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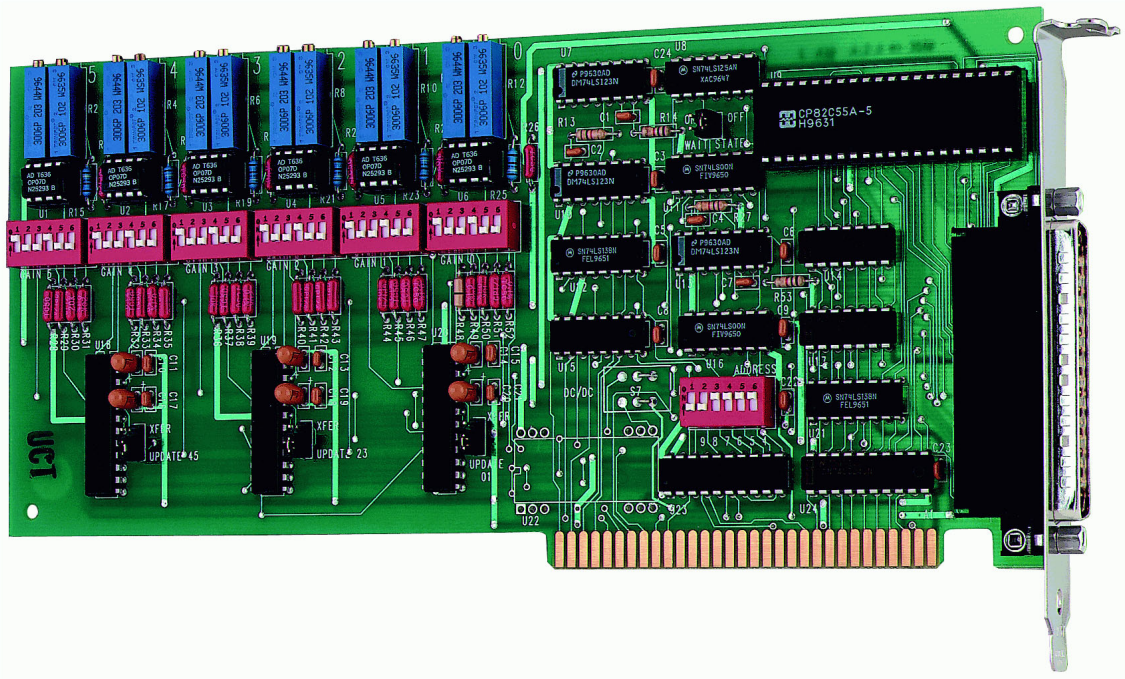
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CIO-DDA06

6 Analog Outputs, 24 Digital I/O

User's Guide



MEASUREMENT COMPUTING™

CIO-DDA06

Analog Output Board

User's Guide



Document Revision 7A, 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 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.

- MCC's *Specifications: CIO-DDA06* (the PDF version of the *Specifications* chapter in this guide) is available on our web site at www.mccdaq.com/pdfs/CIO-DDA06.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 User's Guide (this document) is also available on our web site at www.mccdaq.com/PDFmanuals/CIO-DDA06.pdf.

Introducing the CIO-DDA06

Overview: CIO-DDA06 features

The CIO-DDA06 has six channels of 12-bit analog output and 24 lines of digital I/O. Analog outputs are dual-DAC AD7273s (two analog outputs per chip), with each output buffered by an OP07. Digital I/O is performed with one 82C55 chip. The CIO-DDA06 is 100% compatible with MetraByte's DDA-06.

Analog output ranges are switch-selectable for a Bipolar or Unipolar range. Bipolar ranges are ±10 V, ±5 V, ±2.5 V, and ±1.67 V. Unipolar ranges are 0 to 10 V, 0 to 5 V, 0 to 2.5 V, and 0 to 1.67 V.

Analog outputs are grouped in pairs (0/1, 2/3, and 4/5). Each analog output pair is jumper-selectable for either individual or simultaneous transfer in groups of two, four, or all six.

When a DAC pair is set for simultaneous update, the CIO-DDA06 may be set to hold new values until all channels are loaded, then update any two, four, or all six channels simultaneously.

The CIO-DDA06 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.

The power up and reset state is jumper-selectable (hardware revision 3 and later). You can also enable a wait state generator with an on-board jumper.

Software features

For information on the features of *Insta*Cal and the other software included with your CIO-DDA06, 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.

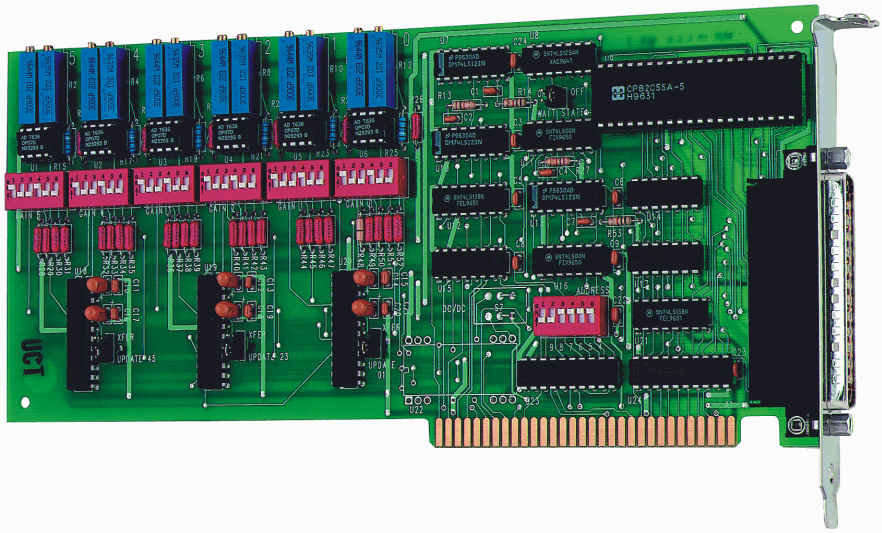
Installing the CIO-DDA06

What comes with your CIO-DDA06 shipment?

The following items are shipped with the CIO-DDA06.

Hardware

- CIO-DDA06

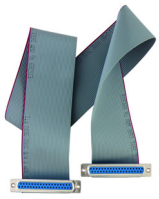


Additional documentation

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 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. Refer to Field wiring, signal termination, and conditioning on page 14 for a complete list of compatible accessory products.

Unpacking the CIO-DDA06

As with any electronic device, you should take care while handling to avoid damage from static electricity. Before removing the CIO-DDA06 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

The CIO-DDA06 has one base address switch, one bank of gain switches for each analog output channel, a simultaneous update jumper for each DAC pair, a "power-up state" selection jumper, and one wait state 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 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)
WAIT STATE	Jumper to enable a wait state generator	OFF position (disabled)
XFER UPDATE ##	Jumpers to select simultaneous or single channel update for each DAC channel pair	UPDATE position (single channel update)
GAIN #	DIP switches to set the output range for each analog output channel	±5V
PWR UP	Jumper to select the power up and reset state	STD position — standard mode (undefined output values at power up)

Before installing the CIO-DDA06 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 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 1 shows the base address switch set to its factory-default base address of 300 hex.

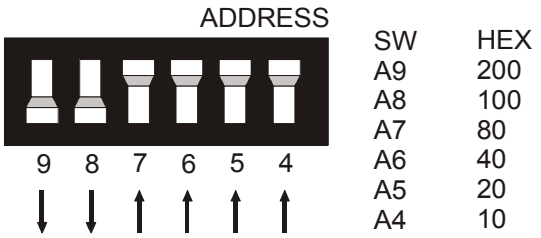


Figure 1. Base address switch

In the default configuration shown in Figure 1, 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.

Wait state jumper

The CIO-DDA06 board has a wait state jumper which you can set to enable an on-board wait state generator. A wait state is an extra delay injected into the processor's clock via the bus. This delay slows down the processor when the processor addresses the CIO-DDA06 board so that signals from slow devices (chips) will be valid.

This jumper is shown in Figure 2 configured for OFF (wait state is disabled).

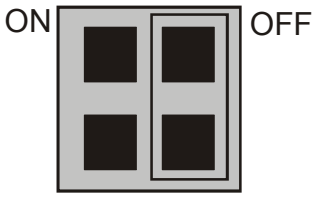


Figure 2. Wait State jumper

The wait state generator on the CIO-DDA06 is only active when the CIO-DDA06 is being accessed. Your PC will not be slowed down in general by using the wait state.

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 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).

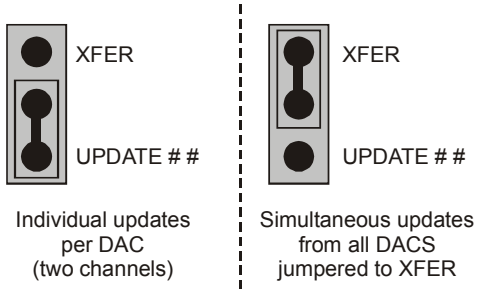


Figure 3. Individual / simultaneous update jumper

- 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 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.

Power up and reset jumper

The power up and reset jumper (hardware revision 3 and later) controls the state of the DAC outputs when the CIO-DDA06 board is powered up or reset. This jumper is shown in Figure 4.

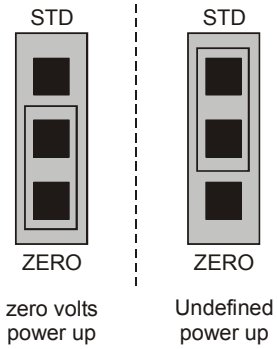
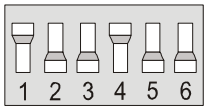


Figure 4. Power up and reset jumper

- When set for **ZERO**, all DACs are cleared to 0 volts, ±32 mV on power up and reset. In addition, all DACs are set to simultaneous update mode until first read.
- When set for **STD**, the analog output values are undefined on power up and reset.

Analog output range switch

The analog output voltage range of each channel can be set with a set of six-position DIP switches. The switch blocks are located on the board below the calibration potentiometers. The switch blocks are labeled **GAIN 0** to **GAIN 5**, and individual switches are labeled **1** through **6**. Set the switches for each individual channel as shown in Figure 5.



GAIN #

Range	1	2	3	4	5	6	
±10	UP	DN	UP	DN	DN	DN	
±5.0	UP	DN	DN	UP	DN	DN	(Shown)
±2.5	UP	DN	DN	DN	UP	DN	
±1.67	UP	DN	DN	DN	DN	UP	
0-10	DN	UP	UP	DN	DN	DN	
0-5	DN	UP	DN	UP	DN	DN	
0-2.5	DN	UP	DN	DN	UP	DN	
0-1.67	DN	UP	DN	DN	DN	UP	

Figure 5. 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 5 is configured for ±5V range (switch settings UP>DN>DN>UP>DN>DN).

Installing the CIO-DDA06

After you configure the board's switches and jumpers, you can install the CIO-DDA06 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.

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, ERB24, RACK08, 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 I/O connector is a standard 37-pin male connector that is accessible through the PC/AT expansion bracket.

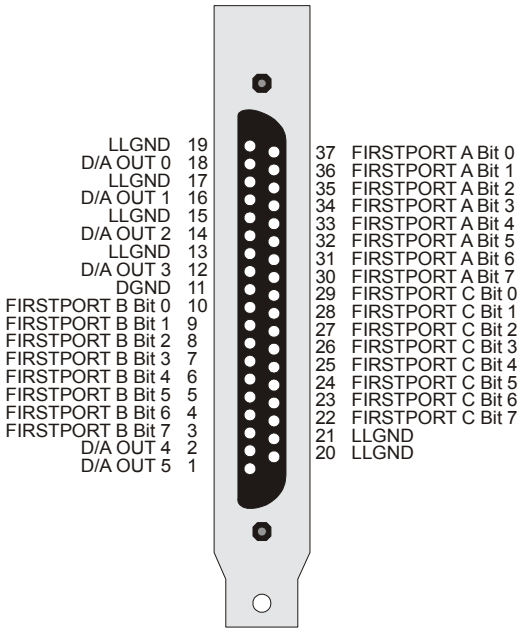


Figure 6. I/O connector pin-out

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.

Cabling

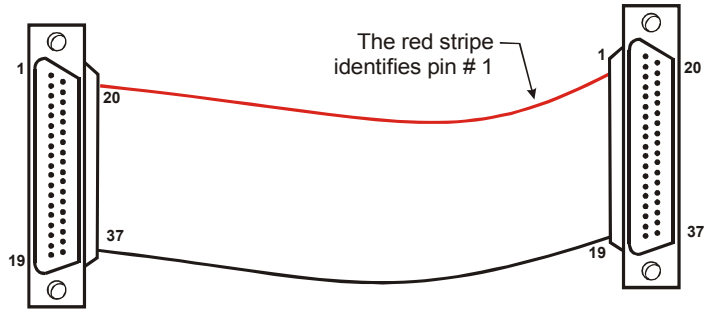


Figure 7. C37FF-x cable

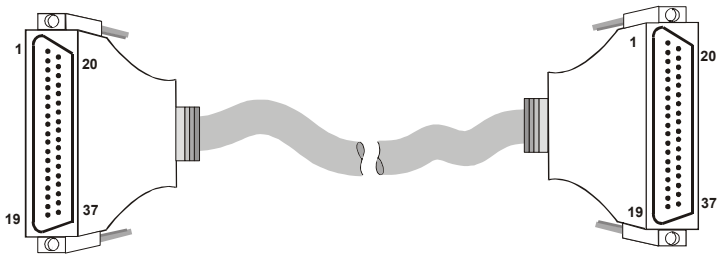


Figure 8. C37FFS-x cable

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. Details on this product are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=103&pf_id=304.
- CIO-MINI37 – 37-pin screw terminal board. Details on this product are available at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=102&pf_id=255.
- CIO-TERMINAL – 37-pin screw terminal board with on-board prototyping area. Details on this product are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=102&pf_id=282.
- SCB-37 – 37-conductor, shielded signal connection/screw terminal box. Details on this product are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=196&pf_id=1166.
- SSR-RACK24 – 24-channel, solid-state relay mounting rack for digital signal conditioning. Details on this product are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=122&pf_id=1193.
- CIO-SERB08 – 8 Form C relays, 10 Amp, relay accessory board with socketed and field-replaceable relays. Details on this product are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=123&pf_id=680.
- CIO-ERB24 – 24 Form C relays, 6 Amp relay accessory board for digital signal conditioning. Details on this product are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=123&pf_id=241.
- ENC-MINI37– Enclosure for the MINI37. Details on this product are available at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=98&pf_id=318.

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

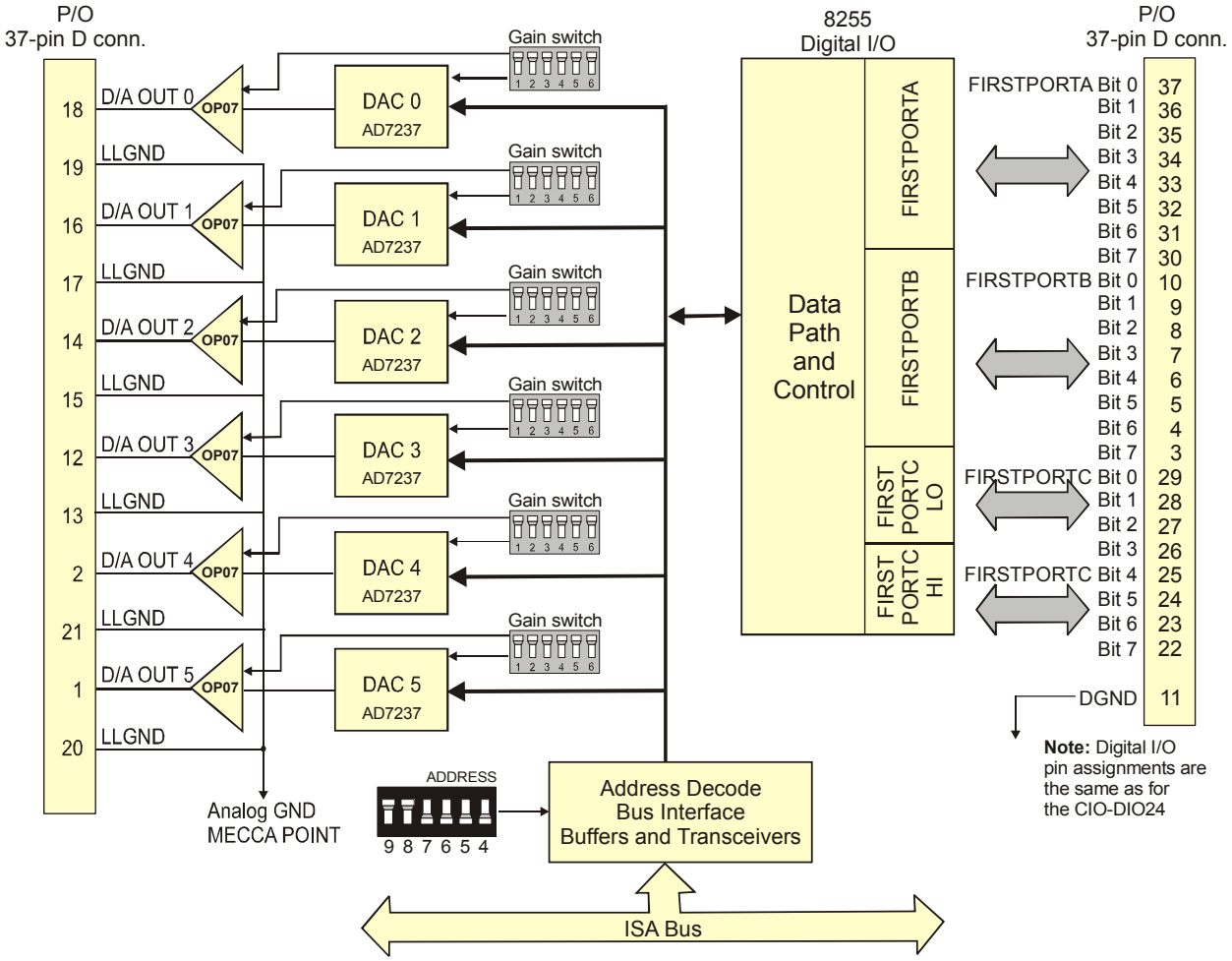
You should use the Universal Library or one of the packaged application programs mentioned above to control your board. Only experienced programmers should try register-level programming.

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

Functional Details

CIO-DDA06 block diagram

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



Signal connections

The CIO-DDA06 outputs are individually buffered through an OP07 operational amplifier (OP-AMP). The OP07s are socketed so that if one fails it can be replaced in the field. The OP07 for each channel is located just below the calibration potentiometers for that channel.

At the full rated output swing of ±10 V, each channel is capable of sinking or sourcing ±5 mA. A load of 2 KΩ can be connected to each channel. As the load resistance rises from 2 K up to 10 MΩ or more, the output load on the DAC decreases. Any load resistance greater than 2 k is acceptable.

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 converter type	*AD7237*
Resolution	*12-bits*
Number of channels	*6*
Output ranges	Bipolar: ±10 V, ±5 V, ±2.5 V, ±1.67 V Unipolar: 0 to 10 V, 0 to 5 V, 0 to 2.5 V, 0 to 1.67 V Each channel is independently switch-selectable.
Offset error	Trimmable to zero
Gain error	Trimmable to zero
Differential nonlinearity	± ½LSB max
Integral nonlinearity	± ½LSB max
Monotonicity	*± ½LSB max*
D/A gain drift	±15 ppm/°C typical, ±30 ppm/°C max
D/A bipolar offset drift	±7 ppm/°C typical, ±15 ppm of FSR/°C max
D/A unipolar offset drift	±1 ppm/°C typical, ±3 ppm of FSR/°C max
D/A settling time (20 V step to ±0.01%)	5 µs typ, 10 µs max
Slew rate	5 V/µs
Current drive	±5 mA
Output short-circuit current	20 mA indefinite
Output coupling	DC
Output impedance	0.1 Ohms max
D/A pacing	Software paced
D/A trigger modes	Software
Data transfer	Programmed I/O
Throughput	System dependent
Miscellaneous	▪ Double buffered output latches ▪ Update DACs individually or simultaneously (jumper selectable by pairs) ▪ Power up and reset option, jumper selectable (revision 3 and up): With jumper set to "ZERO", all DAC's cleared to 0 volts, ±32 mV, DACs set to simultaneous update mode until first read. With jumper set to "STD", DAC output on power-up is undefined.

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	435 mA typical, 525 mA max
+12 V	50 mA typical, 80 mA max
–12 V	120 mA typical, 160 mA max

Table 4. Power consumption specifications with optional DC/DC converter installed

+5 V	935 mA typical / 1.025 A max
+12 V	N/A
–12 V	N/A

Environmental

Table 5. Environmental specifications

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

Main connector and pin out

Table 6. 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 7. 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		

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

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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