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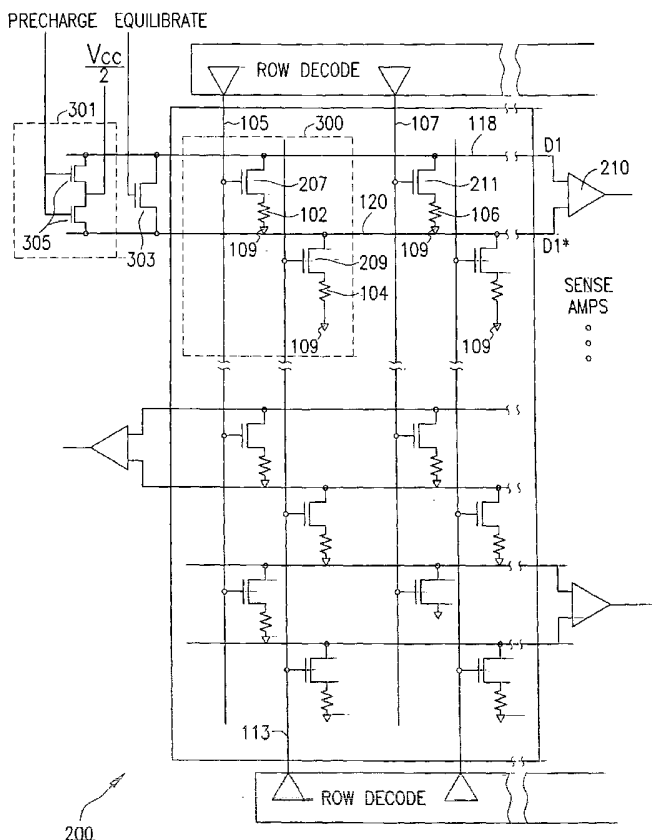
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- (74) Agent: D'AMICO, Thomas, J.; Dickstein Shapiro Morin & Oshinsky LLP, 2101 L Street NW, Washington, WA 20037-1526 (US).
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[Continued on next page]

(54) Title: COMPLEMENTARY BIT PCRAM (PROGRAMMABLE CONDUCTOR RAM) AND METHOD OF OPERATION



(57) Abstract: A method and apparatus is disclosed for sensing the resistance state of a Programmable Conductor Random Access Memory (PCRAM) element using complementary PCRAM elements, one holding the resistance state being sensed and the other holding a complementary resistance state. A sense amplifier detects voltages discharging through the high and low resistance elements to determine the resistance state of an element being read.

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*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.*

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 02/37227

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC 7 G11C11/34

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)

IPC 7 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

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P, X  A	US 6 462 981 B2 (TAKEDA KOICHI ET AL) 8 October 2002 (2002-10-08)  abstract; figures 2,3 column 7, line 45 -column 8, line 49 column 11, line 13 - line 19 --- -/--	1-4, 6-17, 19-32, 34-54, 56-58 5, 18, 33, 55

Further documents are listed in the continuation of box C.

Patent family members are listed in 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

3 June 2003

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INTERNATIONAL SEARCH REPORT

nal Application No  
PCT/US 02/37227

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	SCHEUERLEIN R ET AL: "A 10ns Read and Write Non-Volatile Memory Array Using a Magnetic Tunnel Junction and FET Switch in each Cell" DIGEST OF TECHNICAL PAPERS. 2000 IEEE INTERNATIONAL SOLID-STATE CIRCUITS CONFERENCE / SESSION 7 / PAPER TA 7.2, 8 February 2000 (2000-02-08), pages 128-129, XP010378826	1, 14, 29, 42, 53
Y	Last two paragraphs of the right column. figure 7.2.2	2-8, 13, 15-21, 26-28, 30-36, 41, 43-50, 54, 55, 58
Y	US 6 314 014 B1 (LOWREY TYLER ET AL) 6 November 2001 (2001-11-06)	2-4, 6-8, 13, 15-17, 19-21, 26-28, 30-32, 34-36, 41, 43-50, 54, 58
A	abstract; figures 3, 4, 6B column 16, line 47 - column 19, line 7 column 21, line 52 - line 65 column 19, line 26 - line 45 ----- -/--	5, 9-12, 18, 22-25, 33, 37-40, 51, 52, 55-57

INTERNATIONAL SEARCH REPORT

International Application No  
PCT/US 02/37227

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	<p>US 6 191 972 B1 (MIURA SADAHIKO ET AL) 20 February 2001 (2001-02-20)</p> <p>abstract; figures 1,3,7 column 5, line 45 -column 7, line 6 column 9, line 2 - line 49 ---</p>	<p>1, 14, 29, 42, 53 9, 10, 22, 23, 37, 38, 51, 52 2-4, 6-8, 11-13, 15-17, 19-21, 24-28, 30-32, 34-36, 39-41, 43-50, 54, 56-58</p>
X Y	<p>EP 1 109 170 A (TOKYO SHIBAURA ELECTRIC CO) 20 June 2001 (2001-06-20)</p> <p>paragraphs '0016!', '0023!', '0149!'-'0151!; figure 27 ---</p>	<p>1, 14, 29, 42, 53 2-4, 6-8, 13, 15-17, 19-21, 26-28, 30-32, 34-36, 41, 43-50, 54, 58</p>
Y	<p>US 4 112 512 A (ARZUBI LUIS MARIA ET AL) 5 September 1978 (1978-09-05)</p> <p>column 2, line 55 -column 3, line 9; figure 2 ----- -/--</p>	<p>2-4, 6-8, 13, 15-17, 19-21, 26-28, 30-32, 34-36, 41, 43-50, 54, 58</p>

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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.
Y	US 5 883 827 A (MORGAN DONALD M) 16 March 1999 (1999-03-16)	5, 9-12, 18, 22-25, 33, 37-40, 51, 52, 55-57
A	abstract; figures 6, 7 column 1, line 56 -column 2, line 3 column 8, line 1 - line 19; claim 44 ----	7, 20, 35
Y	US 5 699 293 A (CHEN EUGENE ET AL) 16 December 1997 (1997-12-16)	11, 12, 24, 25, 39, 40, 56, 57
A	abstract; figure 1 column 2, line 24 - line 36 ----	
A	US 6 243 311 B1 (KEETH BRENT) 5 June 2001 (2001-06-05)	11, 12, 24, 25, 39, 40, 56, 57
A	column 7, line 54 -column 8, line 2; figures 14, 37-39 ----- US 6 191 989 B1 (SCHEUERLEIN ROY EDWIN ET AL) 20 February 2001 (2001-02-20) abstract; figure 2 -----	1-58

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US 02/37227

## 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 additional 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.

## FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-4,6-8,13-17,19-21,26-32,34-36,41-50,53,54,58

Device and method for sensing a memory device as in claim 1, i.e. a memory with a sense amplifier connected via an access device with two memory elements storing complementary (high/low) resistance states. Digit lines are precharged and the sense amplifier detects the voltages when the digit lines discharge through the programmable resistive elements. The technical problem addressed is how to sense a resistive cell.

2. Claims: 5,18,33,55

Memory device as in claim 1 with memory elements made of chalcogenite glass. The technical problem addressed is to find an appropriate material for memory elements.

3. Claims: 9,10,22,23,37,38,51,52

Refresh of memory cells in a memory device as in claim 1. The refresh of the cells is controlled with the activation of the row lines. The technical problem addressed is how to prevent rewriting of memory elements.

4. Claims: 11,12,24,25,39,40,56,57

Memory device as in claim 1, which is divided into arrays. The technical problem addressed is how to group memory elements in a memory.



# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No  
PCT/US 02/37227

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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