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17 November 2016

(54) **Title:** DEVICE-SPECIFIC VARIABLE ERROR CORRECTION

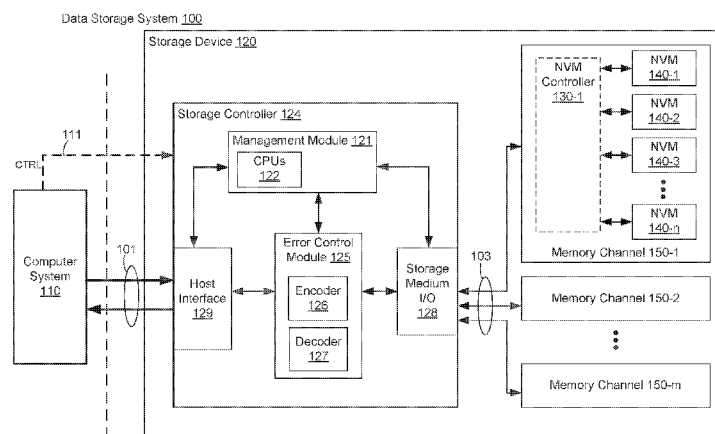


Figure 1

(57) **Abstract:** The various implementations described herein include systems, methods and/or devices for encoding and decoding data for memory portions of non-volatile memory in a storage device. In one aspect, the method includes, for respective memory portions of the non-volatile memory, in accordance with an error correction format of the respective memory portion: encoding data to produce codewords; storing the codewords in the respective memory portion; and decoding the codewords to produce decoded data. Furthermore, each memory portion of the non-volatile memory has a corresponding error correction format corresponding to a code rate, a codeword structure, and an error correction type, and comprising one of a sequence of predefined error correction formats. A plurality of the predefined error correction formats have a same number of error correction bits and different numbers of data bits, where at least two memory portions have distinct error correction formats.

WO 2016/164367 A3

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2016/026052

A. CLASSIFICATION OF SUBJECT MATTER
 INV. G06F11/10 G06F3/06 G06F12/02
 ADD.

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)
 G06F

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 practicable, search terms used)
 EPO-Internal

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 2 447 842 A1 (THOMSON LICENSING [FR]) 2 May 2012 (2012-05-02) column 5, paragraph 21-22 column 7, paragraph 28 - column 10, paragraph 42; figures 1,3,5 -----	1-21
X	US 2008/086677 A1 (YANG XUESHI [US] ET AL) 10 April 2008 (2008-04-10) page 2, paragraph 25 - page 3, paragraph 28 page 4, paragraph 47 - page 5, paragraph 51; figures 2,5 -----	1-21
X	US 2008/195900 A1 (CHANG YU-AN [TW] ET AL) 14 August 2008 (2008-08-14) page 2, paragraph 54 - page 3, paragraph 61; figures 2,4,5,7 -----	1-21
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Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents :

<p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent but published on or after the international filing date</p> <p>"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)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p>	<p>"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</p> <p>"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</p> <p>"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</p> <p>"&" document member of the same patent family</p>
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Date of the actual completion of the international search 19 September 2016	Date of mailing of the international search report 30/09/2016
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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, Fax: (+31-70) 340-3016	Authorized officer Bauer, Regine
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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2016/026052

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2009/144598 A1 (YOON TONY [US] ET AL) 4 June 2009 (2009-06-04) page 3, paragraph 37-40 page 4, paragraph 42-44 page 6, paragraph 65 - page 8, paragraph 88; figures 4-7	22-39
X	----- US 2012/317463 A1 (SUGAHARA TAKAHIKO [JP] ET AL) 13 December 2012 (2012-12-13) page 3, paragraph 54 - page 6, paragraph 88 figures 3-6	22-39
X	----- US 2005/094459 A1 (SESEK ROBERT [US] ET AL) 5 May 2005 (2005-05-05) page 5, paragraph 51 - page 7, paragraph 78; figures 5,6	22-39
X	----- US 2012/079229 A1 (JENSEN CRAIG [US] ET AL) 29 March 2012 (2012-03-29) page 1, paragraph 4-5 page 4, paragraphs 33-34,37-38 page 6, paragraph 53; figures 1B,4A,4B	40-58
X	----- US 2013/346671 A1 (MICHAEL ORON [US] ET AL) 26 December 2013 (2013-12-26) pages 6-7 page 4, paragraph 45 - paragraph 52 page 6, paragraph 57 page 7, paragraph 62 - page 8, paragraph 65 figures 2,4,5,6	40-58

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2016/026052

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 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 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.:

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.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

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

1. claims: 1-21

ECC encoding and decoding data for a plurality of distinct memory portions of a non-volatile memory where at least two memory portions have different ECC formats.

2. claims: 22-39

Modifying an ECC format of a memory portion of a non-volatile memory in accordance with obtained performance metrics of that memory portion.

3. claims: 40-58

Reading and storing data from / to a non-volatile memory using logical to physical address mapping.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No PCT/US2016/026052

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