

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
14 November 2002 (14.11.2002)

PCT

(10) International Publication Number
WO 2002/091164 A3

- (51) International Patent Classification⁷: **G06F 7/00**, 17/50
- (21) International Application Number:
PCT/US2002/014267
- (22) International Filing Date: 7 May 2002 (07.05.2002)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
09/849,312 7 May 2001 (07.05.2001) US
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- (81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZM, ZW.
- (84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).
- Published:**
— with international search report
- (88) Date of publication of the international search report:
5 August 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.*



WO 2002/091164 A3

(54) Title: MULTI-RAIL ASYNCHRONOUS FLOW WITH COMPLETION DETECTION AND SYSTEM AND METHOD FOR DESIGNING THE SAME

(57) Abstract: A method for designing a multi-rail asynchronous circuit is provided. The method includes providing a circuit having n circuit paths, defining a plurality of nodes, each node having an n-rail signal output and at least one n-rail signal input, each rail of the n-rail signal input being connected to a different one of the plurality of circuit paths, and adding completeness detection to each of the plurality of nodes, completion detection for a downstream one of the plurality of nodes being at least partially based on completion detection from an upstream one of the nodes. Signals propagate along the plurality of data paths independent of the completeness detection.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/02/14267

<p>A. CLASSIFICATION OF SUBJECT MATTER IPC 7 G06F7/00 G06F17/50</p>		
<p>According to International Patent Classification (IPC) or to both national classification and IPC</p>		
<p>B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) IPC 7 G06F</p>		
<p>Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched</p>		
<p>Electronic data base consulted during the international search (name of data base and, where practical, search terms used) EPO-Internal</p>		
<p>C. DOCUMENTS CONSIDERED TO BE RELEVANT</p>		
Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>LIGHTHART M ET AL: "Asynchronous design using commercial HDL synthesis tools" ADVANCED RESEARCH IN ASYNCHRONOUS CIRCUITS AND SYSTEMS, 2000. (ASYNC 2000). PROCEEDINGS. SIXTH INTERNATIONAL SYMPOSIUM ON EILAT, ISRAEL 2-6 APRIL 2000, LOS ALAMITOS, CA, USA, IEEE COMPUT. SOC, US, 2 April 2000 (2000-04-02), pages 114-125, XP010377321 ISBN: 0-7695-0586-4 paragraph [0005]</p> <p style="text-align: center;">----- -/--</p>	1-12
<p><input checked="" type="checkbox"/> Further documents are listed in the continuation of box C. <input type="checkbox"/> Patent family members are listed in annex.</p>		
<p>° Special categories of cited documents :</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document 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>		
<p>Date of the actual completion of the international search 6 August 2003</p>		<p>Date of mailing of the international search report 09. 12. 2003</p>
<p>Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016</p>		<p>Authorized officer Cohen B.</p>

INTERNATIONAL SEARCH REPORT

International Application No

PCT/S 02/14267

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>AHMED J ET AL: "Asynchronous design in dynamic CMOS" ELECTRICAL AND COMPUTER ENGINEERING, 1997. ENGINEERING INNOVATION: VOYAGE OF DISCOVERY. IEEE 1997 CANADIAN CONFERENCE ON ST. JOHNS, NFLD., CANADA 25-28 MAY 1997, NEW YORK, NY, USA, IEEE, US, 25 May 1997 (1997-05-25), pages 528-531, XP010235061 ISBN: 0-7803-3716-6 paragraph [03.2]</p> <p style="text-align: center;">-----</p>	1-12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 02/14267

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.: **1-12 (in part)**
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:
see FURTHER INFORMATION sheet PCT/ISA/210

- 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.:
1-12

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

Continuation of Box I.2

Claims Nos.: 1-12 (in part)

Present claims 1-12 relate to a method for designing a circuit defined by reference to a desirable characteristic or property, namely that, in the circuit, completion detection does not retard propagation of logic signals through the data paths.

The claims cover all methods for designing having this characteristic or property, whereas the application provides support within the meaning of Article 6 PCT and/or disclosure within the meaning of Article 5 PCT for only a very limited number of such methods. In the present case, the claims so lack support, and the application so lacks disclosure, that a meaningful search over the whole of the claimed scope is impossible. Independent of the above reasoning, the claims also lack clarity (Article 6 PCT). An attempt is made to define the method by reference to a result to be achieved. Again, this lack of clarity in the present case is such as to render a meaningful search over the whole of the claimed scope impossible. Consequently, the search has been carried out for those parts of the claims which appear to be clear, supported and disclosed, namely those parts relating to the method described with reference to figures 2-4.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.5), should the problems which led to the Article 17(2) declaration be overcome.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

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

1. claims: 1-12

Design method of multirail asynchronous circuit with a plurality of nodes, where completion detection of a node depends on completion detection of an upstream node.

2. claims: 13-19

Optimizing of, and multirail asynchronous circuit with a plurality of nodes having optimized completion detection circuit.

3. claim: 20

Register for use in asynchronous n-rail circuits.
