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CIO-DDA06/16

Six 16-bit Analog Ouputs (One D/A per Channel)
24 Digital I/O

User's Guide

MEASUREMENT COMPUTING™

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CIO-DDA06/16

Analog Output Board

User's Guide

Document Revision 8A, December, 2006
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About this User's Guide

What you will learn from this user's guide

This user's guide explains how to install, configure, and use the CIO-DDA06/16 board so that you get the most out of its analog output features. This user's guide also refers you to related documents available on our web site, and to technical support resources.

Conventions in this user's guide

The following conventions are used in this manual to convey special information:

For more information on …

Text presented in a box signifies additional information and helpful hints related to the subject matter you are reading.

Caution! Shaded caution statements present information to help you avoid injuring yourself and others, damaging your hardware, or losing your data.

<#:#> Angle brackets that enclose numbers separated by a colon signify a range of numbers, such as those assigned to registers, bit settings, etc.

bold text **Bold** text is used for the names of objects on the screen, such as buttons, text boxes, and check boxes. For example:

1. Insert the disk or CD and click the **OK** button.

italic text *Italic* text is used for the names of manuals and help topic titles, and to emphasize a word or phrase. For example:

The *Insta*Cal installation procedure is explained in the *Quick Start Guide*.

Never touch the exposed pins or circuit connections on the board.

Where to find more information

The following electronic documents provide information relevant to the operation of the CIO-DDA06/16.

- MCC's *Specifications: CIO-DDA06/16* (the PDF version of the *Specifications* chapter in this guide) is available on our web site at www.mccdaq.com/pdfs/CIO-DDA06-16.pdf.
- MCC's *Quick Start Guide* is available on our web site at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf.
- MCC's *Guide to Signal Connections* is available on our web site at www.mccdaq.com/signals/signals.pdf.
- MCC's *Universal Library User's Guide* is available on our web site at www.mccdaq.com/PDFmanuals/sm-ul-user-guide.pdf.
- MCC's *Universal Library Function Reference* is available on our web site at www.mccdaq.com/PDFmanuals/sm-ul-functions.pdf.
- MCC's *Universal Library for LabVIEW™ User's Guide* is available on our web site at www.mccdaq.com/PDFmanuals/SM-UL-LabVIEW.pdf.

CIO-DDA06/16 User's Guide (this document) is also available on our web site at www.mccdaq.com/PDFmanuals/CIO-DDA06_16.pdf.

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Introducing the CIO-DDA06/16

Overview: CIO-DDA06/16 features

The CIO-DDA06/16 has six channels of 16-bit analog output and 24 lines of digital I/O. The analog outputs are from AD660 DACs, with each output buffered by an OP27. Digital I/O is performed with one 82C55 chip.

Analog output ranges are switch-selectable for a Bipolar or Unipolar range. Bipolar ranges are ±10 V and ±5 V. Unipolar ranges are 0 to 10 V and 0 to 5 V.

The analog outputs are jumper-selectable for either individual or simultaneous transfer. When a DAC pair is set for simultaneous update, writing new digital values to the DAC's control register does not update the DAC's voltage output. In this way, the CIO-DDA06/16 may be set to hold new values until all channels are loaded, then update all six channels simultaneously. This is a very useful feature for multi-axis motor control.

The CIO-DDA06/16 digital I/O lines are a direct interface to an 82C55. The 82C55 is a CMOS chip with TTL level inputs and outputs. The 8255 can source or sink about 2.5 mA. This is adequate to switch other TTL or similar inputs, but is inadequate to drive relays, LEDs or solid state relays. The digital I/O is controlled by programming the 8255's mode register. There are three possible modes. The simplest and most commonly used mode is mode 0 — simple input and output.

Software features

For information on the features of *Insta*Cal and the other software included with your CIO-DDA06/16, refer to the *Quick Start Guide* that shipped with your device. The *Quick Start Guide* is also available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf.

Check www.mccdaq.com/download.htm for the latest software version.

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CIO-DDA06/16 block diagram

CIO-DDA06/16 functions are illustrated in the block diagram shown here.

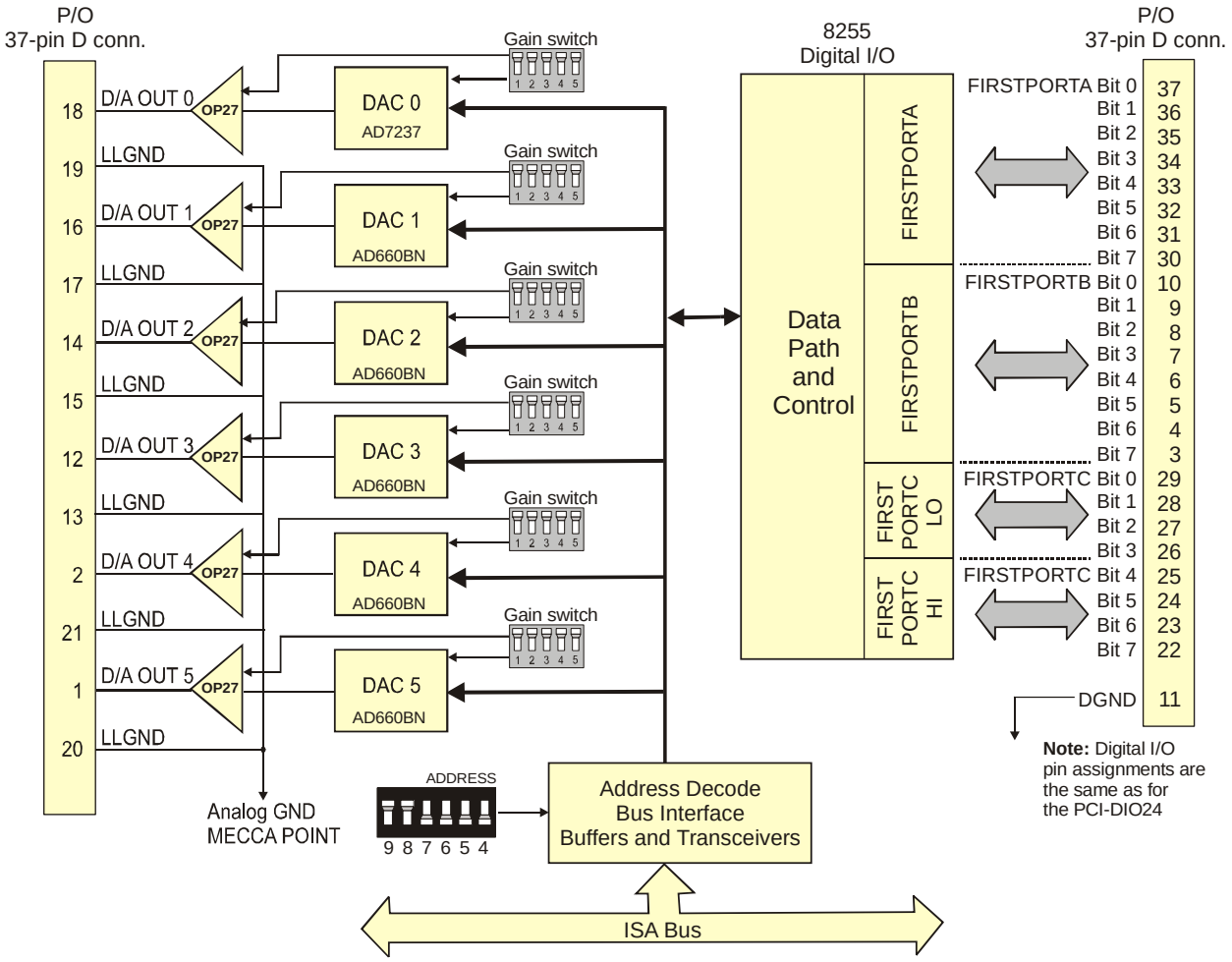


Figure 1. Functional block diagram

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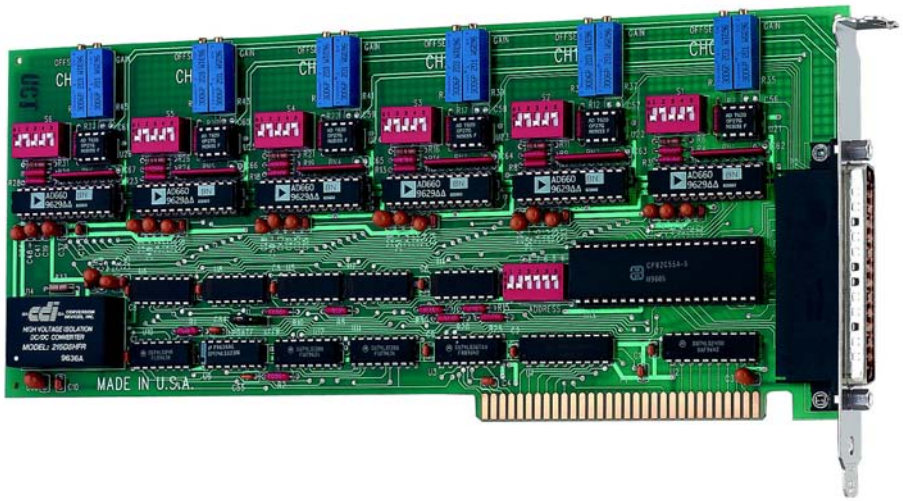
Installing the CIO-DDA06/16

What comes with your CIO-DDA06/16 shipment?

The following items are shipped with the CIO-DDA06/16.

Hardware

- CIO-DDA06/16



Additional documentation

In addition to this hardware user's guide, you should also receive the *Quick Start Guide* (available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf). This booklet supplies a brief description of the software you received with your CIO-DDA06/16 and information regarding installation of that software. Please read this booklet completely before installing any software or hardware.

Optional components

- Cables



C37FF-x



C37FFS-x

- Signal termination and conditioning accessories

  MCC provides signal conditioning and termination products for use with the CIO-DDA06/16. Refer to Field wiring, signal termination, and conditioning on page 14 for a complete list of compatible accessory products.

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Unpacking the CIO-DDA06/16

As with any electronic device, you should take care while handling to avoid damage from static electricity. Before removing the CIO-DDA06/16 from its packaging, ground yourself using a wrist strap or by simply touching the computer chassis or other grounded object to eliminate any stored static charge.

If any components are missing or damaged, notify Measurement Computing Corporation immediately by phone, fax, or e-mail:

- Phone: 508-946-5100 and follow the instructions for reaching Tech Support.
- Fax: 508-946-9500 to the attention of Tech Support
- Email: techsupport@mccdaq.com

Installing the software

Refer to the *Quick Start Guide* for instructions on installing the software on the *Measurement Computing Data Acquisition Software CD*. This booklet is available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf.

Configuring the CIO-DDA06/16

The CIO-DDA06/16 has one base address switch, one bank of gain switches for each analog output channel, and one simultaneous update jumper. The *Insta*Cal calibration and test program will show you how to set the switches. Run *Insta*Cal before you open your computer and install the board.

The CIO-DDA06/16 is shipped with the factory-default settings listed in the table below.

Factory-configured default settings

Board label	Switch/jumper description	Default setting
ADDRESS	DIP switch for setting the base address	300h (768 decimal)
J1	Jumper to select simultaneous or single channel update	UPDATE position (single channel update)
S1 – S6	DIP switches to set the output range for each analog output channel	±5V

Before installing the CIO-DDA06/16 in the computer, verify that the board is configured with the settings that you want. Review the following information to change the default configuration of a jumper or switch on the CIO-DDA06/16 board.

Base address switch

Set the base address with the dip switch labeled **ADDRESS** located on the board. The easiest way to set the base address switch is to let *Insta*Cal show you the correct settings. However, if are already familiar with setting ISA base addresses, you may use the base address switch description below to guide your base address selection.

Unless there is already another board in your system using address 300 hex (768 decimal), leave the switches as they are set at the factory. Figure 2 shows the base address switch set to its factory-default base address of 300 hex.

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Figure 2. Base address switch

In the default configuration shown in Figure 2, addresses 9 and 8 are DOWN, and all others are UP. Address 9 = 200 hex (512 decimal), and address 8 = 100 hex (256 decimal). When added together they equal 300 hex (768 decimal).

Disregard the numbers printed on the switch

When setting the base address, refer to the numbers printed in white on the printed circuit board.

Individual / simultaneous transfer jumper

The analog outputs can be jumpered so that new output data is held until several DACs have been loaded with new digital data. Then, as a group, the data for each DAC is simultaneously transferred and the DAC voltage outputs are updated when any of the addresses BASE + 0 to BASE + B are read.

The analog output chips on the CIO-DDA06/16 are dual DACs (two analog outputs per chip). Each DAC channel pair has an associated jumper that sets both DACs on a single chip to be either simultaneously transferred on a read, or individually updated when the control register is written.

Figure 3 shows the jumper block configured for each update mode. Two numbers are listed on the board next to each simultaneous transfer jumper (45, 23, and 01 from left to right). The numbers indicate which channel pair is configured by the jumper (channels 0 and 1, 2 and 3, 4 and 5).

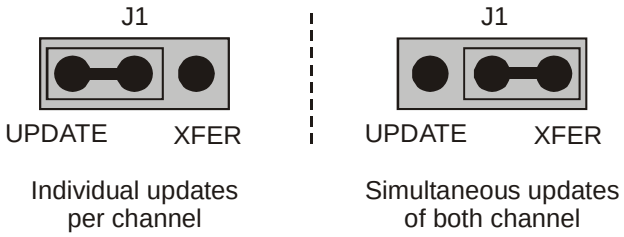


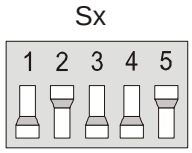
Figure 3. Individual / simultaneous update jumper

- When the jumpers are in the **XFER** position, new output data is held until one or more DACs have been loaded with new digital data. The new data transfers to the voltage outputs as a group. The simultaneous transfers occur when any of the CIO-DDA06/16 addresses are read (and the jumpers are in the **XFER** position).
- When the jumpers are in the **UPDATE ##** position, the DAC channel pair is individually updated when the control register is written.

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Analog output range switch

The analog output voltage range of each channel can be set with a set of five-position DIP switches. The switch blocks are located on the board below the calibration potentiometers. The switch blocks are labeled **S1** to **S6**, and individual switches are labeled **1** through **5**. Set the switches for each individual channel as shown in Figure 4.



Range	1	2	3	4	5	
±10 V	DN	UP	DN	UP	DN	
±5.0 V	DN	UP	DN	DN	UP	(Shown)
0-10 V	UP	DN	UP	UP	DN	
0-5 V	UP	DN	UP	DN	UP	

Figure 4. Analog output range switch — one per DAC — configured for ±5 V

To set a channel to a particular range, read the switch positions as UP or DN (down) from left to right in the row beside the range you want to set. The switch shown in Figure 4 is configured for ±5V range (switch settings DN>UP>DN>DN>UP).

Installing the CIO-DDA06/16

After you configure the board's switches and jumpers, you can install the CIO-DDA06/16 into your computer. To install your board, follow the steps below.

Install the MCC DAQ software before you install your board

The driver needed to run your board is installed with the MCC DAQ software. Therefore, you need to install the MCC DAQ software before you install your board. Refer to the *Quick Start Guide* for instructions on installing the software.

1. Turn your computer off, open it up, and insert your board into an available ISA slot.
2. Close your computer and turn it on.
3. To test your installation and configure your board, run the *Insta*Cal utility you installed in the previous section. Refer to the *Quick Start Guide* that came with your board www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf for information on how to initially set up and load *Insta*Cal.

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Connecting the board for I/O operations

Connectors, cables – main I/O connector

The table below lists the board connector, applicable cables, and compatible accessory products.

Board connector, cables, and accessory equipment

Connector type	37-pin male "D" connector
Compatible cables	C37FF-x C37FFS-x DFCON-37 (D-connector, D-shell, and termination pins to construct your own cable)
Compatible accessory products with the C37FF-x cable or C37FFS-x cable	CIO-MINI37 CIO-TERMINAL SCB-37 SSR-RACK24, CIO-ERB24, SSR-RACK08, CIO-ERB08 ENC-MINI37

Information on signal connections

General information regarding signal connection and configuration is available in the *Guide to Signal Connections* (available at www.mccdaq.com/signals/signals.pdf).

Pinout – main I/O connector

The CIO-DDA06/16 I/O connector is a standard 37-pin male connector that is accessible through the PC/AT expansion bracket.

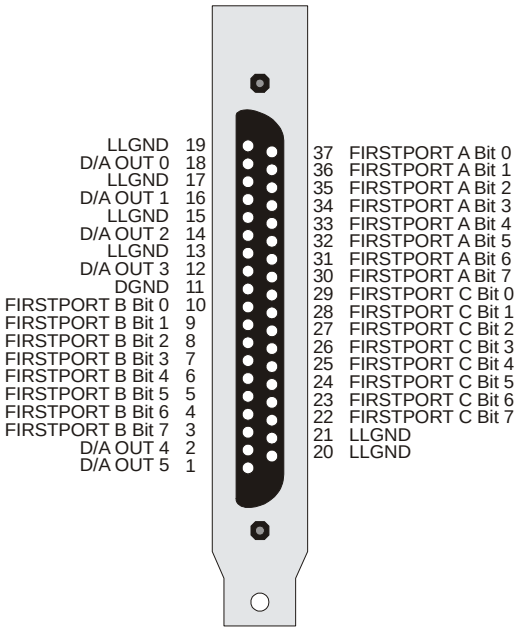


Figure 5. I/O connector pin-out

The analog outputs are two-wire hook-ups. Always use low-level ground (LLGND) as the ground reference for all analog hook-ups.

All the digital outputs inputs are TTL level. Before connecting external devices, review the specifications in this manual to avoid damage to the CIO-DDA06/16.

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Cabling

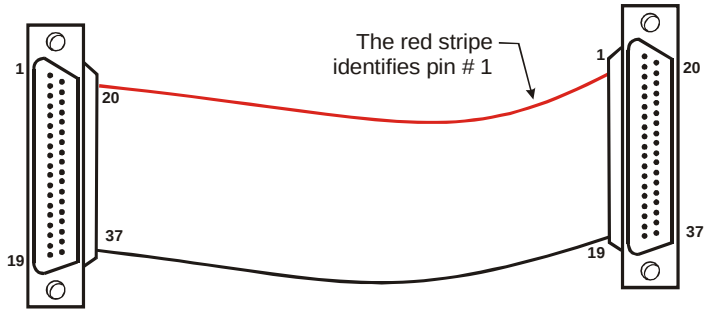


Figure 6. C37FF-x cable

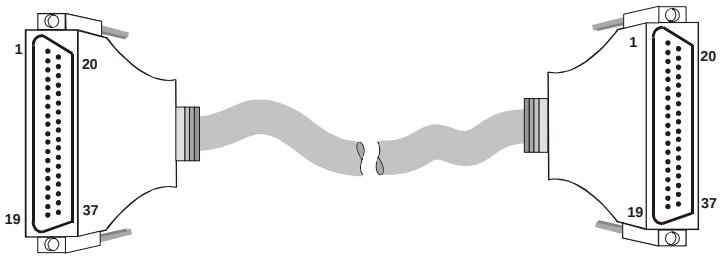


Figure 7. C37FFS-x cable

Field wiring, signal termination, and conditioning

You can use the following cabling, screw termination, and signal conditioning products with the CIO-DDA06.

- DFCON37 – Connector kit that includes a 37-pin female D-connector, D-shell, 37 crimp pins, and cable termination kit to construct your own cable.
- CIO-MINI37 – 37-pin screw terminal board.
- CIO-TERMINAL – 37-pin screw terminal board with on-board prototyping area.
- CIO-SPADE50 — 16" X 4" termination panel which mates with both 37-pin and 50-pin connectors.
- SCB-37 – 37-conductor, shielded signal connection/screw terminal box.
- SSR-RACK24 – 24-channel, solid-state relay mounting rack for digital signal conditioning.
- ENC-MINI37– Enclosure for the MINI37.

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Programming and Developing Applications

After following the installation instructions in Chapter 2, your board should now be installed and ready for use. In general there may be no correspondence among registers for different boards. Software written at the register level for other models will not function correctly with your board.

Programming languages

Measurement Computing's Universal Library provides access to board functions from a variety of Windows programming languages. If you are planning to write programs, or would like to run the example programs for Visual Basic® or any other language, please refer to the *Universal Library User's Guide* (available on our web site at www.mccdaq.com/PDFmanuals/sm-ul-user-guide.pdf).

Packaged applications programs

Many packaged application programs now have drivers for your board. If the package you own does not have drivers for your board, please fax or e-mail the package name and the revision number from the install disks. We will research the package for you and advise how to obtain drivers.

Some application drivers are included with the Universal Library package, but not with the application package. If you have purchased an application package directly from the software vendor, you may need to purchase our Universal Library and drivers. Please contact us by phone, fax or e-mail:

- Phone: 508-946-5100 and follow the instructions for reaching Tech Support.
- Fax: 508-946-9500 to the attention of Tech Support
- Email: techsupport@mccdaq.com

Register-level programming

You should use the Universal Library or one of the packaged application programs mentioned above to control your board. Only experienced programmers should try register-level programming.

If you need to program at the register level in your application, refer to the *Register Map for the CIO-DDA06/16*. This document is available on our website at www.mccdaq.com/registermaps/RegMapCIO-DDA06-16.pdf.

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Specifications

Typical for 25 °C unless otherwise specified.

Specifications in *italic* text are guaranteed by design.

Analog output

Table 1. Analog output specifications

D/A type	AD660BN (OP27 buffer)
Resolution	16 bits
Number of channels	6
Voltage ranges	Bipolar: ±10 V, ±5 V Unipolar: 0 to 10 V, 0 to 5 V
D/A pacing	Software polled
Throughput	System dependant
Offset error	Trimmable by potentiometer to 0
Gain error	Trimmable by potentiometer to 0
Differential nonlinearity	±1 LSB max
Integral nonlinearity	±1 LSB max
Monotonicity	Guaranteed monotonic to 15 bits over temperature
Gain drift	±15 ppm/°C max
Offset drift	±5 ppm/°C max
Slew rate	1.7V/µs min
Current drive	±5 mA min
Output short-circuit duration	indefinite
Miscellaneous	▪ Double buffered output latches ▪ Update DACs individually or simultaneously (jumper selectable)

Digital input / output

Table 2. DIO specifications

Digital type	*82C55*
Number of channels	*24 I/O*
Configuration	*2 banks of 8, 2 banks of 4, programmable by bank as input or output*
Output high	*3.0 volts min @ –2.5 mA*
Output low	*0.4 volts max @ 2.5 mA*
Input high	*2.0 volts min, 5.5 volts absolute max*
Input low	*0.8 volts max, –0.5 volts absolute min*
Power-up / reset state	*Input mode (high impedance)*

Power consumption

Table 3. Power consumption specifications

+5 V supply	1 A typ, 1.3 A max

Environmental

Table 4. Environmental specifications

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

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Main connector and pin out

Table 5. Connector specifications

Connector type	37-pin male "D" connector
Compatible cables	C37FF-x C37FFS-x DFCON-37 (D-connector, D-shell, and termination pins to construct your own cable)
Compatible accessory products with the C37FF-x cable or C37FFS-x cable	CIO-MINI37 CIO-TERMINAL SCB-37 SSR-RACK24, CIO-ERB24, SSR-RACK08, CIO-ERB08 ENC-MINI37

Table 6. Connector pin out

Pin	Signal Name	Pin	Signal Name
1	D/A OUT 5	20	LLGND
2	D/A OUT 4	21	LLGND
3	FIRSTPORTB Bit 7	22	FIRSTPORTC Bit 7
4	FIRSTPORTB Bit 6	23	FIRSTPORTC Bit 6
5	FIRSTPORTB Bit 5	24	FIRSTPORTC Bit 5
6	FIRSTPORTB Bit 4	25	FIRSTPORTC Bit 4
7	FIRSTPORTB Bit 3	26	FIRSTPORTC Bit 3
8	FIRSTPORTB Bit 2	27	FIRSTPORTC Bit 2
9	FIRSTPORTB Bit 1	28	FIRSTPORTC Bit 1
10	FIRSTPORTB Bit 0	29	FIRSTPORTC Bit 0
11	DGND	30	FIRSTPORTA Bit 7
12	D/A OUT 3	31	FIRSTPORTA Bit 6
13	LLGND	32	FIRSTPORTA Bit 5
14	D/A OUT 2	33	FIRSTPORTA Bit 4
15	LLGND	34	FIRSTPORTA Bit 3
16	D/A OUT 1	35	FIRSTPORTA Bit 2
17	LLGND	36	FIRSTPORTA Bit 1
18	D/A OUT 0	37	FIRSTPORTA Bit 0
19	LLGND		

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CE Declaration of Conformity

Manufacturer: Measurement Computing Corporation
Address: 10 Commerce Way
Suite 1008
Norton, MA 02766
USA

Category: Electrical equipment for measurement, control and laboratory use.

Measurement Computing Corporation declares under sole responsibility that the product

CIO-DDA06/16

to which this declaration relates is in conformity with the relevant provisions of the following standards or other documents:

EU EMC Directive 89/336/EEC: Electromagnetic Compatibility, EN55022 (1987), EN50082-1

Emissions: Group 1, Class B

- EN55022 (1987): Radiated and Conducted emissions.

Immunity: EN50082-1

- IEC 801-2 (1987): Electrostatic Discharge immunity, Criteria B.
- IEC 801-3 (1984): Radiated Electromagnetic Field immunity Criteria A.
- IEC 801-4 (1988): Electric Fast Transient Burst immunity Criteria B.

Declaration of Conformity based on tests conducted by Chomerics Test Services, Woburn, MA 01801, USA in December, 1995. Test records are outlined in Chomerics Test Report #EMI0168B.95.

We hereby declare that the equipment specified conforms to the above Directives and Standards.



Carl Haapaoja, Director of Quality Assurance

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