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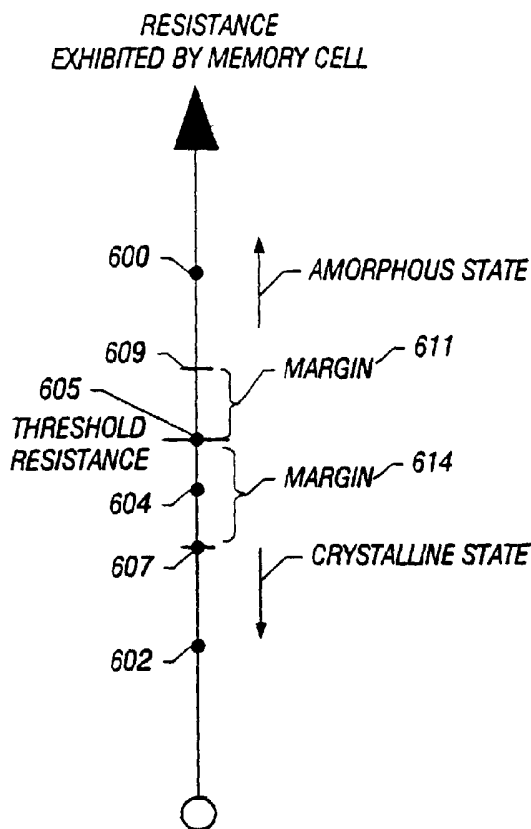
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[Continued on next page]

(54) Title: REFRESHING MEMORY CELLS OF A PHASE CHANGE MATERIAL MEMORY DEVICE



(57) Abstract: A technique includes determining whether a storage level of a phase change memory cell is within a predefined margin from a resistance threshold. In response to the determination, the cell is selectively written.

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**Published:**

- *with international search report*
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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.*

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18 March 2004

# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/US 03/18066

**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, WPI Data, PAJ, INSPEC, COMPENDEX, IBM-TDB

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 912 839 A (PASHMAKOV BOIL ET AL) 15 June 1999 (1999-06-15) column 19, line 35 - line 45	1-46
A	column 11, line 24 - line 36 ---	51
A	US 5 687 112 A (OVSHINSKY STANFORD R) 11 November 1997 (1997-11-11) column 20, line 23 - line 39 ---	1-46
A	US 5 296 716 A (HUDGENS STEPHEN J ET AL) 22 March 1994 (1994-03-22) column 16, line 15 - line 33 column 17, line 10 - line 17 ---	1-46
A	WO 99 54128 A (ENERGY CONVERSION DEVICES INC) 28 October 1999 (1999-10-28) page 11, line 35 -page 12, line 11 ---	1-46
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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

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- "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

16 December 2003

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21.01.04

Name and mailing address of the ISA

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## INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 03/18066

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	WO 03 038830 A (OVONYX INC) 8 May 2003 (2003-05-08) page 12, line 20 -page 13, line 3 ----	47
P,X	US 6 487 113 B1 (PARK EUNGJOON ET AL) 26 November 2002 (2002-11-26) column 2, line 14 -column 3, line 5 ----	51
P,X	US 2003/002332 A1 (LOWREY TYLER A) 2 January 2003 (2003-01-02) paragraph '0015! - paragraph '0019! ----	51
E	WO 03 058633 A (INTEL CORP) 17 July 2003 (2003-07-17) page 11, line 24 -page 12, line 9 ----	51
A	STEVENTON A G: "Microfilaments in amorphous chalcogenide memory devices" JOURNAL OF PHYSICS D (APPLIED PHYSICS), 21 JUNE 1975, UK, vol. 8, no. 9, pages L120-L122, XP002265174 ISSN: 0022-3727 page 120 ----	51
A	US 6 075 719 A (KOSTYLEV SERGEY A ET AL) 13 June 2000 (2000-06-13) column 4, line 20 - line 60 -----	51

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US 03/18066

## 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.

# INTERNATIONAL SEARCH REPORT

International Application No. PCT/US 03 /18066

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

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

1. Claims: 1-46

Refreshing of phase change material memory cells

2. Claims: 47-50

Determination of an optimum write current for reset

3. Claims: 51-54

Determination of an optimum write sweep fall time for set

## INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 03/18066

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Information on patent family members

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			WO	0079539 A1	28-12-2000

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