CIO-DAS08/JR
&
CIO-DAS08/JR-AO

Analog I/O and Digital I/O Board

User's Manual

Revision 4
April, 2001

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1 INTRODUCTION

The CIO-DAS08/JR combines analog inputs with digital input and output capability. The CIO-DAS08/JR-AO adds analog output capability. Throughout this manual, we will refer to the CIO-DAS08/JR except where the analog outputs are being discussed. In all other respects, the boards are identical.

The CIO-DAS08/JR can be upgraded to a CIO-DAS08/JR-AO by purchasing and installing the CIO-DUAL-DAC chip set. See the "Upgrading the CIO-DAS08/JR" section.

1.1 ANALOG INPUTS AND OUTPUTS

The CIO-DAS08/JR has eight single-ended analog inputs and can supply two analog outputs. Twelve-bit resolution at a fixed ±5V range is provided for both inputs and outputs.

1.2 DIGITAL INPUTS AND OUTPUTS

There are eight inputs and eight outputs for sensing and controlling digital devices. They are port-addressable and are dedicated to either input or output. The digital outputs and inputs are TTL level.

2 SOFTWARE INSTALLATION

The board has a set of address switches to set before installing the board in your computer. The simplest way to configure your board is to use the *Insta*Cal™ program provided as part of your software package. *Insta*Cal™ will show you how to configure the switches to match your application requirements, and will create a configuration file that your application software (and the Universal Library) will refer to so the software you use will automatically know the exact configuration of the board.

Please refer to the *Software Installation Manual* regarding the installation and operation of *Insta*Cal™. The following information will allow you to do the hardware configuration of the board if you do not have immediate access to *Insta*Cal™ and/or your computer.

3 HARDWARE INSTALLATION

3.1 BASE ADDRESS

The base address of the CIO-DAS08/JR is set by switching a bank of DIP switches on the board. This bank of switches is labeled ADDRESS and numbered 9 to 3 (Figure 3-1).
Ignore the word ON and the numbers printed on the switch
The address logic works by adding up the weights of individual switches to make up a base address. A switch is active when down. Shown to the right, switches 9 and 8 are down, all others are up.
Weights 200h and 100h are active, equaling 300h base address.
Refer to Table 3-1 for PC I/O addresses.

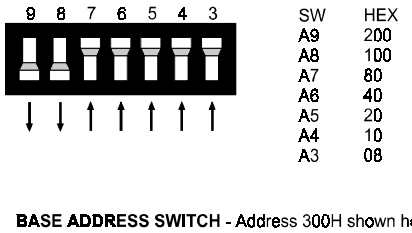


Figure 3-1. Base Address Switches

Table 3-1. PC I/O Addresses

HEX RANGE	FUNCTION	HEX RANGE	FUNCTION
000-00F	8237 DMA #1	2C0-2CF	EGA
020-021	8259 PIC #1	2D0-2DF	EGA
040-043	8253 TIMER	2E0-2E7	GPIB (AT)
060-063	8255 PPI (XT)	2E8-2EF	SERIAL PORT
060-064	8742 CONTROLLER (AT)	2F8-2FF	SERIAL PORT
070-071	CMOS RAM & NMI MASK (AT)	300-30F	PROTOTYPE CARD
080-08F	DMA PAGE REGISTERS	310-31F	PROTOTTYPE CARD
0A0-0A1	8259 PIC #2 (AT)	320-32F	HARD DISK (XT)
0A0-0AF	NMI MASK (XT)	378-37F	PARALLEL PRINTER
0C0-0DF	8237 #2 (AT)	380-38F	SDLC
0F0-0FF	80287 NUMERIC CO-P (AT)	3A0-3AF	SDLC
1F0-1FF	HARD DISK (AT)	3B0-3BB	MDA
200-20F	GAME CONTROL	3BC-3BF	PARALLEL PRINTER
210-21F	EXPANSION UNIT (XT)	3C0-3CF	EGA
238-23B	BUS MOUSE	3D0-3DF	CGA
23C-23F	ALT BUS MOUSE	3E8-3EF	SERIAL PORT
270-27F	PARALLEL PRINTER	3F0-3F7	FLOPPY DISK
2B0-2BF	EGA	3F8-3FF	SERIAL PORT

3.2 INSTALLING THE CIO-DAS08/JR IN THE COMPUTER

1. Turn the power off.

2. Remove the cover of your computer. Please be careful not to dislodge any of the cables installed on the boards in your computer as you slide the cover off.

3. Locate an empty expansion slot in your computer.

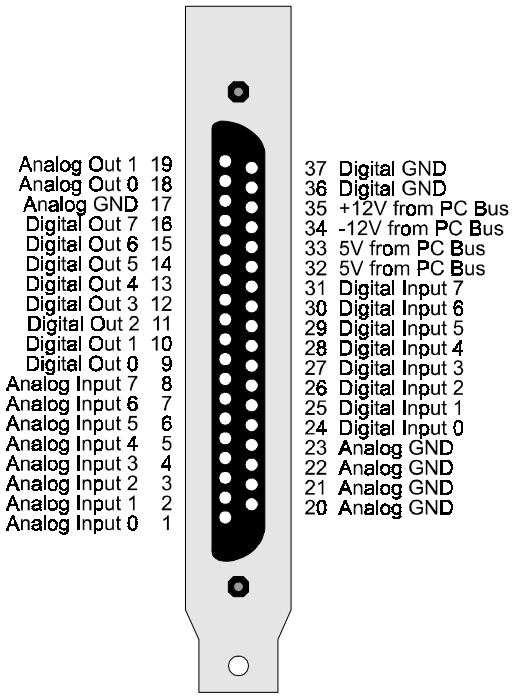
4. Push the board firmly down into the expansion bus connector. If it is not seated fully it may fail to work and could short circuit the PC bus power onto a PC bus signal. This could damage the motherboard in your PC as well as the CIO-DAS08/JR.

4 CALIBRATION AND TEST

The CIO-DAS08/JR is supplied with software for calibration and test in the InstaCal program under the CALIBRATE option. The CIO-DAS08/JR has a fixed input range and does not have any input amplification or gain/offset compensation electronics. When using the optional Universal Library, all compensation for gain/offset errors is done in software after the signal is acquired. The gain and offset calibration factors are stored in the CB.CFG file and applied to the analog samples after they are acquired.

The calibration factors can be set as often as you like. Simply run the CALIBRATE option from the InstaCal menu.

5 SIGNAL CONNECTIONS



37 PIN CONNECTOR

NOTE: The Analog Out pins apply only to the CIO-DAS08/JR-AO.

The CIO-DAS08/JR analog connector is a 37-pin, D-type connector accessible from the rear of the PC through the expansion backplate.

The connector accepts female 37-pin, D-type connectors, such as the C37FF-2, a 2-foot cable with connectors. For quick and easy access to the board, use a CIO-MINI37 screw terminal board.

6 REGISTER ARCHITECTURE

All of the programmable functions of the CIO-DAS08/JR are accessible through the control and data registers, which are explained here. We recommend programming with Universal Library rather than direct register programming.

6.1 REGISTER LAYOUT

The CIO-DAS08/JR is controlled and monitored by writing to and reading from four consecutive 8-bit I/O addresses (eight consecutive addresses on the CIO-DAS08/JR-AO). The first address, or BASE ADDRESS, is determined by setting a bank of switches on the board.

Most often, register manipulation is best left to ASSEMBLY language programs as most possible functions are implemented in Universal Library routines.

Note that an X is an unspecified bit. There is no function associated with that bit position. All X bits should be masked out of reads.

To write to or read from a register in decimal or HEX, the following weights apply:

Table 6-1. Bit Weights

BIT POSITION	DECIMAL VALUE	HEX VALUE
0	1	1
1	2	2
2	4	4
3	8	8
4	16	10
5	32	20
6	64	40
7	128	80

To write control words or data to a register, the individual bits must be set to 0 or 1 then combined to form a byte. Data read from registers must be analyzed to determine which bits are on or off.

The registers and their function are listed on Table 6-2. Each register has eight bits which may constitute a byte of data or eight individual bit set/read functions.

Table 6-2. Board Registers

ADDRESS	READ FUNCTION	WRITE FUNCTION
BASE	A/D Bits 8-11 (LSB)	None
BASE + 1	A/D Bits 0 (MSB) - 7	Start 12 bit A/D conversion
BASE + 2	A/D status & MUX Address	Set A/D channel
BASE + 3	Digital input, 8 bits	Digital output, 8 bits
BASE + 4		D/A 0 LSB (-AO only)
BASE + 5		D/A 0 MSB (-AO only)
BASE + 6		D/A 1 LSB (-AO only)
BASE + 7		D/A 1 MSB (-AO only)

6.2 A/D REGISTERS

BASE ADDRESS

7	6	5	4	3	2	1	0
A/D8	A/D9	A/D10	A/D11 LSB	X	X	X	X

A read only register.

On a read, it supplies the least significant four digits of the analog input data. These four bits of analog input data must be combined with the eight bits of analog input data in BASE + 1 to form a complete 12-bit number. The data is in the format 0 = minus FS (full scale); 4095 = +FS.

BASE ADDRESS + 1

7	6	5	4	3	2	1	0
A/D0 MSB	A/D1	A/D2	A/D3	A/D4	A/D5	A/D6	A/D7

READ: The most significant A/D byte is read.

WRITE: Any write to this register causes an immediate A/D conversion.

A note of caution: Place several NO-OP instructions between consecutive 12-bit A/D conversions to avoid over-running the A/D converter.

6.3 STATUS AND CONTROL REGISTER

BASE ADDRESS + 2

This register address is two registers, one for reading and one for writing.

READ = STATUS

7	6	5	4	3	2	1	0
EOC	X	X	X	X	ChAdd2	ChAdd1	ChAdd0

EOC = 1 the A/D is busy converting and data should not be read.

EOC = 0 the A/D is not busy and data may be read.

ChAdd 2 to ChAdd 0 is the current analog input multiplexer channel. The current channel is a binary coded number between 0 and 7 .

WRITE = CONTROL

7	6	5	4	3	2	1	0
X	X	X	X	X	ChAdd2	ChAdd1	ChAdd0

ChAdd 2 to ChAdd 0. Set the current channel address by writing a binary coded number between 0 and 7 to these three bits.

6.4 DIGITAL I/O CONTROL REGISTER

BASE ADDRESS + 3

This address contains two registers, one for output and one for input. The output register is latched and holds the last value written to it. The input register is not latched. Each time the register is read the current state of the inputs is passed through this port into the computer.

WRITE = Set digital output port, all bits.

READ = Read digital input port, all bits and update both D/A channels simultaneously with the last values written to D/A output registers.

7	6	5	4	3	2	1	0
D7	D6	D5	D4	D3	D2	D1	D0

6.5 D/A CONTROL REGISTERS (CIO-DAS08/JR-AO ONLY)

Each D/A is controlled by a pair of 8-bit write only registers. These registers contain the high nibble and the low byte of the D/A 12 bit control word. The value written to these two registers controls the output of the D/A chip.

To update the D/A outputs with the values in the D/A output registers, read the register at BASE + 3.

The D/A output range can be calculated as [(#/4096) * 10V] – 5V (for # between 0 and 4095 inclusive).
The #/4096 is a proportion of the Full Scale Range, which is ±5V.

D/A 0 CONTROL REGISTERS

BASE ADDRESS + 4, DAC 0 LOW BYTE

7	6	5	4	3	2	1	0
DA7	DA6	DA5	DA4	DA3	DA2	DA1	DA0 LSB

BASE ADDRESS + 5, DAC 0 HIGH BYTE

7	6	5	4	3	2	1	0
X	X	X	X	DA11 MSB	DA10	DA9	DA8

D/A 1 CONTROL REGISTERS

BASE ADDRESS + 6, DAC 1 LOW BYTE

7	6	5	4	3	2	1	0
DA7	DA6	DA5	DA4	DA3	DA2	DA1	DA0 LSB

BASE ADDRESS + 7, DAC 1 HIGH BYTE

7	6	5	4	3	2	1	0
X	X	X	X	DA11 MSB	DA10	DA9	DA8

7 UPGRADING THE CIO-DAS08/JR

To add analog output capability to a CIO-DAS08/JR, order and install the CIO-DUAL-DAC upgrade kit. Insert the AD7237 received in the CIO-DUAL-DAC kit into the socket labeled U13. Align the notch or dimple indicating pin 1 on the chip with the notch in the white silkscreen outline printed on the board at the U13 position.

8 SPECIFICATIONS

Power consumption

+5V	200 mA typical, 240A max
+12V	
CIO-DAS08/JR	17 mA typical, 22mA max
CIO-DAS08/JR-AO	27 mA typical, 35mA max
-12V	
CIO-DAS08/JR	28 mA typical, 36mA max
CIO-DAS08/JR-AO	28 mA typical, 36mA max

Analog input section

A/D converter type	AD574
Resolution	12 bits
Number of channels	8 single-ended
Input ranges	±5V
A/D pacing	Software-polled
Data transfer	Software-polled
A/D conversion time	25 µs
Throughput	System-dependant
Gain drift (A/D specs)	±50 ppm/°C
Zero drift (A/D specs)	±10 ppm/°C
Absolute maximum input voltage	±30V continuous

Analog Output (CIO-DAS08/JR-AO Only)

D/A converter type	AD7237
Resolution	12 bits
Number of channels	2
Output Ranges	±5V
D/A pacing	Software-paced
Data transfer	Programmed I/O
Offset error	±2 LSB typical, ±5LSB max
Gain error	±2 LSB typical, ±5LSB max
Differential nonlinearity	±0.9 LSB max
Relative accuracy	±1 LSB max
Monotonicity	Guaranteed monotonic to 12 bits over temperature
D/A Gain drift	±25 ppm/°C max
Settling time (10V step to ±½LSB)	10 µs max
Current Drive	±5 mA
Output coupling	DC
Output impedance	0.5 Ohms max
Miscellaneous	Update DACs simultaneously

Digital Input / Output

Digital Type	
Output	74LS273
Input	74LS244
Configuration	8 fixed input, 8 fixed output
Number of channels	8
Output High	2.7 volts min @ –0.4 mA
Output Low	0.5 volts max @ 8 mA
Input High	2.0 volts min, 7 volts absolute maximum
Input Low	0.8 volts max, –0.5 volts absolute minimum

Environmental

Operating temperature range	0 to 50°C
Storage temperature range	–20 to 70°C
Humidity	0 to 90% non-condensing

For your notes

EC Declaration of Conformity

We, *Measurement Computing Corp*., declare under sole responsibility that the product:

Part Number	Description
CIO-DAS08/JR	Analog Input & Digital I/O Board
CIO-DAS08/JR-AO	Analog & Digital I/O Board

to which this declaration relates, meets the essential requirements, is in conformity with, and CE marking has been applied according to the relevant EC Directives listed below using the relevant section of the following EC standards and other normative documents:

EU EMC Directive 89/336/EEC: Essential requirements relating to electromagnetic compatibility.

EU 55022 Class B: Limits and methods of measurements of radio interference characteristics of information technology equipment.

EN 50082-1: EC generic immunity requirements.

IEC 801-2: Electrostatic discharge requirements for industrial process measurement and control equipment.

IEC 801-3: Radiated electromagnetic field requirements for industrial process measurements and control equipment.

IEC 801-4: Electrically fast transients for industrial process measurement and control equipment.

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