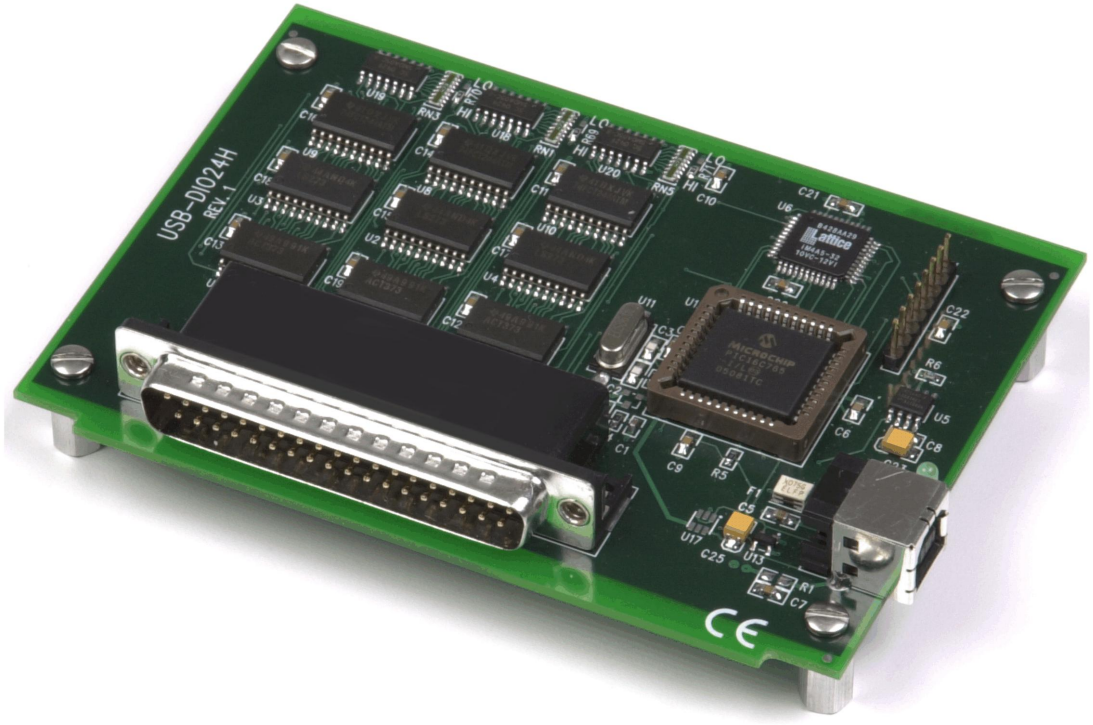
USB-DIO24H/37

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

User's Guide



MEASUREMENT COMPUTING™

USB-DIO24H/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-DIO24H/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-DIO24H/37

Overview: USB-DIO24H/37 features

This manual explains how to install, configure and use the USB-DIO24H/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-DIO24H/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 was tested for full compatibility with both USB 1.1 and USB 2.0 ports.

The USB-DIO24H/37 is a high drive, 24-line digital I/O device that includes one 32-bit external event counter. Power is supplied by the +5 volt USB supply from your computer. No external power is required.

Digital I/O lines are accessed through a 37-pin connector. Each digital port can be configured for either input or output. Digital channels are pulled up to +5V with 47k resistors.

The control register that sets the direction of the I/O ports is an emulation of the 82C55 in mode 0 (only). The 74FCT244 outputs are high-drive TTL, capable of sourcing 15 mA and sinking 64 mA.

The USB-DIO24H/37 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.

USB-DIO24H/37 block diagram

USB-DIO24H/37 functions are illustrated in the block diagram shown here.

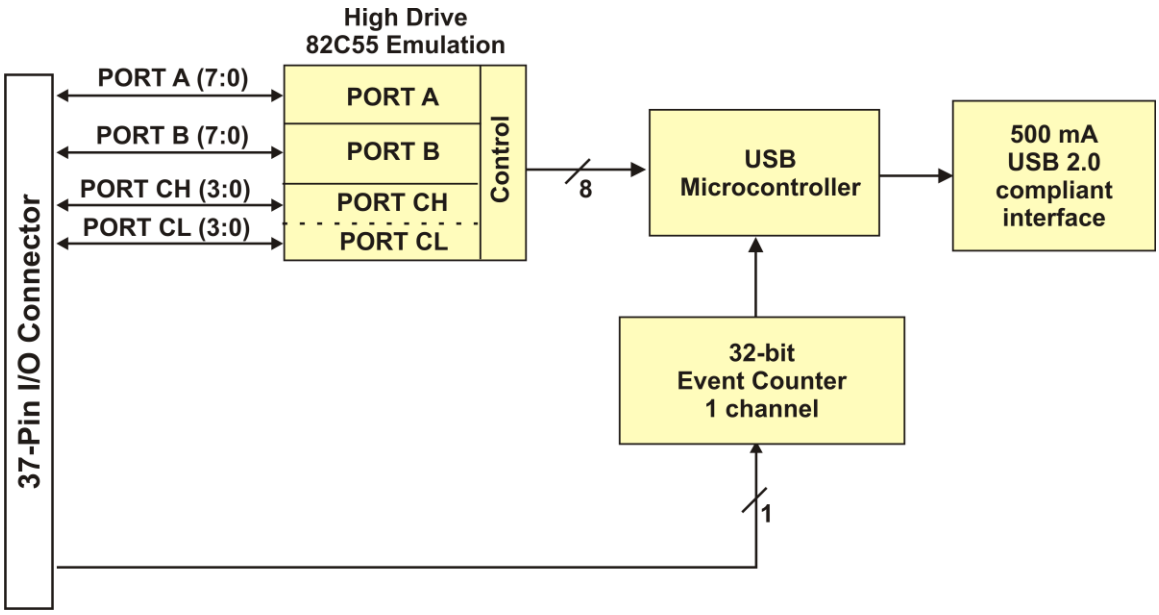


Figure 1. USB-DIO24H/37 functional block diagram

Software features

For information on the features of InstaCal and the other software included with your USB-DIO24H/37, refer to the *Quick Start Guide* that shipped with your device.

Connecting a USB-DIO24H/37 to your computer is easy

Installing a data acquisition device has never been easier.

- The USB-DIO24H/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-DIO24H/37. No third-party device driver is required.
- The USB-DIO24H/37 is plug-and-play. There are no jumpers to position, DIP switches to set, or interrupts to configure.
- You can connect the USB-DIO24H/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."

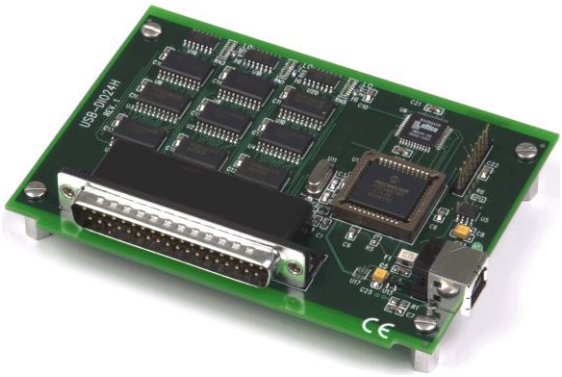
Installing the USB-DIO24H/37

What comes with your USB-DIO24H/37 shipment?

The following items are shipped with the USB-DIO24H/37.

Hardware

- USB-DIO24H/37



- USB cable (2 meter length)

Additional documentation

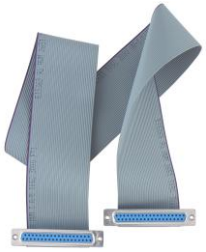
In addition to this hardware user's guide, you should also receive the *Quick Start Guide* (available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf). This booklet supplies a brief description of the software you received with your USB-DIO24H/37 and information regarding installation 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-DIO24H/37. Refer to the "Field wiring, signal termination and conditioning" section on page 11 for a list of accessory products.

Unpacking the USB-DIO24H/37

As with any electronic device, you should take care while handling to avoid damage from static electricity. Before removing the USB-DIO24H/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 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

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-DIO24H/37

Be sure you are using the latest system software

Before you connect the USB-DIO24H/37, make sure that you are using the latest versions of the USB drivers.

Before installing the USB-DIO24H/37, download and install the latest Microsoft Windows updates. In particular, when using Windows XP, make sure you have XP Hotfix KB822603 installed. This update is intended to address a serious error in Usbport.sys when you operate a USB device. You can run Windows Update or download the update from www.microsoft.com/downloads/details.aspx?familyid=733dd867-56a0-4956-b7fe-e85b688b7f86&displaylang=en. For more information, refer to the Microsoft Knowledge Base article "*Availability of the Windows XP SP1 USB 1.1 and 2.0 update.*" This article is available at support.microsoft.com/?kbid=822603.

Connecting the USB-DIO24H/37 to your system

To connect the USB-DIO24H/37 to your 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-DIO24H/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-DIO24H/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-DIO24H/37, or you may lose data and/or your ability to communicate with the USB-DIO24H/37.

Connecting the board for I/O operations

Connectors and cables

The table below lists the board connectors, compatible cables, and compatible accessory products for the USB-DIO24H/37.

Board connectors, cables, and accessory equipment

I/O connector type	37-pin D-type connector	
Compatible cable	C37FFS-x cable shielded round cable. x = length in feet. (Figure 3) C37FF-x unshielded ribbon cable. x = length in feet. (Figure 4)	
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-SPADE-50 SSR-RACK08 SSR-RACK24

Connector pinout

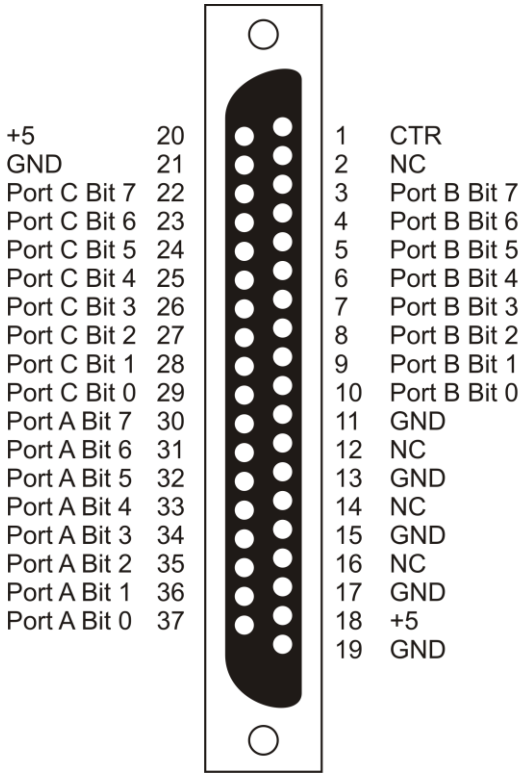


Figure 2. Main I/O connector pinout

Cables

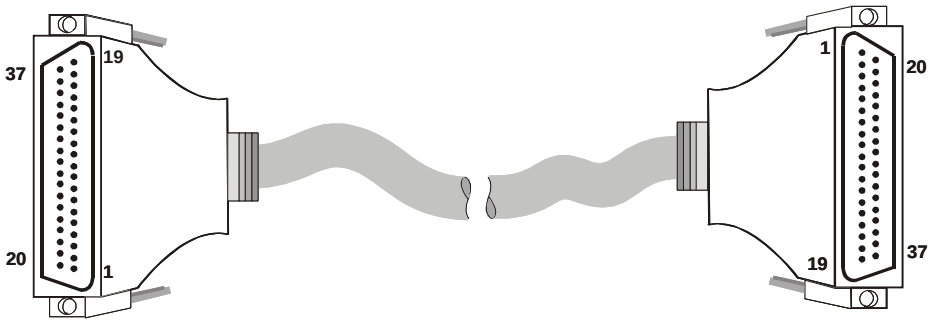


Figure 3. C37FFS-*x* cable

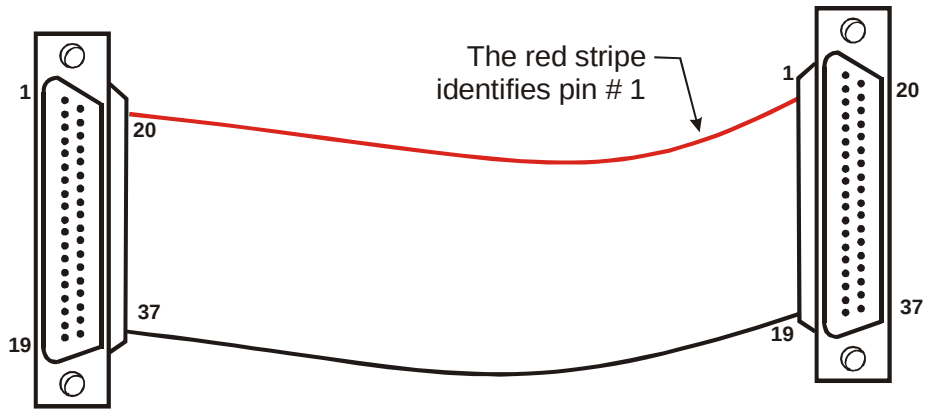


Figure 4. C37FF-*x* cable

Field wiring, signal termination and conditioning

You can connect the USB-DIO24H/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-DIO24H/37 has the following external components, as shown in Figure 5.

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

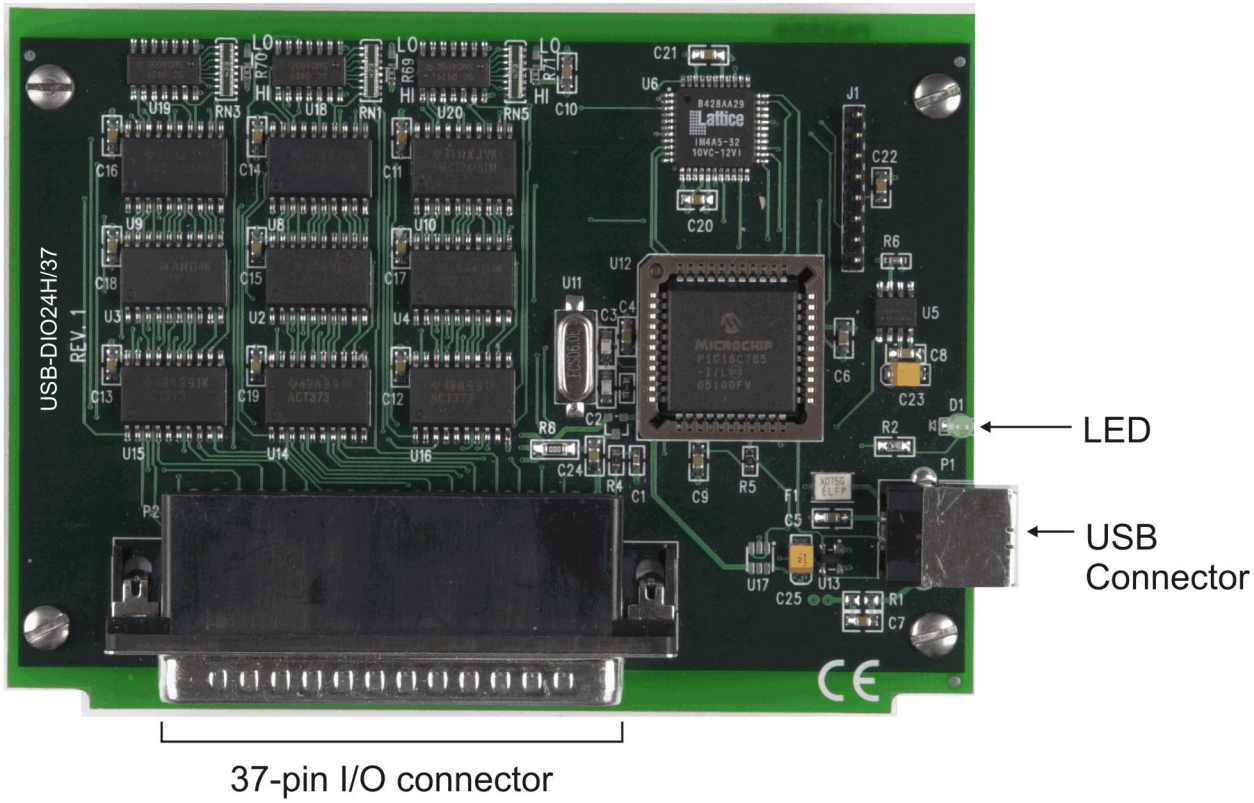


Figure 5. USB-DIO24H/37 components

37-pin I/O connector

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

The digital I/O port is configured as two 8-bit and two 4-bit ports based on an 82C55 mode 0 emulation. You can 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 TTL levels transition from low to high. The counter can count frequencies of up to 1 MHz.

The six ground (**GND**) pins are identical, and provide a common ground for all USB-DIO24H/37 functions.

The two power pins (**+5V**) draw power from the USB connector. Each pin is a +5 volt output that is supplied by the computer.

Caution! The +5 V pins are outputs. Do not connect to an external power supply or you may damage the USB-DIO24H/37 and possibly the computer

When configured for input, you can use the USB-DIO24H/37 digital I/O terminals to detect the state of any TTL level input. Refer to the schematic shown in Figure 6. If you set the switch to the +5 V input, Port A0 reads TRUE (1). If you move the switch to GND, Port A0 reads FALSE.

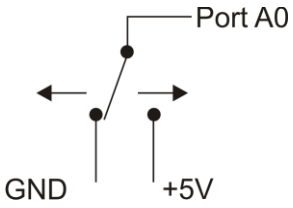


Figure 6. Schematic showing switch detection by digital channel Port A0

For more information on digital signal connections

For more information on 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).

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-DIO24H/37. It uses up to 5 mA of current and cannot be disabled. The table below explains the function of the USB-DIO24H/37 LED.

LED Illumination

LED status	Description
Steady green	The USB-DIO24H/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-DIO24H/37 and the computer.

Pull-up resistors

Each digital port has an internal 47k 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-DIO24H/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. To overcome this limitation, an external self-powered hub can be used to supply the proper current level required for full output capability.

Once you start running applications with the USB-DIO24H/37, each DIO bit can draw up to 15 mA. The maximum amount of +5 V current available for external use, over and above that required by the USB-DIO24H/37, is the difference between the total current requirement of the USB-DIO24H/37 (based on the application), and the *allowed current draw* of the computer platform 500 mA for desktop PCs and self-powered hubs.

The following power limits depend on whether you are sourcing current out of the USB-DIO24H/37, or you are sinking current into the USB-DIO24H/37.

Output (source) current limits

The maximum allowed current draw for a typical desktop computer and self-powered hub is 500 mA. You must account for the supply current drawn from the USB supply for the USB-DIO24H/37 itself, plus the current used by each DIO line. Since each DIO line can output 15 mA maximum, 24 DIO × 15 mA = 360 mA (maximum rating for the chips).

Output (sink) current limits

Each USB-DIO24H/37 DIO output can sink up to 64 mA. For an individual line, this is not a problem. But if you were to apply this maximum load to all 24 DIO lines, you would damage the USB-DIO24H/37 because the total amount of current is well over the maximum for the USB supply.

If you want to sink the maximum of 64 mA per DIO line, you can only do so with up to six lines. To sink current with all 24 DIO outputs at any one time, you can sink a maximum of 18 mA per line.

Mechanical Drawings

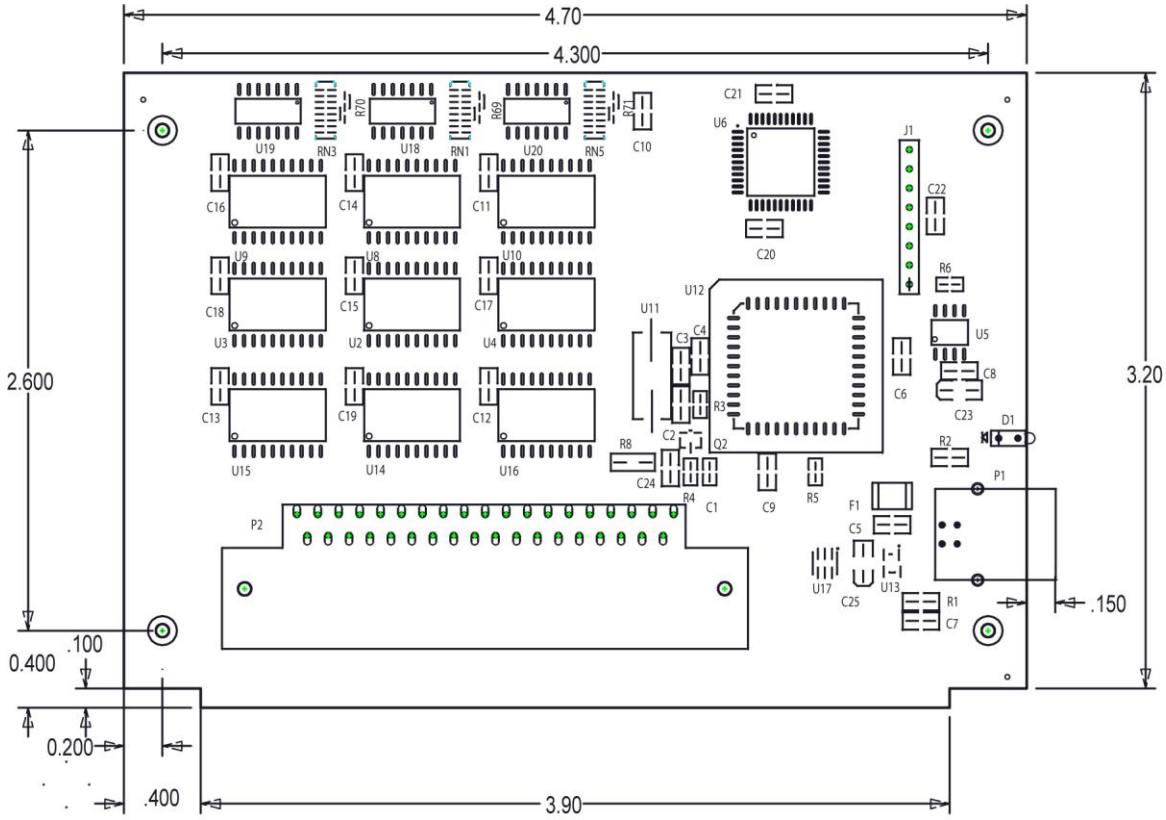


Figure 7. Circuit board dimensions

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 input type	74ACT373
Digital output type	74FCT244
Number of I/O	24 (Port A Bit 0 through Port C Bit 7)
Configuration	2 banks of 8 and 2 banks of 4, or 3 banks of 8
Pull up/pull-down configuration	Internal 47K resistors configured for pull-up to +5 V
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 = -15 mA)	2.4 V min
Output low voltage (IOL=64 mA)	0.55 V max
Source current – (Note 1) Self -powered hub Externally-powered root port hub	Maximum = 15 mA per output
Source current – (Note 2) Bus-powered hub Battery-powered root port hub.	Not supported
Sink current – (Note 3)	Current sink max: 365 mA / [number of outputs]. 64 mA max sink current for any single output.
Power up/reset state	Input mode (high impedance)

Note 1: "Self-powered hub" refers to a USB hub with an external power supply. Self-powered hubs allow a connected USB device to draw up to 500 mA. "Root port hubs" reside in the PC's USB Host Controller. The USB port(s) on your PC are root port hubs. All externally powered root port hubs (i.e. desktop PC's) provide up to 500 mA of current for a USB device. In this configuration, all 24 digital outputs of the USB-DIO24H/37 can source their per-pin maximum of 15 mA. This provides a total requirement of 15 mA*24 = 360 mA. Combining this with the USB-DIO24H/37 operating current of 135 mA a fully-loaded current draw of 495 mA is realized.

Note 2: "Bus-powered hub" refers to a USB hub that derives power directly from the USB +5 V and does not have its own power supply. These hubs allow a connected USB device to draw up to 100 mA. Battery-powered root port hubs provide 100 mA or 500 mA, depending upon the manufacturer. A laptop PC that is not connected to an external power adapter is an example of a battery-powered root port hub. If your laptop is constrained to the 100 mA maximum a USB-DIO24H/37 is not guaranteed to work. In order to use the product you will need to purchase a self-powered hub.

Note 3: A low-side resettable fuse protects the USB-DIO24H/37. This is designed to protect the host PC or hub from an over current condition. Assuming all return currents in sinking applications return via the USB cable ground signal, the maximum allowable return current is 500 mA. Please include the USB-DIO24H/37 unloaded operating current (135 mA) in your power budget.

Counter

Table 2. Counter specifications

Pin name (Note 4)	CTR
Counter type	Event counter
Number of channels	1
Input source	*CTR screw terminal*
Input type	TTL, rising edge triggered
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 4: 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 5)	No Load	100mA typ, 135 mA max
Input power requirements (Note 6)		4.75 V min, 5.25 V max
USB +5 V power available	Measured at "USB +5 V" screw terminals (pins 10, 14, and 30)	4.4 V min, 5.25 V max
USB +5 V power output current (Note 7)	Connected to: ▪ Self-powered hub ▪ Externally-powered root port hub	[350 mA] – [total output source current]
USB +5 V over-current protection	Resettable fuse	Hold current: 350 mA, typical
		Trip current: 700 mA typical
		Trip/recovery time: 100 mS, max
		On resistance: 1.3 Ohms max

Note 5: This is the total (no load) current requirement for the USB-DIO24H/37.

Note 6: Bus-powered hubs are allowed to provide downstream USB power as low as 4.4 V. Although your USB-DIO24H/37 will typically function at this 4.4 V minimum, guaranteed performance requires a minimum power supply voltage of 4.75 V. All self-powered and root port hubs will meet this 4.75 V minimum.

Note 7: Refer to the available source/sink current level listed in the "Digital input/output" section.

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 cable)	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
Category:	Electrical equipment for measurement, control and laboratory use.

Measurement Computing Corporation declares under sole responsibility that the product

USB-DIO24H/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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