User's Guide

PCI-DIO48H

Logic Level 48-bit Digital I/O Board

MEASUREMENT COMPUTING

PCI-DIO48H

Digital Input/Output

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 PCI-DIO48H so that you get the most out of the 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

> **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 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 *DAQ Software Quick Start*.
 ▪ *Never* touch the exposed pins or circuit connections on the board.

Where to find more information

The following electronic documents provide information that is relevant to the operation of the PCI-DIO48H.

 ▪ MCC's *Specifications: PCI-DIO48H* (the PDF version of Chapter 5 in this guide) is available on our web site at www.mccdaq.com/pdfs/PCI-DIO48H.pdf.
 ▪ MCC's *Register Map for the PCI-DIO48H and the PCI-DIO96H* is available on our web site at www.mccdaq.com/registermaps/RegMapPCI-DIOxxH.pdf.
 ▪ MCC's *DAQ Software Quick Start* 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.

This user's manual is also available on our web site at www.mccdaq.com/PDFManuals/PCI-DIO48H.pdf.

Introducing the PCI-DIO48H

Overview: PCI-DIO48H features

This manual explains how to install and use the PCI-DIO48H board. The PCI-DIO48H is a high-density, logic-level digital I/O board designed for the PCI-bus.

The PCI-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 PORTA, PORTB and PORTC. PORTC 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. Each board is equipped with open locations where you can install SIP resistor networks for either pull-up or pull-down.

The PCI-DIO48H board is completely plug-and-play, with no jumpers or switches to set. All board addresses are set by the board's plug-and-play software. Board configuration is controlled by your system's BIOS.

Software features

The following software ships with the PCI-DIO48H free of charge.

- *Insta*Cal installation, calibration, and test utility
- TracerDAQ™ suite of virtual instruments
- SoftWIRE® for Visual Studio® .NET graphical programming
- MCC DAQ Components for VS .NET (installed with SoftWIRE for VS .NET)

For information on the features of *InstaCal*, TracerDAQ, and SoftWIRE, refer to the *DAQ Software Quick Start* booklet that shipped with the PCI-DIO48H.

PCI-DIO48H functions are illustrated in the block diagram shown here.
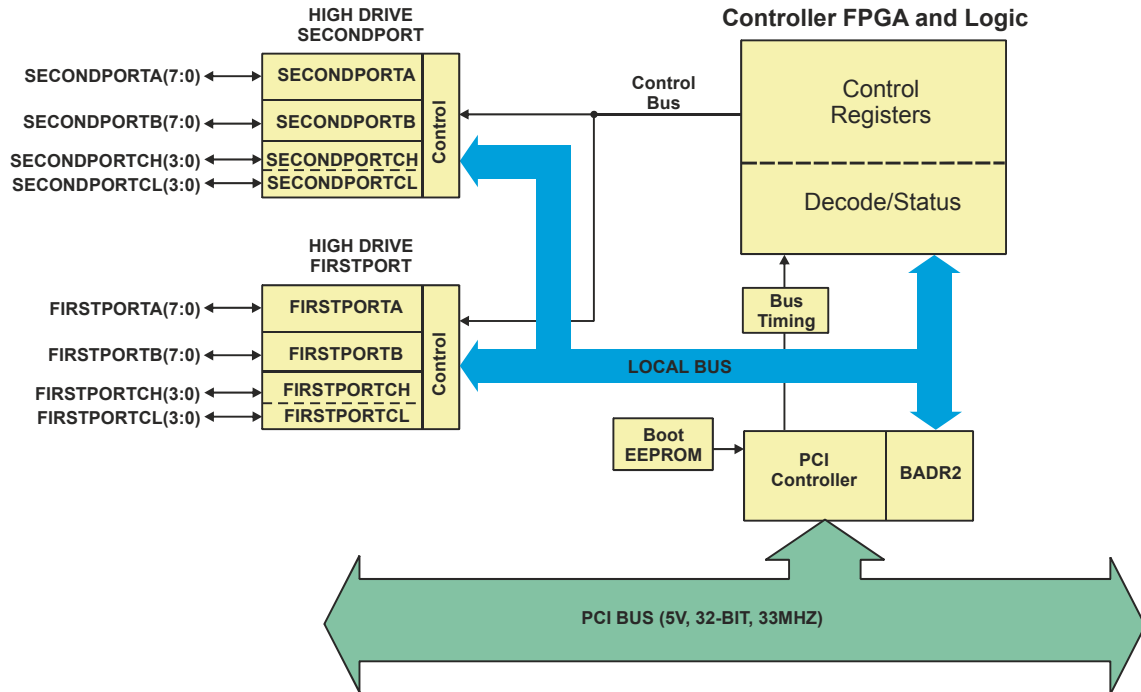
Figure 1-1. PCI-DIO48H block diagram

Installing the PCI-DIO48H

What comes with your PCI-DIO48H shipment?

The following items are shipped with the PCI-DIO48H.

Hardware

▪ PCI-DIO48H board
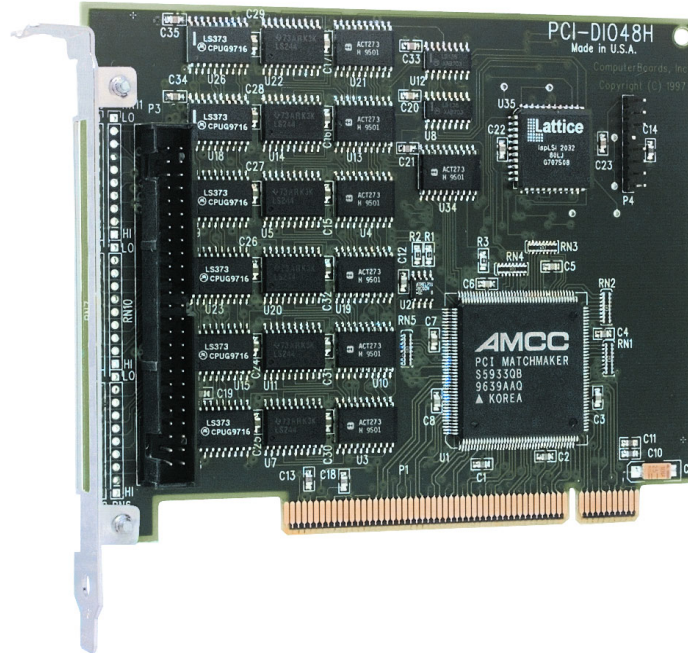
Software

The *Measurement Computing Data Acquisition Software* CD contains the following software:

▪ *Insta*Cal installation, calibration, and test utility
▪ TracerDAQ suite of virtual instruments
▪ SoftWIRE for VS .NET
▪ SoftWIRE MCC DAQ Components for .NET
  (installed with SoftWIRE for VS .NET)

Documentation

In addition to this hardware user's guide, you should also receive the *DAQ Software Quick Start* (available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf). Please read this booklet completely before installing any software and hardware.

Optional components

If you ordered any of the following products with your board, they should be included with your shipment.

Universal Library

▪ Universal Library™ Data Acquisition and Control Programming Tools (also includes the *Insta*Cal utility, the *Universal Library User's Guide*, and the *Universal Library Function Reference*)

Cables

Signal termination and conditioning accessories

MCC provides signal termination products for use with the PCI-DIO48H. Refer to Field wiring, signal termination and conditioning on page 2-4 for a complete list of compatible accessory products.

Unpacking the board

The PCI-DIO48H board is shipped in an antistatic container to prevent damage by an electrostatic discharge. To avoid such damage, perform the following procedure when unpacking and handling your board.

1. Before opening the antistatic container, ground yourself with a wrist-grounding strap or by holding onto a grounded object (such as the computer chassis).

2. Touch the antistatic container to the computer chassis before removing the board from the container.

3. Remove the board from the container. *Never* touch the exposed pins or circuit connections on the board.

If your board is damaged, notify Measurement Computing Corporation immediately by phone, fax, or e-mail. For international customers, contact your local distributor where you purchased the board.

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

Installing the software

Install the software included with your board *before* you install the hardware. Installing the software first ensures that the information required for proper board detection is installed and available at boot up.

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

Installing the hardware

The PCI-DIO48H board is completely plug-and-play. There are no switches or jumpers to set on the board. Configuration is controlled by your system's BIOS. 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 *DAQ Software Quick Start* 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 PCI slot.

2. Close your computer and turn it on.

   If you are using an operating system with support for plug-and-play (such as Windows 2000 or Windows XP), a dialog box pops up as the system loads indicating that new hardware has been detected. If the information file for this board is not already loaded onto your PC, you will be prompted for the disk containing this file. The MCC DAQ software contains this file. If required, insert the *Measurement Computing Data Acquisition Software* CD and click **OK**.

3. To test your installation and configure your board, run the *Insta*Cal utility installed in the previous section. Refer to the *DAQ Software Quick Start* that came with your board 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

Table 2-1 lists the board connectors, applicable cables and compatible accessory boards.

Table 2-1. Board connectors, cables, accessory equipment

Connector type	50-pin, high-density IDC male header connector
Compatible cables	C50FF-*x* (Figure 2-1)
Compatible accessory products with the C50FF-x cable	SCB-50 CIO-MINI50 CIO-SPADE50 CIO-ERB24 CIO-SERB24/FD CIO-ERB48 CIO-SERB48 SSR-RACK24 SSR-RACK48

The PCI-DIO48H board has a 50-pin, high-density male header connector that is accessible through the slot in the expansion bracket. Connector pin outs are listed in Table 2-2.

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.

Caution! When connecting a cable to the board's I/O connector, make sure that the arrow indicating pin 1 on the board connector lines up with the arrow indicating pin 1 on the cable connector. Incorrectly connected cables can damage the board and the I/O controller.

Pin out – main I/O connector

Table 2-2. Main I/O connector pin out

| Signal name	Pin		Pin	Signal name
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

PCI slot ↓

Cabling
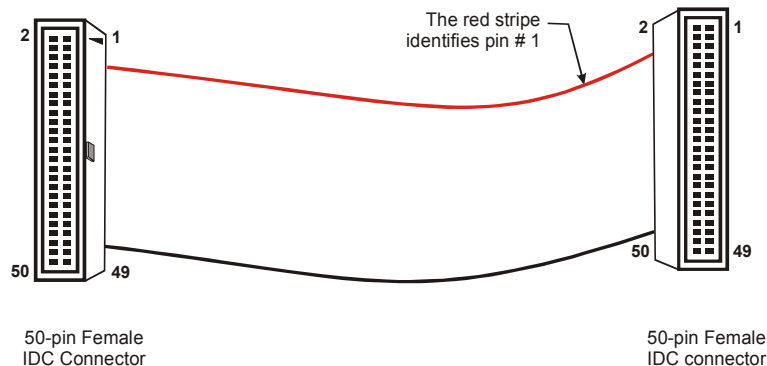
Figure 2-1. C50FF-x cable

Field wiring and signal termination accessories

You can use the following screw terminal boards to terminate field signals and route them into the PCI-DIO48H using the C100FF-*x* cable.

- 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.
- CIO-TERM100 – 100-pin screw terminal board (Two 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.
- SCB-50 – 50 conductor, shielded signal connection/screw terminal box provides two independent 50-pin connections. Details on this product are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=196&pf_id=1168.

- 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-SERB24/FD – 24 Form C relays, 10 Amp, fault detecting 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=678.
- 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.
- CIO-SERB48 – 24 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=676.
- 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.

For additional information about digital interfacing…

Detailed information regarding digital interfacing is contained in MCC's *Guide to Signal Connections*. This document is available on our web site at www.measurementcomputing.com/signals/signals.pdf.

Programming and Developing Applications

After following the installation instructions in Chapter 2, your board should now be installed and ready for use.

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, such as SoftWIRE®, Labtech Notebook™, and HP-VEE™, 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@measurementcomputing.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 PCI-DIO48H and PCI-DIO96H*. This document is available at www.mccdaq.com/registermaps/RegMapPCI-DIOxxH.pdf.

Functional Details

CIO-ERB24 and SSR-RACK24 daisy chain configuration

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 PCI-DIO48H board. An example of the daisy chain configuration scheme for each board is shown below.

The PCI-DIO48H provides digital I/O in a group of 48 bits. To use all of the board's 48 digital I/O bits to monitor and control relays and/or SSRs, configure the daisy chain as shown in Figure 4-1.
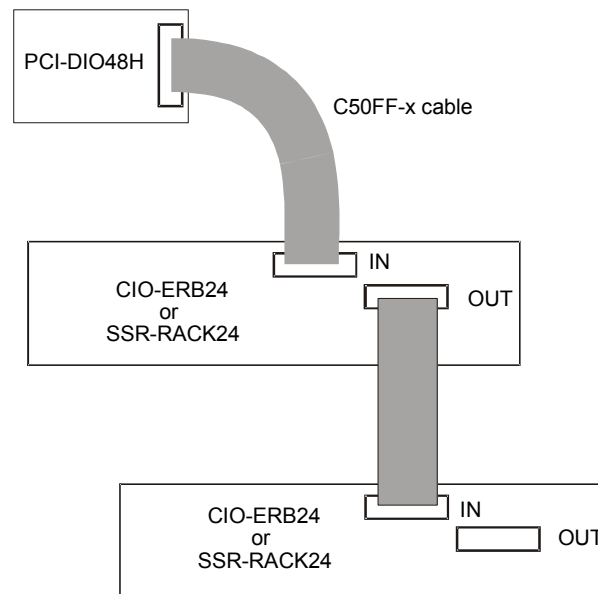
Figure 4-1. PCI-DIO48H to CIO-ERB24 or SSR-RACK24 Daisy Chain

The 24 digital I/O bits on pins 1-24 control the first relay board on the chain. The 24 digital I/O bits on pins 25-50 control the second relay/SSR board on the daisy chain.

82C55 emulation

The PCI-DIO48H 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.

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.

Pull-up and pull-down resistors

The PCI-DIO48H board has open locations where you can install a 2.2 KΩ, eight-resistor single inline package (SIP) resistor network for each port. The locations are marked **A**, **B** or **C** in the **PORT 1** or **PORT 2** area on the board (RN6 through RN11), and are adjacent to the I/O connectors.

The SIP is made up of eight 2.2 K 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 4-2).

2.2 KOhm SIP
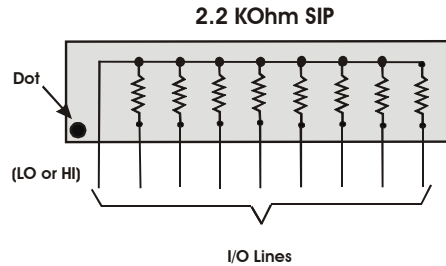
Dot

(LO or HI)

I/O Lines

Figure 4-2. Eight-Resistor SIP Schematic

The SIP may be installed as pull-up or pull-down. At each RN# location, there are 10 holes in a line. One end of the line is +5V, the other end is GND. They are marked **HI** and **LO** respectively. The eight holes in the middle are connected to the eight lines of a port.

- For a pull-up function, mount the SIP with the common pin (marked with a dot or line) in the **HI** position.
- For a pull-down function, mount the SIP with the common pin in the **LO** position.

When installing pull-up and pull-down resistor SIP packs, we recommend using a 2.2 K, eight-resistor SIP (MCC part number SP-K2.29C).

Unconnected inputs float

Unconnected inputs typically float high, but not reliably. If you are using a PCI-DIO48H board 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. Ensure that you mask out any unconnected bits in software.

Specifications

Typical for 25 °C unless otherwise specified.

Digital Input / Output

Table 5-1. Digital I/O specifications

Digital Type	8255 emulation, Mode 0
Output:	74S244
Input:	74LS373
Configuration	4 banks of 8, 4 banks of 4, programmable by bank as input or output
Number of I/O	48
Output High	2.4 volts min @ -15mA
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)
Pull-Up/Pull-Down Resistors	SIP resistor locations provided for pull-up or pull-down configuration.

Power Consumption

Table 5-2. Power consumption specifications

+5V Operating	1.2 A typical, 1.6 A max

Environmental

Table 5-3. Environmental specifications

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

Mechanical

Table 5-4. Mechanical specifications

Card dimensions	174.7 mm L x 106.6 mm H x 14.5mm W

Software

Table 5-5. Software specifications

Software Support	Universal Library and *Insta*Cal

Main Connector and Pin Out

Table 5-6. Main connector specifications

Connector type	50-pin, high-density IDC male header connector.
Compatible cables	C50FF-*x*
Compatible accessory products	CIO-MINI50 CIO-SPADE50 SCB-50 CIO-ERB24 CIO-SERB24/FD CIO-ERB48 CIO-SERB48 SSR-RACK24 SSR-RACK48

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

EC Declaration of Conformity

We, Measurement Computing Corporation, declare under sole responsibility that the products:

PCI-DIO48H	48-bit digital I/O board for the PCI bus
Part Number	*Description*

to which this declaration relates, meets the essential requirements, is in conformity with, and CE marking has been applied according to the relevant EC Directives listed below using the relevant section of the following EC standards and other informative documents:

- EU EMC Directive 89/336/EEC: Essential requirements relating to electromagnetic compatibility.
- EN 55022 Class B (1995): Radiated and conducted emission requirements for information technology equipment.
- ENV 50204 (1995): Radio-frequency electromagnetic field immunity.
- EN 55024 (1998): EC generic immunity requirements.
- EN 50082-1 (1997): EC generic immunity requirements.
- EN 61000-4-2 (1995): Electrostatic discharge immunity.
- EN 61000-4-3 (1997) ENV 50204 (1996): RF immunity.
- EN 61000-4-4 (1995): Electric fast transient burst immunity.
- EN 61000-4-5 (1995): Surge immunity.
- EN 61000-4-6 (1996): Radio frequency common mode immunity.
- EN 61000-4-8 (1994): Power frequency magnetic field immunity.
- EN 61000-4-11 (1994): Voltage dip and interrupt immunity.

Carl Haapaoja, Vice-President of Design Verification