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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,
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[Continued on next page]

(54) Title: ANTENNALESS WIRELESS DEVICE

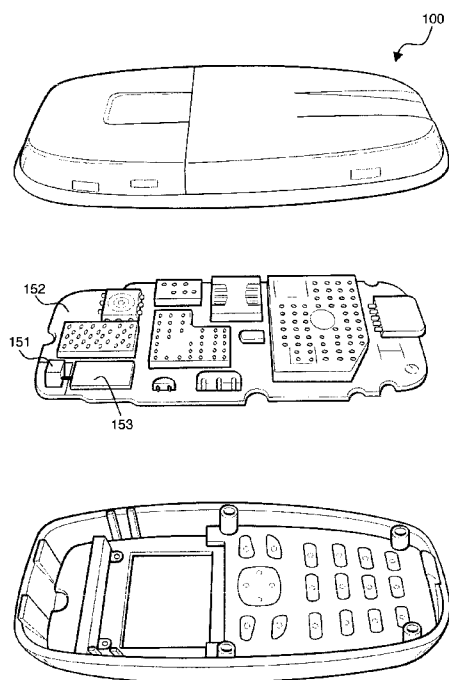


Fig. 1a

(57) Abstract: The invention refer to an antennaless wireless handheld or portable device (100) comprising: a user interface module (101), a processing module (102), a memory module (103), a communication module (104) and, a power management module (105); the communication module (104) including a radiating system (200) capable of transmitting and receiving electromagnetic wave signals in a first frequency region; said radiating system (200) comprising a radiating structure (201) comprising or consisting of at least one ground plane layer (206) including a connection point (207), at least one radiation booster (204) including a connection point (205) and an internal port (208), wherein the internal port (208) is defined between the connection point (205) of the at least one radiation booster (204) and the connection point (207) of the at least one ground plane layer (206); wherein a ground plane rectangle (450) is defined as being the minimum-sized rectangle that encompasses the at least one ground plane layer (206, 402), so that the sides of the ground plane rectangle (450) are tangent to at least one point of the at least one ground plane layer (206, 402), wherein the ratio between a side of the ground plane rectangle (450) and the free-space wavelength corresponding to the lowest frequency of the first frequency region is larger than 0.1 such that the ground plane layer supports a radiation mode; wherein the at least one radiation booster (204) couples the electromagnetic energy from the radiofrequency system (202) to the ground plane layer (206) in transmission, and from the ground plane layer (206) to the radiofrequency system (202) in reception; wherein the at least one radiation booster (204) has a maximum size smaller than 1/30 times the free-space wavelength corresponding to the lowest frequency of the first frequency region; the radiating system (200) further comprising a radiofrequency system (202), and an external port (203); the radiofrequency system (202) comprising a first port (209) connected to the internal port of the radiating structure (208) and a second port (210) connected to the external port (203) of the radiating system

(200); wherein the input impedance of the radiating structure (201) at said internal port (208) when disconnected from the radiofrequency system (202) has an imaginary part not equal to zero for any frequency of the first frequency region; and wherein said radiofrequency system (202) modifies the impedance of the radiating structure (201), providing impedance matching to the radiating system (200) in the first frequency region of operation of the radiating system (200).



NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, 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).

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INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER

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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)

H01Q

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

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

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	MEINKE H ET AL: "Taschenbuch der Hochfrequenztechnik Bd. 2 Komponenten" 1 January 1992 (1992-01-01), Springer Verlag, Berlin, Germany., XP002560328 ISBN: 3540547150 vol. 2, pages N14-N14, page N14, line 5	1-10
X	SKRIVERVIK A K ET AL: "PCS Antenna Design: The Challenge of Miniaturization" IEEE ANTENNAS AND PROPAGATION MAGAZINE, IEEE SERVICE CENTER, PISCATAWAY, NJ, US, vol. 43, no. 4, 1 August 2001 (2001-08-01), pages 12-27, XP011091611 ISSN: 1045-9243 paragraph [03.5]	1-10

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

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Name and mailing address of the ISA/

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	MEINKE H ET AL: "Taschenbuch der Hochfrequenztechnik Bd. 2 Komponenten" TASCHENBUCH DER HOCHFREQUENZTECHNIK, XX, XX, vol. 2, 1 January 1992 (1992-01-01), pages N36-N40, XP002462630 Berlin, Germany ISBN: 3-540-54715-0 figures 2,5 -----	1-10
X	EP 1 662 604 A1 (SONY ERICSSON MOBILE COMM AB [SE]) 31 May 2006 (2006-05-31) abstract; figure 1 -----	1-10
X	WO 02/071541 A1 (KONINKL PHILIPS ELECTRONICS NV [NL]) 12 September 2002 (2002-09-12) abstract; figure 3 -----	1-10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2009/005579

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-10

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-10

An antenna composed of a ground plane, a small piece of conductive material ("radiation booster") and a matching circuit, wherein the small piece of conductive material is smaller than $1/30$ lambda. Dependent claims specify, in substance, the sizes and shapes of the ground plane and small piece of conductive material.

2. claims: 11-12

An antenna composed of a ground plane, a small cut in the ground plane ("radiation booster") and a matching circuit, wherein the small cut is smaller than $1/30$ lambda.

3. claims: 13-18

An antenna composed of a ground plane, a small piece of conductive material ("radiation booster") and a matching circuit, wherein the small piece of conductive material is smaller than $1/30$ lambda. Claims specify, in substance, the relative positions of the ground plane and small piece of conductive material.

4. claims: 19-26

An antenna composed of a ground plane, a small piece of conductive material ("radiation booster") and a matching circuit, wherein the small piece of conductive material is smaller than $1/30$ lambda. Claims specify, in substance, the construction of the matching circuit.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2009/005579

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EP 1662604	A1	31-05-2006	AT 405966 T	15-09-2008
			CN 101057366 A	17-10-2007
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			US 2002149524 A1	17-10-2002