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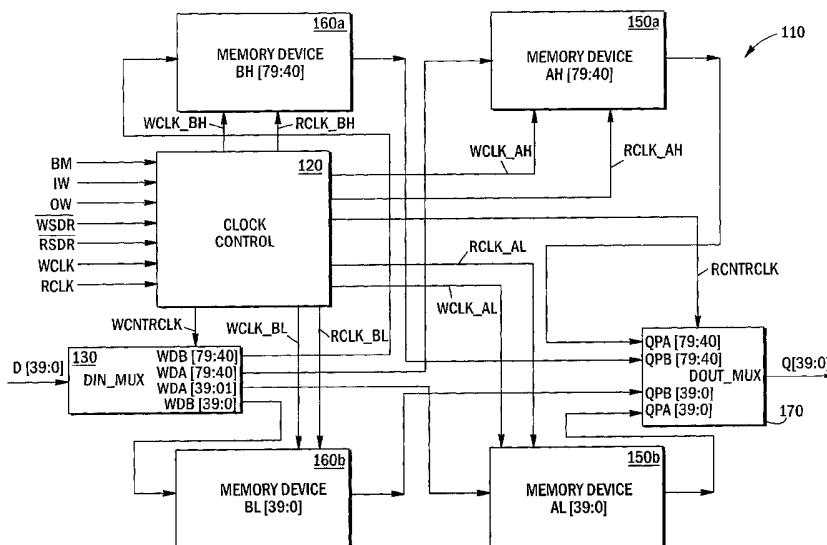
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19 February 2004

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.

(54) Title: FIFO MEMORY DEVICES HAVING SINGLE DATA RATE (SDR) AND DUAL DATA RATE (DDR) CAPABILITY



(57) Abstract: First-in first-out (FIFO) memory devices include a plurality of memory devices that are configured to support any combination of dual data rate (DDR) or single data rate (SDR) write modes that operate in-sync with a write clock signal (WCLK) and DDR or SDR read modes that operate in-sync with a read clock signal (RCLK). These FIFO memory devices provide flexible x4N, x2N and xN bus matching on both read and write ports and enable data to be written and read on both rising and falling edges of the write and read clock signals. Custom flag generation circuitry and retransmit circuitry are also provided that can efficiently handle any width DDR write mode with any width SDR read mode or any width SDR write mode with any width DDR read mode.

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# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/US 02/26516

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 G06F5/06

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 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 practical, search terms used)

EPO-Internal

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category ° | Citation of document, with indication, where appropriate, of the relevant passages  | Relevant to claim No. |
|------------|---|-----------------------|
| X          | EP 0 978 842 A (SAMSUNG ELECTRONICS CO LTD) 9 February 2000 (2000-02-09) paragraphs [0027], [0032], [0048] - [0050]   | 1-13,30,<br>31,42     |
| A          | -----<br>EP 0 421 627 A (ADVANCED MICRO DEVICES INC) 10 April 1991 (1991-04-10) abstract<br>column 1, line 27 - line 38<br>column 7, line 1 - line 52; figure 5               | 1-13,30,<br>31,42     |
| A          | -----<br>PATENT ABSTRACTS OF JAPAN<br>vol. 1996, no. 12,<br>26 December 1996 (1996-12-26)<br>& JP 08 202618 A (SONY CORP),<br>9 August 1996 (1996-08-09)<br>abstract<br>----- | 1-13,30,<br>31,42     |

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

- "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

26 September 2003

Date of mailing of the international search report

14. 11. 2003

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# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US 02/26516

## 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.:

1-13, 30, 31, 42

### Remark on Protest

- The additional search fees were accompanied by the applicant's protest.
- 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: 1-13, 30, 31, 42

A FIFO configured to support any combination of SDR / DDR, with, in claim 2, details of write/read in-sync with clock edges

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2. claims: 14-27

A FIFO with details of write/read in-sync with clock edges

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3. claims: 28, 29, 32, 33, 40, 41

A FIFO configured to support any combination of SDR / DDR, with details of flag circuitry

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4. claims: 34, 35

A FIFO configured to support any combination of SDR / DDR, with details of its quad-port memory devices

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5. claims: 36-39

A FIFO configured to support DDR, with details of write/read in-sync with clock edges, marking read data for a specific read and retransmit method

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

|                 |                  |
|-----------------|------------------|
| Int             | I Application No |
| PCT/US 02/26516 |                  |

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