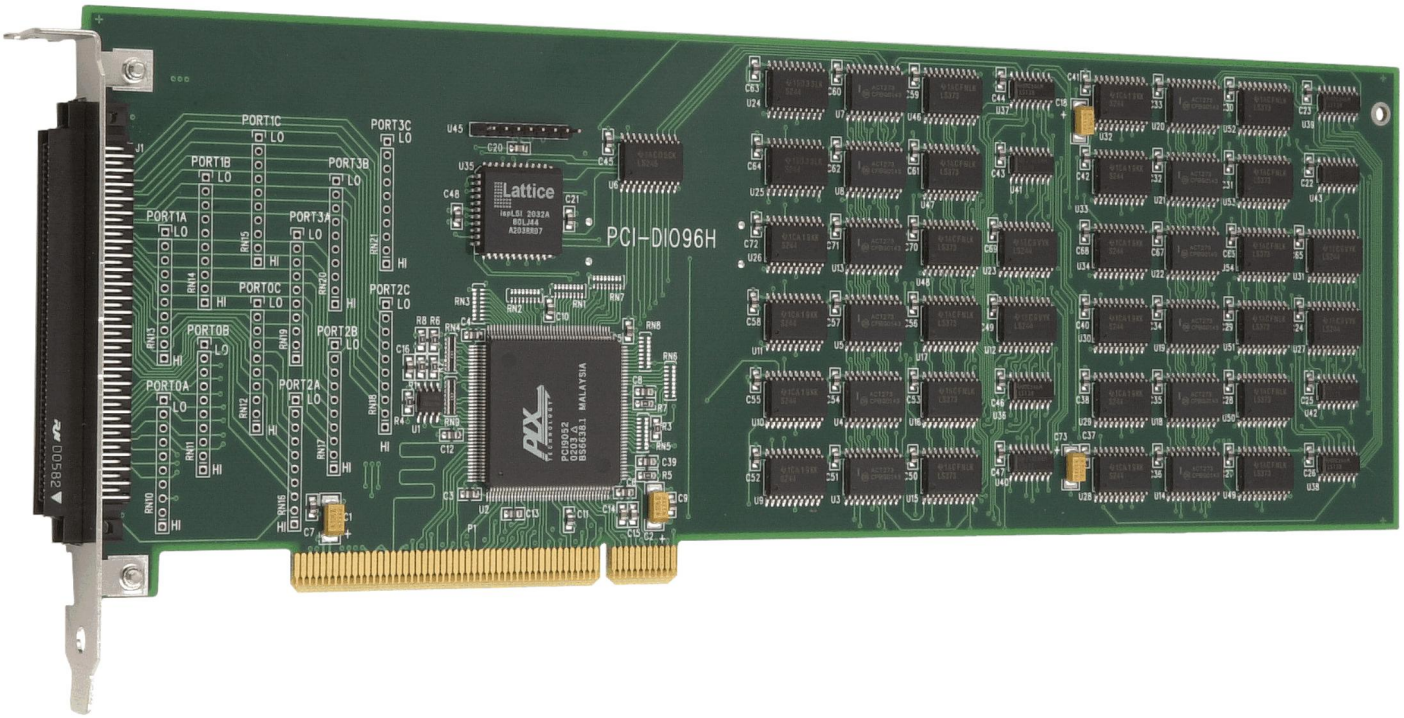
PCI-DIO96H

High-Density, Logic-Level Digital I/O Board

User's Guide



MEASUREMENT COMPUTING™

PCI-DIO96H

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-DIO96H so that you get the most out of its 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 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, you can find more information in the *Register Map for the PCI-DIO48H and PCI-DIO96H*. This document is available at www.mccdaq.com/registermaps/RegMapPCI-DIOxxH.pdf.

Introducing the PCI-DIO96H

Overview: PCI-DIO96H features

This manual explains how to install and use the PCI-DIO96H board. The PCI-DIO96H is a high-density, logic-level digital I/O board designed for the PCI-bus.

The PCI-DIO96H provides 96-bits of digital I/O. The I/O is organized into four 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-DIO96H 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.

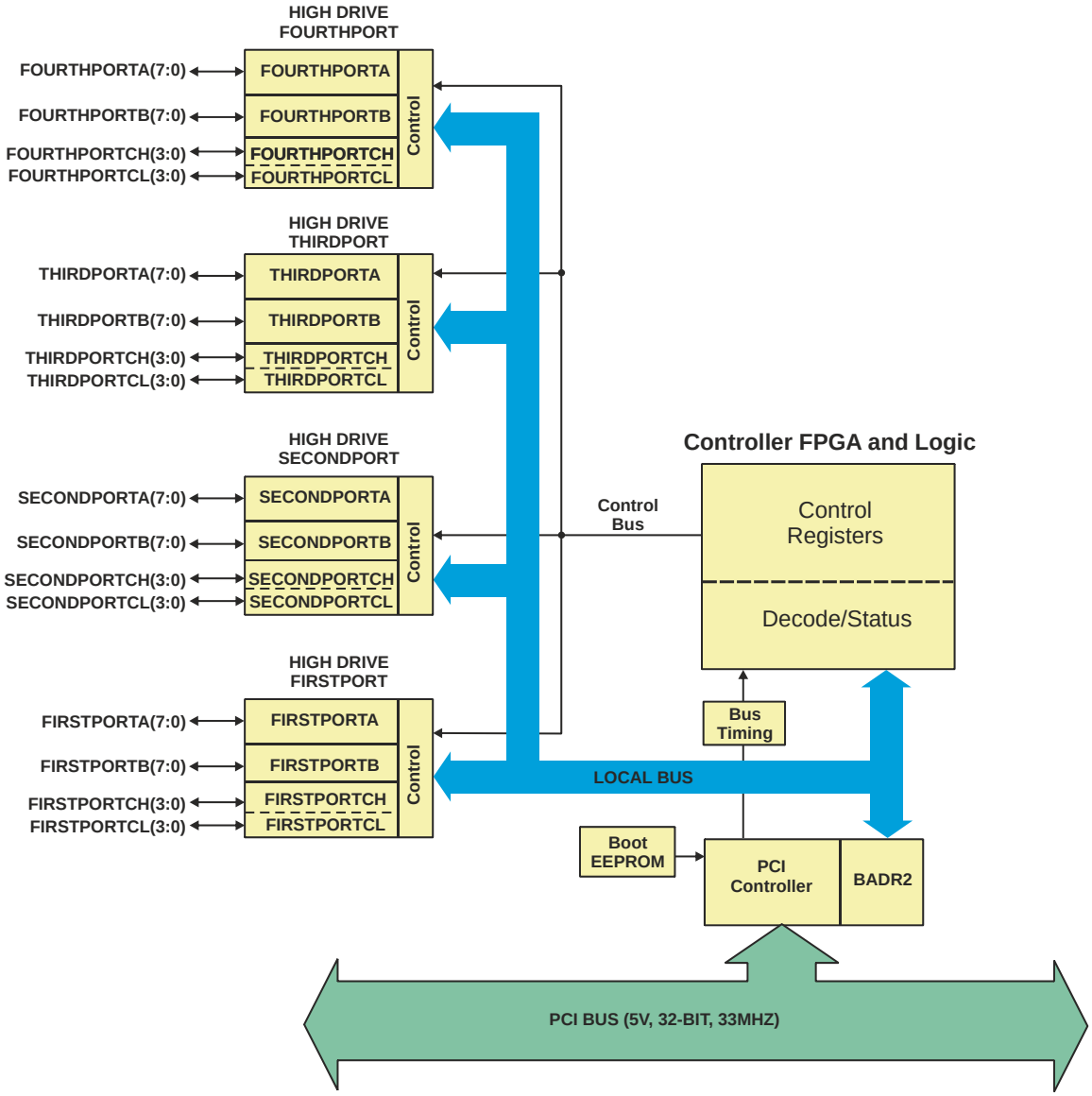
Software features

For information on the features of *Insta*Cal and the other software included with your PCI-DIO96H, 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 or versions of the software supported under less commonly used operating systems.

PCI-DIO96H block diagram

PCI-DIO96H functions are illustrated in the block diagram shown here.



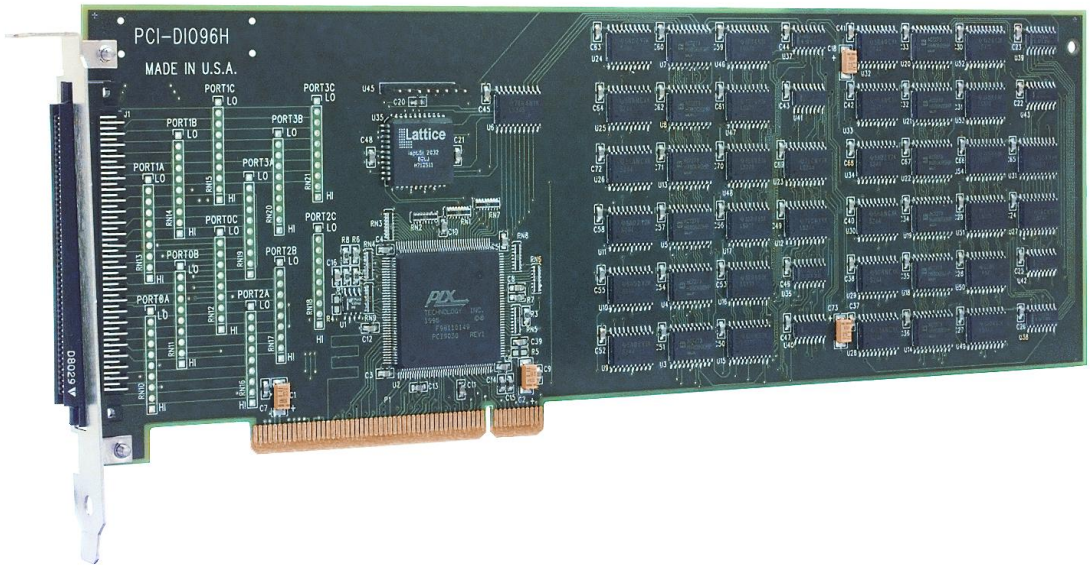
Installing the PCI-DIO96H

What comes with your PCI-DIO96H shipment?

The following items are shipped with the PCI-DIO96H.

Hardware

- PCI-DIO96H board



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

Optional components

- C100FF-x cable

- Signal termination and conditioning accessories

  MCC provides signal termination products for use with the PCI-DIO96H. Refer to Field wiring, signal termination and conditioning on page 14 for a complete list of compatible accessory products.

Unpacking the PCI-DIO96H

As with any electronic device, you should take care while handling to avoid damage from static electricity. Before removing the PCI-DIO96H 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

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 *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.

Installing the hardware

The PCI-DIO96H 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 *Quick Start Guide* for instructions on installing the software.

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 *Quick Start Guide* 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

The table below lists the board connectors, applicable cables and compatible accessory boards.

Board connectors, cables, accessory equipment

Connector type	100-pin, high-density connector
Compatible cables	C100FF-x (Figure 1)
Compatible accessory products with the C100FF-x cable	CIO-MINI50* CIO-SPADE50* CIO-TERM100 SCB-50 CIO-ERB24 CIO-SERB24/FD CIO-ERB48 CIO-SERB48 SSR-RACK24 SSR-RACK48 * two devices are required

The PCI-DIO96H board has a 100-pin, high-density Robinson-Nugent male connector. Connector pinouts are listed on page 12. The C100FF-x cable can be used to split the 100 I/O lines into two, 50-pin cables.

Board connector pins 1 to 50 are mapped directly to pins 1 to 50 on the C100FF-*x* cable's first 50-pin connector. Board connector pins 51 to 100 are mapped directly to pins 1 to 50 on the C100FF-*x* cable's second 50-pin connector (pin 51 is mapped to pin 1, and pin 100 is mapped to pin 50.) A sample C100FF-x cable configuration is shown in Figure 2 on page 13.

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

Main I/O connector pin out

Signal name	Pin		Pin	Signal name
GND	100	• •	50	GND
+5V	99	• •	49	+5V
THIRDPORTC Bit 0	98	• •	48	FIRSTPORTC Bit 0
THIRDPORTC Bit 1	97	• •	47	FIRSTPORTC Bit 1
THIRDPORTC Bit 2	96	• •	46	FIRSTPORTC Bit 2
THIRDPORTC Bit 3	95	• •	45	FIRSTPORTC Bit 3
THIRDPORTC Bit 4	94	• •	44	FIRSTPORTC Bit 4
THIRDPORTC Bit 5	93	• •	43	FIRSTPORTC Bit 5
THIRDPORTC Bit 6	92	• •	42	FIRSTPORTC Bit 6
THIRDPORTC Bit 7	91	• •	41	FIRSTPORTC Bit 7
THIRDPORTB Bit 0	90	• •	40	FIRSTPORTB Bit 0
THIRDPORTB Bit 1	89	• •	39	FIRSTPORTB Bit 1
THIRDPORTB Bit 2	88	• •	38	FIRSTPORTB Bit 2
THIRDPORTB Bit 3	87	• •	37	FIRSTPORTB Bit 3
THIRDPORTB Bit 4	86	• •	36	FIRSTPORTB Bit 4
THIRDPORTB Bit 5	85	• •	35	FIRSTPORTB Bit 5
THIRDPORTB Bit 6	84	• •	34	FIRSTPORTB Bit 6
THIRDPORTB Bit 7	83	• •	33	FIRSTPORTB Bit 7
THIRDPORTA Bit 0	82	• •	32	FIRSTPORTA Bit 0
THIRDPORTA Bit 1	81	• •	31	FIRSTPORTA Bit 1
THIRDPORTA Bit 2	80	• •	30	FIRSTPORTA Bit 2
THIRDPORTA Bit 3	79	• •	29	FIRSTPORTA Bit 3
THIRDPORTA Bit 4	78	• •	28	FIRSTPORTA Bit 4
THIRDPORTA Bit 5	77	• •	27	FIRSTPORTA Bit 5
THIRDPORTA Bit 6	76	• •	26	FIRSTPORTA Bit 6
THIRDPORTA Bit 7	75	• •	25	FIRSTPORTA Bit 7
FOURTHPORTC Bit 0	74	• •	24	SECONDPORTC Bit 0
FOURTHPORTC Bit 1	73	• •	23	SECONDPORTC Bit 1
FOURTHPORTC Bit 2	72	• •	22	SECONDPORTC Bit 2
FOURTHPORTC Bit 3	71	• •	21	SECONDPORTC Bit 3
FOURTHPORTC Bit 4	70	• •	20	SECONDPORTC Bit 4
FOURTHPORTC Bit 5	69	• •	19	SECONDPORTC Bit 5
FOURTHPORTC Bit 6	68	• •	18	SECONDPORTC Bit 6
FOURTHPORTC Bit 7	67	• •	17	SECONDPORTC Bit 7
FOURTHPORTB Bit 0	66	• •	16	SECONDPORTB Bit 0
FOURTHPORTB Bit 1	65	• •	15	SECONDPORTB Bit 1
FOURTHPORTB Bit 2	64	• •	14	SECONDPORTB Bit 2
FOURTHPORTB Bit 3	63	• •	13	SECONDPORTB Bit 3
FOURTHPORTB Bit 4	62	• •	12	SECONDPORTB Bit 4
FOURTHPORTB Bit 5	61	• •	11	SECONDPORTB Bit 5
FOURTHPORTB Bit 6	60	• •	10	SECONDPORTB Bit 6
FOURTHPORTB Bit 7	59	• •	9	SECONDPORTB Bit 7
FOURTHPORTA Bit 0	58	• •	8	SECONDPORTA Bit 0
FOURTHPORTA Bit 1	57	• •	7	SECONDPORTA Bit 1
FOURTHPORTA Bit 2	56	• •	6	SECONDPORTA Bit 2
FOURTHPORTA Bit 3	55	• •	5	SECONDPORTA Bit 3
FOURTHPORTA Bit 4	54	• •	4	SECONDPORTA Bit 4
FOURTHPORTA Bit 5	53	• •	3	SECONDPORTA Bit 5
FOURTHPORTA Bit 6	52	• •	2	SECONDPORTA Bit 6
FOURTHPORTA Bit 7	51	• •	1	SECONDPORTA Bit 7

PCI slot ↓

Cabling

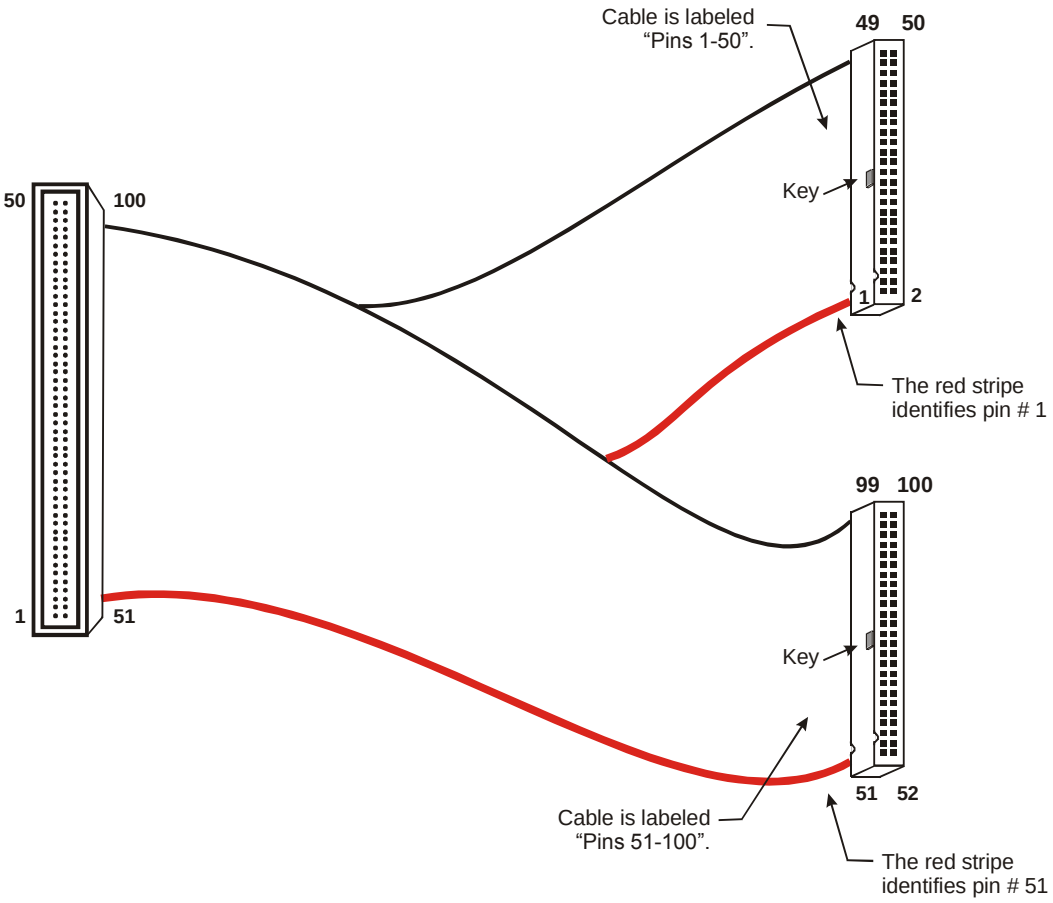


Figure 1. C100FF-x cable

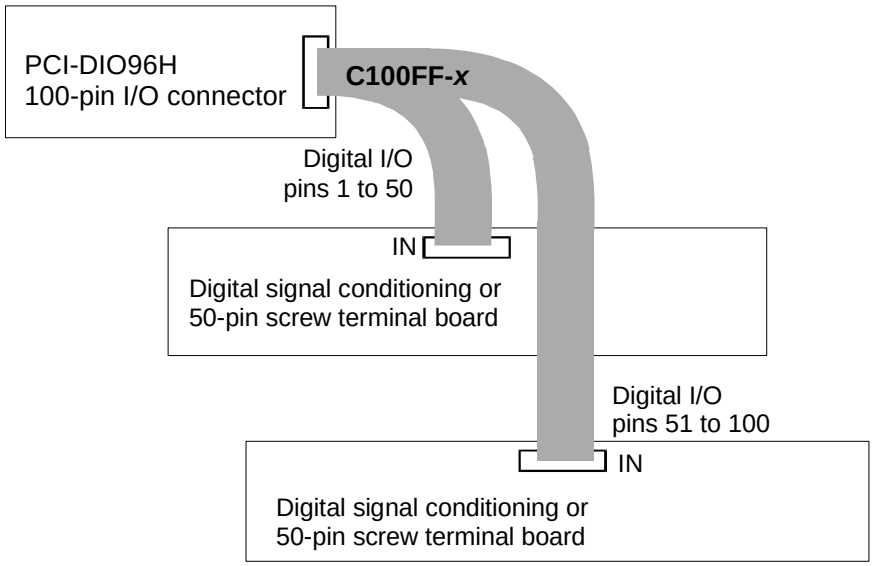


Figure 2. C100FF-x cable configuration

Field wiring and signal termination accessories

You can use the following screw terminal boards to terminate field signals and route them into the PCI-DIO96H using the C100FF-*x* cable.

- CIO-MINI50 – 50-pin screw terminal board.
- 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.
- SCB-50 – 50 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.

- CIO-ERB24 – 24 Form C relays, 6 Amp relay accessory board for digital signal conditioning.
- CIO-SERB24/FD – 24 Form C relays, 10 Amp, fault detecting relay accessory board with socketed and field-replaceable relays.
- CIO-ERB48 – 48 Form C relays, 6 Amp, relay, 50-pin accessory board for digital signal conditioning.
- CIO-SERB48 – 24 Form C relays, 10 Amp relay accessory board with socketed and field-replaceable relays.
- SSR-RACK24 – 24-channel, solid-state relay mounting rack for digital signal conditioning.
- SSR-RACK48 – 48-channel, solid-state relay mounting rack with quad-format modules.

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

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.

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-DIO96H board. An example of the daisy chain configuration scheme for each board is shown below.

The PCI-DIO96H board provides digital I/O in a group of 96 bits. Each of the C100FF-x cable's 50-pin connectors provides 48 bits. To use all of the board's 96 digital I/O bits to control relays and/or SSRs, configure the daisy chain as shown in Figure 3.

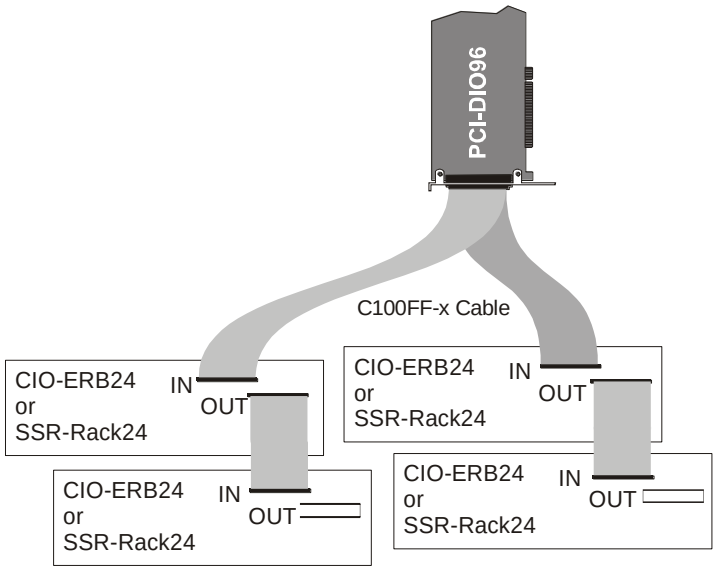


Figure 3. PCI-DIO96H to C100FF-x to relay rack daisy chain cabling

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 and so on, for up to 100 pins.

82C55 emulation

The PCI-DIO96H 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-DIO96H 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 **PORT#A**, **PORT#B** and **PORT#C** (RN10 through RN21), and are adjacent to the I/O connector. PORT0A corresponds to FIRSTPORTA, PORT1A corresponds to SECONDPORTA, etc, as shown on the pinout diagram.

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).

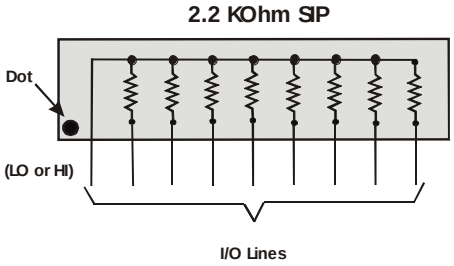


Figure 4. Eight-Resistor SIP Schematic

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-DIO96H 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.

Specifications

Typical for 25 °C unless otherwise specified.
Specifications in *italic text* are guaranteed by design.

Digital input / output

Table 1. Digital I/O specifications

Digital type	8255 emulation, Mode 0
Output	74S244
Input	74LS373
Configuration	8 banks of 8, 8 banks of 4, programmable by bank as input or output
Number of I/O	96
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)
Pull-up/pull-down resistors	SIP resistor locations provided for pull-up or pull-down configuration.

Power Consumption

Table 2. Power consumption specifications

+5V Operating	2.1 A typical, 3.4 A max

Environmental

Table 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 4. Mechanical specifications

Card dimensions	292.1 mm (L) x 106.6 mm (H) x 14.5 mm (W)

Main connector and pin out

Table 5. Main connector specifications

Connector type	100-pin, high-density
Compatible cables	C100FF- x
Compatible accessory products	CIO-MINI50* CIO-SPADE50* CIO-TERM100 SCB-50 CIO-ERB24 CIO-SERB24 CIO-ERB48 CIO-SERB48 SSR-RACK24 SSR-RACK48 * two devices are required

Table 6. Main connector pin out

Pin	Signal name	Pin	Signal name
100	GND	50	GND
99	+5V	49	+5V
98	THIRDPORTC Bit 0	48	FIRSTPORTC Bit 0
97	THIRDPORTC Bit 1	47	FIRSTPORTC Bit 1
96	THIRDPORTC Bit 2	46	FIRSTPORTC Bit 2
95	THIRDPORTC Bit 3	45	FIRSTPORTC Bit 3
94	THIRDPORTC Bit 4	44	FIRSTPORTC Bit 4
93	THIRDPORTC Bit 5	43	FIRSTPORTC Bit 5
92	THIRDPORTC Bit 6	42	FIRSTPORTC Bit 6
91	THIRDPORTC Bit 7	41	FIRSTPORTC Bit 7
90	THIRDPORTB Bit 0	40	FIRSTPORTB Bit 0
89	THIRDPORTB Bit 1	39	FIRSTPORTB Bit 1
88	THIRDPORTB Bit 2	38	FIRSTPORTB Bit 2
87	THIRDPORTB Bit 3	37	FIRSTPORTB Bit 3
86	THIRDPORTB Bit 4	36	FIRSTPORTB Bit 4
85	THIRDPORTB Bit 5	35	FIRSTPORTB Bit 5
84	THIRDPORTB Bit 6	34	FIRSTPORTB Bit 6
83	THIRDPORTB Bit 7	33	FIRSTPORTB Bit 7
82	THIRDPORTA Bit 0	32	FIRSTPORTA Bit 0
81	THIRDPORTA Bit 1	31	FIRSTPORTA Bit 1
80	THIRDPORTA Bit 2	30	FIRSTPORTA Bit 2
78	THIRDPORTA Bit 3	29	FIRSTPORTA Bit 3
78	THIRDPORTA Bit 4	28	FIRSTPORTA Bit 4
77	THIRDPORTA Bit 5	27	FIRSTPORTA Bit 5
76	THIRDPORTA Bit 6	26	FIRSTPORTA Bit 6
75	THIRDPORTA Bit 7	25	FIRSTPORTA Bit 7
74	FOURTHPORTC Bit 0	24	SECONDPORTC Bit 0
73	FOURTHPORTC Bit 1	23	SECONDPORTC Bit 1
72	FOURTHPORTC Bit 2	22	SECONDPORTC Bit 2
71	FOURTHPORTC Bit 3	21	SECONDPORTC Bit 3
70	FOURTHPORTC Bit 4	20	SECONDPORTC Bit 4
69	FOURTHPORTC Bit 5	19	SECONDPORTC Bit 5
68	FOURTHPORTC Bit 6	18	SECONDPORTC Bit 6
67	FOURTHPORTC Bit 7	17	SECONDPORTC Bit 7
66	FOURTHPORTB Bit 0	16	SECONDPORTB Bit 0
65	FOURTHPORTB Bit 1	15	SECONDPORTB Bit 1
64	FOURTHPORTB Bit 2	14	SECONDPORTB Bit 2
63	FOURTHPORTB Bit 3	13	SECONDPORTB Bit 3
62	FOURTHPORTB Bit 4	12	SECONDPORTB Bit 4
61	FOURTHPORTB Bit 5	11	SECONDPORTB Bit 5
60	FOURTHPORTB Bit 6	10	SECONDPORTB Bit 6
59	FOURTHPORTB Bit 7	9	SECONDPORTB Bit 7
58	FOURTHPORTA Bit 0	8	SECONDPORTA Bit 0
57	FOURTHPORTA Bit 1	7	SECONDPORTA Bit 1
56	FOURTHPORTA Bit 2	6	SECONDPORTA Bit 2
55	FOURTHPORTA Bit 3	5	SECONDPORTA Bit 3
54	FOURTHPORTA Bit 4	4	SECONDPORTA Bit 4
53	FOURTHPORTA Bit 5	3	SECONDPORTA Bit 5
52	FOURTHPORTA Bit 6	2	SECONDPORTA Bit 6
51	FOURTHPORTA Bit 7	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

PCI-DIO96H

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

EC EMC Directive 2004/108/EC: General Requirements, EN 61326-1:2006 (IEC 61326-1:2005).

Emissions:

- EN 55011 (2007) / CISPR 11(2003): Radiated emissions: Group 1, Class A
- EN 55011 (2007) / CISPR 11(2003): Conducted emissions: Group 1, Class A

Immunity: EN 61326-1:2006, Table 3.

- IEC 61000-4-2 (2001): Electrostatic Discharge immunity.
- IEC 61000-4-3 (2002): Radiated Electromagnetic Field immunity.
- IEC 61000-4-4 (2004): Electric Fast Transient Burst Immunity.
- IEC 61000-4-5 (2001): Surge Immunity.
- IEC 61000-4-6 (2003): Radio Frequency Common Mode Immunity.
- IEC 61000-4-11 (2004): Voltage Interrupts.

To maintain compliance to the standards of this declaration, the following conditions must be met.

- The host computer, peripheral equipment, power sources, and expansion hardware must be CE compliant.
- All I/O cables must be shielded, with the shields connected to ground.
- I/O cables must be less than 3 meters (9.75 feet) in length.
- The host computer must be properly grounded.
- Equipment must be operated in a controlled electromagnetic environment as defined by Standards EN 61326-1:2006, or IEC 61326-1:2005.

Declaration of Conformity based on tests conducted by Chomerics Test Services, Woburn, MA 01801, USA in September, 2001. Test records are outlined in Chomerics Test Report #EMI3053.01. Further testing was conducted by Chomerics Test Services, Woburn, MA. 01801, USA in January, 2009. Test records are outlined in Chomerics Test report #EMI5243.09.

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

Carl Haapaoja, Director of Quality Assurance

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