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(54) Mobile terminal with hole in patch antenna

(57) The present invention relates to a mobile terminal 1 for a wireless communication system, with a patch antenna 8 located internally of a casing 7 of the mobile terminal 1, an RF unit for processing RF signals received or to be transmitted, an RF connector 14 located underneath the patch antenna 8 and comprising a switch means for selectively connecting the RF unit to the patch antenna or to an external antenna, whereby the patch antenna 8 and said casing respectively comprise an opening aligned with the RF connector 14 enabling the connection of an external antenna connector 16 through the openings of the RF connector.

The mobile terminal 1 according to the present invention can be built very small with a high integration of the respective components.

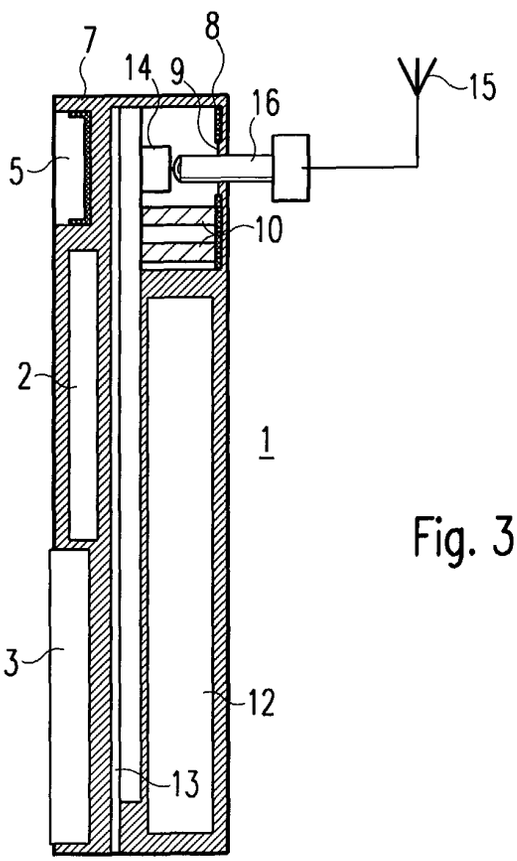

Fig. 3

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Description

[0001] The present invention relates to a mobile terminal for a wireless communication system. Conventionally, mobile terminals for wireless communication systems as e.g. cell phones, personal digital assistants (PDAs) and the like operating in systems like the GSM or the UMTS system, comprise at least one built in antenna often referred to as internal antenna and a connector for connecting a second, external antenna to the mobile terminal. The internal antenna can have different shapes and geometries, may e.g. be a patch antenna, a spiral antenna or the like.

[0002] In many countries nowadays the conventional way of using a mobile terminal for a wireless communication system is prohibited in cars, whereby the mobile terminals have to be used with a hands free kit. Hereby, the mobile terminal is plugged into a cradle which has a connector to an external antenna which in case of a car, is e.g. located at one of the windows or the roof of the car. Connecting an external antenna connector to a corresponding RF connector of the mobile terminal automatically switches off the internal antenna of the mobile terminal so that signals are transmitted and received via the external antenna.

[0003] The present invention is particularly directed to a mobile terminal for a wireless communication system having a patch antenna as an internal antenna. The general trend for development is to make mobile terminals smaller and lighter. This goal is very ambitious and sometimes hard to realise due to the necessary high integration of the obligatory components of a mobile terminal on the one hand and the demand for increasing functionality, memory and battery capacity on the other hand. One of the functional features requiring space in a mobile terminal is the connection of an external antenna connector to the mobile terminal. Usually an external antenna connector is to be connected to the corresponding connector socket somewhere on the back side of the casing of the mobile terminal. The casing hereby has an extra funnel or a dome integrated in the plastic material to guide the external antenna connector to the corresponding RF connector. The RF connector is selectively switching respective RF radio units between the internal antenna and the external antenna connector. Hereby, the distance between the internal antenna and the RF connector for connecting an external antenna connector is disadvantageous due to the required length and the losses of the strip lines necessary for the respective connections on the printed circuit board carrying these components in the mobile terminal. A mobile terminal for a wireless communication system having a patch antenna as an internal antenna on the upper back side of the casing of the mobile terminal and an RF connector on lower back side of the mobile terminal is e.g. shown in EP 0 929 115 A1.

[0004] The object of the present invention is to provide a mobile terminal for a wireless communication system, having a patch antenna as an internal antenna and an RF connector for selectively connecting an RF (radio frequency) unit to the patch antenna and an external antenna, which can be built very small and allows a high integration of its components.

[0005] The above object is achieved by a mobile terminal for a wireless communication system according to claim 1, comprising a patch antenna located internally of the casing of the mobile terminal, an RF unit for processing RF signal received or to be transmitted, an RF (radio frequency) connector located underneath the patch antenna and comprising a switch means for selectively connecting the RF unit to the patch antenna or to an external antenna, whereby the patch antenna and the casing respectively comprise an opening aligned with the RF connector enabling the connection of an external antenna connector through said openings to said RF connector.

[0006] Thus, no particular space in the mobile terminal has to be reserved for the connection of an external antenna connector so that the other necessary components of the mobile terminal can be moved closer to one another. Since the RF connector has a switch means for selectively connecting the RF unit to the patch antenna or to an external antenna, the patch antenna is deactivated if an external antenna connector is connected so that the corresponding degradation of the performance is not the problem. On the other hand, a small opening in the patch antenna for connecting an external antenna connector does not deteriorate the performance of the patch antenna during operation, e.g. when no external antenna connector is connected. A further big advantage of the inventive solution is that the RF connector is located directly underneath the patch antenna so that the connection lines, usually strip lines, connecting the RF unit, the RF connector and the patch antenna can be kept very short so that line losses as well as the required space is minimised.

[0007] Advantageous features of the present invention are claimed in the subclaims.

[0008] Advantageously, the patch antenna is located on a back side of the casing of the mobile terminal.

[0009] Advantageously, the opening in the patch antenna is arranged so that the antenna performance remains essentially unchanged. Essentially unchanged means preferably a degradation of the efficiency of the antenna by up to 5%. Hereby, the opening can advantageously be located in a less radiating area of the antenna, e.g. a corner region of the patch antenna. In this case, if the patch antenna is located in an upper region of the portable communication device on the back side thereof, the opening in the patch antenna is advantageously located in an upper corner region of the patch antenna. The term "upper" hereby designates the upper part of the mobile terminal in a normal operation (conventional) state in which a user holds the mobile terminal to his or her ear. In other words, a patch antenna is located in an upper region of a mobile terminal on a back

side thereof i.e. is arranged on an opposite side of a loudspeaker of the mobile terminal for outputting acoustic speech signals to a user's ear. Likewise, the back side of the mobile terminal is the side of the mobile terminal opposite to the side where the loudspeaker, the display, the key pad and the microphone are located. In normal operation, at least the lower part of the back side of the mobile terminal is covered by a user's hand.

[0010] Further advantageously, the opening in the patch antenna and the RF connector are located close to feeding points for feeding RF signals to the patch antenna. Hereby, line losses and space requirements are further minimised.

[0011] Further advantageously, the mobile terminal comprises a guiding means integral with the casing for guiding an external antenna connector to the RF connector through said openings. The guiding means can e.g. be a correspondingly shaped funnel or dome. Since the casing of a mobile terminal usually consists of plastic, the guiding means also consists of plastic in this case.

[0012] An example of the present invention is explained in more detail in the following description in relation to the enclosed drawings, in which

Fig. 1 shows a schematic front view of a mobile terminal according to the present invention,

Fig. 2 shows a schematic back view of the mobile terminal shown in Fig. 1 and

Fig. 3 shows a side view of a cross section of the mobile terminal shown in Fig. 1 and 2.

[0013] Fig. 1 shows a schematic view of a front side of a mobile phone 1 for a wireless communication system. The mobile phone 1 is an example for a mobile terminal according to the present invention. Alternatively, the mobile terminal can e.g. be a personal digital assistant or the like. The mobile phone 1 is adapted to operate in a wireless communication system, such as the GSM, UMTS or the Bluetooth system or any other wireless communication system in which signals are transmitted and received over a wireless communication link using antennas.

[0014] The mobile phone 1 as shown in Fig. 1 comprises a display 2 for displaying information to a user, a key pad 3 for inputting information or instructions, a microphone 4 for receiving acoustic signals from a user and converting the received acoustic signals into electric signals for further processing, a loudspeaker 5 for outputting acoustic signal to a user, an ear jack 6 for connecting an external headset and an input/output connector 11. All components of the mobile phone are either carried by or integral to the casing 7, which usually consists of molded plastics.

[0015] Fig. 2 shows a back side of the mobile phone 1 shown in Fig. 1 with the back side of the casing 7 removed so that an internal patch antenna 8 on the upper side of the mobile phone 1 is visible. In assembled state, the patch antenna 8 is located internally and directly underneath the back side of the casing 7, as e.g. shown in Fig. 3.

[0016] As shown in Fig. 2, the patch antenna 8 comprises an opening 9 in the upper left corner region if looking at the patch antenna from its back side. Immediately adjacent to the opening 9, two feeding points 10 are located. As can be better seen in Fig. 3, the opening 9 of the patch antenna 8 enables the connection of an external antenna connector 16 with an RF connector 14 located underneath the patch antenna 8 on a printed circuit board 13. The RF connector (radio frequency connector) 14 comprises switch means for selectively connecting a radio frequency (RF) unit for processing RF signals received from or to be transmitted to the patch antenna 8 or to an external antenna 15 connected via the external antenna connector 16. The RF unit is also part of the printed circuit board 13 and comprises an output stage of upconverting and amplifying signals to be transmitted via the respective antenna 8 or 15 and an input stage for downconverting signals received via the respective antenna 8 or 15. If the external antenna connector 16 is guided through the opening 9 of the patch antenna 8 and connected to the RF connector 14, the RF unit is automatically disconnected from the internal patch antenna 8 and connected to the external antenna 15 connected to the external antenna connector 16. Likewise, if the external antenna connector 16 is disconnected from the RF connector 14, the switch means of the RF connector 14 automatically re-connects the RF unit with the internal patch antenna 8.

[0017] The opening 9 of the patch antenna 8 corresponds and is aligned with a corresponding opening in the back side of the casing 7 of the mobile phone 1. Although not shown in the drawings, the opening of the casing 7 has an integral guiding means such as a dome or a funnel for guiding the external antenna connector 16 to the RF connector 14. The RF connector 14 is located directly underneath (internal to) the opening 9 of the patch antenna 8 and the corresponding opening of the casing 7. Immediately adjacent to the opening 9 of the patch antenna 8, feeding points 10 are connecting the RF connector 14 and the patch antenna 8 for guiding RF signals from the RF unit to the patch antenna 8 and vice versa.

[0018] As can be further seen from Fig. 3, the entire mobile phone 1 can be built very tiny and small with a high integration of the necessary components. E.g. a battery pack 12 removably located on the middle and lower back side of the mobile phone 1 can be located very close to the patch antenna 8 without any further space being required for a separate connection unit for connecting the external antenna connector 16. On the printed circuit board 13, all necessary elements for processing signals and operating the system are arranged. It is to be understood that the mobile phone 1

further comprises all other elements necessary for its operation although these elements are not shown in the drawings for the sake of clarity.

Claims

1. Mobile terminal (1) for a wireless communication system, with
a patch antenna (8) located internally of a casing (7) of the mobile terminal (1),
an RF unit for processing RF signals received or to be transmitted,
an RF connector (14) located underneath said patch antenna (8) and comprising a switch means for selectively connecting said RF unit to the patch antenna or to an external antenna,
whereby said patch antenna (8) and said casing (7) respectively comprise an opening aligned with said RF connector (14) enabling the connection of an external antenna connector (16) through said openings to said RF connector (14).

2. Mobile terminal (1) for a wireless communication system,
characterized in,
that the patch antenna (8) is located on a back side of the casing (7).

3. Mobile terminal (1) according to claim 1 or 2,
characterized in,
that said opening (9) in said patch antenna (8) is arranged so that the antenna performance remains essentially unchanged.

4. Mobile terminal (1) according to claim 3,
characterized in,
that said opening (9) in said patch antenna (8) is located in a corner region thereof.

5. Mobile terminal (1) according to claim 4,
characterized in,
that said patch antenna (8) is located in an upper region of mobile terminal (1) and said opening (9) in said patch antenna (8) is located in an upper corner region of said patch antenna (8).

6. Mobile terminal (1) according to one of the claims 1 to 5,
characterized in,
that said opening (9) in said patch antenna (8) and said RF connector (14) are located close to feeding points (10) for feeding RF signals to said patch antenna (8).

7. Mobile terminal (1) according to one of the claims 1 to 6,
characterized by
a guiding means integral with said casing (7) for guiding an external antenna connector (16) to said RF connector (14) through said openings.

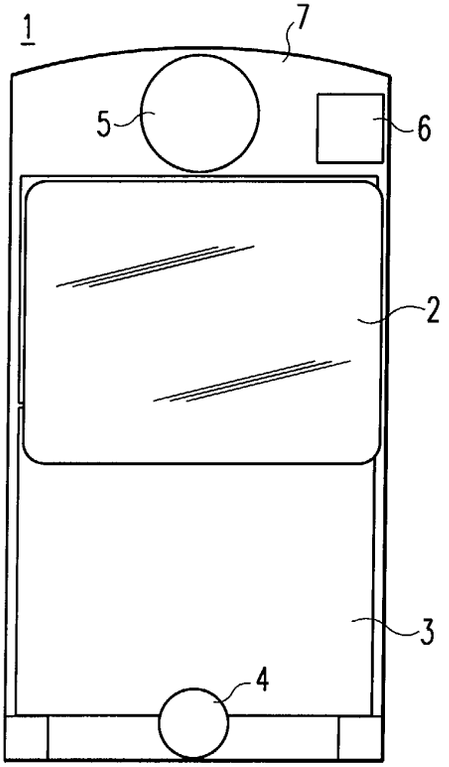

Fig. 1

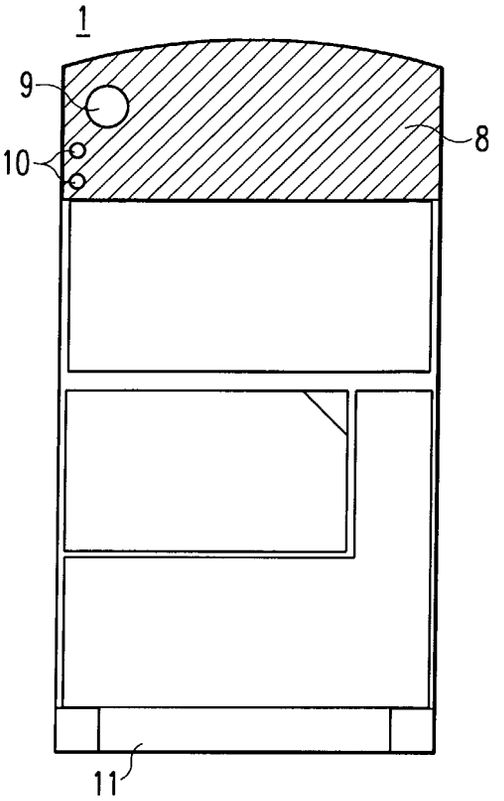

Fig. 2

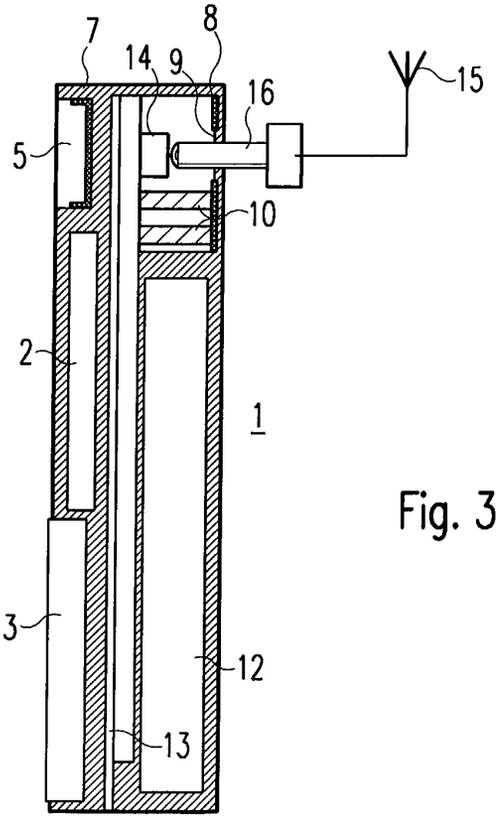

Fig. 3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 01 10 6944

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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TECHNICAL FIELDS SEARCHED (Int.Cl.7)
H01Q

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	24 September 2001	von Walter, S-U

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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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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