# User's Guide

## PCI-DIO24/S

24-bit, TTL-compatible, Digital I/O Board

On-board Surge Suppression/Protection

**MEASUREMENT COMPUTING**™

# PCI-DIO24/S

## Digital Input/Output

## User's Guide
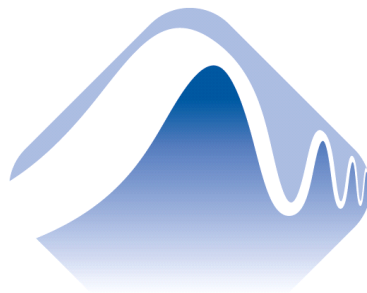
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# Table of Contents

# 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 *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-DIO24/S.

▪ MCC's *Specifications: PCI-DIO24/S* (the PDF version of Chapter 5 in this guide) is available on our web site at www.mccdaq.com/pdfs/PCI-DIO24-S.pdf.
▪ MCC's *Register Map for the PCI-DIO24, PCI-DIO24H, PCI-DIO24/S, and PCI-DIO24/LP* is available on our web site at www.mccdaq.com/registermaps/RegMapPCI-DIO24X.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-DIO24-S.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

The following software ships with the PCI-DIO24/S 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 ships with the PCI-DIO24/S.
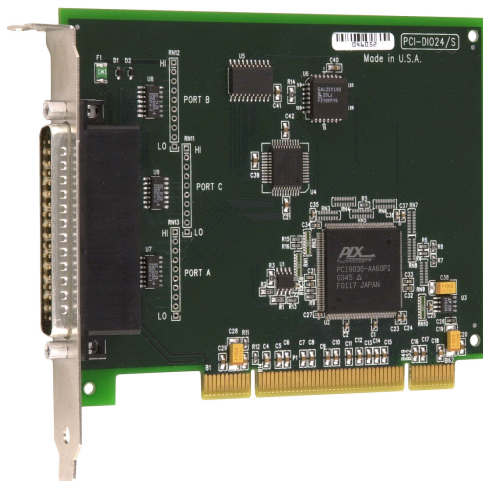
# Installing the PCI-DIO24/S

## 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



### 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



### 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.
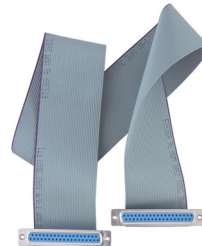
### Universal Library

▪ 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



C37FFS-x                                                      C37FF-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 2-5 for a complete list of compatible accessory products.

# Unpacking the hardware

The PCI-DIO24/S 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 unpainted portion of the computer chassis).

2. Touch the antistatic container to the unpainted portion of 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-DIO24/S are 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.

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**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 you installed in the previous section. Refer to the *DAQ Software Quick Start* that came with your board www.mccdaq.com/PDFmanuals/sm-installation.pdf for instructions 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 2-2) |
| | C37FF-*x*, where x = length in feet (Figure 2-3) |
| 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

| | | | |
|---|---|---|---|
| IRQ INPUT | 20 | 1 | IRQ INPUT |
| GND | 21 | 2 | IRQ Enable |
| PORT C0 | 22 | 3 | Port B0 |
| PORT C1 | 23 | 4 | Port B1 |
| PORT C2 | 24 | 5 | Port B2 |
| PORT C3 | 25 | 6 | Port B3 |
| PORT C4 | 26 | 7 | Port B4 |
| PORT C5 | 27 | 8 | Port B5 |
| PORT C6 | 28 | 9 | Port B6 |
| PORT C7 | 29 | 10 | Port B7 |
| PORT A7 | 30 | 11 | GND |
| PORT A6 | 31 | 12 | -5V |
| PORT A5 | 32 | 13 | GND |
| PORT A4 | 33 | 14 | -12V |
| PORT A3 | 34 | 15 | GND |
| PORT A2 | 35 | 16 | +12V |
| PORT A1 | 36 | 17 | GND |
| PORT A0 | 37 | 18 | +5V |
| | | 19 | GND |
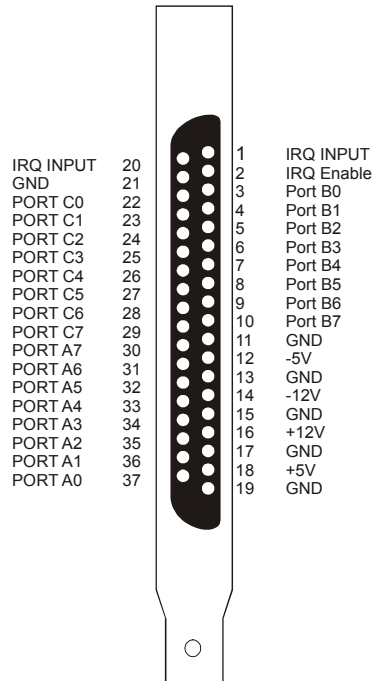
Figure 2-1. Main I/O connector pin out
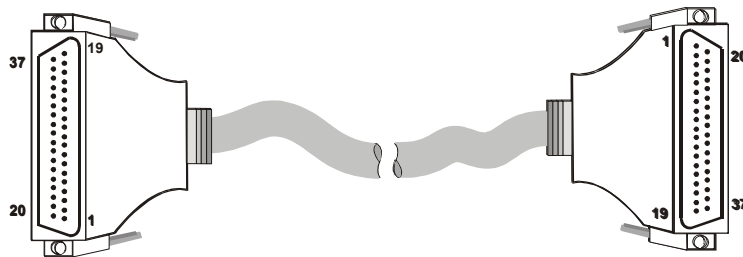
## Cables

Figure 2-2. C37FFS-*x* cable
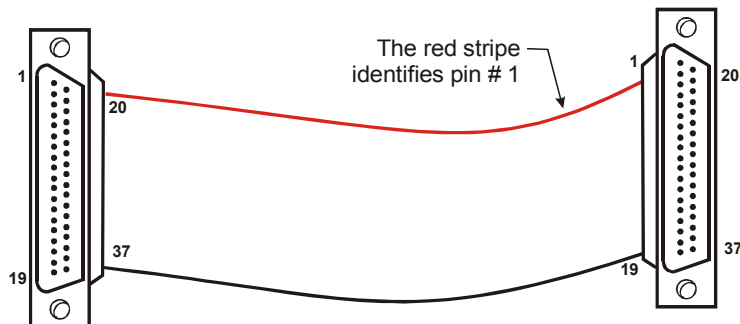
The red stripe identifies pin # 1

Figure 2-3. 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 – 37-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=1543.
- SCB-37 – 37-conductor, shielded signal connection/screw terminal box. Details on this product are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=196&pf_id=1166.
- CIO-ERB24 – 24 Form C, 6A relays. Details on this product are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=123&pf_id=241.
- CIO-ERB08 – Eight Form C, 6A relays. Details on this product are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=123&pf_id=240.
- SSR-RACK24 – 24-channel solid state I/O module rack. Details on this product are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=122&pf_id=1193.
- SSR-RACK08 – 24-channel solid state I/O module rack. Details on this product are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=122&pf_id=620.

# 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 the 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-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.

# 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.

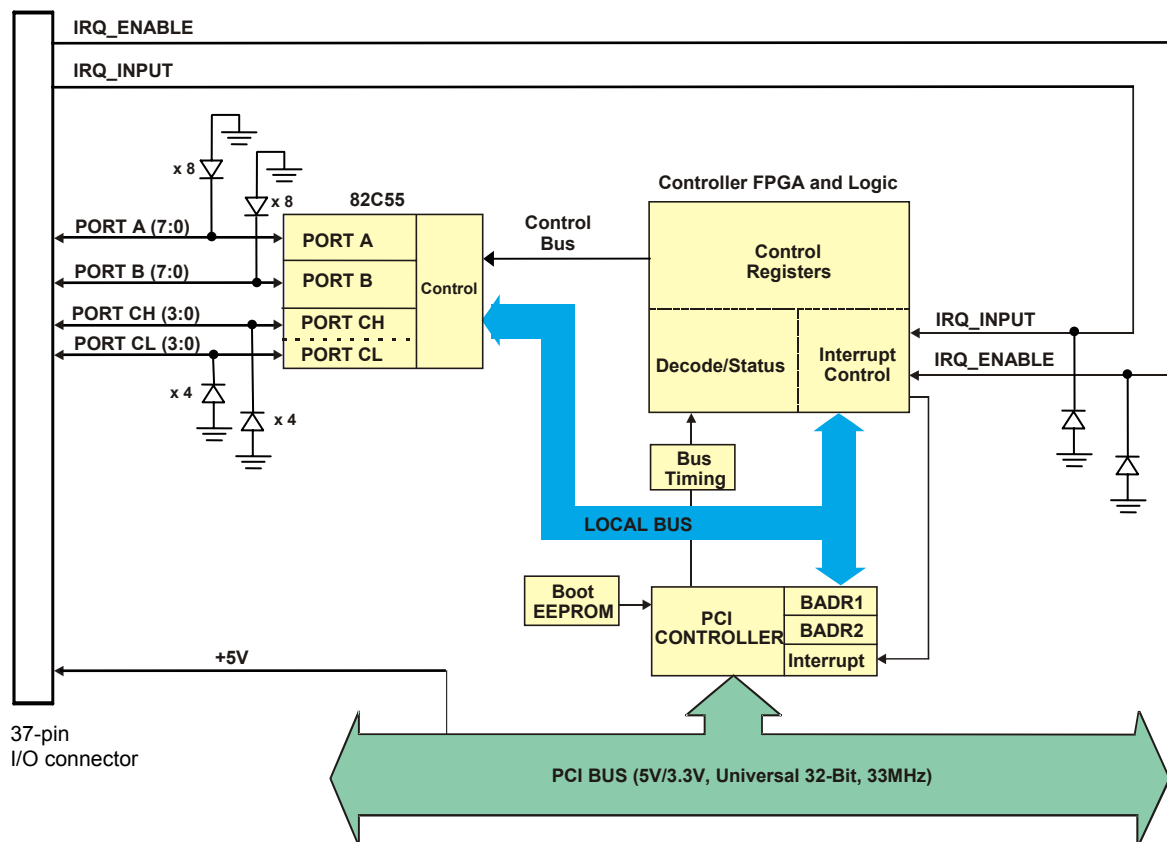PCI-DIO24/S functions are illustrated in the block diagram shown here.



Figure 4-1. PCI-DIO24/S functional block diagram

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**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).

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**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 4-2).
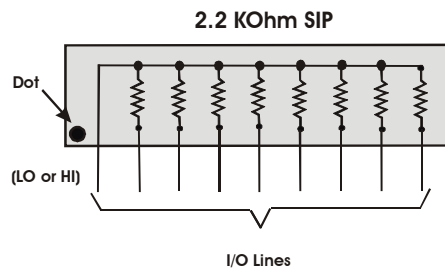


Figure 4-2. Eight-Resistor SIP Schematic

Each port provides 10 holes. Install an SIP on the board at the locations labeled **Port A**, **Port B** and **Port C** (see Figure 4-3).
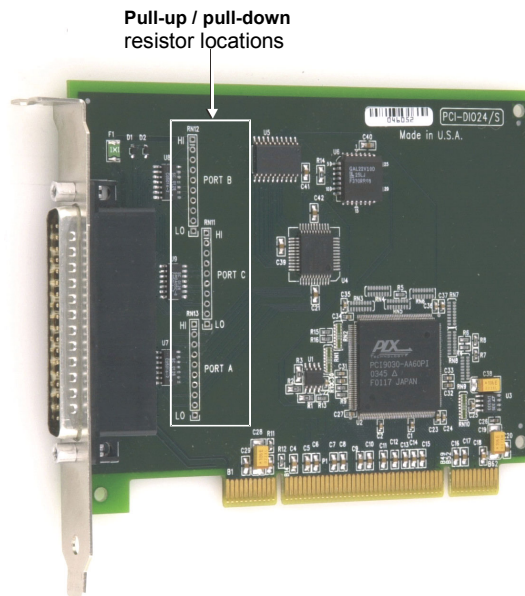


Figure 4-3. Pull-up/down resistor locations

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 4-4 shows an SIP resistor network installed in both pull-up and pull-down positions.
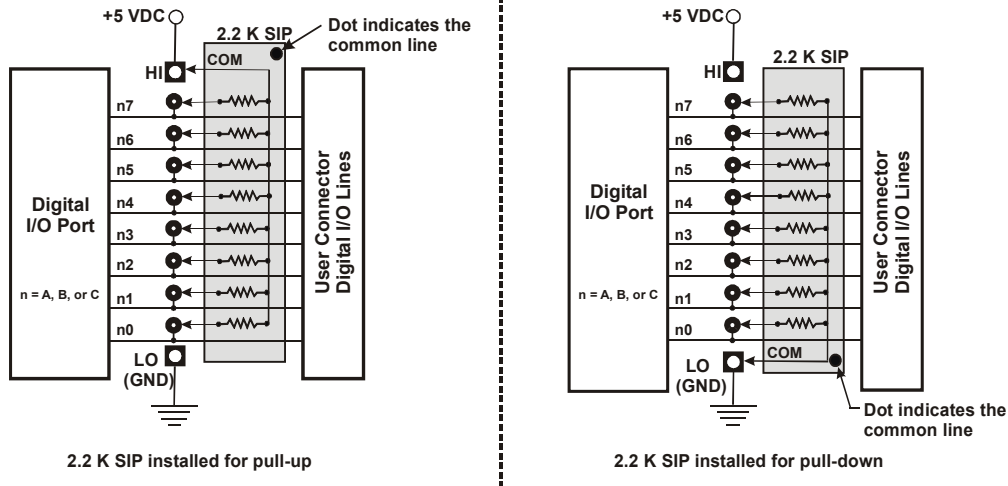
Figure 4-4. Pull-up and pull-down resistor SIP schematic

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 5-1. 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 5-2. 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 5-3. 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 5-4. Environmental specifications

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

## Mechanical

Table 5-5. Mechanical specifications

| Card dimensions | PCI length:<br>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 5-6. 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 5-7. 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<br>SCB-37<br>CIO-ERB24<br>CIO-ERB08<br>SSR-RACK24<br>SSR-RACK08 |

Table 5-8. 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 | | |

# EC Declaration of Conformity

We, Measurement Computing Corporation, declare under sole responsibility that the product

| PCI-DIO24/S | High resolution digital IO board with surge protection 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