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[Continued on next page]

(54) Title: RESTORING ECC SYNDROME IN NON-VOLATILE MEMORY DEVICES

(57) Abstract: A method of restoring an ECC syndrome in a non-volatile memory device having memory cells arranged in a plurality of sectors within a memory cell array, the method includes identifying a first sector having a page with a disabled ECC (error correction code) flag; reading the value of all data bits in the page; calculating values for ECC bits in the page; and writing the data bit values and the calculated ECC bit values to a second sector in the memory cell array.

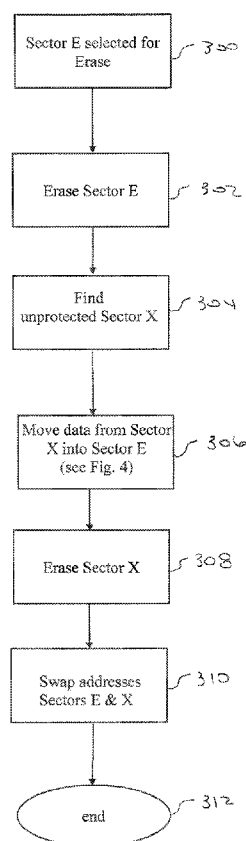


FIGURE 3



OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, 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.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB2014/060643

A. CLASSIFICATION OF SUBJECT MATTER IPC(8) - G11C 29/42 (2014.01) CPC - G11C 29/42 (2014.09) 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(8) - G11C 29/42, 52 (2014.01) USPC - 714/758, 764, 766, 768, 785, 799 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched CPC - G06F 11/1068; G11C 29/42, 44, 4401, 52, 2029/1208 (2014.09) Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) Orbit, Google Patents, Google Scholar		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category**	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2006/0156189 A1 (TOMLIN) 13 July 2006 (13.07.2006) entire document	1, 3, 4, 6
Y		2, 5
Y	US 2010/0205504 A1 (FUNG et al) 12 August 2010 (12.08.2010) entire document	2, 5
A	US 2010/0202203 A1 (CHOI et al) 12 August 2010 (12.08.2010) entire document	1-6
A	US 2008/0109705 A1 (PAWLOWSKI et al) 08 May 2008 (08.05.2008) entire document	1-6
A	US 2011/0078544 A1 (GRUNER et al) 31 March 2011 (31.03.2011) entire document	1-6
A	US 2012/0159281 A1 (SHALVI et al.) 21 June 2012 (21.06.2012), para. 0054, 0056, 0070, 0091	1-6
☐ Further documents are listed in the continuation of Box C. ☐		
* 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 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 08 October 2014		Date of mailing of the international search report 05 NOV 2014
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201		Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No. .

PCT/IB2014/060643

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 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 No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
See extra 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 additional fees, this Authority did not invite payment of additional fees.
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.:
1-6

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB2014/060643

Continuation of Box III.

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I, claims 1-6, drawn to a method of restoring an ECC syndrome in a non-volatile memory device

Group II, claim 7, drawn to a method for performing a program-on-program operation on a page in a memory array sector of a non-volatile memory device.

Group III, claims 8-10, drawn to a non-volatile memory device comprising: a memory cell array including memory cells distributed among a plurality of sectors.

The inventions listed as Groups I, II and III do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: the special technical feature of the Group I invention: "identifying a first sector including at least one page having a disabled ECC (error correction code) flag; reading the value of all data bits in said at least one page; calculating values for ECC bits in said at least one page" as claimed therein is not present in the invention of Groups II and III. The special technical feature of the Group II invention: "reading the page; rewriting the page with a different value for at least one of the data bits in the page; disabling an ECC flag in the page" as claimed therein is not present in the invention of Groups I or III. The special technical feature of the Group III invention: "a memory cell array including memory cells distributed among a plurality of sectors; a controller operable to program, read, and erase memory cells in said memory array, said controller further operable to set an indicator flag in at least one sector of said plurality of sectors when rewriting a page in said at least one sector with a different value for at least one of the data bits in said page" as claimed therein is not present in the invention of Groups I or II.

Groups I, II and III lack unity of invention because even though the inventions of these groups require the technical feature of a non-volatile memory device having memory cells in a plurality of sectors within a memory cell array and a method of identifying, reading, calculating and writing with the device, this technical feature is not a special technical feature as it does not make a contribution over the prior art.

Specifically, US 2012/0159281 A1 (SHALVI et al.) teaches a non-volatile memory device (non-volatile memory systems, para. 0057) having memory cells in a plurality of sectors within a memory cell array (memory cells in array 28, para. 0056) and a method of identifying, reading, calculating and writing with the device (identifying a subset of memory cells 32 that are defective, para. 0054. Writing and reading data into and out of the memory array, para. 0070. Calculating the number of bad pages, para. 0091).

Since none of the special technical features of the Group I, II or III inventions are found in more than one of the inventions, unity of invention is lacking.