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(54) **Portable electronic equipment having improved radio performance**

(57) The present invention is directed towards a portable electronic equipment (10) comprising antenna circuitry (2) including:

an antenna (1) arranged to be matched in receiving path (RX path)

a proximity switch (3) for controlling the RX path, wherein said proximity path is arranged to open an element (4) for matching the RX path in talking position. In this way radiation performance is improved.

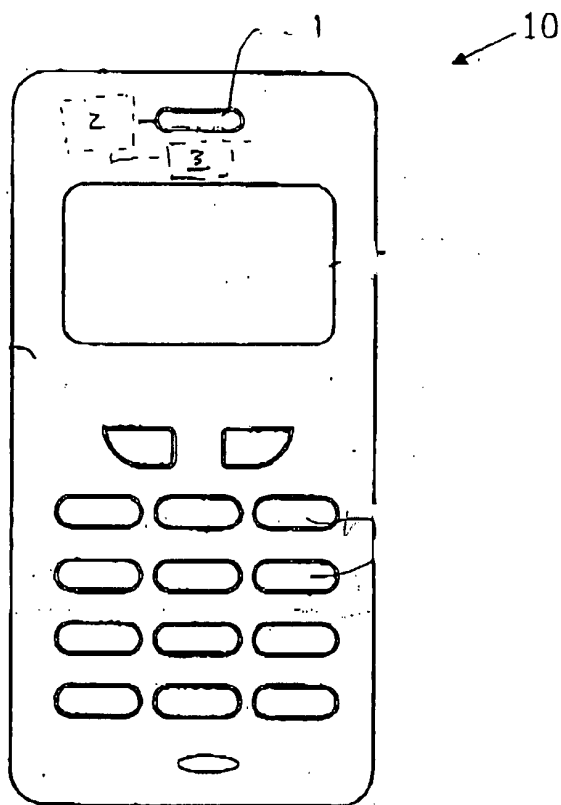


FIG. 1

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Description

TECHNICAL FIELD OF THE INVENTION

[0001] The present invention relates to the field of portable electronic equipment, in particular to the field of antennas thereof.

DESCRIPTION OF RELATED ART

[0002] There is a trend within the field of portable communicating equipments, and especially within the field of cellular phones to have the antenna in-built in the phone itself. The phones are also becoming smaller and smaller, with a need to use the space of the phone as effectively as possible, which may influence antenna performance. At the same time the phones have more and more functions and features and therefore also more components provided in them, which may also influence antenna performance. It is also known that antenna performance is degrading in a so-called "talking position", i. e. when a user holds the phone to his/her ear and talks.

[0003] Today, the antenna is typically trimmed for free space position, i. e. not in the talking position. For getting a higher output power (i. e. better radiation performance) it is better to trim the antenna in Tx (transmitting). Due to this fact, it is hard to get antennas with a good Rx (receiving) performance, since for instance at high GSM band edge, the performance is highly degraded because of poor matching for talking position.

[0004] Thus, there is a need for a portable electronic equipment which provides high antenna performance also in talking position.

SUMMARY OF THE INVENTION

[0005] The present invention is therefore directed towards solving the problem of providing a portable electronic equipment having high antenna performance also in talking position.

[0006] One object of the present invention is thus directed towards providing a portable electronic equipment arranged such that radiation performance is improved in talking position, but not degrading performance in free space position.

[0007] According to a first aspect of the present invention, this object is achieved by a portable electronic equipment comprising:

antenna circuitry including:

an antenna arranged to be matched in receiving path (RX path)

a proximity switch for controlling the RX path, wherein said proximity switch is arranged to open a matching element the RX path in talking position, such that a network including induc-

tors, capacitors, and antenna switch are matched.

[0008] A second aspect of the present invention includes the features of the first aspect, wherein the antenna is further arranged to be matched also in transmitting path (Tx).

[0009] A third aspect of the present invention includes the features of the first or the second aspect, wherein said matching element is arranged for matching in all bands.

[0010] A fourth aspect of the present invention includes the features of the third aspect, wherein said matching element comprises one element for each Rx path.

[0011] A fifth aspect of the present invention includes the features any one of the first to the fourth aspect, wherein said proximity switch comprises a voltage source.

[0012] A sixth aspect of the present invention includes the aspect of any one of the previous aspects wherein said matching element for matching the RX path is a non linear element comprising at least one transistor.

[0013] A seventh aspect of the present invention includes the aspect of any one of the previous aspects, wherein the equipment is a cellular phone, a smart phone or a communicator.

[0014] The present invention has many advantages, one being that it prevents loss in performance in talking position. Another advantage of the present invention is that radiation performance will be improved especially in high channels EGSM.

[0015] It is also possible to provide good Tx performance (due to matching in Tx region) and Rx performance due to the arrangement of the proximity switch according to the invention.

[0016] Moreover, it is also possible to apply the invention in high bands such as DCS, PCS as well, even if the invention is only described in relation to EGSM. Thus, the invention is by no means limited to EGSM only, or thereto related parameters, but can be applied to any suitable band.

[0017] It should be emphasized that the term "comprises/comprising" when used in this specification is taken to specify the presence of stated features, integers, steps or components, but does not preclude the presence or addition of one or more other features, integers, steps, components or groups thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The present invention will now be described in more detail in relation to the enclosed drawings, in which:

Fig. 1 is a schematic front view (not to scale) illustrating a portable electronic equipment according to a first embodiment of the present invention,

Fig. 2 is a block diagram showing the brief internal composition of the first embodiment of the invention,

Fig. 3 illustrates the functionality of the switch in more detail, and.

Fig. 4 illustrates an insertion loss graph.

DETAILED DESCRIPTION OF EMBODIMENTS

[0019] Referring now to the drawings, a description will be given in detail of embodiments in accordance with the present invention.

[0020] A portable communication equipment according to the invention will now be described in relation to a cellular phone, which is a preferred variation of the invention. The portable communication equipment can also be another type of device though, like a cordless phone, a communication module, a PDA or any other type of portable device communicating with radio waves.

[0021] Fig. 1 schematically shows a front view of a cellular phone according to the invention. The phone 10 includes an antenna 1, and thereto related antenna circuitry 2 including a proximity switch 3. Here it is worth noting that there is no antenna protruding from the phone. The antenna 1 is in-built and comprises or is connected to different electrical elements including an antenna feeding circuit.

[0022] The cellular phone 10 receives signals transmitted from radio base stations by its antenna (not shown). The signals received are transmitted the antenna circuitry 2 including for instance: a radio unit (not shown) comprising or connected to conventional units for modulation/demodulation and sound processing.

[0023] The antenna 1 is typically connected via electrical leads to both the ground plane and to a radio circuit (not shown) provided in the phone for enabling transmission at suitable frequencies. The ground plane is also connected to the radio circuit. The antenna 1 in this particular embodiment is therefore a so-called PIFA antenna. However, it is important to note that the invention is by no means to a PIFA antenna, but any suitable antenna type could be employed without departing from the invention.

[0024] Fig. 2 is a view illustrating the brief internal composition of the cellular phone for implementing the invention, showing a block schematic of the antenna circuitry 2.

[0025] The antenna circuitry 2 includes a proximity switch 3 for controlling the RX path. The proximity switch 3 is arranged to open a matching element 4 for matching the RX path in talking position, in this embodiment a non-linear element, for instance a transistor. In this way, the EX performance will be improved by a couple of dB in talking position and the performance in free space position will not be degraded.

[0026] This is a great advantage with the present invention, since this prevents loss in the RX path and improves RX performance in talking position.

[0027] Fig. 3 illustrates the functionality of the switch in even more detail. Herein, reference numeral "port 1" (for instance representing transceiver input, impedance) and "port 2", are representing a so-called "PIFA S11 impedance antenna" in different conditions, i. e. talking position and free space position. The antenna 1 per se is of conventional type. Also the transistor 4 is of conventional type, in this case BFR505.

[0028] The proximity switch 3 is embodied as a voltage source. It is also possible that the proximity switch 3 is of any other suitable type such as inductive, capacitive or optoelectronic type. The proximity switch could also be of touch type, even if this is not preferred. The proximity switch can also be of digital type including self-adaptive types indicating presence or absence of a target, i. e. a user.

[0029] The proximity switch 3 is used as a voltage for opening the transistor 4. So when the phone is positioned close to the ear, the proximity switch 3 provides a voltage switch, which opens the transistor 4, thereby providing a new match for the Rx path, such that that a network 6 including inductors, capacitors, and antenna switch 5 are matched. To be able to match all bands, the transistor typically has to be multiplied, but not the proximity switch. This is not further shown or described since it is obvious for the person skilled in the art.

[0030] Thus, in free space position, the proximity switch 3 will be closed, whereby the transistor 14 will also be closed such that free space matching is operating in normal mode. In talking position, the proximity switch will be open, such that the transistor 4 will also be open making matching of the RX path possible such that new so-called "S-parameters" will be matched for talking position.

[0031] Fig. 4 illustrates a graph dB(S21) showing insertion loss. Compared to a phone without the antenna circuitry according to the invention, insertion loss is improved by means of the invention.

[0032] It should be realised that cellular phone is just one type of device in which the invention can be implemented. It can just as well be provided in other types of portable electronic equipments such as a lap top computer, a palm top computer, an electronic organizer, a smart-phone, a communicator, a calculator or a gaming machine.

[0033] There are more ways in which the invention can be varied. Therefore the invention is only to be limited by the accompanying claims.

Claims

1. Portable electronic equipment (10) comprising:

antenna circuitry (2) including:

an antenna (1) arranged to be matched in receiving path (RX path)
a proximity switch (3) for controlling the RX path, wherein said proximity switch (3) is arranged to open an element (4) for matching the RX path in talking position, such that a network (6) including inductors, capacitors, and antenna switch (5) are matched.

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2. The equipment of claim 1, wherein the antenna (1) is further arranged to be matched also in transmitting path (Tx).
3. The equipment of claim 1 or 2, wherein said matching element (4) is arranged to match all bands.
4. The equipment of claim 3, wherein said matching element (4) comprises one element for each Rx path.
5. The equipment of any one of the claims 1-4, wherein said proximity switch (3) comprises a voltage source.
6. The equipment of any one of the claims 1-5, wherein said matching element (4) for matching the RX path is a non linear element comprising at least one transistor.
7. The equipment according to any one of the claims 1-6, wherein the equipment (10) is a cellular phone, a smart phone or a communicator.

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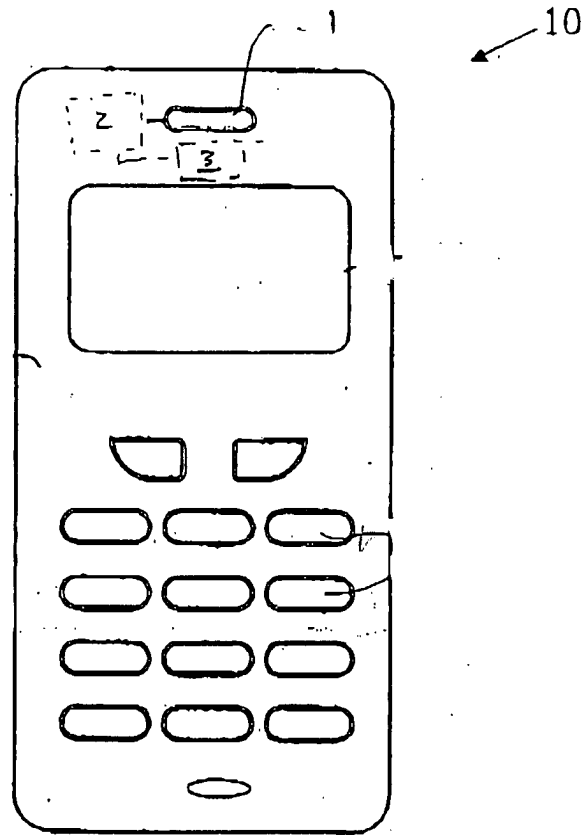


FIG. 1

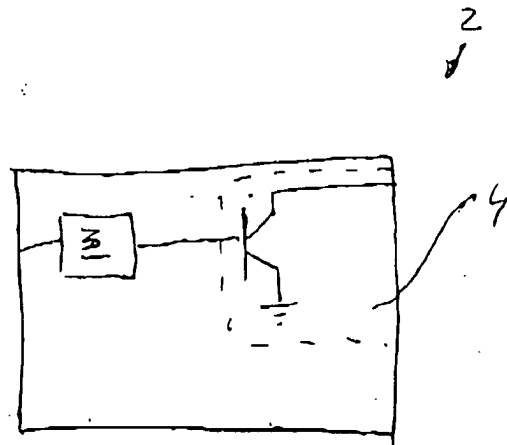


FIG. 2

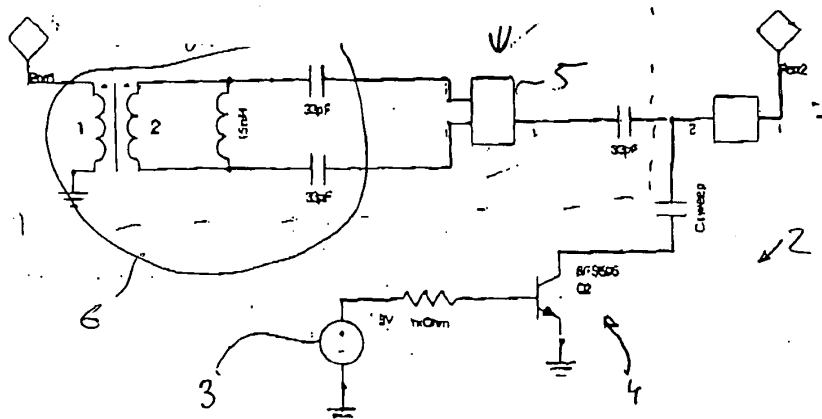


Fig 3

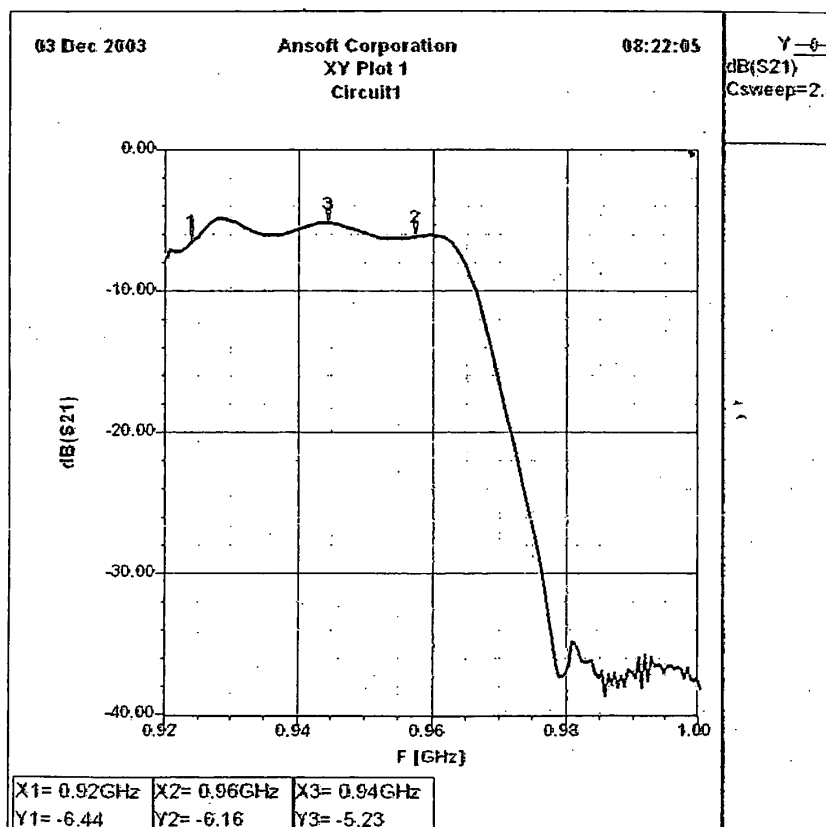


Fig. 4



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EUROPEAN SEARCH REPORT

Application Number
EP 04 00 9204

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X	US 6 219 532 B1 (TANAKA MASAHIKO ET AL) 17 April 2001 (2001-04-17) * column 1, line 44 - line 59 * * column 9, line 50 - line 60 * * column 10, line 1 - line 37; figures 1-6 *	1-7	H01Q1/24 H01Q9/04
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A	----- US 2002/094789 A1 (HARANO NOBUYA) 18 July 2002 (2002-07-18) * the whole document *	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		19 August 2004	Moumen, A
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.82 (P04C01)

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

EP 04 00 9204

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
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