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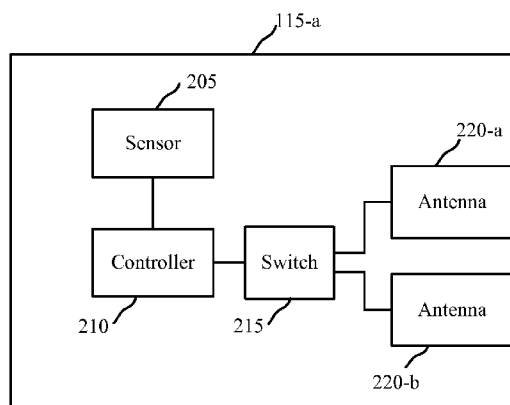
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[Continued on next page]

(54) **Title:** METHOD AND APPARATUS TO REDUCE PA/DEVICE TEMPERATURE BY SWITCHING THE ANTENNAS ON A DEVICE



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FIG. 2

(57) **Abstract:** Methods, systems, and devices are described for thermal management of a wireless communication device. The described techniques may be used, for example, to monitor an operating temperature of the device to determine if the operating temperature has exceeded a threshold value. Other aspects may provide for monitoring of a PA temperature, a transmission power level, and/or input from one or more additional sensors associated with the wireless communication device. Based on any of the above inputs, alone or in combination, an operating temperature of the wireless communication device may be determined. When the temperature exceeds the threshold value, a transmission antenna can be switched from a first antenna to a second antenna. Additional aspects may provide for reduction of the transmission power level in response to the operating temperature exceeding the predetermined threshold value.



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INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
INV. H04B7/06 H03F1/30
ADD.

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)
H04B H03F

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 practicable, search terms used)

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2001 332984 A (MATSUSHITA ELECTRIC IND CO LTD) 30 November 2001 (2001-11-30) abstract; figure 1 -----	1-5,7, 10-16, 18, 21-27, 29, 32-38, 40,43,44
X	WO 2009/020780 A1 (WIQUEST COMMUNICATIONS INC [US]; RAJAGOPAL SRIDHAR [US]; JOSEPH BRIAN) 12 February 2009 (2009-02-12) page 3, line 32 - page 5, line 2; figure 3 page 6, line 25 - page 7, line 36; figure 5 ----- -/--	6,17,28

☒ 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 application or patent 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

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"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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INTERNATIONAL SEARCH REPORT

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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.
A	US 7 546 103 B1 (KOPIKARE MILIND [US] ET AL) 9 June 2009 (2009-06-09) column 3, line 3 - column 4, line 34; figures 3B-4B column 4, line 56 - column 5, line 21; figure 5B -----	8,9,19, 20,30,31

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/010588

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.:

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: 1-5, 7, 10-16, 18, 21-27, 29, 32-44

A method for thermal management of a wireless communication device having two or more antennas, the method comprising: monitoring an operating temperature associated with the wireless communication device; and switching, when the operating temperature exceeds a predetermined threshold value, a transmitting antenna of the wireless communications device from a first antenna to a second antenna.

1.1. claims: 1-4, 7, 11-15, 18, 22-26, 29, 33

A method for thermal management of a wireless communication device having two or more antennas, the method comprising: monitoring an operating temperature associated with the wireless communication device; and switching, when the operating temperature exceeds a predetermined threshold value, a transmitting antenna of the wireless communications device from a first antenna to a second antenna, wherein the monitoring comprises monitoring a temperature associated with a power amplifier of the wireless communication device.

1.2. claims: 5, 16, 27

A method for thermal management of a wireless communication device having two or more antennas, the method comprising: monitoring an operating temperature associated with the wireless communication device; and switching, when the operating temperature exceeds a predetermined threshold value, a transmitting antenna of the wireless communications device from a first antenna to a second antenna, further comprising monitoring a transmission power level, wherein the switching is based at least in part on the monitored transmission power level.

1.3. claims: 10, 21, 32

A method for thermal management of a wireless communication device having two or more antennas, the method comprising: monitoring an operating temperature associated with the wireless communication device; and switching, when the operating temperature exceeds a predetermined threshold value, a transmitting antenna of the wireless communications device from a first antenna to a second antenna, wherein the device comprises user equipment coupled with and operating on a multicarrier communications system.

1.4. claims: 34-44

A wireless communication device configured for thermal management, the wireless communication device comprising at least one controller configured to monitor an operating

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

temperature associated with the wireless communication device; and switch, when the operating temperature exceeds a predetermined threshold value, a transmitting antenna of the wireless communication device from a first antenna to a second antenna; and a memory coupled to the at least one controller.

2. claims: 6, 17, 28

A method for thermal management of a wireless communication device having two or more antennas, the method comprising: monitoring an operating temperature associated with the wireless communication device; and switching, when the operating temperature exceeds a predetermined threshold value, a transmitting antenna of the wireless communications device from a first antenna to a second antenna, further comprising reducing a transmission power level of the wireless communication device to a predetermined transmission power level when the operating temperature of the device exceeds the predetermined threshold value.

3. claims: 8, 19, 30

A method for thermal management of a wireless communication device having two or more antennas, the method comprising: monitoring an operating temperature associated with the wireless communication device; and switching, when the operating temperature exceeds a predetermined threshold value, a transmitting antenna of the wireless communications device from a first antenna to a second antenna, further comprising switching the transmitting antenna from the second antenna to the first antenna after a predetermined time has elapsed and the monitored temperature of the wireless communications device does not fall or increase in excess of a threshold amount from the predetermined threshold value.

4. claims: 9, 20, 31

A method for thermal management of a wireless communication device having two or more antennas, the method comprising: monitoring an operating temperature associated with the wireless communication device; and switching, when the operating temperature exceeds a predetermined threshold value, a transmitting antenna of the wireless communications device from a first antenna to a second antenna, wherein the switching the transmitting antenna from the first antenna to the second antenna is initiated when the operating temperature exceeds the predetermined threshold value for a predetermined period of time.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2014/010588

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2001332984 A	30-11-2001	NONE	

WO 2009020780 A1	12-02-2009	CN 101809874 A	18-08-2010
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