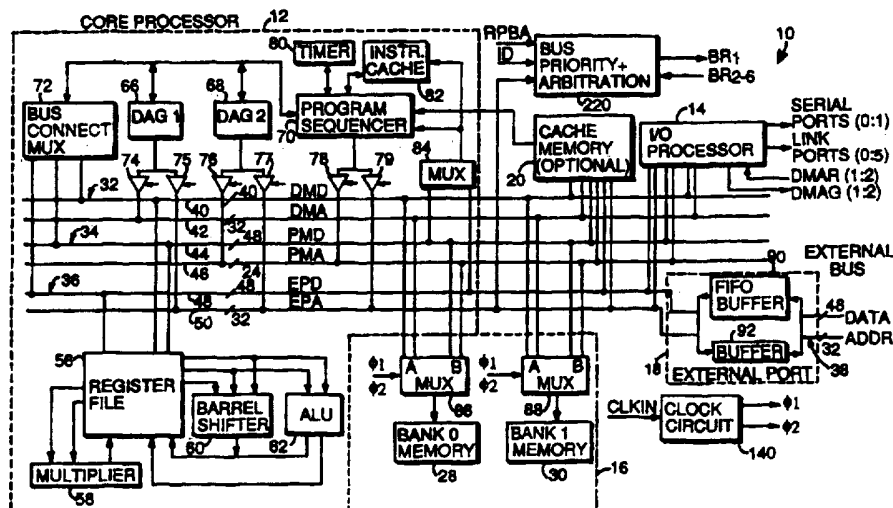




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : G06F 15/78, 12/02, 13/28, 13/38	A3	(11) International Publication Number: WO 96/10904 (43) International Publication Date: 18 April 1996 (18.04.96)
(21) International Application Number: PCT/US95/13386 (22) International Filing Date: 4 October 1995 (04.10.95) (30) Priority Data: 08/317,744 4 October 1994 (04.10.94) US 08/317,891 4 October 1994 (04.10.94) US 08/317,313 4 October 1994 (04.10.94) US 08/317,886 4 October 1994 (04.10.94) US (71) Applicant: ANALOG DEVICES, INC. [US/US]; One Technology Way, Norwood, MA 02062-9106 (US). (72) Inventors: GARDE, Douglas; 35A Hartford Street, Dover, MA 02030 (US). YEE, Ronnin, J.; 2261E Washington Street, Newton, MA 02162 (US). VALLEY, Mark, A.; 148 Deanville Road, Attleboro, MA 02703 (US). COX, Steven, L.; 11 Goddard Road, Sharon, MA 02067 (US). GORIUS, Aaron, H.; 73 Hartford Avenue, Upton, MA 01568 (US). (74) Agent: MCCLELLAN, William, R.; Wolf, Greenfield & Sacks, P.C., 600 Atlantic Avenue, Boston, MA 02210 (US).		(81) Designated States: AL, AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TT, UA, UG, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG), ARIPO patent (KE, MW, SD, SZ, UG). Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i> (88) Date of publication of the international search report: 12 September 1996 (12.09.96)

(54) Title: DIGITAL SIGNAL PROCESSOR



(57) Abstract

A monolithic digital signal processor includes a core processor for performing digital signal computations, an I/O processor for controlling external access to and from the digital signal processor through an external port, first and second memory banks for storing instructions and data for the digital signal computations, and first and second buses interconnecting the core processor, the I/O processor and the memory banks. The core processor and the I/O processor access the memory banks on the first bus without interference on different clock phases of a clock cycle. The internal memory and the I/O processor of the digital signal processor are assigned to a region of a global memory space, which facilitates multiprocessing configurations. In a multiprocessor system, each digital signal processor is assigned a processor ID. The digital signal processor includes a bus arbitration circuit for controlling access to an external bus through the external port. The digital signal processor may include one or more serial ports and one or more link ports for point-to-point communication with external devices. A DMA controller controls DMA transfers through the external port, the serial ports and the link ports.

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 95/13386

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 G06F15/78 G06F12/02 G06F13/28 G06F13/38

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 6 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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	IEEE TRANSACTIONS ON COMPONENTS, PACKAGING AND MANUFACTURING TECHNOLOGY, PART B: ADVANCED PACKAGING, AUG. 1994, USA, ISSN 1070-9894, XP002009148 BREWER J E ET AL: "A monolithic processing subsystem" see the whole document --- -/--	1-32

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

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- *&* document member of the same patent family

Date of the actual completion of the international search

24 July 1996

Date of mailing of the international search report

02.08.96

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Michel, T

INTERNATIONAL SEARCH REPORT

Internal Application No
PCT/US 95/13386

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	IEEE MICRO, vol. 12, no. 4, 1 August 1992, pages 60-69, XP000293560 SIMAR JR R ET AL: "FLOATING-POINT PROCESSORS JOIN FORCES IN PARALLEL PROCESSING ARCHITECTURES" see page 60, right-hand column, line 22 - page 61, right-hand column, line 8; figure 1 see page 63, left-hand column, line 19 - line 26; figure 5	33-46
A	see page 62, right-hand column, line 9 - page 63, left-hand column, line 18; figures 1,4	47-60
A	--- EP,A,0 540 206 (IBM) 5 May 1993 see abstract; figure 1 see column 14, line 55 - column 15, line 5 see column 15, line 16 - line 43 see column 17, line 5 - line 34	33-46
Y	--- EP,A,0 537 072 (GOLD STAR CO) 14 April 1993 see column 6, line 7 - line 13 see column 6, line 54 - column 7, line 25	59,60
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A	--- EP,A,0 427 407 (COMPAQ COMPUTER CORP) 15 May 1991 see the whole document	33-46
A	--- COMPUTER DESIGN, vol. 33, no. 11, 1 October 1994, page 69/70, 72, 74, 76, 78, 80, 82, 84, 86, 88 XP000477330 "DSP TOOLS: NAVIGATING THE HARDWARE/SOFTWARE INTERFACE" see page 76, left-hand column, line 8 - right-hand column, line 15	33-60
A	--- EP,A,0 560 020 (IBM) 15 September 1993 see claims 3,4	56,59,60

INTERNATIONAL SEARCH REPORT

Internat. Application No.
PCT/US 95/13386

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	1994 PROCEEDINGS. SIXTH ANNUAL IEEE INTERNATIONAL CONFERENCE ON WAFER SCALE INTEGRATION (CAT. NO.94CH3412-4), PROCEEDINGS OF 1994 INTERNATIONAL CONFERENCE ON WAFER SCALE INTEGRATION (ICWSI), SAN FRANCISCO, CA, USA, 19-21 JAN. 1994, ISBN 0-7803-1850-1, 1994, NEW YORK, NY, USA, IEEE, USA, pages 265-272, XP0002009149 BREWER J E ET AL: "A single-chip digital signal processing subsystem" see the whole document ---	1-32
X	ELEKTRONIK, 14 JUNE 1994, GERMANY, vol. 43, no. 12, ISSN 0013-5658, pages 98-102, 104, 106, XP000464141 COUNIHAN T ET AL: "On-chip integrated memories in DSP (distributed signal processing) architectures" see page 104, left-hand column, line 14 - page 106, right-hand column, line 19 ---	1,10,17, 20,21, 26,30
A	WO,A,90 07154 (FLASHPOINT COMPUTER CORP) 28 June 1990 see the whole document ---	1-32
A	IBM TECHNICAL DISCLOSURE BULLETIN, vol. 33, no. 10A, March 1991, NEW YORK, US, pages 1-5, XP000109937 ANONYMOUS: "Distributed Process Bulletin Board." see the whole document ---	1,10,17, 21,26,30
A	GOVERNMENT MICROCIRCUIT APPLICATIONS CONFERENCE, 1 November 1993, pages 67-70, XP000567621 GARDE D ET AL: "A 120MFLOP DIGITAL SIGNAL PROCESSOR FOR MULTI-PROCESSING APPLICATIONS" see the whole document ---	33-58
Y	see the whole document ---	59,60
	-/--	

INTERNATIONAL SEARCH REPORT

I International application No.

PCT/US 95/ 13386

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:

- 1 Claims 1-32 : Digital signal processor.
- 2 Claims 33-46 : Apparatus and method for processing DMA transfers.
- 3 Claims 47-60 : Apparatus and method for transmitting data to an external device.

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.

INTERNATIONAL SEARCH REPORT

Information on patent family members

Intern: al Application No

PCT/US 95/13386

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