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60/660,882 11 March 2005 (11.03.2005) US(71) Applicant (for all designated States except US): **QUALCOMM INCORPORATED** [US/US]; 5775 Morehouse Drive, San Diego, California 92121 (US).

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Declarations under Rule 4.17:

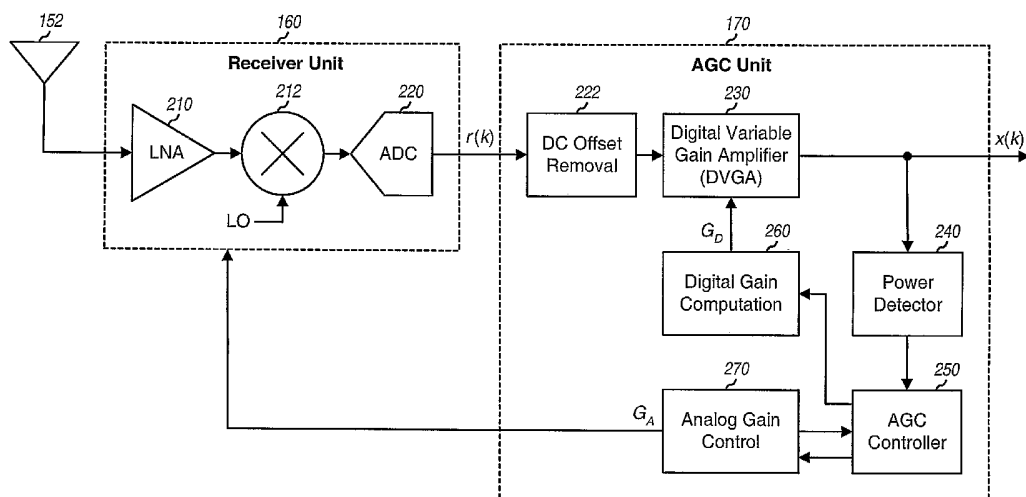
- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))

Published:

- with international search report

[Continued on next page]

(54) Title: AUTOMATIC GAIN CONTROL FOR A WIRELESS RECEIVER



(57) **Abstract:** Techniques for performing automatic gain control (AGC) at a wireless receiver are described. The total gain for the wireless receiver is achieved with discrete gain steps for analog circuitry and continuous gain for a digital variable gain amplifier (DVGA). An AGC loop is updated based on power measurements for an output signal from the DVGA. A first gain for the analog circuitry is selected from among multiple discrete gain values based on the AGC loop to maintain the average power of a baseband signal within a predetermined range at an analog-to-digital converter (ADC) input. A second gain for the DVGA is selected based on the AGC loop to maintain the average power of the output signal at a reference power level. The first gain is switched in a manner to avoid saturation of the ADC caused by the baseband signal and to provide switching hysteresis. The AGC may be performed in log domain and with multiple modes.



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21 December 2006

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2006/009473

A. CLASSIFICATION OF SUBJECT MATTER

INV. H03G3/30

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)

H03G

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, 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	US 2003/143967 A1 (CICCARELLI STEVEN C ET AL) 31 July 2003 (2003-07-31)	1,5-8, 10-12, 14-23
A	abstract; figures 1,4,6 paragraph [0034] - paragraph [0037] paragraph [0054] - paragraph [0057] -----	2-4,9
X	WO 2004/082136 A (GLOBESPANVIRATA INC) 23 September 2004 (2004-09-23) abstract; figures 1,5,6 page 3, line 21 - page 5, line 11 page 10, line 21 - page 20, line 26 ----- -/--	1-12, 14-23

☒ 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

18 July 2006

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02.10.2006

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INTERNATIONAL SEARCH REPORT

International application No

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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	US 2004/152432 A1 (GU QIZHENG) 5 August 2004 (2004-08-05) abstract; figure 2	1,3,5-7, 10,14-23
A	paragraph [0018] paragraph [0043] - paragraph [0045] paragraph [0047] - paragraph [0050]	2,4,8,9, 11,12
A	US 2005/032487 A1 (MONTALVO ANTONIO J) 10 February 2005 (2005-02-10) abstract; figure 2 paragraphs [0032], [0033]	3,4,9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2006/009473

Box 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 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 fee, this Authority did not invite payment of any additional fee.
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.:

1-12, 14-23

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ 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: 1-12, 14-23

Independent claims 1, 14, 17, 20, 22, 23:
Apparatus, method and computer-readable medium for controlling the gain of analog circuitry in discrete steps to maintain average power within a predetermined range at an input of an A/D converter and digital variable gain amplifier controlled to maintain average power of output signal at a reference power level.

Dependent claims:

Various criterions to be considered in AGC (backoff, peak to average power ratio of the baseband signal; hysteresis for gain steps).

2. claim: 13

Apparatus according to claim 1 and configured to delay the gain change for the variable gain amplifier when changing gain in the analog circuitry.

3. claims: 23-37

Processor, method and computer-readable medium for determining a logarithmic error, filtering the log error and determining a gain used to correct the log error.

4. claims: 38-53

Apparatus, processor, method and computer-readable medium for updating an AGC loop in a first update rate in an acquisition mode and for updating the AGC loop at a second update rate in a tracking mode

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2006/009473

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2003143967 A1	31-07-2003	AU 2003302214 A1 CA 2474350 A1 EP 1618674 A2 JP 2006504358 T WO 2004049580 A2	18-06-2004 10-06-2004 25-01-2006 02-02-2006 10-06-2004
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