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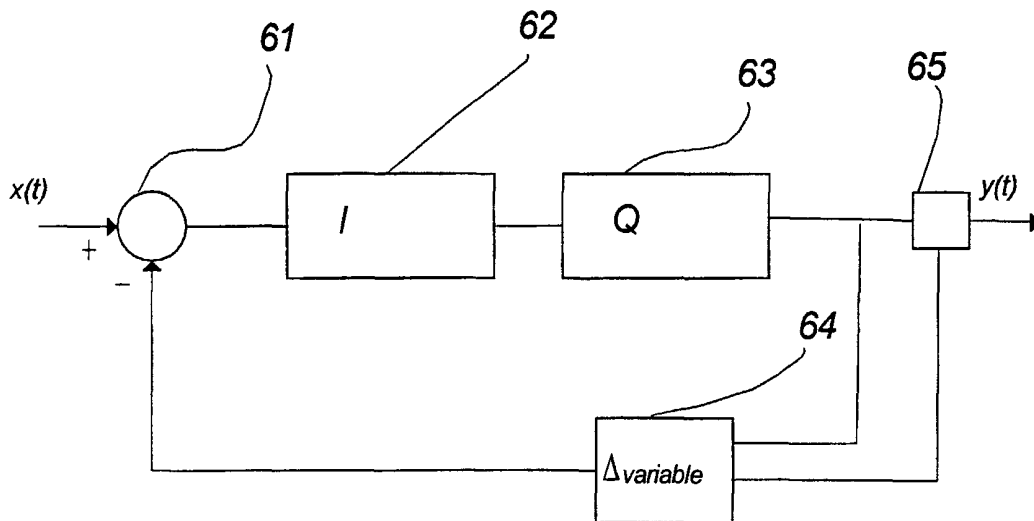
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27 September 2001

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.

(54) Title: SIGMA-DELTA MODULATOR



(57) Abstract: The invention relates to an adaptive differential sigma-delta modulator, wherein delta is adapted to the input and/or output signal. Basically, the invention introduces a new approach within the field of sigma-delta converters, as the invention introduces a non-fixed Δ value and consequently a variable quantisation noise.



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INTERNATIONAL SEARCH REPORT

International application No.

PCT/DK 00/00382

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H03M 3/02

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)

IPC7: H03M

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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5471209 A (PHILIP H. SUTTERLIN ET AL), 28 November 1995 (28.11.95), column 3, line 27 - column 4, line 11; column 5, line 1 - line 33 --	1,11
X	US 5311181 A (PAUL F. FERGUSON, JR. ET AL), 10 May 1994 (10.05.94), column 1, line 19 - line 25; column 6, line 24 - line 54; column 7, line 56 - column 8, line 25 --	1,11,13,14
A	US 5844514 A (ULF RINGH ET AL), 1 December 1998 (01.12.98), column 3, line 57 - column 4, line 53 --	2-7,9

 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

"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

20 March 2001

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/DK 00/00382

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0645893 A1 (ADVANCED MICRO DEVICES INC.), 29 March 1995 (29.03.95), column 1, line 38 - column 2, line 23 --	2-7,9
X	EP 0709970 A2 (THE GENERAL ELECTRIC COMPANY, P.L.C.), 1 May 1996 (01.05.96), figure 3, abstract --	8
X	US 5541600 A (ENRIQUE M. BLUMENKRANTZ ET AL), 30 July 1996 (30.07.96), column 5, line 1 - line 17 --	10
A	US 5793316 A (MASAYOSHI NOGUCHI ET AL), 11 August 1998 (11.08.98), column 3, line 50 - column 6, line 67 -- -----	12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/DK 00/00382

Box I Observations where certain claims were found unsearchable (Continuation of item 1 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 II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

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

See extra 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.:

Remark on Protest

- The additional search fees were accompanied by the applicant's protest.
 No protest accompanied the payment of additional search fees.

The application is not considered to comply with the requirements of unity of invention for the following reasons:

The invention according to claim 1 relates to a sigma-delta modulator wherein the signal delta is adapted to the input signal of the modulator circuit.

The invention according to claim 11 relates to a sigma-delta modulator wherein delta is adapted to the input signal of the modulator circuit using at least one algorithm.

The search has revealed that the sigma-delta modulator of claims 1 and 11 is not novel since it is disclosed in any the following documents:

D1) US 5 471 209 A

D2) US 5 311 181 A

Consequently, this International Searching Authority considers that there are 10 inventions claimed in the international application covered by the claims indicated below:

I A sigma-delta modulator according to claims 1-3 wherein a delta signal is established on the basis of a measurement of the input signal of the modulator circuit over a measuring fixed period.

II A sigma-delta modulator according to claim 4 and 5 wherein a measuring period corresponds to a TDMA time slot and wherein the power level of a previous time slot is a measure parameter.

III A sigma-delta modulator according to claim 6 wherein the delta signal is kept at a constant during a measuring period.

IV A sigma-delta modulator according to claim 7 wherein a measuring period is not longer than the input signal period of the modulator circuit.

V A sigma-delta modulator according to claim 8 wherein a current delta is established in dependency of a currently measured output signal and at least one previously measured output signal.

VI A sigma-delta modulator according to claim 9 wherein a time period is adapted to the time constant of the human ear.

VII A sigma-delta modulator according to claim 10 comprising at least one feedback loop, wherein a variable signal delta is adapted to the input signal of the modulator circuit.

.../...

VIII A sigma-delta modulator according to claim 12 wherein delta is determined as the maximum value of a set of amplitude samples of a previous measuring period multiplied by 1,5.

IX A sigma-delta modulator, using said modulator according to claim 13

X A sigma-delta modulator, using said modulator according to claim 14

Unity of invention is fulfilled only when there is a technical relationship among the inventions involving one or more of the same corresponding technical features.

The only common special technical feature between inventions I-IV, VI, and IX-X, is a measuring period. Since claim 1 and claim 11 lacks novelty, the inventions V, VII and VIII are not so linked as to form a "single general inventive concept", according to PCT rule 13.2.

Therefore, á posteriori, the application comprises 4 inventions not fulfilling the requirements for unity of invention, namely:

I A sigma-delta modulator according to claims 1-7 9, 11, 13 and 14

II A sigma-delta modulator according to claim 8,

III A sigma-delta modulator according to claim 10,

IV A sigma-delta modulator according to claim 12,

INTERNATIONAL SEARCH REPORT
Information on patent family members

25/02/01

International application No.

PCT/DK 00/00382

Patent document: cited in search report:	Publication date	Patent family member(s)	Publication date
US 5471209 A	28/11/95	AU 2094895 A EP 0748537 A JP 9510056 T WO 9524077 A	18/09/95 18/12/96 07/10/97 08/09/95
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INTERNATIONAL SEARCH REPORT

Information on patent family members

25/02/01

International application No.

PCT/DK 00/00382

Patent document cited in search report			Publication date	Patent family member(s)		Publication date
US	5793316	A	11/08/98	AU	709109 B	19/08/99
				AU	7640796 A	03/07/97
				CN	1171661 A	28/01/98
				EP	0783207 A	09/07/97
				JP	9307452 A	28/11/97
