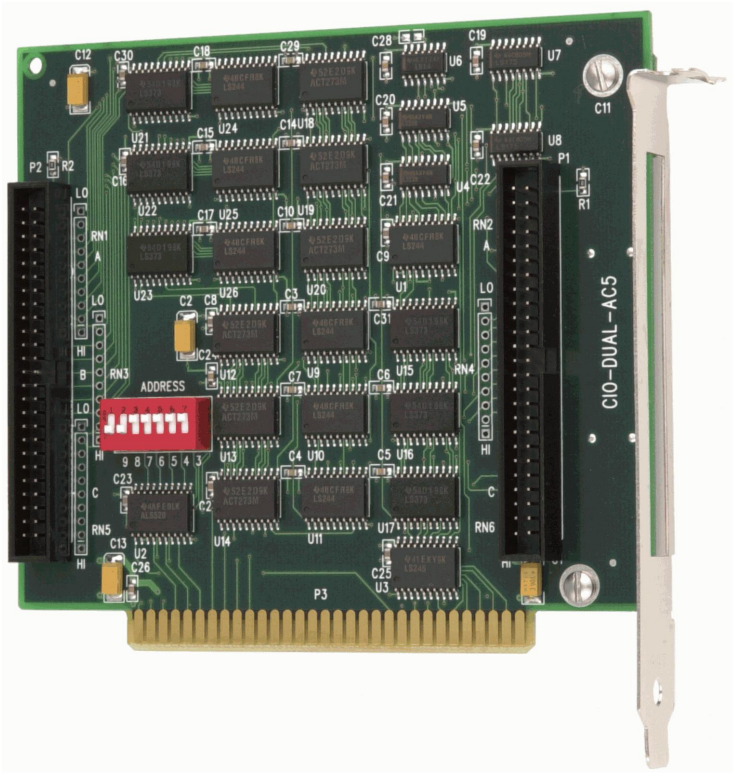
CIO-DUAL-AC5

48-bit Digital I/O

User's Guide



MEASUREMENT COMPUTING™

CIO-DUAL-AC5

High Drive Digital I/O

User's Guide

Document Revision 4A, March, 2010

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Table of Contents

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-DUAL-AC5 board so that you get the most out of its high current digital I/O 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

For additional information relevant to the operation of your hardware, refer to the *Documents* subdirectory where you installed the MCC DAQ software (C:\Program Files\Measurement Computing\DAQ by default), or search for your device on our website at www.mccdaq.com.

If you need to program at the register level in your application, refer to the *Register Map for the CIO-DUAL-AC5*. This document is available on our website at http://www.mccdaq.com/registermaps/RegMapCIO-DUAL-AC5.pdf.

Introducing the CIO-DUAL-AC5

Overview: CIO-DUAL-AC5 features

The CIO-DUAL-AC5 is a 48-bit digital I/O board. The 48-bits of digital I/O are organized into two 24-bit groups based on an 82C55 mode 0 emulation (no strobed I/O or bi-directional I/O bits). Each 24-bit group is divided into three eight-bit ports — Port A, Port B, and Port C. PORTC can be split into two four-bit nibbles — Port C-HI and Port C-LO. Each port can be individually programmed as input or output.

The CIO-DUAL-AC5 has two 50-pin header connectors which are compatible with the pin out of OPTO-22 and GORDOS solid state relay racks. If you are using OPTO or GORDOS form factor solid state relay racks, you can connect the CIO-DUAL-AC5 directly to the relay racks through 50-pin cables, such as the C50FE-x.

All inputs and outputs are TTL compatible. The digital output drivers are 74S244 chips that can sink 64 mA and source 15 mA. The input buffers are 74LS373 chips and have standard high input impedance of the 74LS series devices.

On power up and reset, all I/O bits are set to input mode. If you are using the board to control items that must be OFF on reset, install pull-down resistors. Each board is equipped with open locations where you can install SIP resistor networks for either pull-up or pull-down.

Software features

For information on the features of *Insta*Cal and the other software included with your CIO-DUAL-AC5, refer to the *Quick Start Guide* that shipped with your device.

Installing the CIO-DUAL-AC5

What comes with your CIO-DUAL-AC5 shipment?

The following items are shipped with the CIO-DUAL-AC5.

Hardware

- CIO-DUAL-AC5

Additional documentation

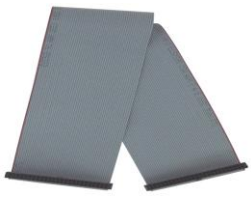
In addition to this hardware user's guide, you should also receive the *Quick Start Guide* (available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf). This booklet supplies a brief description of the software you received with your CIO-DUAL-AC5 and information regarding installation of that software. Please read this booklet completely before installing any software or hardware.

Optional components

You can also order the following MCC product to use with your CIO-DUAL-AC5.

- Cables

C50FE-x



C50FF-x

- Signal termination and conditioning accessories

  MCC provides signal conditioning and termination products for use with the CIO-DUAL-AC5. Refer to Field wiring, signal termination, and conditioning on page 12 for a complete list of compatible accessory products.

Unpacking the CIO-DUAL-AC5

As with any electronic device, you should take care while handling to avoid damage from static electricity. Before removing the CIO-DUAL-AC5 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.

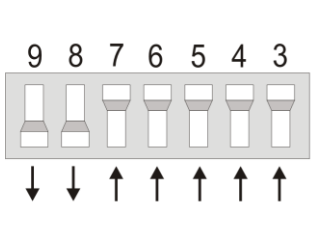
Configuring the CIO-DUAL-AC5

The CIO-DUAL-AC5 has one base address switch which you must set before installing the board in your computer. The *Insta*Cal calibration and test program included with the CIO-DUAL-AC5 will show you how to set the switches. Run *Insta*Cal before you open your computer and install the board.

Base address

Before you install the CIO-DUAL-AC5 in your computer, set the base address by using 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. The example shown in Figure 1 shows the settings for the factory-default base address of 300 hex.



SW	HEX
A9	200
A8	100
A7	80
A6	40
A5	20
A4	10
A3	08

Figure 1. CIO-DUAL-AC5 base address switches

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.

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	Prototype 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-3BB	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

The CIO-DUAL-AC5 Base switch can be set for an address in the range of 000-3E0, so it should not be hard to find a free address area for your CIO-DUAL-AC5. If you are not using IBM prototyping cards, or some other board which occupies these addresses, then 300-31F HEX are free to use. Addresses not specifically listed, such as 390-39F, are free.

Installing the CIO-DUAL-AC5

After you configure the board's switches and jumpers, you can install the CIO-DUAL-AC5 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	**50-pin header connectors (2)**
Compatible cables	C50FE-x C50FF-x
Compatible accessory products with the C50FE-x	SSR-PB24
Compatible accessory products with the C50FF-x	CIO-TERM100 CIO-SPADE50 CIO-MINI50 SCB-50 SCB-100

Pin out – I/O connectors

The CIO-DUAL-AC5 I/O uses two 50-pin header-type connectors. These connectors are board-mounted and are *not* accessible on the rear of the PC expansion backplate. The signals available are direct connections to an 82C55 digital I/O integrated circuit.

Figure 2 shows the pin outs for the connectors. The pin assignments for each are identical for each group of 24 pins (three, eight-I/O ports).

- The **front** connector (P1) is for first Port A, first Port B, and first Port C I/O lines (at BASE + 0, 1, and 2).
- The **rear** connector (P2) is for second Port A, second Port B and second Port C (at BASE + 4, 5, and 6).

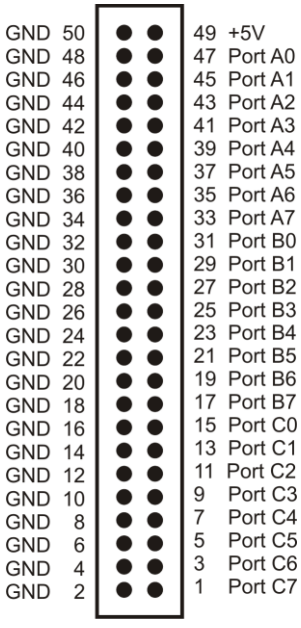


Figure 2. I/O connector pin out — P1 and P2 connectors

Field wiring, signal termination, and conditioning

The CIO-DUAL-AC5 is typically used for driving the SSR-PB24 solid state relay rack. Use the C50FE-x cable for connections.

- SSR-PB24 – 24 channel solid-state relay mounting and interface rack.

Details on this product are available on our web site at www.mccdaq.com/products/signal_conditioning.aspx.

You can use the following cabling, screw termination, and signal conditioning products with the C50FF-x cable.

- CIO-TERM100 – 100-pin screw terminal board (Two 50-pin IDC connectors).
- CIO-SPADE50 — 16" X 4" termination panel which mates with both 37-pin and 50-pin connectors.
- CIO-MINI50 – 50-pin screw terminal board.
- SCB-50 – 50 conductor, shielded signal connection/screw terminal box provides two independent 50-pin connections.
- SCB-100 – 100 conductor, shielded signal connection/screw terminal box provides two independent 50-pin connections.

Details on these products are available on our web site at www.mccdaq.com/products/screw_terminal_bnc.aspx.

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).

Functional Details

82C55 emulation

The CIO-DUAL-AC5 board emulates the 82C55 chip. The 82C55 emulation initializes all ports as inputs on power-up and reset. A TTL input is a high impedance input. If you connect another TTL input device to the output, it could be turned *on* or *off* every time the board is reset.

To establish a consistent TTL level at power-up, use resistors tied to either +5V (pull-up) or ground (pull-down). There are open locations for pull-up and pull-down resistor packs on the board.

Whenever an 82C55 emulation is powered on or reset, all pins are set to high-impedance input. Based on standard TTL functionality, these inputs will typically float high, and may have enough drive current to turn on external devices.

Unconnected inputs typically float high, but not reliably. The direction they float is dependent on the characteristics of the circuit and is unpredictable. Consequently, if you have output devices such as solid state relays, they may be switched on whenever the computer is powered on or reset. To prevent unwanted switching at power-on or reset, force all digital I/O pins to a known state by pulling all pins either high or low through a 2.2 K ohm resistor tied to either 5V or GND.

Pull-up and pull-down resistors

Whenever the CIO-DUAL-AC5 is powered on or reset, the control register is set to a known state. That state is mode 0, all ports are inputs. When used as an output device to control other TTL input devices, the CIO-DUAL-AC5 applies a voltage level of 0V for low and 2.5V to 5V for high.

The pull-up resistor pulls the input to a high state (+5V) when the board is in input mode, as it would be on power-up or reset. A 2.2 K ohm resistor draws only 2 mA. A grounded 2.2 K ohm pull-down resistor pulls the I/O line low when the board is in input mode.

The SIP is made up of eight 2.2 K ohm resistors. One side of each resistor is connected to a single common point and brought out to a pin. The common line is marked with a dot or line at one end of the SIP. The remaining resistor ends are brought out to the other eight pins (refer to Figure 3).

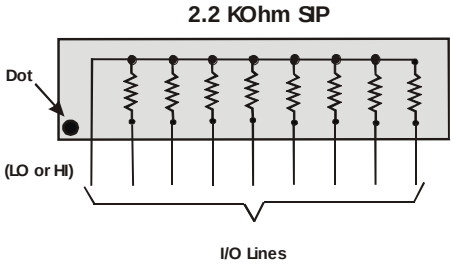


Figure 3. Eight-resistor SIP Schematic

The CIO-DUAL-AC5 board has open locations (RN1 through RN6) where you can install a 2.2 K ohm, eight-resistor single inline package (SIP) resistor network for each port. The locations are adjacent to each I/O connector and are marked **A**, **B**, and **C**.

Connector P1 is for the first Port A, first Port B, and first Port C I/O lines (at BASE + 0, 1, and 2). Connector P2 is for second Port A, second Port B and second Port C (at BASE + 4, 5, and 6).

When installed, the SIP establishes either a high or low logic level at each of the eight I/O lines on the port. At each board location, A, B, and C, there are 10 holes in a line. The hole on one end is marked "HI" and is connected to +5V. The other end is marked "LO" and is connected to GND. The eight holes in the middle connect to eight lines of the port, A, B or C.

To pull-up lines, orient the SIP with the common pin (dot) toward the HI end; to pull-down, install the resistor with the common pin in the LO end.

Figure 4 shows a schematic of an SIP installed in both the pull-up and pull-down positions.

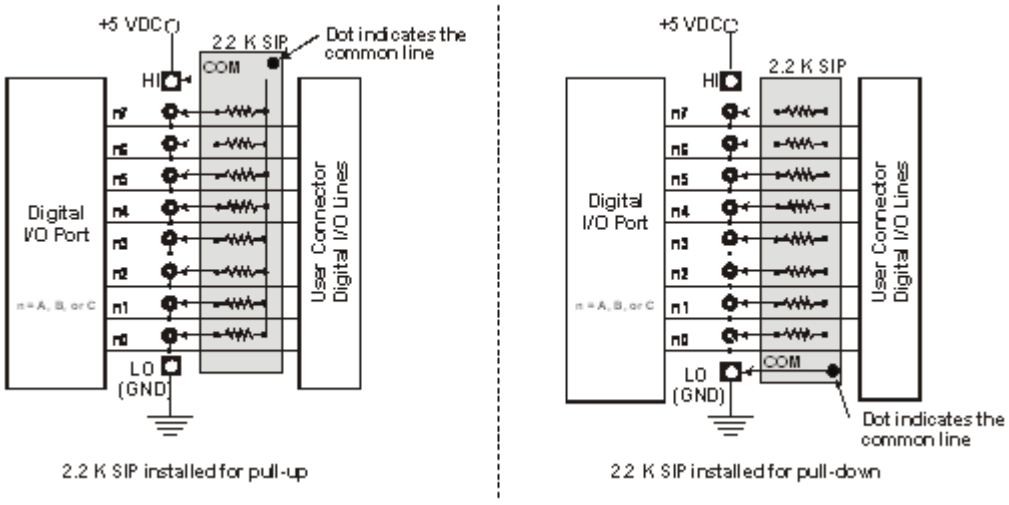


Figure 4. Pull-up and pull-down resistor SIP schematic

We recommend using 2.2 K ohm SIPs (MCC part number SP-K2.29C). Use a different value only if necessary.

Unconnected inputs float

Unconnected inputs typically float high, but not reliably. If you are using a CIO-DUAL-AC5 board for input and have unconnected inputs, ignore the data from those lines. You do not have to terminate input lines, and unconnected lines will not affect the performance of connected lines. Ensure that you mask out any unconnected bits in software.

TTL to solid state relays

Many applications require digital outputs to switch AC and DC voltage motors on and off or to monitor AC and high DC voltages. These AC and high DC voltages cannot be controlled or read directly by the TTL digital lines of a CIO-DUAL-AC5.

Solid State Relays (SSRs) allow control and monitoring of AC and high DC voltages and provide 750 V isolation. SSRs are the recommended method of interfacing to AC and high DC signals.

The most convenient way to use solid state relays and a CIO-DUAL-AC5 board is to use a solid state relay rack. A SRR rack circuit board has output buffers to switch the socketed SSRs. The rack recommended for use with the CIO-DUAL-AC5 board is the SSR-PB24 from Measurement Computing Corporation.

Information on digital I/O techniques

General information regarding digital I/O techniques is available in the *Guide to Signal Connections* (available at www.mccdaq.com/signals/signals.pdf).

Specifications

All specifications are subject to change without notice.
Typical for 25°C unless otherwise specified.
Specifications in *italic text* are guaranteed by design.

Digital I/O

Table 1. DIO specifications

Digital type (main connector)	*8255 mode 0 emulation*
Output	*74S244*
Input	*74LS373*
Configuration	*4 banks of 8, 4 banks of 4, programmable by bank as input or output*
Number of channels	*48 I/O*
Output high	*2.4 volts min @ -15 mA*
Output low	*0.5 volts max @ 64 mA*
Input high	*2.0 volts min, 7 volts absolute max*
Input low	*0.8 volts max, -0.5 volts absolute min*
Power-up / reset state	*Input mode (high impedance)*
Miscellaneous	*Locations provided for installation of pull-up or pull-down resistors.*

Power consumption

Table 2. Power consumption specifications

+5 V Operating	800 mA typical, 1.30 A max

Environmental

Table 3. Environmental specifications

Operating temperature range	0 to 70 °C
Storage temperature range	-40 to 100 °C
Humidity	0 to 90% non-condensing

Main connectors and pin out

Table 4. Main connector specifications

Connector type	50-pin header connectors P1 (front) and P2 (rear)
Compatible cables	C50FE-x C50FF-x
Compatible accessory products with the C50FE-x	SSR-PB24
Compatible accessory products with the C50FF-x	CIO-TERM100 CIO-SPADE50 CIO-MINI50 SCB-50 SCB-100

Connector P1 pin out

Table 5. Connector P1 pin out

Pin	Signal Name	Pin	Signal Name
1	Port C7	2	GND
3	Port C6	4	GND
5	Port C5	6	GND
7	Port C4	8	GND
9	Port C3	10	GND
11	Port C2	12	GND
13	Port C1	14	GND
15	Port C0	16	GND
17	Port B7	18	GND
19	Port B6	20	GND
21	Port B5	22	GND
23	Port B4	24	GND
25	Port B3	26	GND
27	Port B2	28	GND
29	Port B1	30	GND
31	Port B0	32	GND
33	Port A7	34	GND
35	Port A6	36	GND
37	Port A5	38	GND
39	Port A4	40	GND
41	Port A3	42	GND
43	Port A2	44	GND
45	Port A1	46	GND
47	Port A0	48	GND
49	+5V	50	GND

Connector P2 pin out

Table 6. Connector P2 pin out

Pin	Signal Name	Pin	Signal Name
1	Port C7	2	GND
3	Port C6	4	GND
5	Port C5	6	GND
7	Port C4	8	GND
9	Port C3	10	GND
11	Port C2	12	GND
13	Port C1	14	GND
15	Port C0	16	GND
17	Port B7	18	GND
19	Port B6	20	GND
21	Port B5	22	GND
23	Port B4	24	GND
25	Port B3	26	GND
27	Port B2	28	GND
29	Port B1	30	GND
31	Port B0	32	GND
33	Port A7	34	GND
35	Port A6	36	GND
37	Port A5	38	GND
39	Port A4	40	GND
41	Port A3	42	GND
43	Port A2	44	GND
45	Port A1	46	GND
47	Port A0	48	GND
49	+5V	50	GND

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-DUAL-AC5

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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