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(54) **Antenna arrangement for a portable radio communication device, and portable radio communication device comprising such an antenna arrangement**

(57) The present invention relates to an antenna arrangement for a portable radio communication device, comprising a radiating element, a ground plane means and a decoupling means, wherein the radiating element is provided at a first end of the ground plane means. The radiating element is configured to provide radio frequency operation for at least a first radio frequency band, and the decoupling means is provided on the ground plane means to decouple a second end of the ground plane means, opposite the first end, from the first radio frequency band.

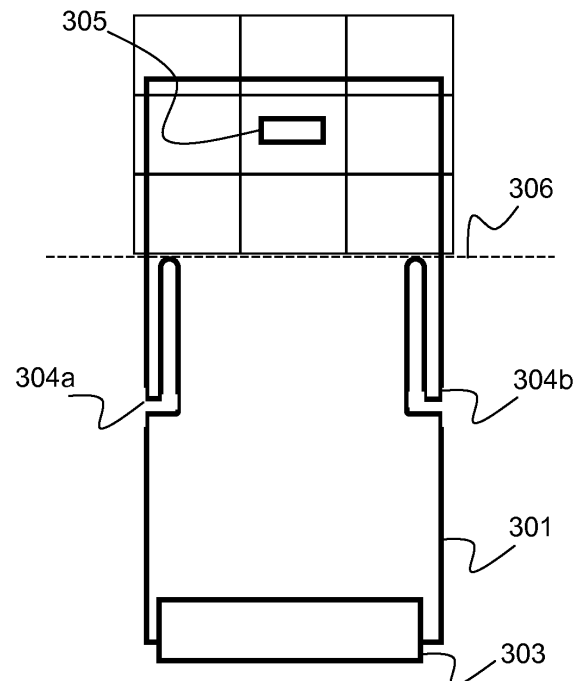


FIG. 4

Description

TECHNICAL FIELD

[0001] The present invention relates to an antenna arrangement for a portable radio communication device. The present invention relates more specifically to an antenna arrangement for a portable radio communication device with low external coupling.

BACKGROUND OF THE INVENTION

[0002] A portable radio communication device, such as a mobile phone, PDA, portable computer or similar device, generally couples to external tissues or external devices due to use of radio frequency communication. Lately, demands in e.g. US, requires a limited coupling to e.g. hearing aids, which is formulated in the Hearing Aid Compatibility (HAC) requirement given by the FCC in the US. The HAC requirement is today defined as an E-field and H-field limitation around and above the speaker of a mobile phone, which requirement is illustrated in Fig. 1. A 3x3 grid 1 is positioned centred 15 mm over a speaker 2 of a mobile phone 3, wherein each grid is 50x50 mm. The E-field and H-field limitation needs to be fulfilled for each grid apart from the three worst connected grids, since listening adjustment of the mobile phone position relative a hearing aid should provide low enough coupling thereto. The amount of allowed coupling is defined in a number of categories (M1-M4 and T1-T4), and FCC regulations now state that at least an M3 rating for 50 percent of handset models that is offered to consumers on the US market, must be fulfilled.

SUMMARY OF THE INVENTION

[0003] An object of the present invention is to provide an antenna arrangement for a portable radio communication device with low external coupling, particularly regarding coupling to a hearing aid.

[0004] One major source of hearing aid interference is power emitted by the antenna element of a mobile phone. As the antenna element advantageously is located in one end of the mobile phone and the speaker in the other, the interference is mainly coupled from the antenna element to the hearing aid through the chassis of the mobile phone. This is particularly true for slider type phones, where the antenna and speaker are on separate PCBs (where the slider and/or a flex-film provide the PCB-to-PCB connection). Therefore, the problem of achieving a high HAC rating is generally translated into the problem of reducing the coupling between an antenna element and as chassis of a portable radio communication device at a frequency band of interest.

[0005] This object, among others, is according to one aspect of the present invention, attained by an antenna arrangement and a portable radio communication device, respectively, as defined by the appended claims.

[0006] By providing an antenna arrangement for a portable radio communication device, comprising a radiating element, a ground plane means and a decoupling means, wherein the radiating element is provided at a first end of the ground plane means, the radiating element is configured to provide radio frequency operation for at least a first radio frequency band, and the decoupling means is provided on the ground plane means to decouple a second end of the ground plane means, opposite the first end, from the first radio frequency band, currents on the ground plane means, close to the position of a speaker of the portable radio communication device, can be reduced enough to meet e.g. the HAC requirements of the FCC regulations in US.

[0007] The present invention is particularly advantageous for radiating elements which generate currents on a ground plane means, such as monopoles, IFAs and parasites.

[0008] The decoupling means preferably comprises a first conductor electrically connected to a decoupling position on the ground plane means and extend in a general direction towards the first end of the ground plane means, which provides for short circuiting for a specific frequency.

[0009] Advantageously the first conductor is a quarter of the wavelength of the first radio frequency band, which preferably is GSM1900 Tx, which has the toughest HAC requirements.

[0010] Preferably, the decoupling means also comprises a second conductor electrically connected to the decoupling position and extend in a general direction towards the first end of the ground plane means, wherein the first and second conductors are located on opposite sides of ground plane means, which efficiently decouples the second end of the ground plane means from a desired frequency of the radiating element.

[0011] A simple configuration is of the conductors are obtained by means of a conductive wiring, or alternatively of a flex film comprising conductive portions. A preferred configuration of the conductors are provided by an L-shaped cut-out in the ground plane means, which would not require additional space of the portable radio communication device.

[0012] By providing a decoupling position 75 mm from the center of the speaker, i.e. the outer rim of the HAC grid, the E- and H-field requirements are easily achievable for all but the three connected lowest grids, in line with the HAC requirement.

[0013] By providing a portable radio communication device comprising a radiating element, a ground plane means and a decoupling means, wherein said radiating element is provided at a first end of said ground plane means, said decoupling means is provided on said ground plane means to decouple a second end of said ground plane means, opposite said first end, from said radiating element, preferably having a speaker provided at said second end, the decoupling means is possible to configure to pass M3 HAC requirements.

[0014] Further features and advantages of the present invention will be evident from the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] 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 schematically illustrates how HAC requirements are defined.

Fig. 2a is a schematic top view of a first embodiment of the present invention.

Fig. 2b is a schematic side view of the first embodiment of the present invention shown in Fig. 2a.

Fig. 3a is a schematic top view of a second embodiment of the present invention.

Fig. 3b is a schematic side view of the second embodiment of the present invention shown in Fig. 3a.

Fig. 4 is a schematic top view of the second embodiment of the present invention shown in Fig. 3a combined with HAC requirements.

DETAILED DESCRIPTION OF EMBODIMENTS

[0016] In the following description, for purpose of explanation and not limitation, specific details are set forth, such as particular techniques and applications in order to provide a thorough understanding of the present invention. However, it will be apparent for a person skilled in the art that the present invention may be practiced in other embodiments that depart from these specific details. In other instances, detailed description of well-known methods and apparatuses are omitted so as not to obscure the description of the present invention with unnecessary details.

[0017] 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 Figs. 2a-2b.

[0018] A ground plane means 201 is provided in a portable radio communication device 202, such as a mobile phone, PDA, or similar device. The ground plane means 201 is most often provided as a part of a printed wiring board (not shown), but may also be provided by other means.

[0019] As can be seen in figures 2a and 2b the ground plane means 201 has a substantially plane, rectangular shape with a radiating element 203 provided at a first end 201b of the ground plane means 201. The radiating element 203 is configured to provide the portable radio com-

munication device with an operating frequency band, such as at least GSM1900, and typically also GSM850, GSM900 and GSM1800. The radiating element may be provided completely over, partially over or at the side of the ground plane means 201. Furthermore, the radiating element may be a PIFA, IFA, L-antenna, half-loop, monopole, non-resonant or any other antenna means which induces radiating currents in the ground plane.

[0020] At a second end 201a opposite to the first end 201b a speaker 205 is provided.

[0021] A decoupling means 204 is provided on the ground plane means 201. The decoupling means 204 comprises a first and second conductive wire 204a and 204b provided on opposite sides of the ground plane means 201. The conductive wires 204a and 204b extends a short bit out from, or orthogonally to the ground plane means 201, is bent 90 degrees and extends further, at the side of the ground plane means 201, in the direction towards the first end 201b. The length of the conductive wires 204a and 204b are approximately a quarter of the wavelength for GSM1900 Tx (1850 MHz). If the space between the conductive wires and the ground plane is filled with a dielectric the length may be shortened. This may affect the electrical impedance, but then again this may be corrected by adjusting the spacing between the conductive wires and the ground plane.

[0022] The conductive wires 204a and 204b may conveniently be provided in the housing of the mobile device or at any other convenient place. The space between the conductive wires 204a and 204b and the ground plane means 201 may be filled with a suitable dielectric material for further tuning of the bandwidth. The conductive wires 204a and 204b could alternatively be exchanged with a flex film comprising conductive portions.

[0023] Although the decoupling means has been described having two conductive wires on opposite sides of the ground plane means it is possible to only provide one conductive wire on one side of the ground plane means, but the decoupling effect will be significantly reduced.

[0024] A second embodiment of the present invention will now be described with reference to Figs. 3-4.

[0025] Figure 3a is a schematic top view of a variant of the present invention showing a ground plane means 301. Figure 3b is a schematic side view of the arrangement according to figure 3a. A radiating element 303 is provided at a first end 301b of the ground plane means 301. The radiating element 303 is configured to provide the portable radio communication device with an operating frequency band, such as at least GSM1900, and typically also GSM850, GSM900 and GSM1800. The radiating element may be provided completely over, partially over or at the side of the ground plane means 301. Furthermore, the radiating element may be a PIFA, IFA, L-antenna, half-loop, monopole, non-resonant or any other antenna means which induces radiating currents in the ground plane.

[0026] At a second end 301a opposite to the first end

301b a speaker 305 is provided.

[0027] A decoupling means 304 is provided on the ground plane means 301. The decoupling means 304 comprises first and second conducting means 304a and 304b provided on opposite sides of the ground plane means 301. The conducting means 304a and 304b, respectively, are provided by a cut-out in the ground plane means 301. The cut-out is L shaped as is seen in figure 3a. The length of the conductive means 304a and 304b are approximately a quarter of the wavelength for GSM1900 Tx (1850 MHz). If the space between the conductive wires and the ground plane is filled with a dielectric the length may be shortened. This may affect the electrical impedance, but then again this may be corrected by adjusting the spacing between the conductive wires and the ground plane.

[0028] The positioning of the decoupling means 304, i.e. the decoupling position 306, at the side of the ground plane means 301, is preferably at the rim of the HAC grid. The part of the ground plane means beyond the decoupling position, relative the radiating element 303 at the first end of the ground plane means, is decoupled for GSM1900 Tx frequencies. Depending on the specific design of the radiating structure, the design of the ground plane means, circuitry located in the PCB, the design of the handset etc, the decoupling could be positioned closer to the speaker and still fulfill M3 HAC requirements.

[0029] The discussion of the decoupling position in connection with the second embodiment of the present invention is valid also for the first embodiment of the present invention described above.

[0030] It should be mentioned that currents will still flow in the ground plane means in the decoupled portion. There will be a current minimum at the open ends of the conductive means and a current maximum at the connection between the conductive means and the ground plane means. The currents in the ground plane in the decoupled portion will however not be significant for e.g. HAC requirements.

[0031] 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 arrangement for a portable radio communication device, comprising a radiating element, a ground plane means and a decoupling means, wherein said radiating element is provided at a first end of said ground plane means,
characterised in that
said radiating element is configured to provide radio frequency operation for at least a first radio frequency

band, and said decoupling means is provided on said ground plane means to decouple a second end of said ground plane means, opposite said first end, from said first radio frequency band.

2. The antenna arrangement as claimed in claim 1, wherein said radiating element is configured to generate currents on said ground plane means.
3. The antenna arrangement as claimed in any of claims 1-2, wherein said ground plane means has a substantially rectangular shape.
4. The antenna arrangement as claimed in any of claims 1-3, wherein said decoupling means comprises a first conductor electrically connected to a decoupling position on said ground plane means and extending in a general direction towards said first end.
5. The antenna arrangement as claimed in claim 4, wherein said first conductor is a quarter of the wavelength of said first radio frequency band.
6. The antenna arrangement as claimed in claim 4 or 5, wherein said decoupling means comprises a second conductor electrically connected to said decoupling position and extending in a general direction towards said first end, and said first and second conductors are located on opposite sides of said ground plane means.
7. The antenna arrangement as claimed in any of claims 4-6, wherein said conductor(s) is a conductive wiring.
8. The antenna arrangement as claimed in any of claims 4-6, wherein said conductor(s) is provided by an L-shaped cut-out in said ground plane means.
9. The antenna arrangement as claimed in any of claims 4-6, wherein said conductor(s) is a flex film comprising conductive portions.
10. The antenna arrangement as claimed in any of claims 1-9, wherein said first radio frequency band is GSM1900 Tx.
11. A portable radio communication device comprising a radiating element, a ground plane means and a decoupling means, wherein said radiating element is provided at a first end of said ground plane means,
characterised in that
said decoupling means is provided on said ground plane means to decouple a second end of said ground plane means, opposite said first end, from said radiating element.

12. The portable radio communication device as claimed in claim 11, comprising a speaker provided at said second end.
13. The portable radio communication device as claimed in claim 12, wherein said decoupling means is configured pass M3 HAC requirements. 5
14. The portable radio communication device as claimed in claim 13, wherein said decoupling means is provided at a specified distance from said second end of said ground plane means. 10

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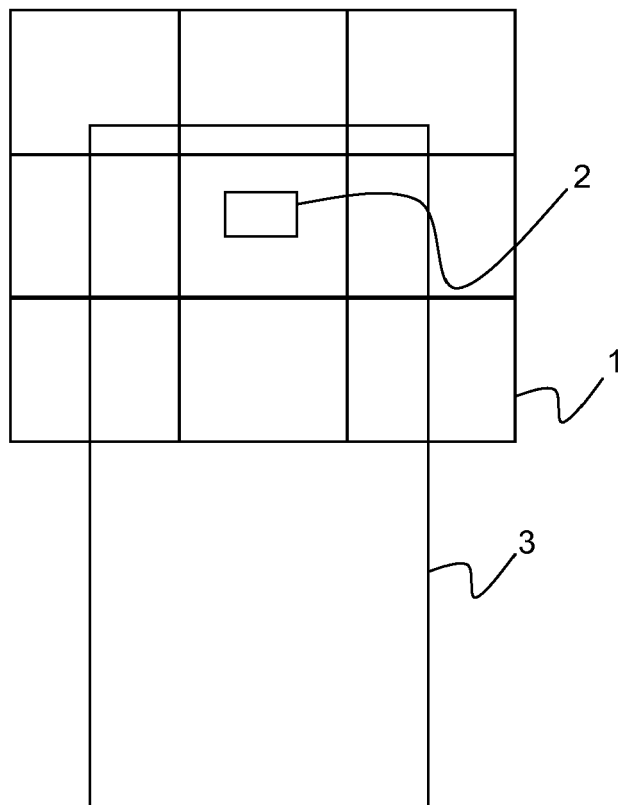
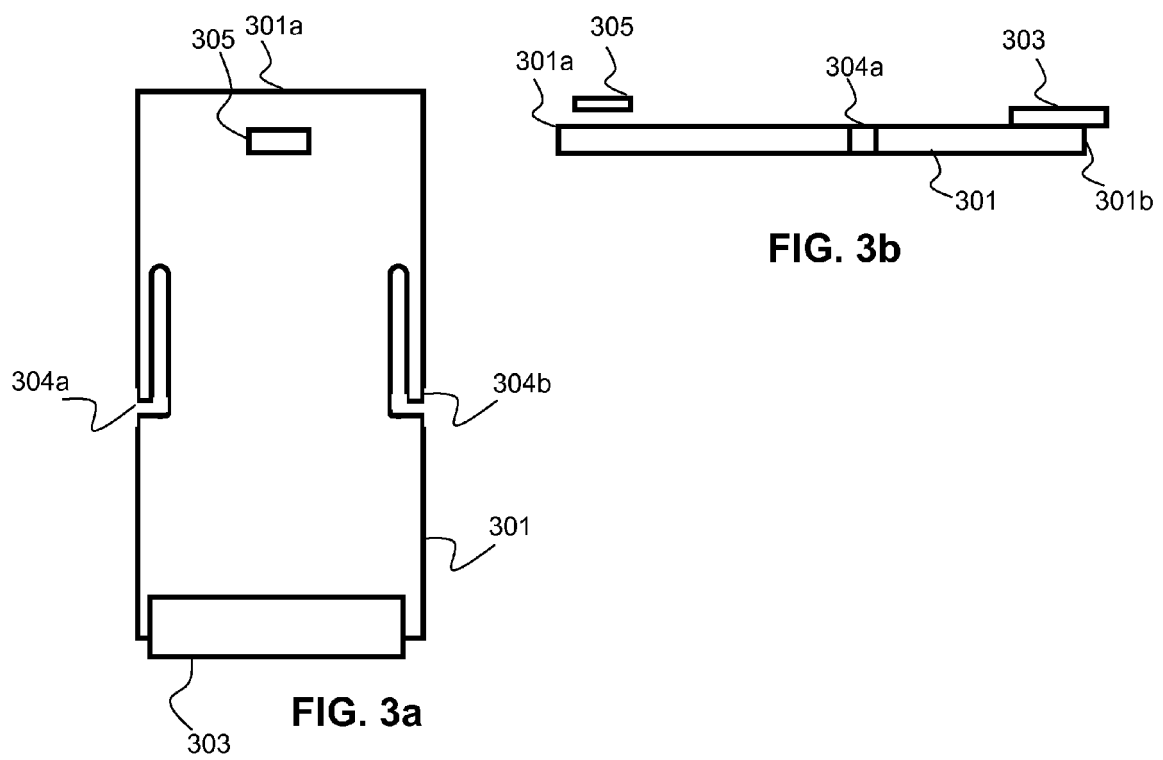
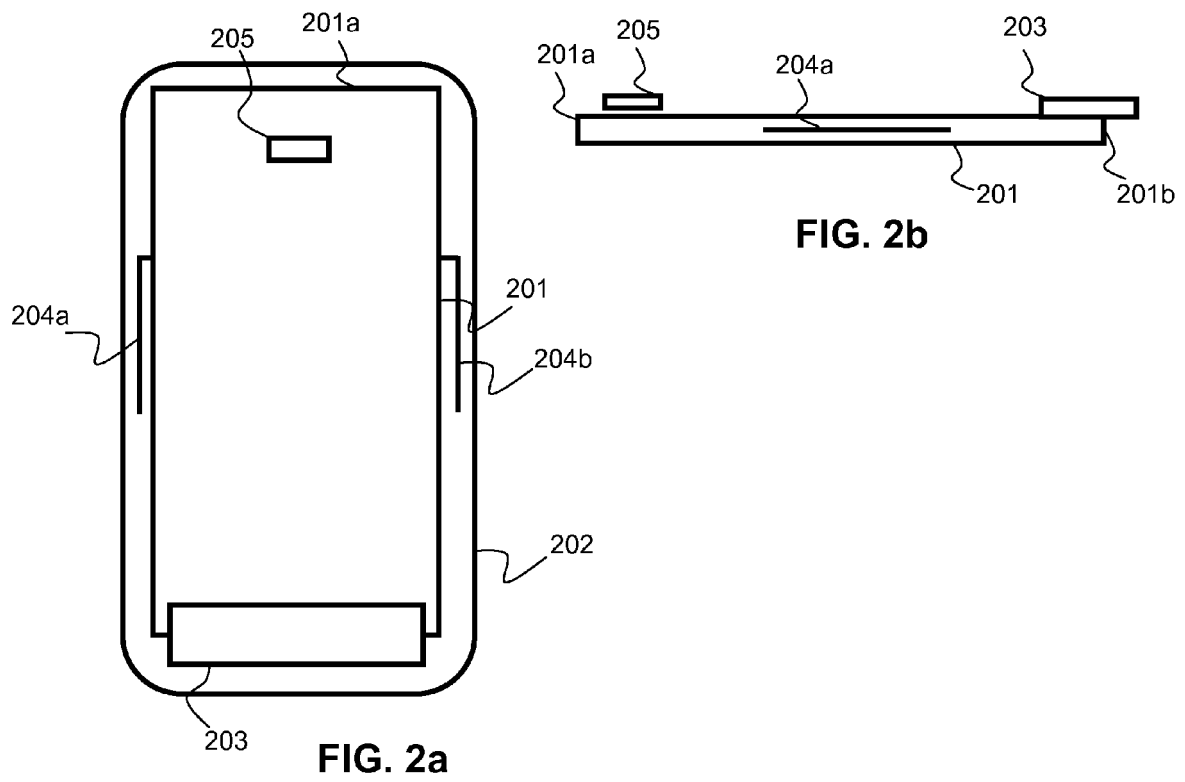


FIG. 1



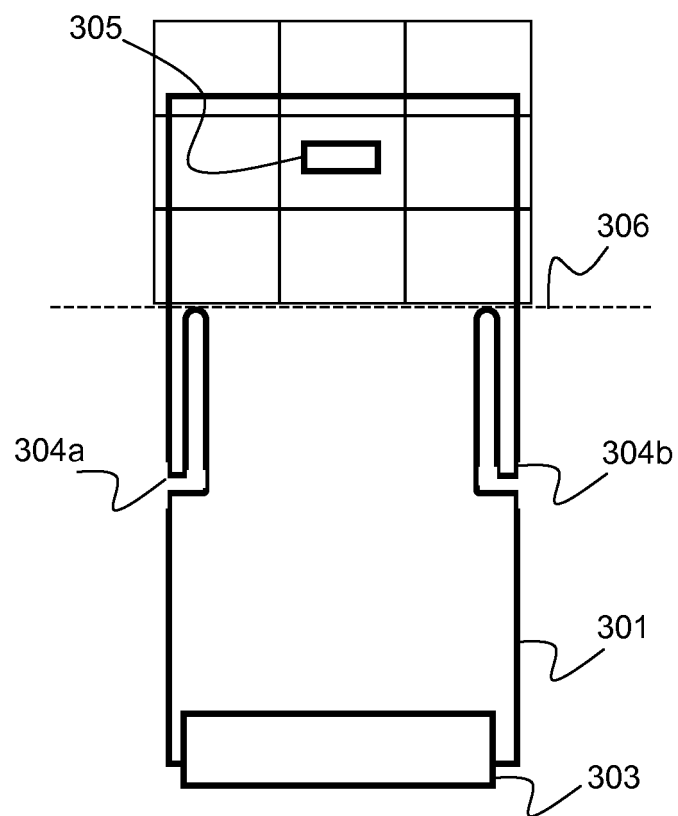


FIG. 4



EUROPEAN SEARCH REPORT

Application Number
EP 08 16 2020

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 6 624 789 B1 (KANGASVIERI TOMI [FI] ET AL) 23 September 2003 (2003-09-23) * figures 1-3 * * column 5, line 56 - column 7, line 40 * -----	1-3, 10-12,14	INV. H01Q1/52 H01Q1/24
X	US 2006/262026 A1 (GAINEY KENNETH M [US] ET AL) 23 November 2006 (2006-11-23) * figure 4 * * paragraphs [0026] - [0030] * -----	1,4,5, 7-12	
A	WO 2008/005616 A (FLEXTRONICS AP LLC [US]; MARSH FISCHMANN & BREYFOGLE LL [US]; PIISILA) 10 January 2008 (2008-01-10) * abstract; figures 1-5 * * page 7, line 4 - page 11, line 3 * -----	1-14	
A	JP 10 261914 A (MURATA MANUFACTURING CO; FUJI ELECTRIC CO LTD) 29 September 1998 (1998-09-29) * abstract *	1-14	
A	EP 0 716 470 A (AT & T CORP [US]) 12 June 1996 (1996-06-12) * abstract; figures 1-3 * * column 1, line 54 - column 3, line 30 * -----	1-14	TECHNICAL FIELDS SEARCHED (IPC) H01Q
A	US 2004/125029 A1 (MAOZ JOSEPH [IL] ET AL) 1 July 2004 (2004-07-01) * abstract; figures 3-5 * * paragraphs [0040] - [0044] * -----	1-14	
A	WO 2008/084273 A (NOKIA CORP [FI]; KROGERUS JOONAS [FI]) 17 July 2008 (2008-07-17) * abstract; figures 4-7 * * page 8, line 6 - page 12, line 5 * -----	1-14	
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 27 November 2008	Examiner Unterberger, Michael
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 08 16 2020

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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27-11-2008

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6624789 B1	23-09-2003	US 2003193437 A1	16-10-2003
US 2006262026 A1	23-11-2006	NONE	
WO 2008005616 A	10-01-2008	US 2008058035 A1	06-03-2008
JP 10261914 A	29-09-1998	JP 3139975 B2	05-03-2001
EP 0716470 A	12-06-1996	CA 2160285 A1	09-06-1996
		DE 69517774 D1	10-08-2000
		DE 69517774 T2	23-11-2000
		US 5559521 A	24-09-1996
US 2004125029 A1	01-07-2004	AT 399431 T	15-07-2008
		AU 8007601 A	13-03-2002
		CA 2420959 A1	07-03-2002
		CN 1600016 A	23-03-2005
		EP 1323281 A1	02-07-2003
		WO 0219671 A1	07-03-2002
		JP 4162993 B2	08-10-2008
		JP 2004522332 T	22-07-2004
		TW 504858 B	01-10-2002
WO 2008084273 A	17-07-2008	NONE	