



- (51) International Patent Classification:  
G11C 11/22 (2006.01)
- (21) International Application Number:  
PCT/US2011/061266
- (22) International Filing Date:  
17 November 2011 (17.11.2011)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:  
12/956,845 30 November 2010 (30.11.2010) US
- (71) Applicant (for all designated States except US): **RADI-  
ANT TECHNOLOGIES, INC.** [US/US]; 2835 Pan  
American Freeway NE, Suite D, Albuquerque, NM 87107-  
1652 (US).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): **EVANS, Joseph, T.**  
[US/US]; 2835 Pan American Freeway NE, Suite D, Al-  
buquerque, NM 87107-1652 (US). **WARD, Calvin, B.**  
[US/US]; 18 Crow Canyon Ct., Suite 305, San Ramon, CA  
94583 (US).
- (74) Agent: **WARD, Calvin, B.**; 18 Crow Canyon Ct., Suite  
305, San Ramon, CA 94583 (US).

- (81) Designated States (unless otherwise indicated, for every  
kind of national protection available): AE, AG, AL, AM,  
AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ,  
CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO,  
DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN,  
HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR,  
KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME,  
MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ,  
OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD,  
SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR,  
TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.
- (84) Designated States (unless otherwise indicated, for every  
kind of regional protection available): ARIPO (BW, GH,  
GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ,  
UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU,  
TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE,  
DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU,  
LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK,  
SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ,  
GW, ML, MR, NE, SN, TD, TG).

**Published:**

— with international search report (Art. 21(3))

- (88) Date of publication of the international search report:  
13 December 2012

(54) Title: ANALOG MEMORIES UTILIZING FERROELECTRIC CAPACITORS

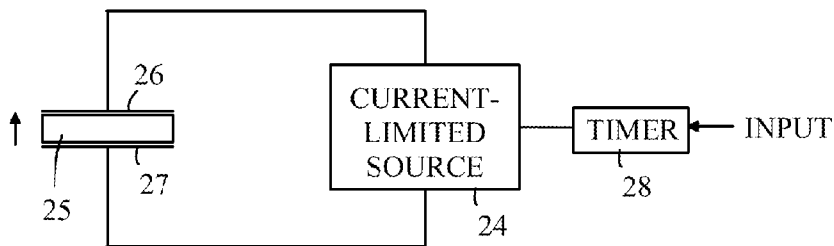


FIGURE 2

(57) Abstract: A ferroelectric memory having a plurality of ferroelectric memory cells, each ferroelectric memory cell including a ferroelectric capacitor is disclosed. The ferroelectric memory includes read and write lines and a plurality of ferroelectric memory cell select buses, one select bus corresponding to each of the ferroelectric memory cells. Each of the ferroelectric memory cells includes first and second gates for connecting the ferroelectric memory cell to the read line and the write line, respectively, in response to signals on the ferroelectric memory cell select bus corresponding to that ferroelectric memory cell. A write circuit causes a charge to be stored in the ferroelectric capacitor of the ferroelectric memory cell currently connected to the write line, the charge having a value determined by a data value having at least three states. A read circuit measures the charge stored in the ferroelectric capacitor of the ferroelectric memory cell currently connected to the read line to generate an output value, the output value corresponding to one of the states.

WO 2012/074776 A3

**A. CLASSIFICATION OF SUBJECT MATTER***G11C 11/22(2006.01)i*

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)

G11C 11/22; G11C 5/06; H01L 27/105; G11C 11/24; G11C 11/42

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) &amp; Keywords: ferroelectric capacitor, analog, tri-state, gate, switch, select bus

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6639823 B2 (HASEGAWA, KAZUMASA) 28 October 2003 See figures 2,5,7; column 4, lines 43-49, column 5, lines 18-31 and column 8, lines 7-64	11-21
A	See column 1 lines 39-60 and column 2 line 36 - column 3 line 15	1-10
A	US 2001-0053087 A1 (KATO, YOSHIHISA et al.) 20 December 2001 See figure 1; claim 1	1-21
A	US 2002-0015323 A1 (MARUYAMA, AKIRA) 07 February 2002 See claim 10	1-21
A	JP 2005-050403 A (SEICO EPSON CO. LTD,) 24 February 2005 See paragraphs [8]-[11],[20] and [22].	1-21
A	US 05559733A A (MCMILLAN, LARRY D. et al.) 24 September 1996 See abstract, claim 1	1-21

 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 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

"&amp;" document member of the same patent family

Date of the actual completion of the international search

10 JULY 2012 (10.07.2012)

Date of mailing of the international search report

**10 JULY 2012 (10.07.2012)**

Name and mailing address of the ISA/KR

Korean Intellectual Property Office  
189 Cheongsu-ro, Seo-gu, Daejeon Metropolitan  
City, 302-701, Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

YOON, Hye Sook

Telephone No. 82-42-481-8370



**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No.

**PCT/US2011/061266**

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6639823 B2	28.10.2003	CN 1307645 C0	28.03.2007
		CN 1426585 A0	25.06.2003
		JP 2002-269973 A	20.09.2002
		US 2002-0145903 A1	10.10.2002
		WO 02-054408 A1	11.07.2002
US 2001-0053087 A1	20.12.2001	CN 1210784 C0	13.07.2005
		CN 1329360 A0	02.01.2002
		EP 1170753 A1	09.01.2002
		JP 03-620588 B2	16.02.2005
		JP 2002-157879 A	31.05.2002
		KR 10-2001-0113554 A	28.12.2001
		TW 481917 A	01.04.2002
		US 6449184 B2	10.09.2002
		US 2002-0015323 A1	07.02.2002
US 6671199 B2	30.12.2003		
JP 2005-050403 A	24.02.2005	None	
US 05559733A A	24.09.1996	AU 2002-333658 A1	17.06.2003
		CA 2163130 A1	21.09.1995
		CA 2163130 C	24.05.2005
		CN 1083161 C	17.04.2002
		CN 1103116 C	12.03.2003
		CN 1120249 C	03.09.2003
		CN 1127755 C0	12.11.2003
		CN 1156518 A	06.08.1997
		CN 1156518 C0	06.08.1997
		CN 1179231 A	15.04.1998
		CN 1179231 C0	15.04.1998
		CN 1179232 A0	15.04.1998
		CN 1194060 A0	23.09.1998
		CN 1212734 A0	31.03.1999
		CN 1213457 A0	07.04.1999
		CN 1263569 A	16.08.2000
		CN 1263569 C0	16.08.2000
		CN 1311897 A0	05.09.2001
		CN 1358326 A0	10.07.2002
		CN 1398426 A0	19.02.2003
		CN 1618123 A	18.05.2005
		CN 1618123 C0	18.05.2005
		EP 0616723 A1	28.09.1994
		EP 0616723 B1	20.06.2001
		EP 0616726 A1	28.09.1994
		EP 0616726 B1	06.06.2001
		EP 0665814 A1	09.08.1995
		EP 0665814 B1	15.01.1997
		EP 0665981 A1	24.01.2001

**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No.

**PCT/US2011/061266**

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
		EP 0665981 B1	20.03.2002
		EP 0699343 A1	05.09.2001
		EP 0699343 B1	12.09.2001
		EP 0708983 A1	27.06.2001
		EP 0708983 B1	26.09.2001
		EP 0769206 A1	07.11.2001
		EP 0769206 B1	27.03.2002
		EP 0770265 A1	07.11.2001
		EP 0770265 B1	27.03.2002
		EP 0777762 A1	11.03.1998
		EP 0777762 B1	02.12.1998
		EP 0815586 A1	05.12.2001
		EP 0815587 A1	17.12.2003
		EP 0815588 A1	07.02.2001
		EP 0815588 B1	05.12.2001
		EP 0815589 A2	27.08.2003
		EP 0846341 A1	13.08.2003
		EP 0885315 A1	23.12.1998
		EP 0885315 B1	31.05.2000
		EP 0890980 A2	13.01.1999
		EP 0890980 A3	03.03.1999
		EP 0891631 A1	13.08.2003
		EP 0902970 A1	28.05.2003
		EP 0948807 A1	31.03.2004
		EP 0998594 A1	10.05.2000
		EP 1032723 A1	06.09.2000
		EP 1032724 A1	06.09.2000
		EP 1103069 A1	30.05.2001
		EP 1153427 A1	14.11.2001
		EP 1192648 A2	03.04.2002
		EP 1449241 A1	25.08.2004
		JP 02-860505 B2	11.12.1998
		JP 03-113281 B2	22.09.2000
		JP 03-162717 B2	23.02.2001
		JP 03-162718 B2	23.02.2001
		JP 03-238663 B2	05.10.2001
		JP 03-462852 B2	15.08.2003
		JP 03-610013 B2	12.01.2005
		JP 03-747325 B2	22.02.2006
		JP 03-788627 B2	21.06.2006
		JP 03-789934 B2	28.06.2006
		JP 03-879015 B2	07.02.2007
		JP 03-879016 B2	07.02.2007
		JP 03-941837 B2	04.07.2007
		JP 03-996767 B2	24.10.2007
		JP 04-010343 B2	21.11.2007
		JP 04-067563 B2	26.03.2008
		JP 04-240542 B2	18.03.2009
		JP 08-502628 A	19.03.1996
		JP 08-502859 A	26.03.1996

**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No.

**PCT/US2011/061266**

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
		JP 08-502946 A	02.04.1996
		JP 08-511895 A	10.12.1996
		JP 09-501019 A	28.01.1997
		JP 09-504500 A	06.05.1997
		JP 10-505338 A	26.05.1998
		JP 10-506227 A	16.06.1998
		JP 10-506228 A	16.06.1998
		JP 11-131247 A	18.05.1999
		JP 11-502375 A	23.02.1999
		JP 11-502673 A	02.03.1999
		JP 11-508086 A	13.07.1999
		JP 11-509683 A	24.08.1999
		JP 2000-505238 A	25.04.2000
		JP 2000-512076 A	12.09.2000
		JP 2001-500318 A	09.01.2001
		JP 2001-503567 A	13.03.2001
		JP 2001-505367 A	17.04.2001
		JP 2001-509641 A	24.07.2001
		JP 2001-523889 A	27.11.2001
		JP 2002-522902 A	23.07.2002
		JP 2002-526907 A	20.08.2002
		JP 2002-536831 A	29.10.2002
		JP 2003-502837 A	21.01.2003
		JP 2005-512323 A	28.04.2005
		JP 2007-184622 A	19.07.2007
		JP 3238663 B2	17.12.2001
		KR 10-0202532 B1	15.06.1999
		KR 10-0234621 B1	15.12.1999
		KR 10-0252744 B1	01.05.2000
		KR 10-0269025 B1	16.10.2000
		KR 10-0274512 B1	15.01.2001
		KR 10-0295698 B1	25.10.2001
		KR 10-0313425 B1	21.08.2003
		KR 10-0316442 B1	28.02.2002
		KR 10-0327612 B1	17.04.2002
		KR 10-0327615 B1	25.09.2002
		KR 10-0327839 B1	17.04.2002
		KR 10-0345014 B1	30.11.2002
		KR 10-0346900 B1	13.11.2002
		KR 10-0392213 B1	17.10.2003
		KR 10-0407232 B1	26.06.2004
		KR 10-0433819 B1	16.07.2004
		KR 10-0442543 B1	20.11.2004
		KR 10-1991-0700103 A	13.03.1991
		KR 10-1998-0703182 A	15.10.1998
		KR 10-1999-0044056 A	25.06.1999
		KR 10-2000-0062325 A	25.10.2000
		KR 10-2001-0021904 A	15.03.2001
		KR 10-2001-0032190 A	16.04.2001
		KR 10-2001-0032205 A	16.04.2001

**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No.

**PCT/US2011/061266**

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
		KR 10-2001-0103563 A	23. 11. 2001
		KR 10-2001-0110429 A	13. 12. 2001
		KR 10-2002-0015048 A	27. 02. 2002
		KR 10-2004-0071692 A	12. 08. 2004
		TW 413840 A	01. 12. 2000
		TW 417147 A	01. 01. 2001
		TW 417147 B	01. 01. 2001
		TW 434699 A	16. 05. 2001
		TW 434699 B	16. 05. 2001
		TW 436875 A	28. 05. 2001
		TW 473902 A	21. 01. 2002
		TW 473902 B	21. 01. 2002
		TW 484173 A	21. 04. 2002
		TW 485536 A	01. 05. 2002
		TW 489512 A	01. 06. 2002
		US 05119760 A	09. 06. 1992
		US 05138520 A	11. 08. 1992
		US 05316579 A	31. 05. 1994
		US 05423285 A	13. 06. 1995
		US 05434102 A	18. 07. 1995
		US 05439845 A	08. 08. 1995
		US 05456945 A	10. 10. 1995
		US 05468679 A	21. 11. 1995
		US 05468684 A	21. 11. 1995
		US 05508226 A	16. 04. 1996
		US 05514822 A	07. 05. 1996
		US 05516363 A	14. 05. 1996
		US 05519234 A	21. 05. 1996
		US 05523964 A	04. 06. 1996
		US 05540772 A	30. 07. 1996
		US 05559260 A	24. 09. 1996
		US 05559733 A	24. 09. 1996
		US 05612082 A	18. 03. 1997
		US 05614018 A	25. 03. 1997
		US 05614252 A	25. 03. 1997
		US 05620739 A	15. 04. 1997
		US 05624707 A	29. 04. 1997
		US 05648114 A	15. 07. 1997
		US 05654456 A	05. 08. 1997
		US 05688565 A	18. 11. 1997
		US 05690727 A	25. 11. 1997
		US 05699035 A	16. 12. 1997
		US 05723171 A	03. 03. 1998
		US 05723361 A	03. 03. 1998
		US 05759923 A	02. 06. 1998
		US 05803961 A	08. 09. 1998
		US 05825057 A	20. 10. 1998
		US 05840110 A	24. 11. 1998
		US 05871853 A	16. 02. 1999
		US 05888583 A	30. 03. 1999

**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No.

**PCT/US2011/061266**

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
		US 05909042 A	01.06.1999
		US 05932295 A	03.08.1999
		US 05955754 A	21.09.1999
		US 05962085 A	05.10.1999
		US 05965219 A	12.10.1999
		US 05997642 A	07.12.1999
		US 06025619 A	15.02.2000
		US 06056994 A	02.05.2000
		US 06072207 A	06.06.2000
		US 06080592 A	27.06.2000
		US 06110531 A	29.08.2000
		US 06116184 A	12.09.2000
		US 06133050 A	17.10.2000
		US 06143063 A	07.11.2000
		US 2001-012698 A1	09.08.2001
		US 2001-054728 A1	27.12.2001
		US 2002-092472 A1	18.07.2002
		US 2002-109178 A1	15.08.2002
		US 2003-052357 A1	20.03.2003
		US 2003-152813 A1	14.08.2003
		US 2003-207470 A1	06.11.2003
		US 2004-051129 A1	18.03.2004
		US 2004-211998 A1	28.10.2004
		US 2005-094457 A1	05.05.2005
		US 6174564 B1	16.01.2001
		US 6258733 B1	10.07.2001
		US 6285048 B1	04.09.2001
		US 6310373 B1	30.10.2001
		US 6327135 B1	04.12.2001
		US 6339238 B1	15.01.2002
		US 6370056 B1	09.04.2002
		US 6372286 B1	16.04.2002
		US 6373743 B1	16.04.2002
		US 6383555 B1	07.05.2002
		US 6404003 B1	11.06.2002
		US 6413883 B1	02.07.2002
		US 6441414 B1	27.08.2002
		US 6454964 B1	24.09.2002
		US 6495878 B1	17.12.2002
		US 6511718 B1	28.01.2003
		US 6537830 B1	25.03.2003
		US 6541279 B2	01.04.2003
		US 6559469 B1	06.05.2003
		US 6639262 B2	28.10.2003
		US 6664115 B2	16.12.2003