PCI-DIO24/S

24-bit, TTL-compatible, Digital I/O board
Onboard surge suppression/protection

User's Guide

MEASUREMENT COMPUTING™
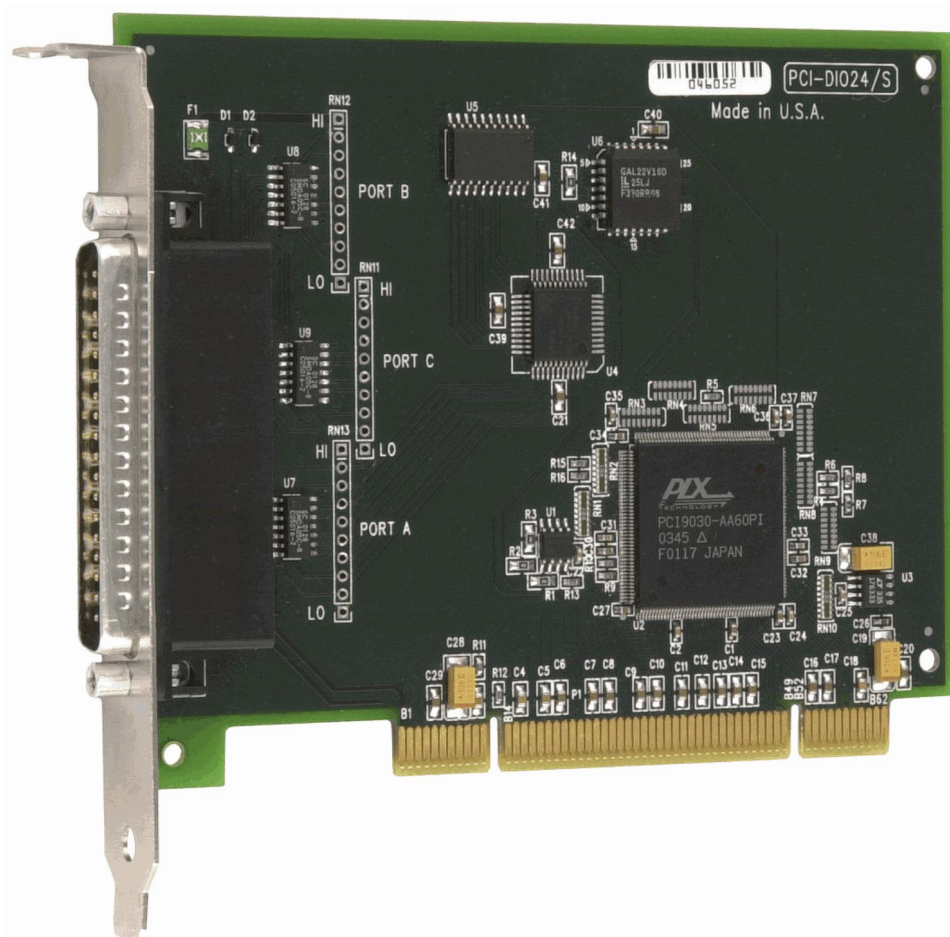
PCI-DIO24/S

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-DIO24/S digital I/O board. 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, refer to the *Register Map for the PCI-DIO24, PCI-DIO24H, PCI-DIO24/S, and PCI-DIO24/LP*. This document is available on our website at www.mccdaq.com/registermaps/RegMapPCI-DIO24X.pdf.

Introducing the PCI-DIO24/S

Overview: PCI-DIO24/S features

This manual explains how to install, configure and use the PCI-DIO24/S digital I/O board. You can use this board in a variety of digital applications to control logic devices such as switches, gauges, relays, pumps, and sensors.

The PCI-DIO24/S is a 24-bit, TTL-compatible digital I/O board. Digital I/O lines are accessed through a 37-pin connector. Digital I/O and interrupt pins are protected from electrostatic discharges of up to ±15 kV (air) and ±8 kV (contact).

An on-board, industry standard 82C55 programmable peripheral interface chip provides the 24 discrete digital I/O lines in three eight-bit ports (Port A, Port B, and Port C) for each board. Port C can be further divided into two four-bit ports (Port C-HI and Port C-LO). You can configure each port independently for either input or output. The PCI-DIO24/S supports 5V or 3.3V TTL/CMOS I/O signaling.

The PCI-DIO24/S has open locations where you can install a pull-up or pull-down resistor for each port. All I/O bits are set to input mode on power up and reset.

The PCI-DIO24/S board is completely plug-and-play, with no jumpers or switches to set. All board addresses are set by your system's plug-and-play software.

Software features

For information on the features of *Insta*Cal and the other software included with your PCI-DIO24/S, 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 http://www.mccdaq.com/download.htm for the latest software version or versions of the software supported under less commonly used operating systems.
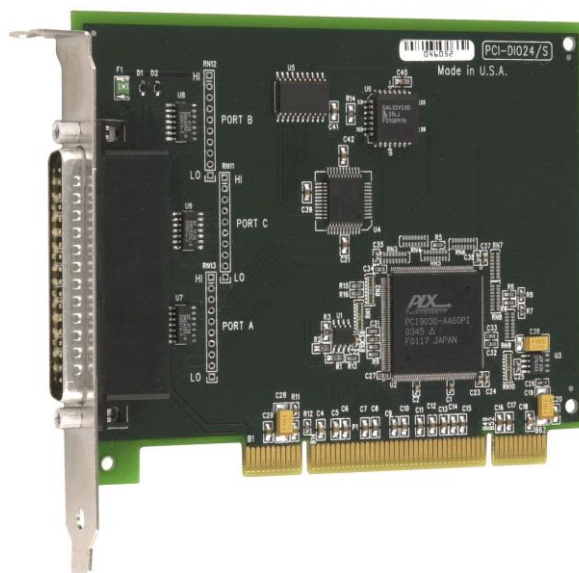
Installing the PCI-DIO24/S

What comes with your PCI-DIO24/S shipment?

As you unpack your board, make sure each of the items shown below is included.

Hardware

- PCI-DIO24/S

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 PCI-DIO24/S and information regarding installation of that software. Please read this booklet completely before installing any software or hardware.

Optional components

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

- Cables

C37FF-x   C37FFS-x

- Signal termination and conditioning accessories

  MCC provides signal termination and conditioning boards that you can use with the PCI-DIO24/S. Refer to the "Field wiring, signal termination and conditioning" section on page 11 for a complete list of compatible accessory products.

Unpacking the hardware

As with any electronic device, you should take care while handling to avoid damage from static electricity. Before removing the PCI-DIO24/S 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-DIO24/S is completely plug-and-play, with no switches or jumpers to set. Configuration is controlled by your system's plug-and-play software. 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 you 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

Table 2-1 lists the board connectors, compatible cables, and compatible accessory products for the PCI-DIO24/S.

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

I/O connector type	CONN37DR male
Compatible cable	C37FFS-*x*, where *x* =5 or 10 feet (Figure 2)
	C37FF-*x*, where x = length in feet (Figure 3)
Compatible accessory products (with the C37FFS-*x* and C37FF-x cables)	CIO-MINI37, CIO-MINI37/DST
	SCB-37
	CIO-ERB24
	CIO-ERB08
	SSR-RACK24
	SSR-RACK08

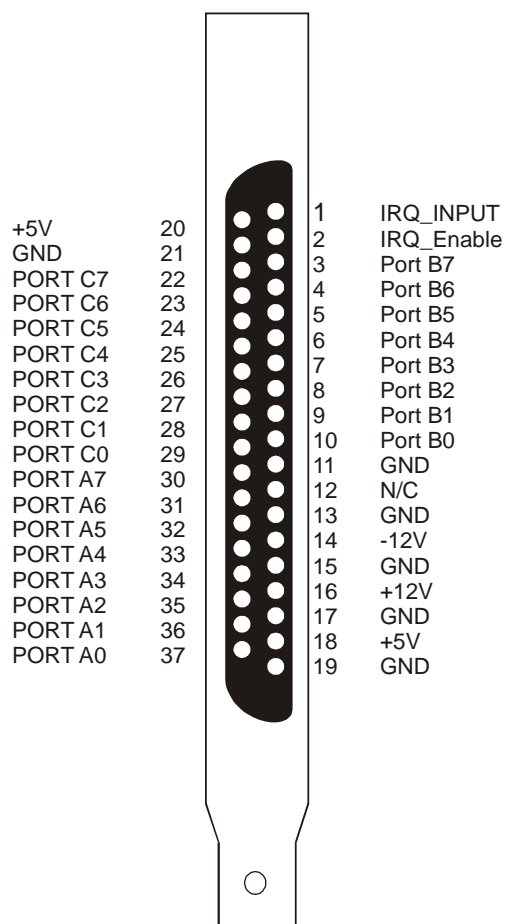## Pin out – main I/O connector

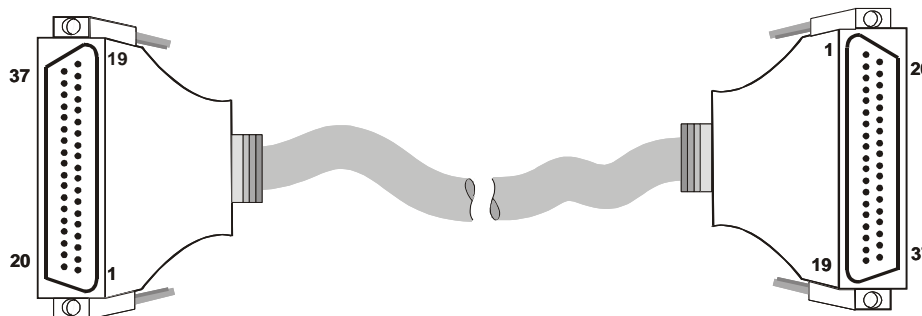Figure 1. PCI-DIO24/S I/O connector pin out
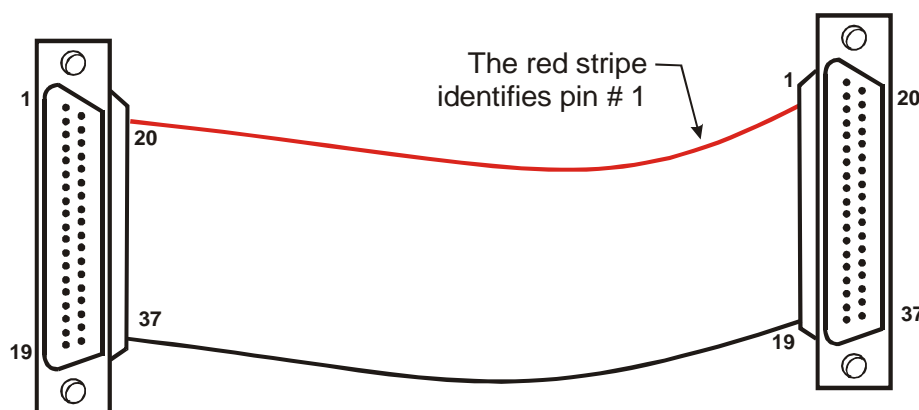
Cables

Figure 2. C37FFS-x cable

Figure 3. C37FF-x cable

Field wiring, signal termination and conditioning

You can connect the PCI-DIO24/S to the following accessory boards using the C37FF-x or C37FFS-x cable:

- CIO-MINI37 — Universal screw terminal board, 37-pin.
- SCB-37 — Signal connection box, 37-conductor, shielded.

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

The following relay racks can be used with the PCI-DIO24/S:

- CIO-ERB24 — 24 Form C, 6A relays.
- CIO-ERB08 — Eight Form C, 6A relays.
- SSR-RACK24 — 24-channel solid state I/O module rack.
- SSR-RACK08 — 24-channel solid state I/O module rack.

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

Functional Details

The PCI-DIO24/S board features the following:

- 82C55 digital I/O chip interfaced to the PCI bus. The I/O pins of an 82C55 are bi-directional CMOS TTL level.
- 24-bits of digital I/O
- 37-pin I/O connector
- Digital I/O and interrupt pins are protected from electrostatic discharges of up to ±15 kV (air) and ±8 kV (contact).

The 82C55 provides the 24-bit digital I/O channels into three eight-bit ports labeled **Port A**, **Port B** and **Port C**. Port C is further divided into two four-bit ports. You can program each port for input or output.

PCI-DIO24/S functions are illustrated in the block diagram shown here.

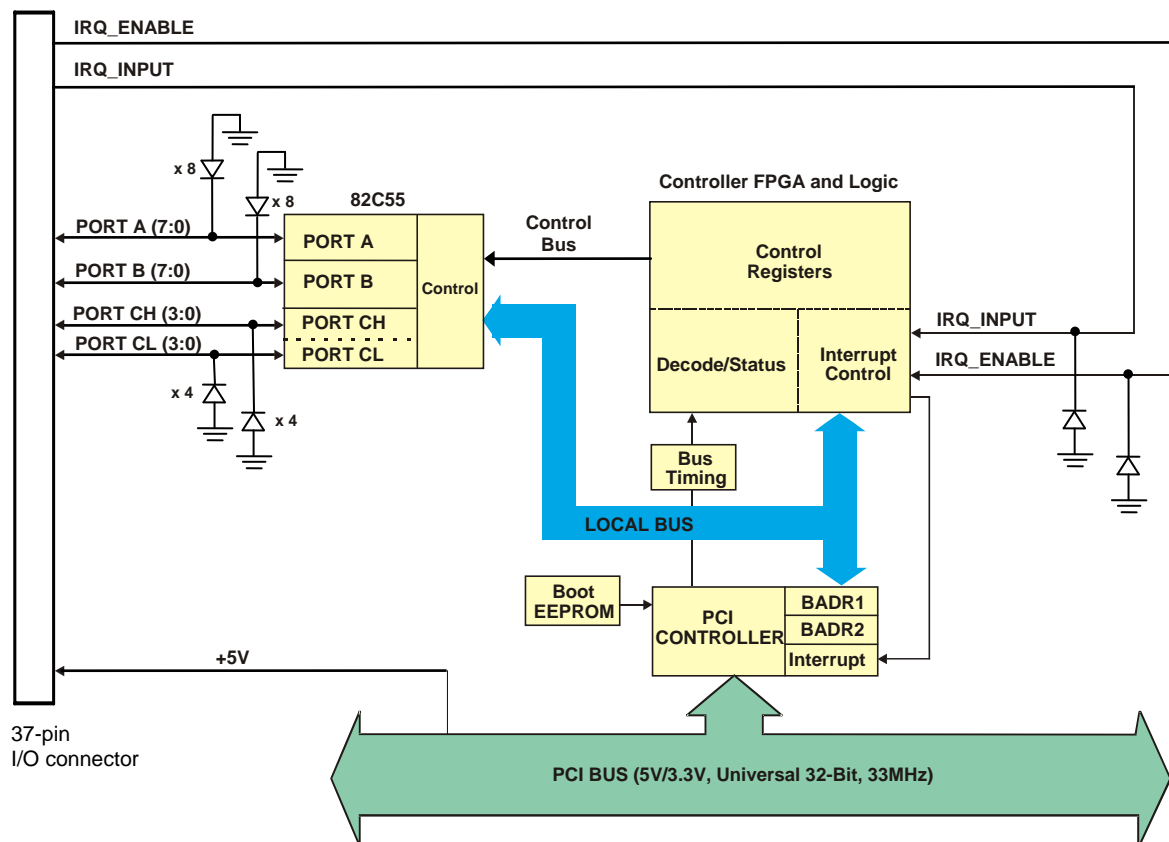Figure 4. PCI-DIO24/S functional block diagram

For more information on digital signal connections

For general information about digital signal connections and digital I/O techniques, refer to the *Guide to Signal Connections* (available on our web site at www.mccdaq.com/signals/signals.pdf).

Caution! Do not connect high current/voltage devices directly to the PCI-DIO24/S or you may damage the board.

Signal level control

All I/O bits are set to a high impedance input mode on power up and reset. To prevent unwanted signal levels, and to drive all outputs on the device you are controlling to a known state after power up or reset, install pull-up or pull-down resistors.

A pull-up resistor pulls all digital pins up to +5 V (high logic level). A pull-down resistor pulls all digital pins down to 0 V (low logic level).

Each board has open locations where you can install a 2.2 KΩ, eight-resistor single inline package (SIP) resistor network for each port. 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 (see Figure 5).
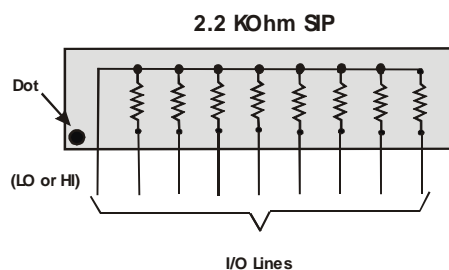
Figure 5. Eight-Resistor SIP Schematic

Each port provides 10 holes. Install an SIP on the board at the locations labeled **Port A**, **Port B** and **Port C** (see Figure 6).

Figure 6. Pull-up/down resistor locations

The end labeled **HI** connects to +5 V. The end labeled **LO** connects to GND. The eight holes in the middle (n0 – n7) connect to the eight lines of the port (Port A, B, or C). Figure 7 shows an SIP resistor network installed in both pull-up and pull-down positions.
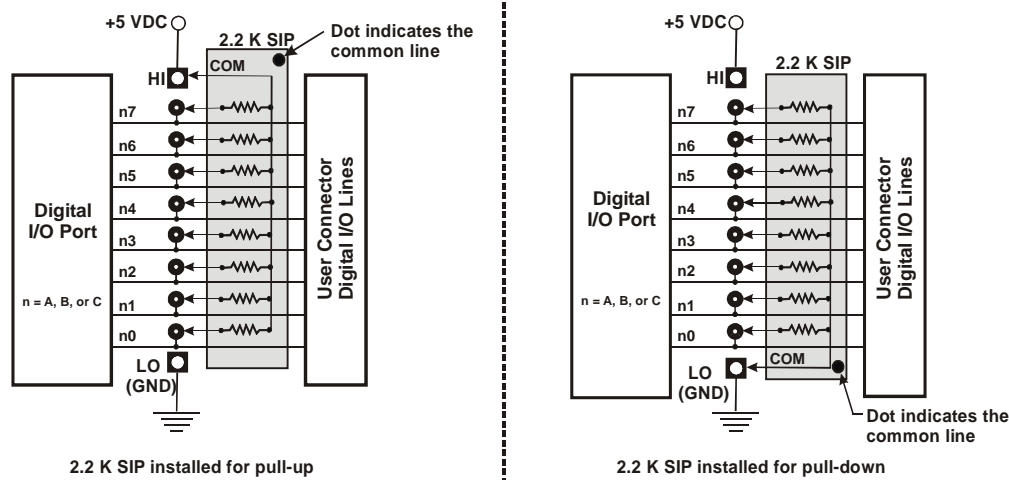
Figure 7. Pull-up and pull-down resistor SIP schematic

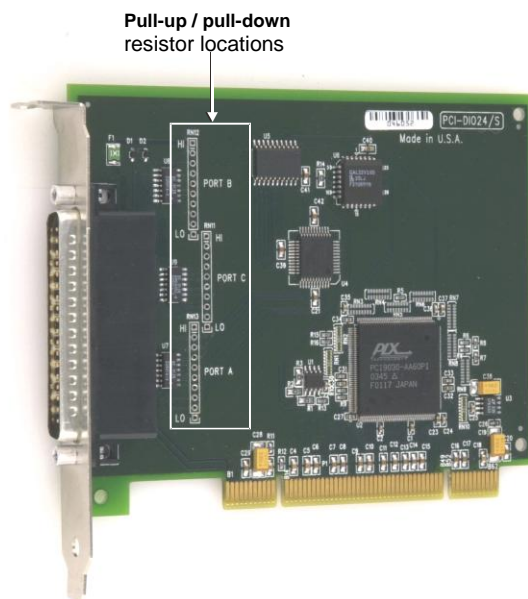To pull up the digital lines for a particular port, install the resistor with the common pin at the **HI** end. To pull down the digital lines for a particular port, install the resistor with the common pin at the **LO** end. When installed, the SIP resistors establish either a high or low logic level for each port when the board is in input mode.

Install MCC SIP packs

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).

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	82C55
Number of I/O	24 (Port A0 through Port C7)
Configuration	2 banks of 8 and 2 banks of 4 or
	3 banks of 8 or
	2 banks of 8 with handshake
Input low voltage	*0.8 V max*
Input high voltage	*2.2 V min*
Output low voltage (IOL = 2.5 mA)	*0.5 V max*
Output high voltage (IOH = -2.5 mA)	*2.4 V min*
Absolute maximum input voltage	*-0.5 V, +6 V*
Power-up / reset state	*Input mode (high impedance)*
Pull-up/pull-down resistors	Dual footprint allows pull-up or pull-down configuration.

Interrupts

Table 2. Interrupt specifications

Interrupts	INTA# - mapped to IRQn via PCI BIOS at boot-time
Interrupt enable	External (IRQ_ENABLE) active low, disabled by default through internal resistor to TTL high and programmable through PLX9030
Interrupt sources	External source (IRQ_INPUT) Polarity programmable through PLX9030 Edge or level triggered programmable through PLX9030 Assertion time: 40 ns min

Power consumption

Table 3. Power consumption specifications

+5 V operating	240 mA typical, 350 mA max. Does not include power consumed through the I/O connector.
+5 V available at I/O connector	300 mA max, protected with a resettable fuse
Resettable fuse	Raychem type *miniSMDC110*. Hold current: 1.1 A max Series resistance 0.21 Ohms max.

Environmental

Table 4. Environmental specifications

Operating temperature range	0 to 70°C
Storage temperature range	-40 to 100°C
Humidity	0 to 95% non-condensing

Mechanical

Table 5. Mechanical specifications

Card dimensions	PCI length: 131.8 mm (L) x 106.7 mm (W) x 18.4 mm (H)
Form factor	Universal PCI keying. Compatible with either 3.3 V or 5 V PCI signaling environments.

I/O pins protection

Table 6. Static discharge protection specifications

DIO lines protected	Port A[7:0], Port B[7:0], Port C[7:0], IRQIN, IRQEN
On board chip	SEMTECH SMDA05C-8, SD05
ESD protection level	*±15 kV (air), ±8 kV (contact)*
DIO maximum voltage	*6V*

Connector and pin out

Table 7. Connector specifications

I/O connector type	CONN37DR male
Compatible cables	C37FF-x, C37FFS-x, x = Length in feet.
Compatible accessories	CIO-MINI37, CIO-MINI37/DST SCB-37 CIO-ERB24 CIO-ERB08 SSR-RACK24 SSR-RACK08

Table 8. Connector pin out

Pin	Signal Name	Pin	Signal Name
1	IRQ_INPUT	20	+5V
2	IRQ_ENABLE	21	GND
3	Port B7	22	Port C7
4	Port B6	23	Port C6
5	Port B5	24	Port C5
6	Port B4	25	Port C4
7	Port B3	26	Port C3
8	Port B2	27	Port C2
9	Port B1	28	Port C1
10	Port B0	29	Port C0
11	GND	30	Port A7
12	N/C	31	Port A6
13	GND	32	Port A5
14	-12V	33	Port A4
15	GND	34	Port A3
16	+12V	35	Port A2
17	GND	36	Port A1
18	+5V	37	Port A0
19	GND		

$C\epsilon$ 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-DIO24/S

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 March, 2009. Test records are outlined in Chomerics Test Report #EMI5299.09.

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

Carl Haapaoja, Director of Quality Assurance