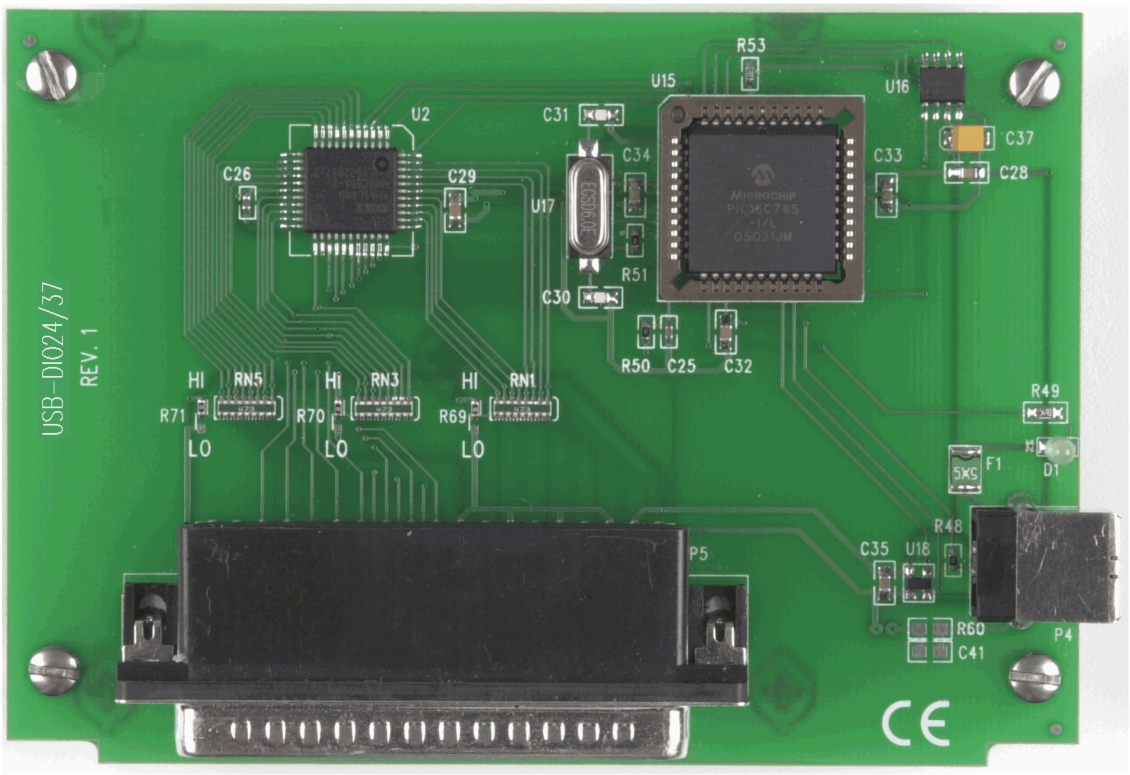
USB-DIO24/37

USB-based, 24-bit digital I/O board

User's Guide



MEASUREMENT COMPUTING™

USB-DIO24/37

Digital Input/Output

User's Guide

Document Revision 3, January, 2011

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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 USB-DIO24/37 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.

bold text — **Bold** text is used for the names of objects on the screen, such as buttons, text boxes, and check boxes.

italic text — *Italic* text is used for the names of manuals and help topic titles, and to emphasize a word or phrase.

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.

Introducing the USB-DIO24/37

Overview: USB-DIO24/37 features

This manual explains how to install, configure and use the USB-DIO24/37 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 USB-DIO24/37 is a USB 2.0 low-speed device supported under popular Microsoft® Windows® operating systems. It is designed for USB 1.1 ports, and is fully compatible with both USB 1.1 and USB 2.0 ports.

The USB-DIO24/37 features 24 bits of digital I/O and one 32-bit external event counter. The device is powered by the +5 volt USB supply. No external power is required. All I/O connections are made to a 37-pin connector. Digital channels are pulled up to +5V with 47 kΩ resistors.

An on-board industry standard 82C55 programmable peripheral interface chip provides the 24 discrete digital I/O lines in four ports. You configure each digital port independently for either input or output.

The USB-DIO24/37 board is completely plug-and-play, with no jumpers or switches to set. All board addresses are set by the system's plug-and-play software.

USB-DIO24/37 block diagram

USB-DIO24/37 functions are illustrated in the block diagram shown here.

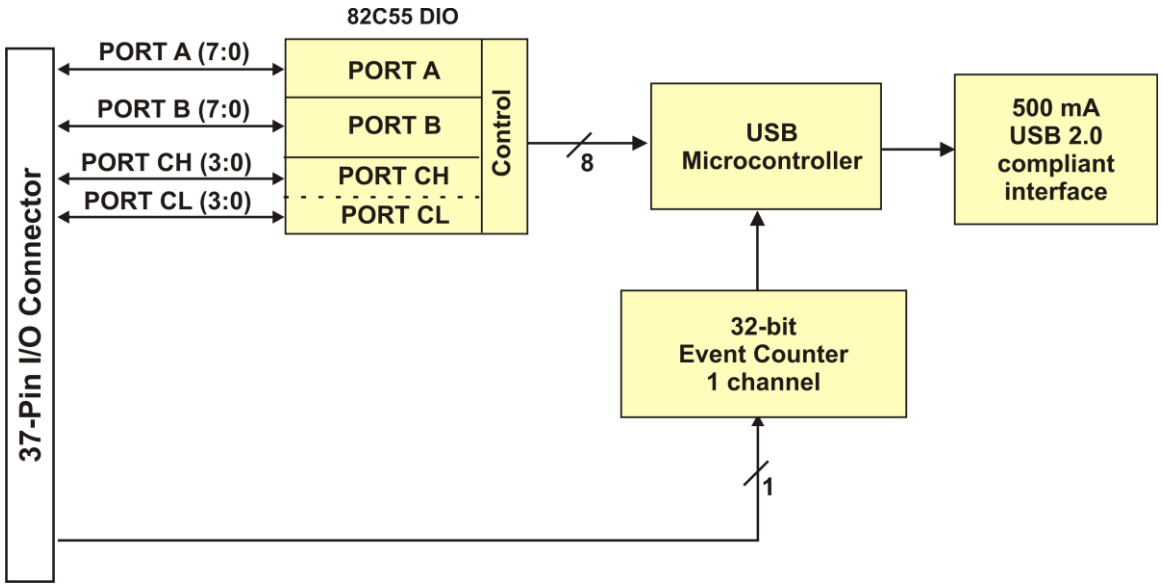


Figure 1. USB-DIO24/37 functional block diagram

Software features

For information on the features of InstaCal and the other software included with your USB-DIO24/37, refer to the *Quick Start Guide* that shipped with your device.

Connecting a USB-DIO24/37 to your computer is easy

Installing a data acquisition device has never been easier.

- The USB-DIO24/37 relies upon the Microsoft Human Interface Device (HID) class drivers. The HID class drivers ship with every copy of Windows that is designed to work with USB ports. We use the Microsoft HID because it is a standard, and its performance delivers full control and maximizes data transfer rates for your USB-DIO24/37. No third-party device driver is required.
- The USB-DIO24/37 is plug-and-play. There are no jumpers to position, DIP switches to set, or interrupts to configure.
- You can connect the USB-DIO24/37 before or after you install the software, and without powering down your computer first. When you connect an HID to your system, your computer automatically detects it and configures the necessary software. You can connect and power multiple HID peripherals to your system using a USB hub.
- You can connect your system to various devices using a standard four-wire cable. The USB connector replaces the serial and parallel port connectors with one standardized plug and port combination.
- Data can flow two ways between a computer and peripheral over USB connections.

Make sure that you have the latest Windows Updates installed for your USB driver, particularly "XP Hotfix KB822603."

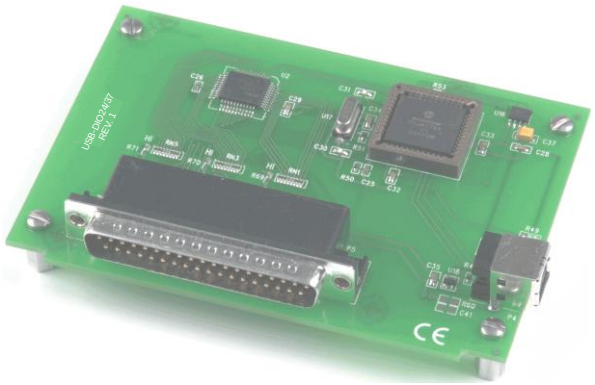
Installing the USB-DIO24/37

What comes with your USB-DIO24/37 shipment?

The following items are shipped with the USB-DIO24/37.

Hardware

- USB-DIO24/37



- USB cable (2 meter length)

Additional Documentation

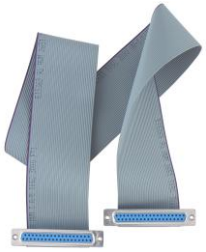
In addition to this hardware user's guide, you should also receive the *Quick Start Guide* (available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf). This booklet supplies a brief description of the software you received with your USB-DIO24/37 and information regarding installation 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

C37FFS-x



C37FF-x

- Signal termination and conditioning accessories

  MCC provides signal termination and conditioning boards for use with the USB-DIO24/37. Refer to the "Field wiring, signal termination and conditioning" section on page 11 for a list of accessory products.

Unpacking the USB-DIO24/37

As with any electronic device, take care while handling to avoid damage from static electricity. Before removing the USB-DIO24/37 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 your USB-DIO24/37 is damaged, notify Measurement Computing Corporation immediately by phone, fax, or e-mail. For international customers, contact your local distributor where you purchased the USB-DIO24/37.

- 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.

Installing the USB-DIO24/37

To connect the USB-DIO24/37 to the system, connect the USB cable to an available USB port on the computer or to an external USB hub connected to the computer.

When you connect the USB-DIO24/37 for the first time, multiple **Found New Hardware** popup balloons open when the operating system detects the device.

When installation is complete, the **USB LED** should flash and then remain lit. This indicates that communication is established between the USB-DIO24/37 and your computer.

If the USB LED turns off

If the USB LED is lit but then turns off, the computer has lost communication with the USB-DIO24/37. To restore communication, disconnect the USB cable from the computer, and then reconnect it. This should restore communication, and the USB LED should turn back *on*.

Caution! Do not disconnect **any** device from the USB bus while the computer is communicating with the USB-DIO24/37, or you may lose data and/or your ability to communicate with the USB-DIO24/37.

Connecting the board for I/O operations

Connectors and cables

The table below lists the board I/O connector type, compatible cables, and compatible accessory products for the USB-DIO24/37.

Board connectors, cables, and accessory equipment

Connector type	37-pin D-type connector	
Compatible cables	C37FF-x unshielded ribbon cable. x = length in feet. C37FFS-x cable shielded round cable. x = length in feet.	
Compatible accessory products (with the C37FFS-x and C37FF-x cables)	SCB-37 CIO-MINI37 CIO-MINI37-VERT CIO-ERB08 CIO-SERB08	CIO-ERB24 CIO-SPADE50 SSR-RACK08 SSR-RACK24

Connector pinout

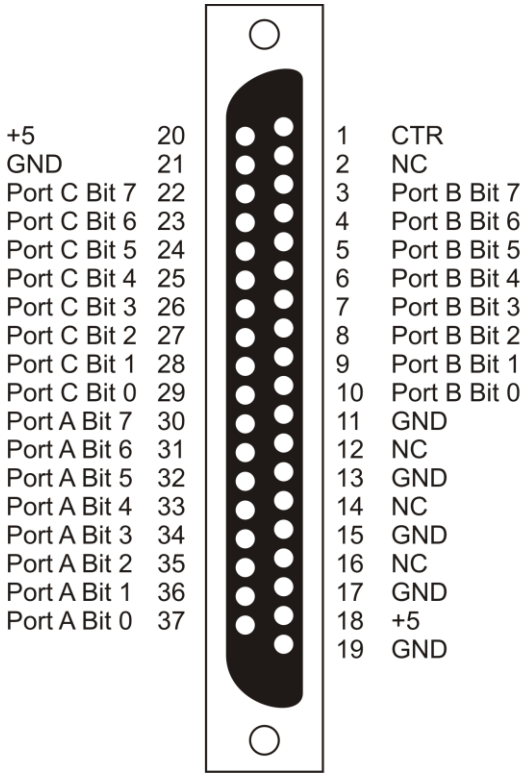


Figure 2. Connector pinout

Cables

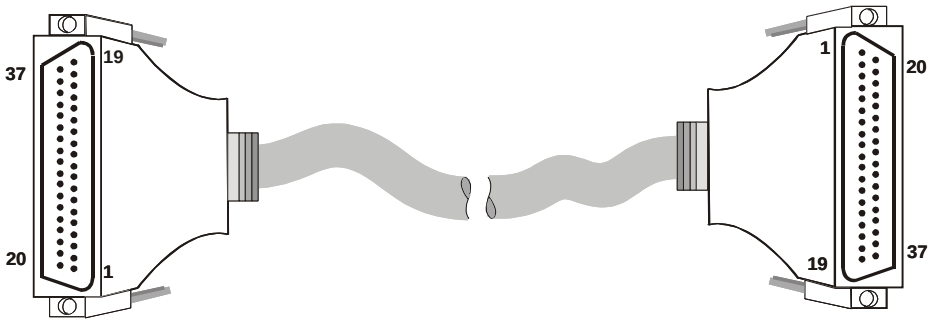


Figure 3. C37FFS-x cable

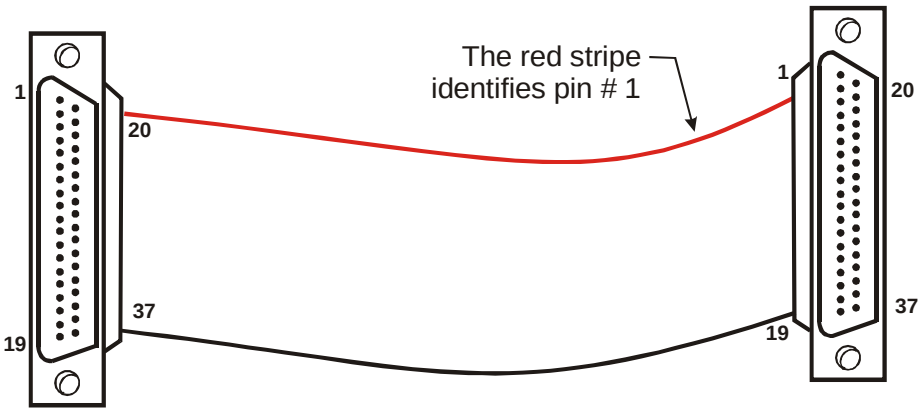


Figure 4. C37FF-x cable

Field wiring, signal termination and conditioning

You can connect the USB-DIO24/37 to the following accessory boards using the C37FF-x or C37FFS-x cable.

- SCB-37 – 37-conductor, shielded signal connection/screw terminal box.
- CIO-MINI37 – 37-pin screw terminal board.
- CIO-MINI37-VERT – 37-pin screw terminal board with vertical 37-pin male D connector.
- CIO-ERB08 – Eight Form C, 6A relays.
- CIO-SERB08 – 8 Form C relays, 10 Amp, relay accessory board with socketed and field-replaceable relays.
- CIO-ERB24 – 24 Form C, 6A relays.
- CIO-SPADE50 — 16" X 4" termination panel which mates with both 37-pin and 50-pin connectors.
- SSR-RACK08 – 24-channel solid state I/O module rack.
- SSR-RACK24 – 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

Components

The USB-DIO24/37 has the following components, as shown in Figure 5.

- 37-pin I/O connector
- USB connector
- LED

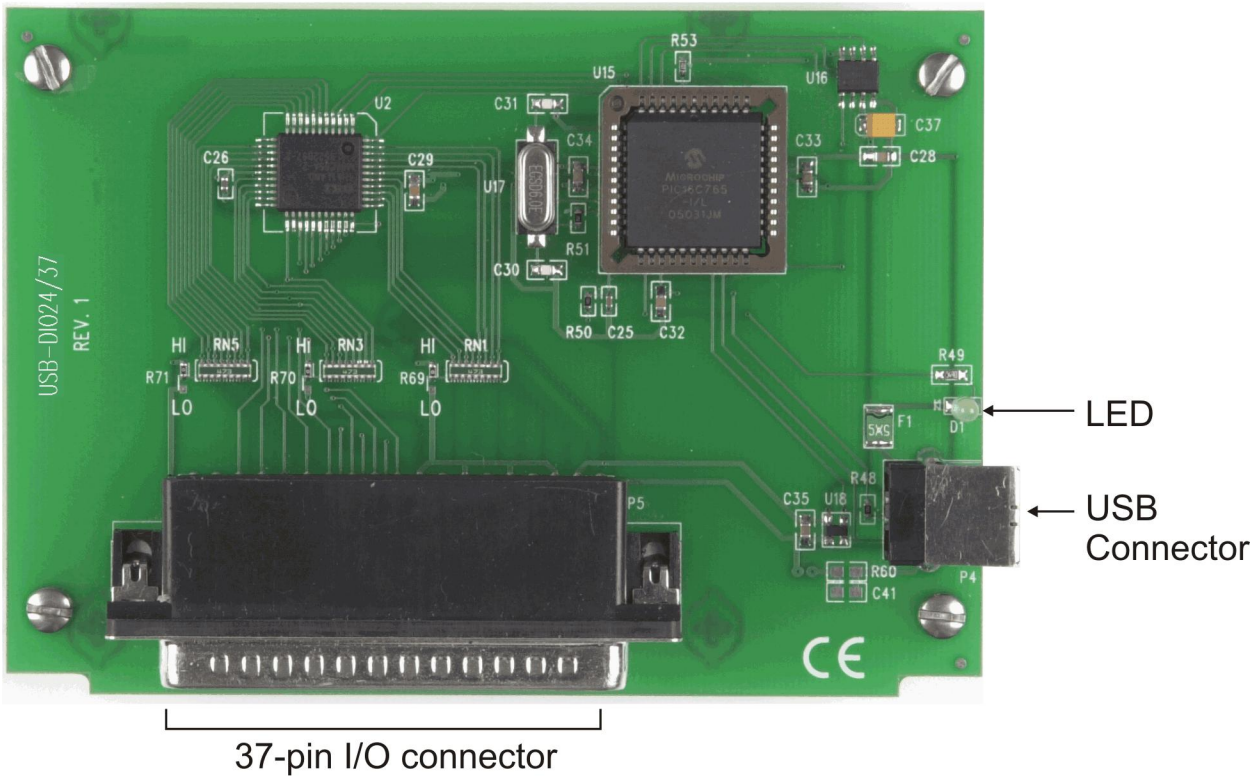


Figure 5. USB-DIO24/37 components

37-pin I/O connector

The 37-pin connector provides 24 digital I/O, one counter, six ground, and two 5V power connections.

- The digital I/O is configured as two 8-bit and two 4-bit ports based on the 82C55 specification. Configure each port independently for input (default) or output.
- The CTR signal is the input to the 32-bit external event counter. The internal counter increments when the digital input level transitions from low to high, and can count frequencies of up to 1 MHz.
- The six ground (**GND**) connections are identical and provide a common ground for all device functions.
- The two power connections draw power from the USB connector. The +5 pin is a +5 volt output that is supplied by the computer.

Caution! The +5 V pin is an output. Do not connect to an external power supply or you may damage the USB-DIO24/37 and possibly the computer

USB connector

The USB connector provides +5 V power and communication. The voltage supplied through the USB connector is system-dependent, and may be less than 5 V. No external power supply is required.

LED

The LED indicates the communication status of the USB-DIO24/37. It uses up to 5 mA of current and cannot be disabled. The table below explains the function of the USB-DIO24/37 LED.

LED Illumination

LED status	Description
Steady green	The USB-DIO24/37 is connected to a computer or external USB hub.
Blinks continuously	Data is being transferred.
Blinks three times	Initial communication is established between the USB-DIO24/37 and the computer.

Pull-up resistors

Each digital port has an internal 47 kΩ pull-up resistor network. All digital pins are pulled up to +5 V (high logic level) on power up and reset.

Power consumption

The maximum total output current that can be drawn from all USB-DIO24/37 connections (power and digital outputs) is 500 mA. This maximum applies to most personal computers and self-powered USB hubs. Bus-powered hubs and notebook computers may limit the maximum available output current to 100 mA.

Once you start running applications with the USB-DIO24/37, each DIO bit can draw up to 2.5 mA. The maximum amount of +5V current available for external use, over and above that required by the USB-DIO24/37, is the difference between the *total current requirement* of the USB-DIO24/37 (based on the application), and the *allowed current draw* of the PC platform (500 mA for desktop PCs and self-powered hubs, or 100 mA for bus-powered hubs and notebook computers).

With all outputs at their maximum output current, you can calculate the total current requirement of the USB-DIO24/37 +5 V as follows:

(USB-DIO24/37 @ 40 mA) + (24 DIO @ 2.5 mA ea) = 100 mA

For an application running on a PC or powered hub, this value yields a maximum user current of 500 mA−100 mA = 400 mA. This number is the total maximum available current at the +5 output pins. Measurement Computing highly recommends that you figure in a safety factor of 20% below this maximum current loading for your applications. A conservative, safe user maximum in this case would be 320 mA.

Since laptop computers typically allow up to 100 mA, the USB-DIO24/37 in a fully-loaded configuration may be above that allowed by the computer. In this case, you must determine the per-pin loading in the application to ensure that the maximum loading criteria is met. The per-pin loading is calculated by simply dividing the +5 V by the load impedance of the pin in question.

Mechanical Drawings

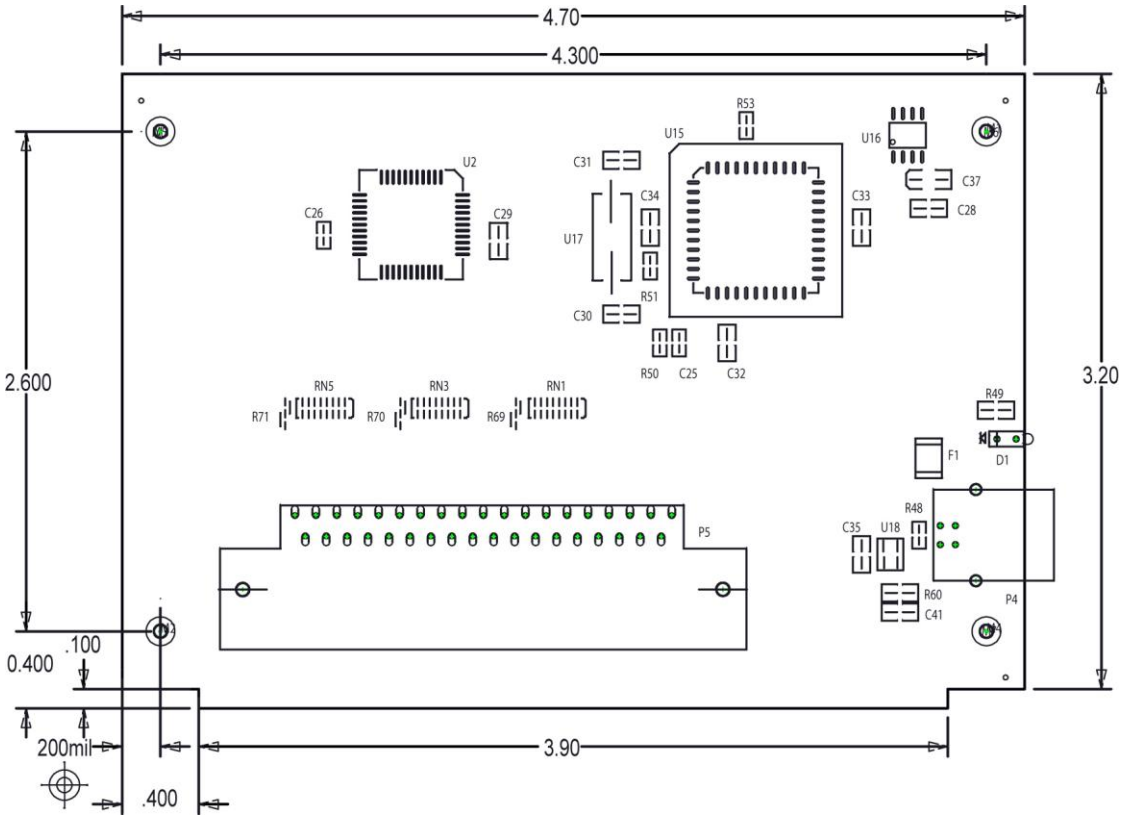


Figure 6. Circuit board dimensions

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 A Bit 0 through Port C Bit7)
Configuration	2 banks of 8 and 2 banks of 4, or
	3 banks of 8
Pull up/pull-down configuration	All pins pulled up to Vs via 47K resistors (default). Selection available for pull down to ground. Hardware selectable via zero ohm resistor.
Input high voltage	2.0 V min, 5.5 V absolute max
Input low voltage	0.8 V max, –0.5 V absolute min
Output high voltage (IOH = -2.5 mA)	3.0 V min
Output low voltage (IOH = -2.5 mA)	0.4V max
Power up / reset state	Input mode

Counter

Table 2. Counter specifications

Pin name (Note 1)	CTR
Counter type	Event counter
Number of channels	1
Input type	TTL, rising edge triggered
Input source	*CTR screw terminal*
Resolution	32 bits
Schmidt trigger hysteresis	*20 mV to 100 mV*
Input leakage current	*±1 µA*
Maximum input frequency	1 MHz
High pulse width	*500 ns min*
Low pulse width	*500 ns min*
Input low voltage	0 V min, 1.0 V max
Input high voltage	4.0 V min, 15.0 V max

Note 1: CTR is a Schmitt trigger input

Data transfer rates

Table 3. Data transfer rate specifications

Digital I/O transfer rates (software paced)	
Digital input	62 port reads or single bit reads per second (typical)
Digital output	125port writes or single bit writes per second (typical)
Counter/timer read/write rates (software paced)	
Counter read	62 port reads per second (typical)
Counter clear	125 port writes per second (typical)

Power

Table 4 . Power specifications

Parameter	**Conditions**	**Specification**
Supply current (Note 2)		20 mA typ, 40 mA max
+5V USB power available (Note3)	Connected to Self-Powered Hub	4.5 V min, 5.25 V max
	Connected to Bus-Powered Hub	4.1 V min, 5.25 V max
Output current (Note 4)	Connected to Self-Powered Hub	460 mA max
	Connected to Bus-Powered Hub	60 mA max

Note 2: This is the total current requirement for the USB-DIO24/37 which includes up to 5 mA for the status LED.

Note 3: Self-powered refers to USB hubs and hosts with a power supply. Bus-powered refers to USB hubs and hosts without their own power supply.

Note 4: This refers to the total amount of current that can be sourced from the USB +5V and digital outputs.

General

Table 5. General specifications

Parameter	**Conditions**	**Specification**
USB controller clock error	*25 °C*	*±30 ppm max*
	0 to 70 °C	*±50 ppm max*
Device type		USB 1.1 low-speed
Device compatibility		USB 1.1, USB 2.0

Environmental

Table 6. Environmental specifications

Operating temperature range	0 to 70 °C
Storage temperature range	-40 to 85 °C
Humidity	0 to 90% non-condensing

Mechanical

Table 7. Mechanical specifications

Dimensions	119 mm (L) x 84 mm (W) x 14 mm (H)
USB cable length	*3 meters max*
USB cable type	*A-B cable, UL type AWM 2527 or equivalent. (min 24 AWG VBUS/GND, min 28 AWG D+/D-)*
User connection length	*3 meters max*

Main connector and pinout

Table 8. Connector specifications

Connector type	37-pin D-type
Compatible cables	C37FF-x unshielded ribbon cable. x = length in feet. C37FFS-x cable shielded round cable. x = length in feet.
Compatible accessory products (with the C37FFS-x and C37FF-x cables)	SCB-37 CIO-MINI37 CIO-MINI37-VERT CIO-ERB08 CIO-SERB08 CIO-ERB24 CIO-SPADE50 SSR-RACK08 SSR-RACK24

Table 9. Connector pinout

Pin	Signal Name	Pin	Signal Name
1	CTR	20	+5
2	NC	21	GND
3	Port B Bit 7	22	Port C Bit 7
4	Port B Bit 6	23	Port C Bit 6
5	Port B Bit 5	24	Port C Bit 5
6	Port B Bit 4	25	Port C Bit 4
7	Port B Bit 3	26	Port C Bit 3
8	Port B Bit 2	27	Port C Bit 2
9	Port B Bit 1	28	Port C Bit 1
10	Port B Bit 0	29	Port C Bit 0
11	GND	30	Port A Bit 7
12	NC	31	Port A Bit 6
13	GND	32	Port A Bit 5
14	NC	33	Port A Bit 4
15	GND	34	Port A Bit 3
16	NC	35	Port A Bit 2
17	GND	36	Port A Bit 1
18	+5	37	Port A Bit 0
19	GND		

CE Declaration of Conformity

Manufacturer: Measurement Computing Corporation
Address: 10 Commerce Way
Suite 1008
Norton, MA 02766
USA

Measurement Computing Corporation declares under sole responsibility that the product

USB-DIO24/37

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, EN 61326 (1997) Amendment 1 (1998)

Emissions: Group 1, Class A

- EN 55011 (1990)/CISPR 11: Radiated and Conducted emissions.

Immunity: EN61326, Annex A

- IEC 61000-4-2 (1995): Electrostatic Discharge immunity, Criteria C.
- IEC 61000-4-3 (1995): Radiated Electromagnetic Field immunity Criteria A.
- IEC 61000-4-8 (1994): Power Frequency Magnetic Field immunity Criteria A.

Declaration of Conformity based on tests conducted by Chomerics Test Services, Woburn, MA 01801, USA in February, 2006. Test records are outlined in Chomerics Test Report #EMI4445.06.

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

Carl Haapaoja, Director of Quality Assurance

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