# CIO-DIO48H

48 Digital I/O bits, High Output Drive

User's Guide

MEASUREMENT COMPUTING.

CIO-DIO48H

Digital Input/Output Board

User's Guide

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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-DIO48H 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-DIO48H.

- MCC's *Specifications: CIO-DIO48H* (the PDF version of the *Specifications* chapter in this guide) is available on our web site at www.mccdaq.com/pdfs/CIO-DIO48H.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-DIO48H User's Guide (this document) is also available on our web site at www.mccdaq.com/PDFmanuals/CIO-DIO48H.pdf.

Introducing the CIO-DIO48H

Overview: CIO-DIO48H features

The CIO-DIO48H provides 48-bits of digital I/O. The I/O is organized into two 24-bit groups based on an 82C55 mode 0 emulation. Each 24-bit group is divided into three eight-bit ports labeled **A**n, **B**n and **C**n, where n is either "1" for FIRSTPORT or "2" for SECONDPORT. Port C can be split into two four-bit nibbles ― Port C-HI and Port C-LO. Each of these ports may be individually programmed as input or output.

All digital inputs are LSTTL. The output signals are buffered high output drive TTL. 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. The board is equipped with open locations where you can install SIP resistor networks for either pull-up or pull-down.

All signals pass through a 50-pin connector.

Software features

For information on the features of *Insta*Cal and the other software included with your CIO-DIO48H, 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-DIO48H

What comes with your CIO-DIO48H shipment?

The following items are shipped with the CIO-DIO48H.

Hardware

▪ CIO-DIO48H
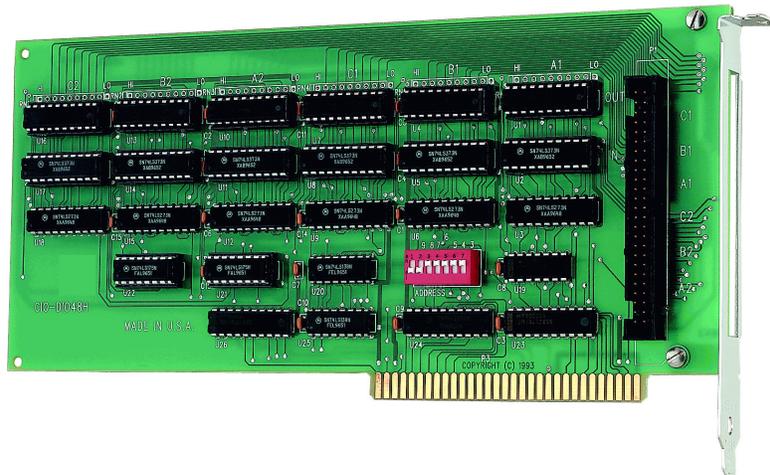
Additional documentation

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-DIO48H and information regarding installation of that software. Please read this booklet completely before installing any software or hardware.

Optional components

▪ C50FF-x cable
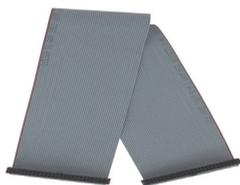
▪ Signal termination and conditioning accessories

MCC provides signal conditioning and termination products for use with the CIO-DIO48H. Refer to Field wiring, signal termination, and conditioning on page 12 for a complete list of compatible accessory products.

Unpacking the CIO-DIO48H

As with any electronic device, you should take care while handling to avoid damage from static electricity. Before removing the CIO-DIO48H 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 base address switch

The CIO-DIO48H employs the PC bus for power, communications and data transfer. It draws power from the PC, monitors the address lines and control signals, responds to its I/O address, and receives and places data on the eight data lines.

The CIO-DIO48H has one bank of base address-select switches. Verify their settings before installing the board in your computer.

Base address switch

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

The base address is the starting location that software writes to when communicating with the CIO-DIO48H. A set of DIP switches is used to set the base address. By placing the switch down, the CIO-DIO48H address decode logic is instructed to respond to that address bit. A complete address is constructed by calculating the HEX or decimal number which corresponds to all the address bits the board has been instructed to respond to.

The board is shipped with the base address set to 300 hex (see Figure 1). 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.

SW	HEX
A9	200
A8	100
A7	80
A6	40
A5	20
A4	10
A3	08
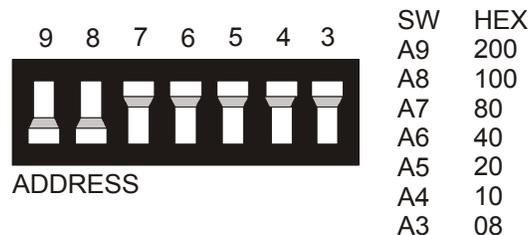
Figure 1. Base address switch

In the default configuration, 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 Address Summary

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-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

You can set the base address switch to any address in the range of 000-3F8. If you are not using IBM prototyping cards or another board which occupies these addresses, 300-31Fh are also free to use.

Addresses not specifically listed, such as 390-39Fh, are not reserved and may be available. Check your computer for other boards which may use I/O addresses.

Installing the CIO-DIO48H

After you configure the base address, you can install the CIO-DIO48H into your computer. 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.

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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 shrouded male header
Compatible cables	C50FF-x
Compatible accessory products with the C50FF-x cable	CIO-TERM100 CIO-SPADE50 CIO-MINI50 SSR-RACK24, SSR-RACK48 CIO-ERB24, CIO-ERB48

Pinout – main I/O connector

The CIO-DIO48H connector is a 50-pin male shrouded header connector that is accessible through the PC/AT expansion bracket.

GND	50	● ●	49	+5V
FIRSTPORTC Bit 0	48	● ●	47	FIRSTPORTC Bit 1
FIRSTPORTC Bit 2	46	● ●	45	FIRSTPORTC Bit 3
FIRSTPORTC Bit 4	44	● ●	43	FIRSTPORTC Bit 5
FIRSTPORTC Bit 6	42	● ●	41	FIRSTPORTC Bit 7
FIRSTPORTB Bit 0	40	● ●	39	FIRSTPORTB Bit 1
FIRSTPORTB Bit 2	38	● ●	37	FIRSTPORTB Bit 3
FIRSTPORTB Bit 4	36	● ●	35	FIRSTPORTB Bit 5
FIRSTPORTB Bit 6	34	● ●	33	FIRSTPORTB Bit 7
FIRSTPORTA Bit 0	32	● ●	31	FIRSTPORTA Bit 1
FIRSTPORTA Bit 2	30	● ●	29	FIRSTPORTA Bit 3
FIRSTPORTA Bit 4	28	● ●	27	FIRSTPORTA Bit 5
FIRSTPORTA Bit 6	26	● ●	25	FIRSTPORTA Bit 7
SECONDPORTC Bit 0	24	● ●	23	SECONDPORTC Bit 1
SECONDPORTC Bit 2	22	● ●	21	SECONDPORTC Bit 3
SECONDPORTC Bit 4	20	● ●	19	SECONDPORTC Bit 5
SECONDPORTC Bit 6	18	● ●	17	SECONDPORTC Bit 7
SECONDPORTB Bit 0	16	● ●	15	SECONDPORTB Bit 1
SECONDPORTB Bit 2	14	● ●	13	SECONDPORTB Bit 3
SECONDPORTB Bit 4	12	● ●	11	SECONDPORTB Bit 5
SECONDPORTB Bit 6	10	● ●	9	SECONDPORTB Bit 7
SECONDPORTA Bit 0	8	● ●	7	SECONDPORTA Bit 1
SECONDPORTA Bit 2	6	● ●	5	SECONDPORTA Bit 3
SECONDPORTA Bit 4	4	● ●	3	SECONDPORTA Bit 5
SECONDPORTA Bit 6	2	● ●	1	SECONDPORTA Bit 7

Figure 2. I/O connector pin-out

All the digital inputs and outputs are TTL. Under normal operating conditions, the voltages on the I/O pins range from near 0 volts for the low state, to near 5 volts for the high state. The voltages and currents of external devices usually exceed these values. Because of this, external relays are usually employed to handle higher current and voltage loads.

In addition to load matching, digital signal sources often need to be filtered or "de-bounced". Refer to the *Guide to Signal Connections* for information on digital interfacing. This document is available at www.mccdaq.com/signals/signals.pdf

Cabling
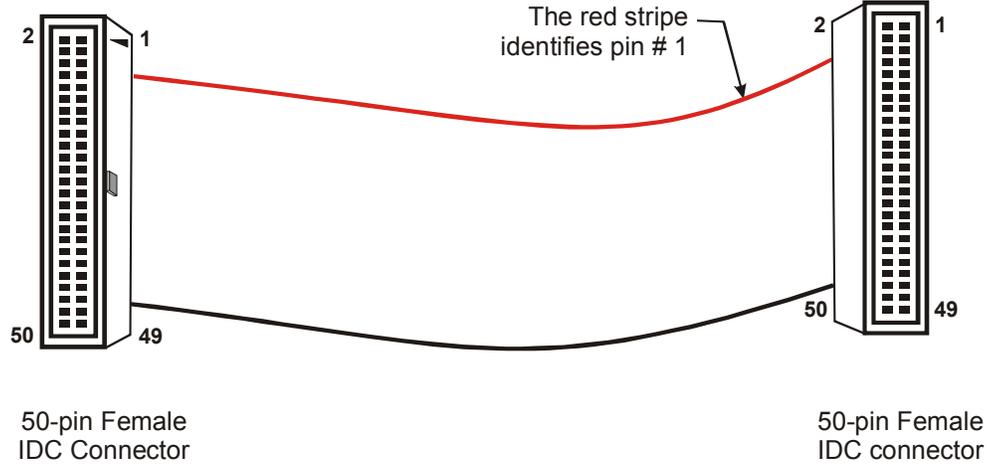
Figure 3. C50FF-x cable

Field wiring, signal termination, and conditioning

You can use the following cabling, screw termination, and signal conditioning products with the CIO-DIO48H.

- CIO-TERM100 – 100-pin screw terminal board (daisy-chained 50-pin IDC connectors). Details on this product are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=102&pf_id=281.
- CIO-SPADE50 – 16" X 4" termination panel which mates with both 37-pin and 50-pin connectors. Details on this product are available on our web site at www.mccdaq.com/pdfs/screw.pdf.
- CIO-MINI50 – 50-pin screw terminal board. Details on this product are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=102&pf_id=258.
- 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.
- SSR-RACK48 – 48-channel, solid-state relay mounting rack with quad-format modules. Details on this product are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=122&pf_id=622.
- 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.
- CIO-ERB48 – 48 Form C relays, 6 Amp, relay, 50-pin 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=242.

Information on signal connections

General information regarding signal connection and configuration is available in the *Guide to Signal Connections*. This document is available on our web site at www.mccdaq.com/signals/signals.pdf.

Functional Details

82C55 emulation

The CIO-DIO48H 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.

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, and to drive all outputs to a known state after power on or reset, pull all pins either high or low through a 2.2 K resistor.

Signal level control

To safeguard against unwanted signal levels, the devices being controlled by the CIO-DIO48H board should be tied low or high as required by a 2.2K Ω resistor. In a 2.2K eight-resistor SIP pack, one side of all of the resistors is connected to a single common point and brought out to a pin. The common line, usually marked with a dot or line, is at one end of the SIP. The remaining resistor ends are brought out to the other eight pins (refer to Figure 4).
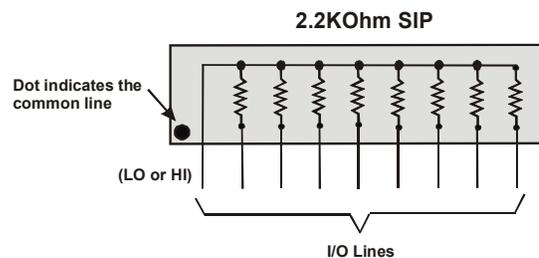
Figure 4. Eight-resistor SIP schematic

Figure 5 shows a schematic of an SIP installed in both the pull-up and pull-down positions. Each port provides 10 holes in a line. The end labeled **HI** connects to +5V. The end marked **LO** connects to GND. The eight holes in the middle (n0 –n7) connect to the eight lines of the port (A, B or C).
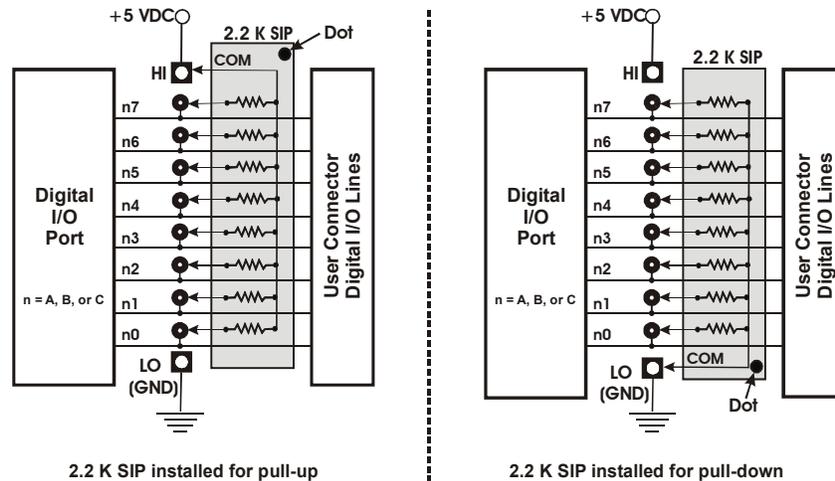
Figure 5. Pull-up and pull-down resistor SIPs schematic

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** hole. When installing pull-up and pull-down resistor SIP packs, we recommend using 2.2K, eight-resistor Single Inline Packages (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-DIO48H for input and have unconnected inputs, ignore the data from those lines. You do not have to terminate input lines. Unconnected lines will not affect the performance of connected lines. Mask out any unconnected bits in software.

Digital I/O Isolation

To provide external signal conditioning and isolation, you can connect the CIO-DIO48H to a CIO-ERB24 or SSR-RACK24. The CIO-ERB24 provides 24 Form C electromechanical relays. The SSR-RACK24 is a mounting rack for 24 solid-state relays.

The CIO-DIO48H provides digital I/O in groups of 48 bits. Many relay and solid-state relay (SSR) racks provide only 24-bits of digital I/O. You can configure the CIO-ERB24 relay output board and SSR-RACK24 I/O module rack in a daisy chain configuration to use all of the digital I/O bits provided by the CIO-DIO48H board. An example of the daisy chain configuration scheme for each board is shown on page 15.
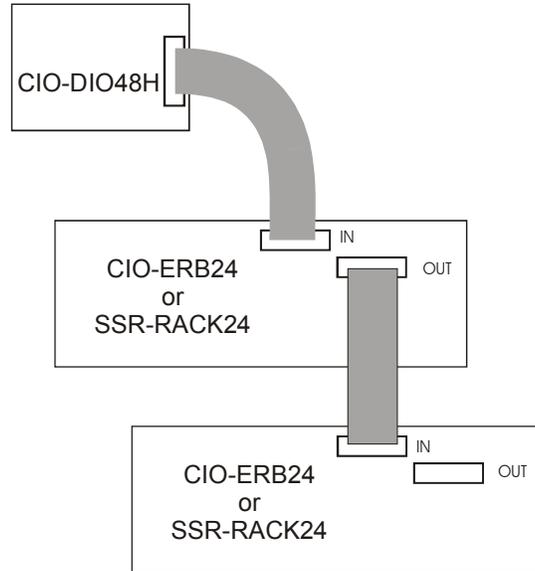
Figure 6. CIO-DIO48H to CIO-ERB24 or SSR-RACK24 daisy chain

The 24 digital I/O bits on pins 25 to 48 (base address +0 through +2) control the first relay board. The 24 digital I/O bits on pins 1 to 24 control the second relay/SSR board on the daisy chain.

Use the C50FF-x cable for interconnections. You can also use SSR-RACK48 or the CIO-ERB48 series relay boards.

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, 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-DIO48, CIO-DIO48H, CIO-DIO96, and CIO-DIO192*. This document is available on our website at http://www.mccdaq.com/registermaps/RegMapCIO-DIO-Series.pdf.

Specifications

Typical for 25 °C unless otherwise specified.

Specifications in *italic* text are guaranteed by design.

Digital input/output

Table 1. DIO specifications

Digital type	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

+5V	700 mA typical, 1200 mA max

Environmental

Table 3. Environmental specifications

Operating temperature range	0 to 50 °C
Storage temperature range	-40 to +100 °C
Humidity	0 to 90% non-condensing

Main connector and pin out

Table 4. Connector specifications

Connector type	50-pin shrouded male header (P1)
Compatible cables	C50FF-x
Compatible accessory products with the C50FF-x	CIO-TERM100 CIO-SPADE50 CIO-MINI50 SSR-RACK24, SSR-RACK48 CIO-ERB24, CIO-ERB48

Table 5. Main connector pin out

Pin	Signal name	Pin	Signal name
50	GND	49	+5V
48	FIRSTPORTC Bit 0	47	FIRSTPORTC Bit 1
46	FIRSTPORTC Bit 2	45	FIRSTPORTC Bit 3
44	FIRSTPORTC Bit 4	43	FIRSTPORTC Bit 5
42	FIRSTPORTC Bit 6	41	FIRSTPORTC Bit 7
40	FIRSTPORTB Bit 0	39	FIRSTPORTB Bit 1
38	FIRSTPORTB Bit 2	37	FIRSTPORTB Bit 3
36	FIRSTPORTB Bit 4	35	FIRSTPORTB Bit 5
34	FIRSTPORTB Bit 6	33	FIRSTPORTB Bit 7
32	FIRSTPORTA Bit 0	31	FIRSTPORTA Bit 1
30	FIRSTPORTA Bit 2	29	FIRSTPORTA Bit 3
28	FIRSTPORTA Bit 4	27	FIRSTPORTA Bit 5
26	FIRSTPORTA Bit 6	25	FIRSTPORTA Bit 7
24	SECONDPORTC Bit 0	23	SECONDPORTC Bit 1
22	SECONDPORTC Bit 2	21	SECONDPORTC Bit 3
20	SECONDPORTC Bit 4	19	SECONDPORTC Bit 5
18	SECONDPORTC Bit 6	17	SECONDPORTC Bit 7
16	SECONDPORTB Bit 0	15	SECONDPORTB Bit 1
14	SECONDPORTB Bit 2	13	SECONDPORTB Bit 3
12	SECONDPORTB Bit 4	11	SECONDPORTB Bit 5
10	SECONDPORTB Bit 6	9	SECONDPORTB Bit 7
8	SECONDPORTA Bit 0	7	SECONDPORTA Bit 1
6	SECONDPORTA Bit 2	5	SECONDPORTA Bit 3
4	SECONDPORTA Bit 4	3	SECONDPORTA Bit 5
2	SECONDPORTA Bit 6	1	SECONDPORTA Bit 7

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-DIO48H

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