QUANSER

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USER MANUAL

Q8-USB Data Acquisition Device

Set Up and Configuration

CAPTIVATE. MOTIVATE. GRADUATE.

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Waste Electrical and Electronic Equipment (WEEE)

This symbol indicates that waste products must be disposed of separately from municipal household waste, according to Directive 2002/96/EC of the European Parliament and the Council on waste electrical and electronic equipment (WEEE). All products at the end of their life cycle must be sent to a WEEE collection and recycling center. Proper WEEE disposal reduces the environmental impact and the risk to human health due to potentially hazardous substances used in such equipment. Your cooperation in proper WEEE disposal will contribute to the effective usage of natural resources. For information about the available collection and recycling scheme in a particular country, go to ni.com/citizenship/weee.

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中国客户 National Instruments 符合中国电子信息产品中限制使用某些有害物质指令 (RoHS)。
关于 National Instruments 中国 RoHS 合规性信息，请登录 ni.com/environment/rohs_china。
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CE Compliance CE

This product meets the essential requirements of applicable European Directives as follows:

- 2006/95/EC; Low-Voltage Directive (safety)
- 2004/108/EC; Electromagnetic Compatibility Directive (EMC)

CONTENTS

1 PRESENTATION

Quanser's Q8-USB Hardware-in-the-Loop (HIL) control board is a high-performance data acquisition and control solution. This robust single-board solution was developed as a portable solution and with a simple installation as an alternative to our equally powerful PCI and PCIe products. When combined with a Power Amplifier and appropriate software, Q8-USB provides an ideal rapid prototyping and Hardware-in-the-Loop development environment. Key features include:

- Functions with QUARC®, LabVIEW™ or custom code.
- No expensive or inflexible DSP used, all processing via CPU.
- Quick-connect terminal board and cabling provided
- Robust metal case
- Watchdog timer for maximum safety and flexibility
- Multiple OS compatibility: Windows XP, Windows Vista, Windows 7
- 500 mA self resettable fuse

Caution: If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Caution: This equipment is designed to be used for educational and research purposes and is not intended for use by the general public. The user is responsible to ensure that the equipment will be used by technically qualified personnel only.

2 SPECIFICATIONS

The feature summary of the Q8-USB data acquisition board (DAQ) are listed below followed by the detailed specifications:

- USB 2.0 Hi-Speed Interface.
- 8 digital inputs.
- 8 digital outputs also configurable as 8 pulse-width modulated (PWM) outputs.
- 8 16-bit analog to digital converters (ADC's) with configurable ranges.
- 8 16-bit digital to analog converters (DAC's) with configurable ranges.
- 8 single-ended encoder inputs with non-quadrature and 4X quadrature decoding with optional filtering, and hardware measured encoder velocities.
- Known state of analog outputs, PWM outputs and digital I/O on power-up or reset.
- Configurable state of analog, PWM and digital outputs on watchdog expiry.
- Duty cycle, frequency, period, one-shot, active pulse time, and encoder emulation PWM modes supported in unipolar, paired and complementary configurations.
- External interrupt, ADC conversion, watchdog lines with configurable polarities.
- Target support for Quanser QUARC® and LabVIEW™ .
- 500 mA self resettable fuse.
- OS Drivers: Microsoft Windows XP, Windows Vista, Windows 7.
- API: C, C++, ActiveX, .NET (Visual Basic, C#, C++ and others), LabVIEW, MATLAB, and Simulink

Analog Input Specifications	Value
Analog Input Specifications Number of Channels	8
Resolution	16-bit
Input Range	$\pm$ 5 V,$\pm$ 10 V
Conversion time for all 8 channels	4 μS[1]
Input impedance	1 MΩ
Max full scale range (FSR) error	$\pm$ 12 LSB,$\pm$ 6 LSB
Input filter bandwidth (-3dB)	15 kHz, 23 kHz

Table 2.1: Q8-USB Analog Input Specifications

[1]The effective conversion time will be limited by the USB communications at a 125µs clock rate
[2]The maximum ADC input range is $\pm$10V so do not connect the DAC's directly to the ADC's when this voltage range is used
[3]Shared with the digital outputs
[4]This is dependent on the frequency selected for the PWM

Analog Output Specifications	Value
Number of Channels	8
Resolution	16-bit
Output Voltage Range	$\pm$10.8 V [2], $\pm$10 V,$\pm$5 V,10.8 V [2], 10 V,5 V
Slew Rate	3.5 V/μS
Integral non-linearity (INL)	$\pm$ 1 LSB
Differential non-linearity (DNL)	$\pm$ 16 LSB
Max full scale range (FSR) error	$\pm$ 65 LSB
Conversion Time (to within FSR error)	10 μ_S [1]
Short-circuit current clamp	20 mA
Max load for specified performance	2 KΩ
Max capacitive load stability	4000 pF
DC output impedance	0.5 Ω

Table 2.2: Q8-USB Analog Output Specifications

Digital Input Specifications	Value
Number of digital I/O Lines	8
Input Low	1.5 V
Input High	3.5 V
Input leakage current	$\pm$ 2 μA

Table 2.3: Q8-USB Digital Input Specifications

Digital Output Specifications	Value
Number of digital I/O Lines	8
Output low (Max at max current)	0.55 V
Output high (Min at max current)	4.5 V
Maximum drive current per pin	$\pm$ 32 mA
Maximum total drive current of all pins	$\pm$ 100 mA

Table 2.4: Q8-USB Digital Output Specifications

Encoder Input Specifications	Value
Number of encoder inputs	8
Input Low	1.5 V
Input High	3.5 V
Input leakage current	$\pm$ 2 μA
Max. A and B frequency in quadrature (no filtering)	24.883 MHz
Max. count frequency in 4X quadrature (no filtering)	99.532 MHz
5V total source current for all 8 encoders (shared with the 5V pin on the control header)	800 mA
Encoder velocities	99.532 MHz

Table 2.5: Q8-USB Encoder Input Specifications

PWM Output Specifications	Value
Number of PWM outputs	8 [3]
Minimum frequency	23.7309 Hz
Maximum frequency	49.766 MHz
Resolution	16 bits [4]
Drive specifications	See digital output specifications

Table 2.6: Q8-USB PWM Output Specifications

Control Header Specifications	Value
+5V source current (shared with with the 5V pins on the encoder connections)	800 mA

Table 2.7: Q8-USB special feature specifications

3 COMPONENTS

3.1 Component Nomenclature

The components on the Q8-USB are depicted in Figure 3.1. Each component on the board has an identification number that corresponds to a short description given in Table 3.1.

ID	Description	ID	Description
1	USB connector	6	Digital output connector
2	Power connector	7	Digital input connector
3	Encoder input connectors	8	Control header
4	Analog output connectors	9	Digital ground lug
5	Analog input connectors	10	Analog ground lug

Table 3.1: Q8-USB Components

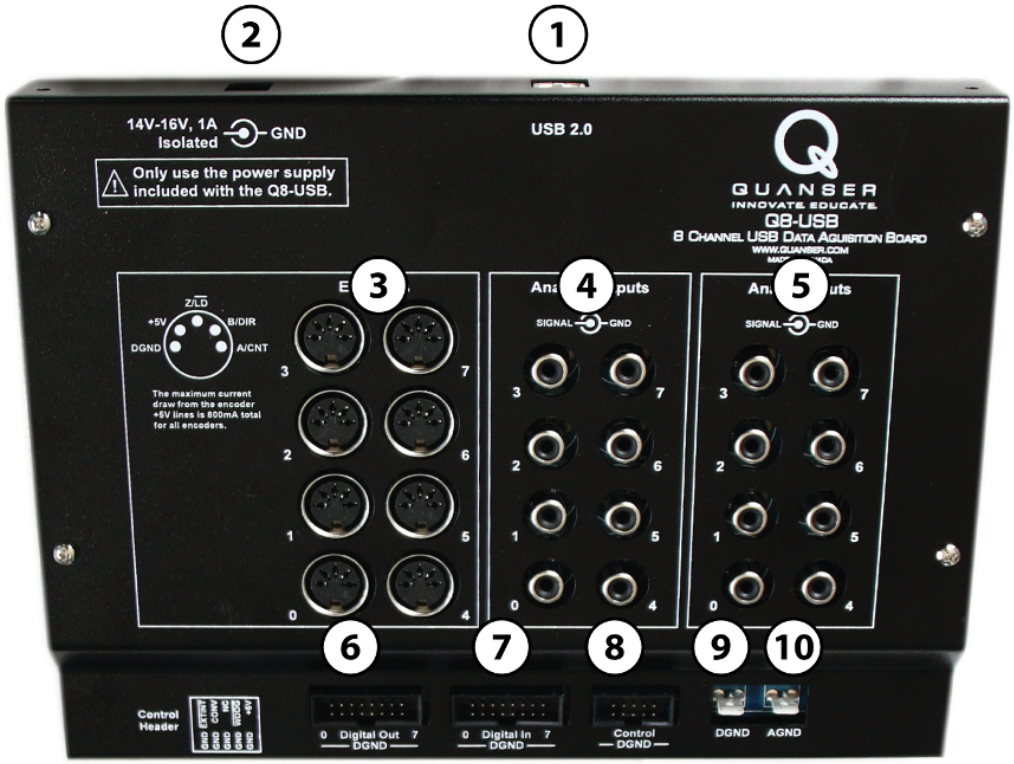


Figure 3.1: Q8-USB

A standard USB Type-B connection is used to connect from the Q8-USB port (ID #1) to a standard USB Type-A on a computer.

Power is connected using the barrel connector (ID #2). **It is highly recommended that you only use the power adapter supplied with the Q8-USB.** Please contact technical support if you need a replacement. **The input is rated for 14V-16V and at least 1A.** Only isolated power supplies such as the one included with the Q8-USB should be used.

Caution: A non-isolated supply can result in ground loops that can damage the Q8-USB and/or the connected computer.

3.2 Component Description

3.2.1 Analog Output

The *Analog Output* RCA connectors are shown in Figure 3.1 with (ID #4). The 12-bit single-ended analog outputs have a range of ±10V at a maximum of 5mA per channel. A 20mA short-circuit clamp is in place for circuit protection. See Section 2 for more specifications.

The center pin of the RCA connection is the signal and the outer shell is ground.

ESD Warning: The analog output is sensitive to electrostatic discharge. Before handling the Q8-USB, make sure you touch something metal to ground yourself. If the analog output stops responding as a result of an electrostatic discharge, cycle the power to restore proper operation.

3.2.2 Analog Input

The Q8-USB has eight *Analog Input* RCA connectors, shown in Figure 3.1 with with ID #5. The 16-bit single-ended analog inputs have a range of ±10V. See Section 2 for more specifications.

The center pin of the RCA connection is the signal and the outer shell is ground.

3.2.3 Digital Output

The *Digital Output* (DO) header, shown in Figure 3.1 with (ID #6) has the pins on one side connected to digital ground, as indicated on the terminal board case. DO0-DO7 output 0V to 5V. Each pin can drive up to 32mA, but the maximum total current for all eight pins cannot exceed 100mA. The digital outputs can also be configured as PWM outputs.

3.2.4 Digital Input

The *Digital Input* (DI) header, shown in Figure 3.1 with (ID #7) has the pins on one side connected to digital ground, as indicated on the terminal board case. DI0-DI7 can input 0V to 5V logic.

3.2.5 Encoder Input

The Q8-USBhas eight 5-pin DIN Encoder Input connectors, Figure 3.1 with #3. Each encoder can provide a 24-bit count values and supports non-quadrature (count and direction) and 4x quadrature.

The encoder pin-out is shown in Figure 3.2 when facing the front of the module. The encoders plus the +5V on the control header can draw a collective total of current up to 800mA at 5V.

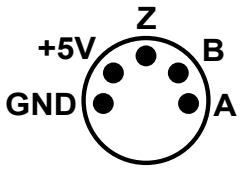


Figure 3.2: Encoder pin-out

3.2.6 Control Header

The control header (ID #8) provides access to the watchdog state, inputs for an external interrupt and to trigger conversions. See Figure 3.3 for pin locations. The details of the pin functions are outlined in Table 3.2.

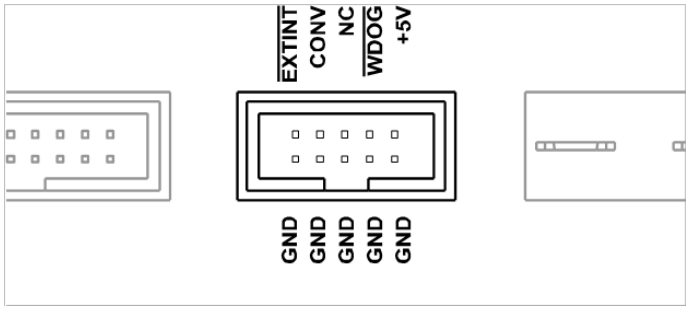


Figure 3.3: The Control Header Pins.

Signal	Full Name	Description
EXTINT	External interrupt	Triggers an interrupt in the model when the configured edge change is detected.
CONV	Convert	Triggers a conversion to synchronize your sample with an external event or as a hardware timebase input depending on the configuration.
NC	No connect	This pin is not connected to any internal circuits.
WDOG	Watchdog	When the watchdog timer expires, this line will go to the configured watchdog expiry state.
+5V	+5V source up to 800mA	This is a 5V source for user circuits. Note that the maximum current is shared with the current drawn by any attached encoders.

Table 3.2: The Control Header Pin Descriptions.

3.2.7 Ground Lugs

The digital ground lug (ID #9) is connected to the digital ground plane. It is provided as a digital ground reference for testing and rapid prototyping purposes. The analog ground lug (ID #10) is connected to the analog ground plane. It is provided as an analog ground reference for testing and rapid prototyping purposes.

4 INSTALLATION

4.1 Hardware Components

The following hardware is necessary to set up the Q8-USB system:

1. Q8-USB Data Acquisition (DAQ) Device, shown in Figure 4.1
2. Power cable, shown in Figure 4.2a
3. Power supply rated between 14-16V and at least 1A, similarly as shown in Figure 4.2b

   Note: Actual supply sent may look different. Regardless, use power supply that was shipped with the Q8-USB.
4. USB 2.0 cable, shown in Figure 4.2c

Figure 4.1: Q8-USB DAQ board

(a) Power cable (b) Power Supply (note: may not be exactly as shown) (c) USB 2.0 cable

Figure 4.2: Power Supply and Cables

4.2 Hardware Installation

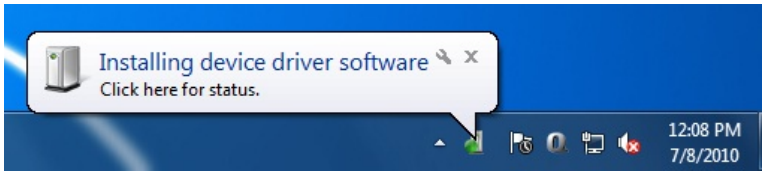
The Q8-USB consists of the DAQ board, a USB 2.0 cable, a power supply, and a power cable.

1. Read all instructions before proceeding.

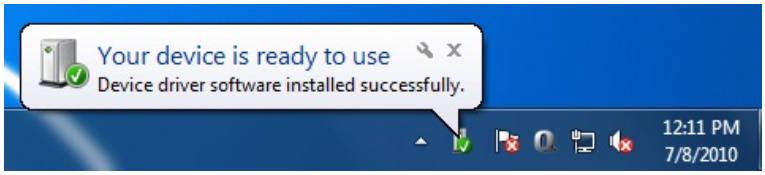
2. Install either LabVIEW™ with NI-DAQmx and Quanser Rapid Control Prototyping Toolkit® or QUARC®. Be sure to accept the installation of any drivers if the installer warns you that they are not signed.
3. **After** the software installation complete, you can plug the DAQ into any USB 2.0 port. For the most consistent sample times, it is preferable to use a USB hub that is not occupied by any other USB devices.
4. Plug barrel connector of the power adapter into the Q8-USB, and the 120V/240V input into a wall outlet
5. Follow the driver installation instructions for your operating system in 4.3.

4.3 Driver Installation for Windows 7

The driver for the Q8-USB is pre-installed during the QUARC Installation or during the Quanser Rapid Control Prototyping Toolkit software installation. After you plug in the device for the first time, a pop-up balloon will indicate that it is searching for the driver.



Upon completion, Windows will notify you that the device is ready for use.



4.4 Q8-USB Software Examples

4.4.1 LabVIEW Users

- Make sure NI-DAQmx and Quanser Rapid Control Prototyping Toolkit® have been installed.
- For the Quanser RCP-related example VIs, go to *Find Examples* in LabVIEW and look under the *Toolkits and Modules* | *Quanser Rapid Control Prototyping* category.

4.4.2 Matlab/Simulink Users

- Make sure QUARC® has been installed.
- Refer to the MATLAB Help page under QUARC Targets/User's Guide/Accessing Hardware. In the HIL Initialize Block, the Board Type will be listed as **q8_usb**.
- Refer to the MATLAB Help pages under QUARC Targets/User's Guide/QUARC Data Acquisition Card Support/Quanser Cards/Q8-USB. [1]

5 TROUBLESHOOTING

Please review the following before contacting Quanser technical support.

Make sure you have setup and tested the Q8-USB as outlined in its **Quick Start Guide** (found on the Q8-USB Resources CD).

- Make sure the correct USB 2.0 cable from the Q8-USB board to an operational and enabled USB 2.0 port connector on the computer is connected.
- Verify that the corresponding cable is firmly connected in both the Q8-USB USB connector and the computer USB port.
- Try a different USB port on the computer.
- Try a diffent USB cable.

6 TECHNICAL SUPPORT

To obtain support from Quanser, go to http://www.quanser.com/ and click on the Tech Support link. Fill in the form with all the requested software and hardware information as well as a description of the problem encountered. Also, make sure your e-mail address and telephone number are included. Submit the form and a technical support person will contact you.

REFERENCES

[1] Quanser Inc. *QUARC User Manual*.

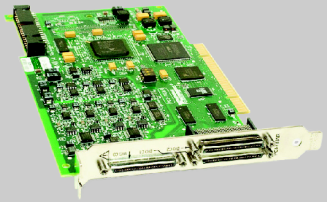
Data acquisition and control interface solutions for education and research

Q8-USB

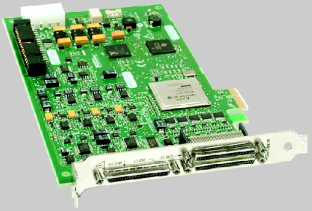
Q2-USB

NI Terminal Board

QPID



QPIDe



Q1-cRIO

Quanser's range of data acquisition and control solutions includes PCI and USB-based boards and the NI CompactRIO-based data acquisition module. These devices offer unmatched convenience and performance for controls system design and implementation. To learn more about which devices can best support your teaching or research needs, please contact info@quanser.com.

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