These are denominated by the English names "inverted F antenna" and
30 "planar inverted F antenna". These antennas have a connection to the ground plane both to be smaller in size and to match the impedance to 50 ohms.

To increase the band width and create extra resonance frequencies, passives conductors connected to ground at one spot can be added. By placing them close to the antenna the energy will put through and the passive conductor becomes a part of the antenna and can create an additional resonance at desired frequency. The resonance frequencies created by passive elements is in general in proximity or higher than the antennas fundamental resonance. The publicized patent applications US2006/0176226, US2007/0030200, US2008/0136711 and US2008/0180330 show different antennas including extra passive elements. These are used to create extra resonances to increase the band width of the antenna or create resonances at higher frequencies. The present invention achieve two different and desirable properties, the antenna can be mounted in close vicinity and above a ground plane and an additional resonance can be created which can have significant lower resonance frequency than the antenna fundamental frequency.

Description of the invention

The present invention includes an antenna having an inner area essentially surrounded by electrically conductive material having a slot into the inner area and at least one antenna element essentially located within the inner area. By this embodiment of the antenna the surrounding electrically conductive material and its slot together with the active antenna element and the electromagnetic coupling between them, creates a resonance at a lower or significant lower frequency than the active elements resonance frequency. By adjusting length, width and location of the slot, of the surrounding electrically conductive material, its resonance frequency and impedance can be changed and adjusted. Another important and simple adjustment of the resonance frequency is made by

changing the slit embodiment and spatial width. The spatial width of the slot can be decreased to lower the resonance frequency and vice versa. Also a longer slot gives a lower resonance frequency. The radio signal connected to the antenna element by the coaxial cable can by advantage be connected to a connection point within the inner area. It is often necessary to adjust the impedance of the antenna element by create a connection between the antenna element and the surrounding electrically conductive material and in general this connection is galvanic. The slot in the surrounding electrically conductive material can be located at any position but good properties often can be achieved having location remote of the antenna elements connection point of the radio signal. Therefore the slot usually is placed in vicinity of the end of the antenna element. Also additional antenna elements which either can be connected to radio signal or ground can be placed within the antenna elements inner area. Additional resonance frequencies to increase the bandwidth, or create an efficient antenna for more frequency bands, can be created by adding additional antenna elements.

To further improve the antenna functionality, the antenna can be equipped with additional antenna elements placed outside the surrounded electrically conductive area. These antenna elements can have any shape and have a proper length fitting the antenna.

It is of advantage to mount an antenna according to present invention within a plastic box and to connect the radio signal by a coaxial cable. By that the antenna can act as an external antenna to a variety of applications. An antenna according to the invention is connected by radio signal to an antenna element and where the surrounding electrically conductive material is connected to the radio signals ground.

Description of drawings

Figure 1: shows an antenna according to present invention having a simple embodiment.

Figure 2: shows an antenna according to present invention connected by coaxial cable and impedance match of the antenna element.

Figure 3: shows an antenna according to present invention having several antenna elements and another shape of the slot.

Figure 4: shows an antenna according to present invention where it is embodied for external mounting.

Preferred embodiments

An antenna according present invention can be embodied according to figure 1. The antenna element (10) is placed within an inner area (11) that is surrounded by an electrically conductive material (12) having a slot (13) into the inner area. The radio signal is preferable connected at (14) and its ground at (15). Figure 2 shows another embodiment where a coaxial cable (16) is connected to the antenna elements connection point (14) and the surrounded electrical conductive material (15). A connection (17) between the antenna element (10) and the surrounding electrical conductive material (12) is added to adjust the antenna impedance to, for example, 50 ohms.

Figure 3 shows another embodiment where an additional antenna element (18) and (19) is added to create additional resonance frequencies to increase the band width or create good antenna functionality at other frequency bands according to the requested antenna requirements. The slot (13) is modified and can be changed embodiment such as slot length and width be

adjusted to appropriate frequency, which usually is lower than the resonance frequency generated by the antenna element (10). The antenna embodiment according to figure 3 have also an antenna element (20) that is located outside the inner area. It is obvious that antennas don't need to have antenna element according to figure 3, but embodiment, placement and number of antenna elements can be changed within the present invention.

Figure 4 shows how an antenna based upon the present invention can be embodied. Figure 4 shows an antenna element according to figure 1 to 3 with a vision from the side where the antenna element (22) with the surrounding electrical conductive material is located on a substrate (21). The antenna is placed into a cover (23) preferable of plastic or other electrical insulators and the connecting coaxial cable (24) is elapsed out of the antenna cover. An antenna according to figure 4 can be mounted both on metallic and non metallic materials (25) having good antenna performance.

An antenna according to the present invention can with advantage be embodied at a laminate for printed circuit board, for example FR4 or other variants, by normal printed circuit board production process. This offers a very low cost antenna solution having good performance. The antenna can also be embodied on flexible substrate and also direct out of sheet metal by punching or etching processing.

An antenna according to the present invention can be operational at many different frequency bands, for example 434 MHz, GSM900 (880 - 960 MHz), GSM1800 (1710 - 1880 MHz) and UMTS (1920 - 1980, 2110 - 2170 MHz). Applied onto figure 3 the antenna element (10) can operate at GSM900, antenna element (18) and (19) at GSM1800 and UMTS, and the surrounding electrical conductive material (12) with the slit (13) and its

coupling to the antenna element (10) can create an efficient antenna for 434 MHz. In this case the surrounding material and its slit creates an antenna having a resonance frequency significant lower than the frequency of the active element (10). The antenna element (20) can also create additional resonance and/or improve the impedance match to, for example, 50 ohms. It is easily realized that different combinations of frequency band can be reached by the present invention. The surrounding electrical conductive material (12) can have shape, length and width proportions differing from the figures 1 to 3.

Claims

- 1) Antenna having at least one antenna element (10) of electrically conductive material, essential located within an inner area (11), and a essentially surrounding electrically conductive material (12) having a slot (13) in the surrounded electrical material (12) into the inner area (11), where the antenna is **characterized in** that the antenna element (10) in the inner area is arranged to be an active antenna element.
- 2) Antenna according to claim 1, **characterized in** that the connection point to the antenna element is located within the inner area.
- 3) Antenna according to claims 1 or 2 **characterized in** that the antenna element have an connection to the surrounding electrically conductive material.
- 4) Antenna according to claims 1 - 3 **characterized in** that the slot into the inner area is located remote from the antenna elements connection point to radio transmitter and/or receiver.
- 5) Antenna according to claims 1 - 4 **characterized in** that the antenna includes additional electrically conductive antenna elements within the inner area.
- 6) Antenna according to claims 1 - 5 **characterized in** that the antenna have electrically conductive material extending or is placed in a trace out of the electrically conductive material surrounding the inner area.
- 7) Antenna according to claims 1 - 6 **characterized in** that it is located inside a plastic box with a coaxial

cable elapsing out of the box for connecting to radio transmitter and/or receiver.

- 8) Antenna according to claims 1 - 7 **characterized in** that a signal from radio transmitter and/or receiver connects to an antenna element and that its ground connects to the surrounding electrically conductive material

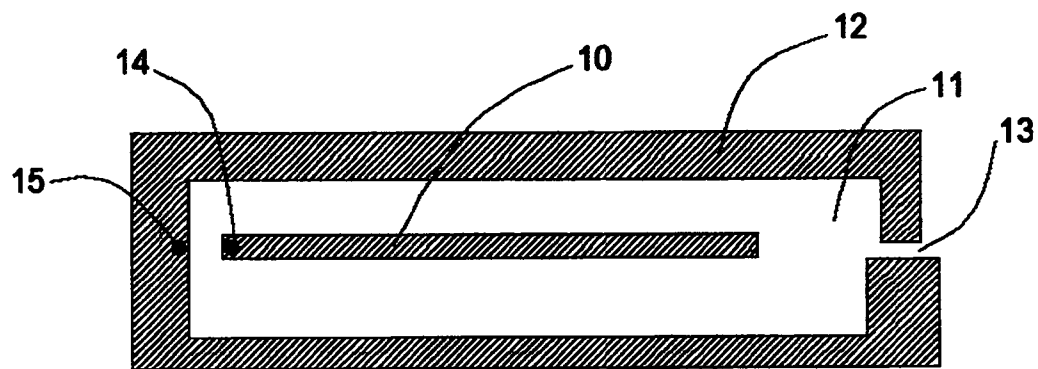
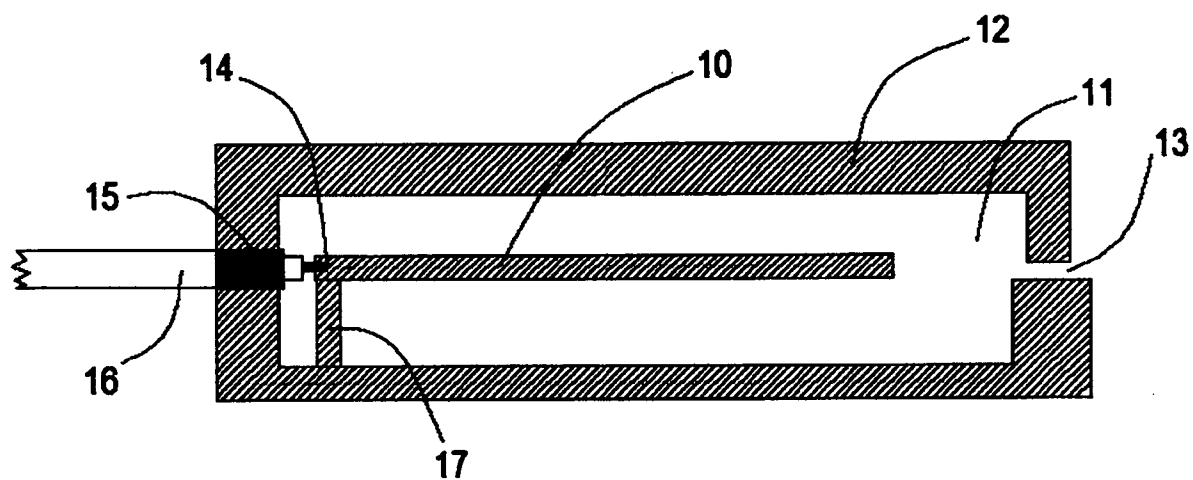
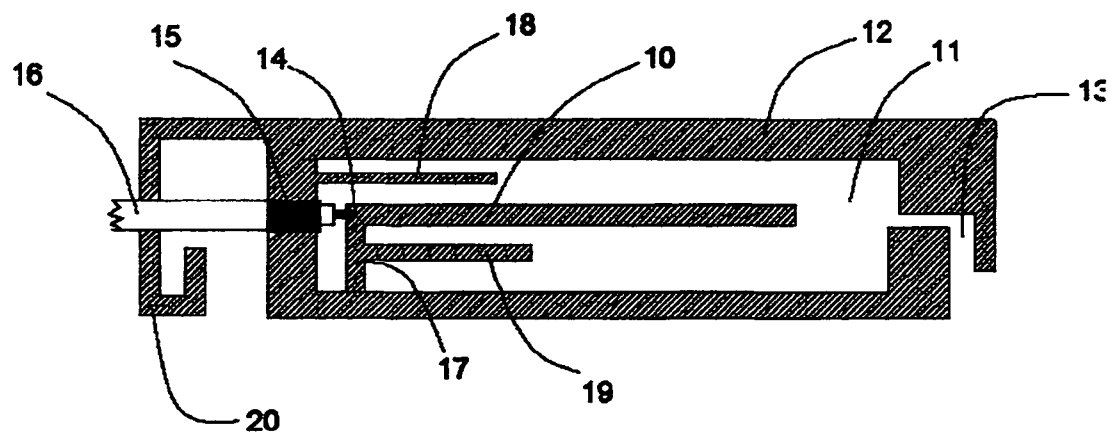
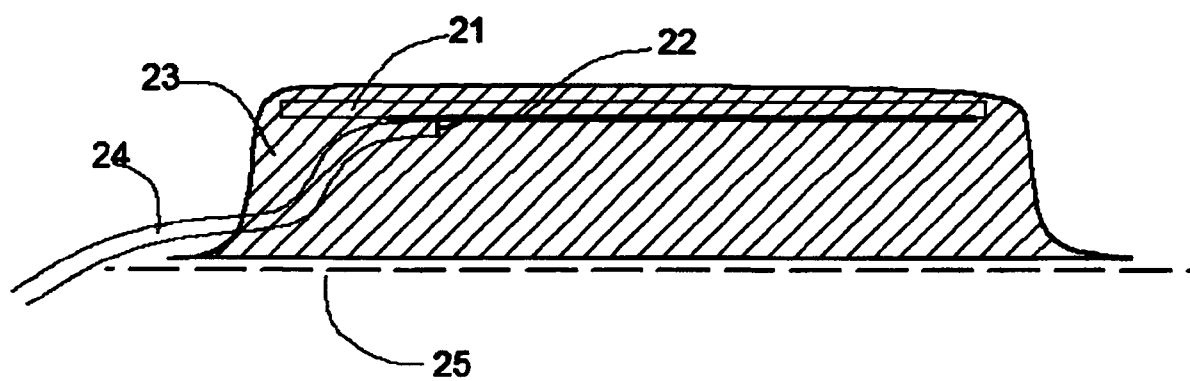
Figure 1**Figure 2**

Figure 3**Figure 4**

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE2010/000020

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

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)

IPC: H01Q

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

SE,DK,FI,NO classes as above

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

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2005008834 A1 (CENTURION WIRELESS TECHNOLOGIES, INC.), 27 January 2005 (27.01.2005), figures 4,5, abstract --	1-8
A	WO 0243182 A1 (SIEMENS AKTIENGESELLSCHAFT), 30 May 2002 (30.05.2002), figure 1, abstract --	1-8
A	WO 2004045019 A2 (CENTURION WIRELESS TECHNOLOGIES, INC.), 27 May 2004 (27.05.2004), figures 1-6, abstract --	1-8

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

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Date of the actual completion of the international search

23 April 2010

Date of mailing of the international search report

27-04-2010

Name and mailing address of the ISA/

Swedish Patent Office

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE2010/000020

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 1760827 A1 (PANTECH & CURITEL COMMUNICATIONS INC), 7 March 2007 (07.03.2007), figure 1, abstract --	1-8
A	US 20070030200 A1 (C.C. HENG ET AL), 8 February 2007 (08.02.2007), cited in the application -- -----	1-8

International patent classification (IPC)**H01Q 1/38** (2006.01)**H01Q 9/04** (2006.01)**Download your patent documents at www.prv.se**

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Cited literature, if any, will be enclosed in paper form.

INTERNATIONAL SEARCH REPORT
Information on patent family members

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