(54) Title: A HIGH SPEED DRAM ARCHITECTURE WITH UNIFORM ACCESS LATENCY

(57) Abstract: A Dynamic Random Access Memory (DRAM) performs read, write, and refresh operations. The DRAM includes a plurality of sub-arrays, each having a plurality of memory cells, each of which is coupled with a complementary bit line pair and a word line. The DRAM further includes a word line enable device for asserting a selected one of the word lines and a column select device for asserting a selected one of the bit line pairs. A timing circuit is provided for controlling the word line enable device, the column select device, and the read, write, and refresh operations in response to a word line timing pulse. The read, write, and refresh operation are performed in the same amount of time.

Date of publication of the international search report:
30 May 2002

Published:
— with international search report
— before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

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**

A. CLASSIFICATION OF SUBJECT MATTER

|--------|-------------|-------------|----------|----------|

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)

<table>
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<tr>
<th>IPC</th>
<th>G11C</th>
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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>EP 0 280 882 A (RCA CORP) 7 September 1988 (1988-09-07) claims 1,2; figure 1</td>
<td>1-3</td>
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<tr>
<td>A</td>
<td>page 11, line 43-49</td>
<td>7</td>
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<tr>
<td>X</td>
<td>JP 2000 137982 A (FUJITSU LTD) 16 May 2000 (2000-05-16) figures 5,6,18,19</td>
<td>10,11</td>
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<tr>
<td>P,X</td>
<td>US 6 108 243 A (SATOH YASUHARU ET AL) 22 August 2000 (2000-08-22) figures 5,6,18,19</td>
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</tr>
</tbody>
</table>

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 document 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

  **X** 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 novel or 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

  **X** document member of the same patent family

Date of the actual completion of the international search: 3 April 2002

Date of mailing of the international search report: 12.04.2002

Name and mailing address of the ISA

European Patent Office, P.B. 5318 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, FAX: (+31-70) 340-3016

Authorized officer: Vidal Verdu, J.
INTERNATIONAL SEARCH REPORT

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.

Form PCT/ISA/210 (continuation of first sheet (1)) (July 1998)
This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-9

DRAM performing read, write and refresh operations in the same amount of time irrespective of the input addresses.

2. Claims: 10-11

A method for performing a read command in a memory device in synchronization with a system clock comprising the steps of: generating a main self-timed pulse derived from the system clock; and generating a plurality of self-timed pulses activated in cascade based on said main self-timed pulse for controlling operation of address and data circuits.
<table>
<thead>
<tr>
<th>Patent document cited in search report</th>
<th>Publication date</th>
<th>Patent family member(s)</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>CA 1299738 A1</td>
<td>28-04-1992</td>
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