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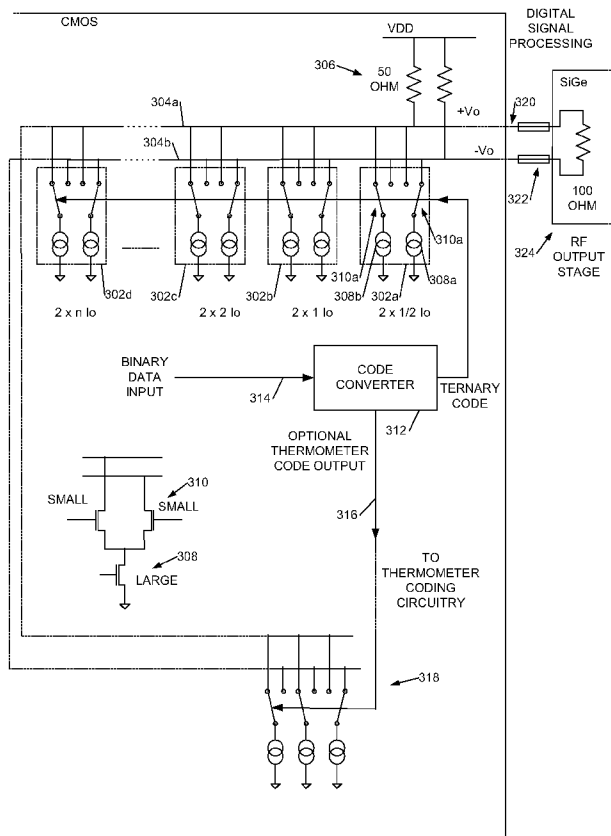
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[Continued on next page]

(54) Title: DIGITAL-TO-ANALOGUE CONVERTERS



(57) Abstract: Digital-to-Analogue Converters This invention generally relates to digital-to-analogue converters (DACs). More particularly it relates to differential, current-steering DACs with reduced small signal differential non-linearity. A differential current-steering digital-to-analogue converter (DAC), the DAC comprising: a digital input to receive a binary code comprising a plurality of bits defining a signed digital value for conversion into a signed differential analogue output signal; a pair of differential analogue output lines to provide said differential analogue output; and a set of binary-weighted steerable substantially constant current generators each coupled to said differential output lines and having a control input to receive a signal derived from said digital input to control current steering to said differential output lines responsive to said binary input code; wherein a said steerable substantially constant current generator comprises a ternary substantially constant current generator configured to generate a three-state differential current in response to a ternary signal on said control input; wherein each of said ternary current generators is associated with a bit of said binary code; and wherein said DAC further comprises a code converter coupled between said DAC digital input and said control inputs of said steerable current generators to convert said binary input code to a ternary code to control said steerable current generators.

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# INTERNATIONAL SEARCH REPORT

International application No  
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<b>A. CLASSIFICATION OF SUBJECT MATTER</b> INV. H03M5/18 H03M7/06 H04L25/49 ADD. H03M1/68		
According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b> Minimum documentation searched (classification system followed by classification symbols) H03M H04L		
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		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 841 384 A (HERMAN RAY MICHAEL [US] ET AL) 24 November 1998 (1998-11-24) column 1, line 54 - column 2, line 27 column 7, line 28 - column 9, line 64; figure 1 abstract	1,2,5,7, 8,12-14
X	----- US 6 507 304 B1 (LORENZ PERRY SCOTT [US]) 14 January 2003 (2003-01-14) column 1, line 47 - column 2, line 35 column 3, line 1 - column 6, line 44; figures 1,2 -----	1,12-14
<input type="checkbox"/> Further documents are listed in the continuation of Box C.		
<input checked="" type="checkbox"/> 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	Date of mailing of the international search report	
25 July 2007	28/02/2008	
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl. Fax: (+31-70) 340-3016	Authorized officer  Waters, Duncan	

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/GB2007/050217

## 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 allsearchable 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.:

see annex

### 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: 1-8,10-14

Differential current-steering digital-to-analogue converter (DAC) in which a binary input is converted to a ternary signal which controls steerable current generators configured to generate a 3-state differential current

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2. claims: 9-14

Differential current-steering digital-to-analogue converter (DAC) with a digital input which controls controllable switches each of which is coupled to a pair of current sources or sinks of substantially-equal value

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3. claims: 15-17

Differential current-steering DAC and corresponding method in which binary input is converted to a ternary code, said ternary code having a ternary digit for each bit of said binary input and being used for DAC current steering

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4. claims: 18-21

A method and a corresponding converter suitable for reducing noise when converting a digital to an analogue signal, the digital signal spending more time in one part of its range than in another part of its range, involving reshaping a differential non-linearity error pattern of said converting

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5841384	A	24-11-1998	NONE
US 6507304	B1	14-01-2003	NONE