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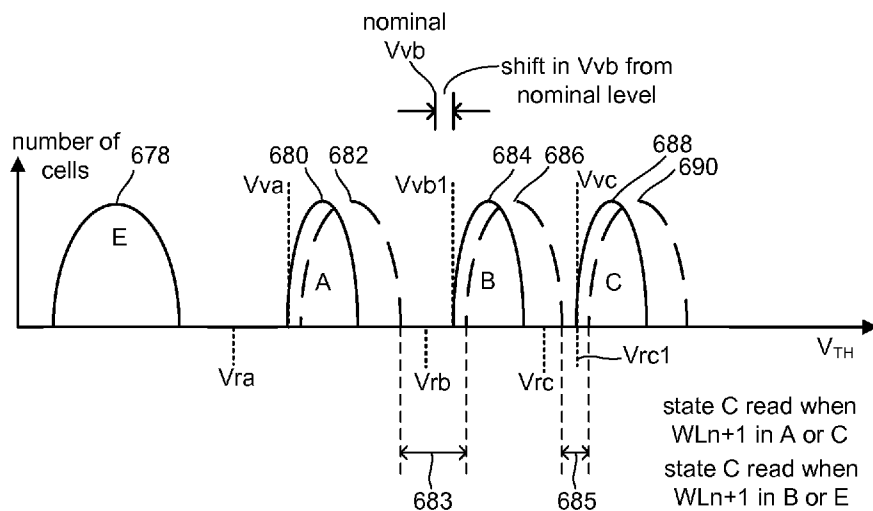
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(54) Title: PROGRAMMING DEFERENTLY SIZED MARGINS AND SENSING WITH COMPENSATIONS AT SELECT STATES FOR IMPROVED READ OPERATIONS IN NON-VOLATILE MEMORY



(57) Abstract: Non-volatile memory read operations compensate for floating gate coupling when the apparent threshold voltage of a memory cell may have shifted. A memory cell of interest can be read using a reference value based on a level of charge read from a neighboring memory cell. Misreading the neighboring cell may have greater effects in particular programming methodologies, and more specifically, when reading the neighboring cell for particular states or charge levels in those methodologies. In one embodiment, memory cells are programmed to create a wider margin between particular states where misreading a neighboring cell is more detrimental. Further, memory cells are read in one embodiment by compensating for floating gate coupling based on the state of a neighboring cell when reading at certain reference levels but not when reading at other reference levels, such as those where a wider margin has been created.

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**INTERNATIONAL SEARCH REPORT**

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**A. CLASSIFICATION OF SUBJECT MATTER**  
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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**

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 5 867 429 A (CHEN JIAN [US] ET AL) 2 February 1999 (1999-02-02) cited in the application	1-4, 14-17
Y	column 4, line 65 - column 6, line 15; figures 5,6	6-12, 19-25
A	column 7, line 11 - column 8, line 51; claims 20,21; figures 9,10	5,13,18, 26
Y	US 6 657 891 B1 (SHIBATA NOBORU [JP] ET AL) 2 December 2003 (2003-12-02) cited in the application	6-12, 19-25
A	column 7, line 47 - column 16, line 60; figures 1,8,9,13-15,18	1,5,13, 14,18,26
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Date of the actual completion of the international search <b>22 February 2008</b>	Date of mailing of the international search report <b>04/03/2008</b>
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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  <b>Cummings, Anthony</b>
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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.
A	US 2005/117401 A1 (CHEN JIAN [US] ET AL) 2 June 2005 (2005-06-02) paragraph [0026] - paragraph [0037]; figures 3,4 paragraph [0042] - paragraph [0048]; figures 6a,6b,7 -----	1,6,14, 19
A	US 2004/136220 A1 (COHEN GUY [IL]) 15 July 2004 (2004-07-15) paragraph [0021] - paragraph [0027]; figures 3,4 -----	5,18
A	JUNG T-S ET AL: "A 117-MM2 3.3-V ONLY 128-MB MULTILEVEL NAND FLASH MEMORY FOR MASS STORAGE APPLICATIONS" IEEE JOURNAL OF SOLID-STATE CIRCUITS, IEEE SERVICE CENTER, PISCATAWAY, NJ, US, vol. 31, no. 11, November 1996 (1996-11), pages 1575-1583, XP000691441 ISSN: 0018-9200 page 1576, left-hand column, line 30 - page 1577, right-hand column, line 14; figures 2-4b -----	1,14

**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 5867429	A	02-02-1999	NONE
US 6657891	B1	02-12-2003	CN 1505153 A KR 20040048344 A
US 2005117401	A1	02-06-2005	NONE
US 2004136220	A1	15-07-2004	US 2004136236 A1