CIO-DAC02

Dual Channel 12-Bit Analog Output User's Manual

Revision 4
October, 2000

Notice

Measurement Computing Corporation does not authorize any Measurement Computing Corporation product for use in life support systems and/or devices without the written approval of the President of Measurement Computing Corporation Life support devices/systems are devices or systems which, a) are intended for surgical implantation into the body, or b) support or sustain life and whose failure to perform can be reasonably expected to result in injury. Measurement Computing Corp. products are not designed with the components required, and are not subject to the testing required to ensure a level of reliability suitable for the treatment and diagnosis of people.

TABLE OF CONTENTS

This page intentionally left blank.

1: INSTALLATION

1.1 SOFTWARE

Before you open your computer and install the board, install and run *Insta*Cal, the installation, calibration and test utility included with your board. *Insta*Cal will guide you through switch and jumper settings for your board. Detailed information regarding these settings can be found below. Refer to the *Extended Software Installation* manual for *Insta*Cal installation instructions.

1.2 HARDWARE

The CIO-DAC02 (Figure 1-1) has one bank of switches and two jumper blocks which must be set before installing the board in your computer.

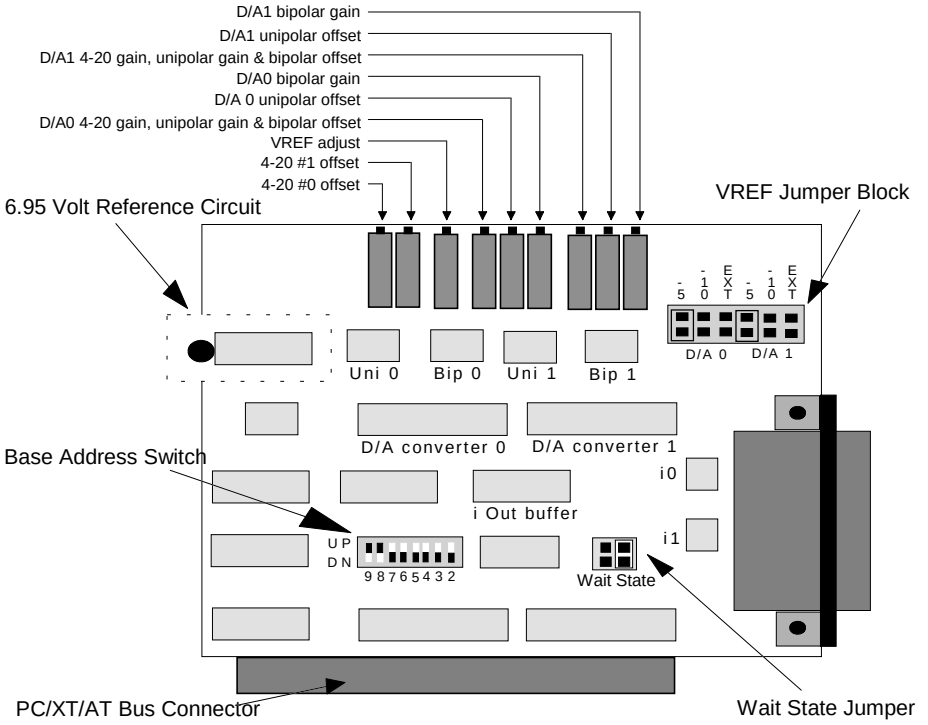


Figure 1-1. Board Layout - CIO-DAC02

1.3 BASE ADDRESS

Unless there is already a board in your system that uses address 300 hex (768 decimal), leave the switches as they were set at the factory. In the example shown in Figure 1-2, the board is set for base address 300 hex (768 decimal).

Table 1-1 lists PC I/O addresses.

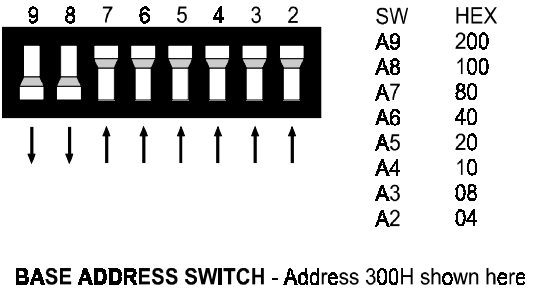


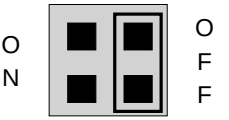
Figure 1-2. Base Address Switches

Table 1-1. 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	300-30F	PROTOTYPE CARD
080-08F	DMA PAGE REGISTERS	310-31F	PROTOTYPE CARD
0A0-0A1	8259 PIC #2	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

1.4 WAIT STATE JUMPER

The wait state generator is only active when the CIO-DAC02 is being accessed. In general, the PC is not slowed down by using the wait state. Normally, a wait state is not required.



WAIT STATE JUMPER - No wait state is selected here. Place jumper on the two leftmost pins for a wait state.

Figure 1-3. Wait-State Jumper

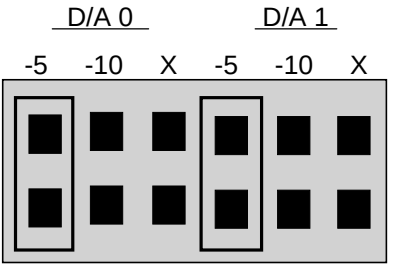
1.5 VOLTAGE REFERENCE JUMPERS

The output voltage of the D/A converters is determined by the value of the reference voltage (VREF) and the digital code written to the DACs (see *Analog Output* section below). The VREF signal must be supplied to each D/A or no voltage output will be present at the D/A's output pin. The VREF is supplied via jumpers or from an external source.

A jumper block consisting of two rows of six pins is located on the upper right corner of the board. There are two groups of pins, one for D/A 0 and one for D/A 1. Each group of pins provide a means of supplying either –5V or –10V to each D/A.

NOTE: The board is shipped with both the D/A 0 and D/A 1 VREF jumpers in the external (X) position. With jumpers in the X position, the required D/A reference voltage(s) must be supplied to the 25-pin connector VREF input pins.

A –5VREF provides a ±5V output on the D/A bipolar output, 0-5V output on the unipolar output and a 4-20 mA output on the current output.
If other ranges are desired, an external voltage between –10 and +10 volts should be supplied.



OUTPUT RANGE SELECT JUMPER BLOCK · The jumpers are in the -5V REF position.

Figure 1-4.
Output Range Select Jumper Block

The on-board voltage reference jumper supplies the same signals available at the 25-pin connector directly to the D/A VREF input, without the bother of looping the –5VREF or –10VREF outputs back into the D/A VREF inputs, as is required with the MetraByte DAC-02.

1.6 INSTALLING BOARD IN THE COMPUTER

1. Turn the power off.

2. Remove the cover of your computer. 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 ISA expansion slot in your computer.

4. Push the board firmly down into the 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 or the board.

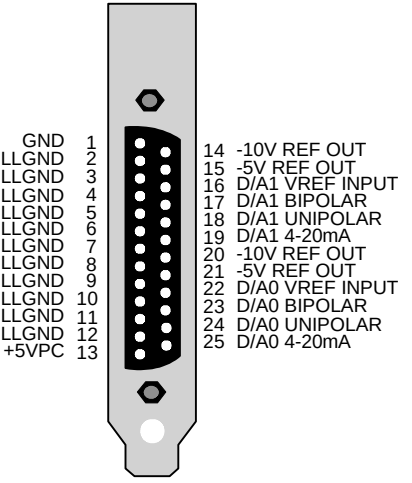
2: SIGNAL CONNECTION

2.1 CONNECTOR DIAGRAM - CIO-DAC02

The CIO-DAC02 signal connector is a 25-pin D type connector accessible from the rear of the PC through the expansion backplate.

The connector accepts male 25-pin D type connectors. The C25FM-# cable may be used along with a CIO-MINI25 screw terminal board for connecting your field wiring.

As an alternative to a cable, you may attach field wiring to the 25-pin connector with a DMCON-25 connector kit available from Measurement Computing.



CIO-DAC02 CONNECTOR - View from the rear of the PC.

Figure 2-1. CIO-DAC02 Signal Connector

2.2 ANALOG OUTPUTS

Each D/A converter has three analog outputs; a unipolar voltage, a bipolar voltage and a 4-20 mA current output. The range of the output is determined by the reference voltage selected on that D/A's VREF input. The CIO-DAC02 provides two on-board jumper selectable reference voltages; –5V and –10V.

Choosing a VREF input of –5V provides a range of 0 to +5 volts on the unipolar output and ±5V on the bipolar output. The 4-20 mA output is also available at this setting.

Choosing a VREF input of –10V provides a unipolar output of 0 to +10 volts and a ±10V bipolar output.

Choosing an external voltage reference will provide:

A **unipolar** output equal to: VREF/4096 * (D/A VALUE) * (–1)

A **bipolar** output equal to: VREF/2048 * ((D/A VALUE) –2048)

2.3 4-20 mA OUTPUTS

In addition to voltage outputs, each D/A can supply a 4-20mA output with a resolution of 0.0039 mA per bit. The 4-20 mA outputs may be used to control devices in a 4-20 mA control loop. The 4-20 mA current loop circuit is a precision current sink employing a VMOS FET. A diode provides reverse hookup protection (Figure 2-2).

Select the on - board -5V reference for 4-20mA use.

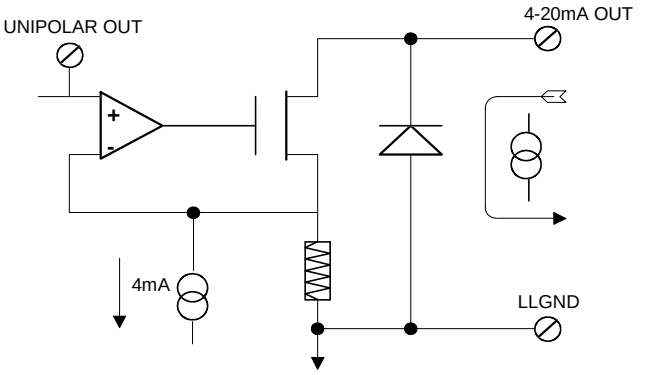


Figure 2-2. Circuit Diagram (Simplified) 4-20 mA Output

A minimum of 8 VDC and a maximum of 36 VDC external excitation voltage is used to power the loop. A typical application would use a 24V loop supply. The loop may use either a grounded load (the supply "floats"), or a grounded supply, (the load "floats"). See Figure 2-3 below.

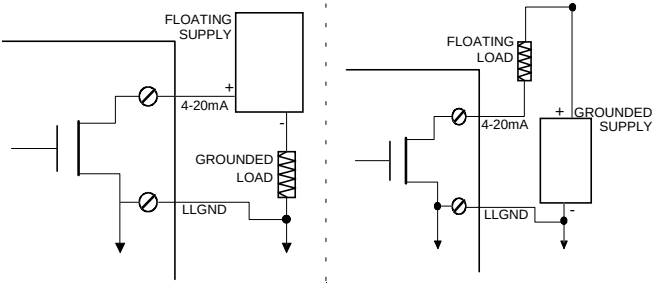


Figure 2-3. Loop Grounding Methods

3: REGISTER PROGRAMMING

3.1 INTRODUCTION AND EXAMPLE

The CIO-DAC02 can be programmed by direct register-writes. The board has four registers grouped in sets of two. Each set corresponds to one D/A output chip. Writing to the registers causes an output of the D/A according to the transfer function explained earlier.

An explanation of direct register programming of the CIO-DAC02 follows. We suggest that using the Measurement Computings Universal Library is a more efficient means of programming the registers.

A short example follows:

```
10 Voltage = 2.25                          'Desired output voltage is 2.25V
20 DACOUNTS % = Int (2.25/0.00244)          'Converts volts to D/A digital value
30 MSB % = Int (DACOUNTS%/16)              'Extract the most significant byte (MSB)
40 LSB% = (DACOUNTS% - MSB% * 16)          'Extract the LSB
50 LSB% = LSB% * 16                        'Shift the LSB four places left
60 OUT & H300, LSB%                        'Write LSB to D/A0 LSB register
70 OUT & H301 MSB%                         'Write MSB to D/A0 MSB and update output
```

This BASIC example can be translated to any other language capable of PORT I/O.

The registers of the CIO-DAC02 are:

BASE + 0	D/A0 LSB
BASE + 1	D/A0 MSB & UPDATE
BASE + 2	D/A1 LSB
BASE + 3	D/A1 MSB & UPDATE

The format of the data registers is:

LSB REGISTER

7	6	5	4	3	2	1	0
D/A9	D/A10	D/A11	D/A12 (LSB)	X	X	X	X

MSB REGISTER

7	6	5	4	3	2	1	0
D/A1 (MSB)	D/A2	D/A3	D/A4	D/A5	D/A6	D/A7	D/A8

The LSB register of each D/A is buffered and writing to it does not update the D/A output. Writing to the MSB updates the D/A output with the full 12 bits from the LSB buffer and the MSB data.

The CIO-DAC02 may be used as an 8-bit D/A by storing a 0 in the LSB. From that point on, write 8-bit bytes to the MSB for immediate 8-bit updates.

3.2 D/A CODING

The coding of the D/A is true binary for the unipolar and 4-20 mA outputs.
The bipolar scheme requires more complex coding. The transfer functions for both are as follows:

A unipolar output is equal to:

D/A OUT = VREF/4096 * (D/A VALUE) * (–1)

A bipolar output is equal to:

D/A OUT = VREF/2048 * ((D/A VALUE) –2048)

Table 3-1. D/A Equivalent Outputs

D/A VALUE	UNIPOLAR OUTPUT	BIPOLAR OUTPUT
0	0.0V	+5V
2048	2.5V	0.0V
4095	5.0V	–5.0V

NOTE: This table applies for VREF = –5V.

4: SPECIFICATIONS

Power Consumption:

+5V supply	135 mA typ, 300mA max
+12V supply	15 mA typ, 25mA max
-12V supply	25 mA typ, 35mA max

Analog Output:

D/A converter type	**AD7548**
Resolution	***12 bits***
Number of channels	***2 Voltage or Current Output***
Voltage Ranges (Bipolar output)	±5V, ±10V and user range (determined by value of external reference between -10V and +10V) jumper selectable
Voltage Ranges (Unipolar output)	0 to 5V, 0 to 10V and user range (determined by value of external reference between -10V and +10V) jumper selectable
Current Ranges (Current output)	4 to 20mA (using on-board or external -5V reference)
Offset error	Adjustable to zero
Gain error	Adjustable to zero
Differential nonlinearity	±0.5LSB max
Integral nonlinearity	±0.5LSB max
Relative accuracy	±0.5LSB (0.01%) max
Monotonicity	***Guaranteed to 12 bits over temperature***
Gain drift (internal referece)	±25 ppm/°C max
Offset drift	±3 ppm/°C max
Slew Rate	0.3 V/uS Typical
Current Drive (voltage outputs)	***±5 mA min***
Voltage Compliance (current out)	8 to 36V
Output resistance (OP-07)	***0.1 ohm max***
Output short-circuit duration	***40 mA min Continuous***
Miscellaneous	Double buffered output latches Reference input resistance 7 kOhm min

Environmental

Operating temerature range	0 to 70°C
Storage temerature range	-55 to 125°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:

CIO-DAC02	Analog Output Board
Part Number	Description

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.

Carl Haapaoja, Director of Quality Assurance

Measurement Computing Corporation
16 Commerce Boulevard,
Middleboro, Massachusetts 02346
(508) 946-5100
Fax: (508) 946-9500
E-mail: info@measurementcomputing.com
www. measurementcomputing.com