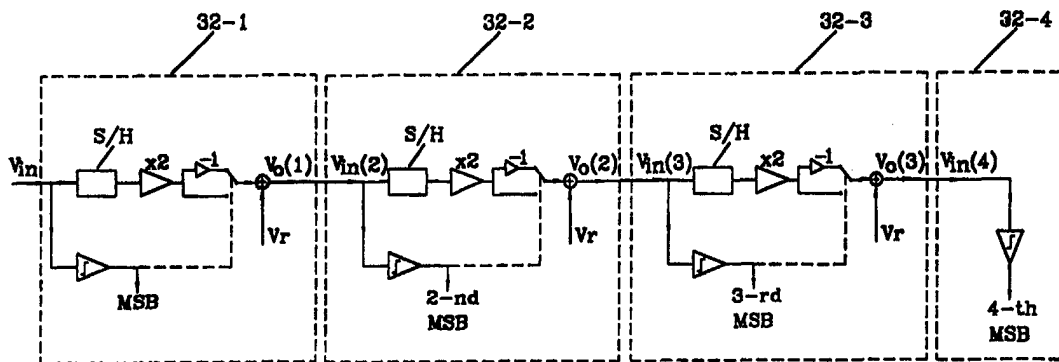




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<p>(51) International Patent Classification ⁶ : H03M 1/44</p>	<p>A3</p>	<p>(11) International Publication Number: WO 98/27655 (43) International Publication Date: 25 June 1998 (25.06.98)</p>
<p>(21) International Application Number: PCT/SE97/02037 (22) International Filing Date: 5 December 1997 (05.12.97) (30) Priority Data: 9604616-4 16 December 1996 (16.12.96) SE (71) Applicant: TELEFONAKTIEBOLAGET LM ERICSSON (publ) [SE/SE]; S-126 25 Stockholm (SE). (72) Inventors: SIGNELL, Svante; Ängsullsvägen 170, S-162 46 Vällingby (SE). JONSSON, Bengt, Erik; Farstavägen 175, S-123 32 Farsta (SE). STENSTRÖM, Helge; Folkskolegatan 3, S-117 35 Stockholm (SE). TAN, Nianxiong; Lomvägen 39, S-192 56 Sollentuna (SE). (74) Agents: HEDMAN, Anders et al.; Dr. Ludwig Brann Patentbyrå AB, P.O. Box 1344, S-751 43 Uppsala (SE).</p>		<p>(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZW, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).</p> <p>Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i></p> <p>(88) Date of publication of the international search report: 6 August 1998 (06.08.98)</p>

(54) Title: PIPELINE ANALOG-TO-DIGITAL CONVERSION



(57) Abstract

Pipeline A/D-conversion of an analog input signal is performed according to a new and inventive algorithm which generates a Gray coded digital output signal. A pipeline A/D-converter comprises a number of cascaded stages through which the analog input signal is propagated. Each stage generally generates an output bit of the digital output signal, and furthermore processes the pipeline signal. According to the inventive Gray coding algorithm, the output bit generated in a stage determines whether or not the pipeline signal of that stage is inverted. In a pipelined A/D-converter based on the Gray coding algorithm according to the invention, the accumulation of offset errors will generally be very low. Furthermore, the fact that the signal inversion is digitally controlled enables high precision implementations which further improve the performance of the inventive pipeline A/D-converter. In another embodiment of the invention, the Gray coding algorithm is modified to form a second algorithm which makes low device count implementations possible.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 97/02037

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H03M 1/44

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)

IPC6: H03M

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

SE,DK,FI,NO classes as above

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

WPI, JAPIO

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4599602 A (AKIRA MATZUZAWA ET AL), 8 July 1986 (08.07.86), column 1, line 1 - column 3, line 60, figures 5,9a,11 --	1-2,5-7, 10-11
X	US 5550492 A (FRANK MURDEN), 27 August 1996 (27.08.96), column 1, line 1 - column 3, line 27, figures 1,2 --	1-2,5-7, 10-11
X	US 4931797 A (MINORU KAGAWA ET AL), 5 June 1990 (05.06.90), column 1, line 1 - column 3, line 43, figures 1,9 -- -----	1-2,5-7, 10-11

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

11 June 1998

Date of mailing of the international search report

13 -06- 1998

Name and mailing address of the ISA/
Swedish Patent Office
Box 5055, S-102 42 STOCKHOLM
Facsimile No. +46 8 666 02 86

Authorized officer

Viktor Skoog
Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

Information on patent family members

29/04/98

International application No.

PCT/SE 97/02037

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4599602 A	08/07/86	JP 60033738 A JP 60079827 A JP 60127820 A	21/02/85 07/05/85 08/07/85
US 5550492 A	27/08/96	EP 0795236 A WO 9617436 A	17/09/97 06/06/96
US 4931797 A	05/06/90	JP 1309419 A JP 1126022 A	13/12/89 18/05/89