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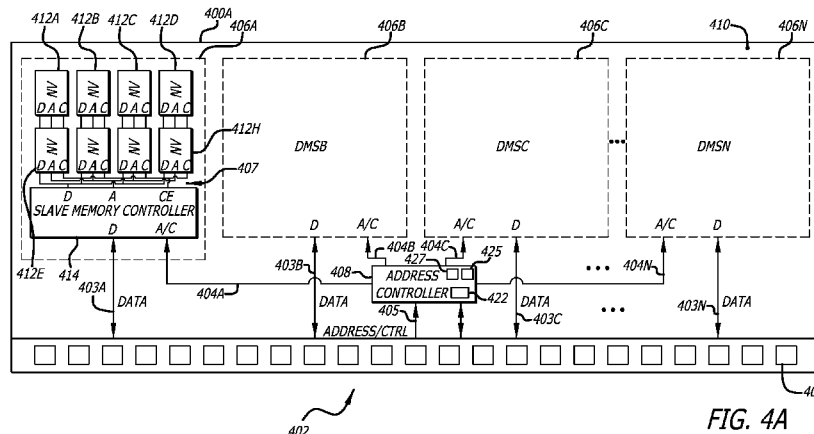


FIG. 4A

(57) Abstract: In one embodiment of the invention, a memory module is disclosed including a printed circuit board with an edge connector; an address controller coupled to the printed circuit board; and a plurality of memory slices. Each of the plurality of memory slices of the memory module includes one or more memory integrated circuits coupled to the printed circuit board, and a slave memory controller coupled to the printed circuit board and the one or more memory integrated circuits. The slave memory controller receives memory access requests for the memory module from the address controller. The slave memory controller selectively activates one or more of the one or more memory integrated circuits in the respective memory slice in response to the address received from the address controller to read data from or write data into selected memory locations in the memory integrated circuits.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 09/33843

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - G11C 8/02 (2009.01)

USPC - 365/231

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:G11C 8/02 (2009.01)

USPC 365/231

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

USPC: 365/189.011, 189.15-189.17, 230.01, 231: 438/106

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Electronic Databases Searched: pubWEST (PGPB,USPT,USOC,EPAB,JPAB); GoogleScholar

Search Terms Used: wear leveling, bad, remap, memory, flash, NVRAM, VRAM, RAM, asymmetric, non-symmetric, heterogeneous, hybrid, voltage, power, conversion, translation, cache, scratch, buffer, slice, slave, secondary controller

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2007/0070669 A1 (TSERN) 29 March 2007 (29.03.2007)	30-42
—	Entire document, especially: Abstract, para [0018], [0026], [0033]-[0034], [0041], [0046], [0052]-[0058], [0062], [0065], [0088], [0097], [0100], [0103]-[0114] and Figs. 1, 9C, 11, 13, 18	---
Y	US 2007/0195613 A1 (RAJAN et al.) 23 August 2007 (23.08.2007)	1-29
Y	Entire document, especially: para [0019], [0024], [0036], [0058] and Figs. 1, 3A, 7A, 11	1-29
Y	US 2007/0047655 A1 (VANNERSON et al.) 01 March 2007 (01.03.2007)	43-59
Y	Entire document, especially: Abstract, para [0010]-[0011] and Fig. 3	43-59
Y	US 2006/0248489 A1 (RUF) 02 November 2006 (02.11.2006)	43-49
Y	Entire document, especially: para [0003], [0006], [0010]-[0011], [0022]	43-49
Y	US 2007/0088995 A1 (TSERN et al.) 19 April 2007 (19.04.2007)	50-56
Y	Entire document, especially: para [0059], [0070], [0073], [0076], [0180] and Fig. 9A	50-56
Y	US 2007/0208697 A1 (SUBRAMANIAN et al.) 06 September 2007 (06.09.2007)	57-59
Y	Entire document, especially: para [0001], [0080], [0089] and Fig. 1	57-59
Y	US 2006/0026375 A1 (CHRISTENSON) 02 February 2006 (02.02.2006)	25-29
Y	Entire document, especially: para [0013]-[0016]	25-29

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

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Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 09/33843

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

Group 1: Claims 1-59 directed to selectively activating one or more of the memory integrated circuits in the respective memory slice of the memory module in response to the address received from the address controller to read data from or write data into selected memory locations in the memory integrated circuits.

Group 2: Claims 60-66 directed to mounting a multi-chip packaged integrated circuit part to a printed circuit board of a memory module. The inventions listed as Groups 1 - 2 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 Group I is selective activation of one or more memory integrated circuit in a respective memory slice of the memory module based on address received from the address controller, which is not present in Group II that has a special technical feature of mounting a multi-chip packaged integrated circuit part to a printed circuit board of a memory module.

- 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.:
1-59

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.