



USER MANUAL

Q1-cRIO Data Acquisition Device

Set Up and Configuration



CAPTIVATE. MOTIVATE. GRADUATE.

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FCC NOTICE

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Industry Canada Notice

This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

Japan VCCI Class A Statement

This is a Class A product based on the standard of the Voluntary Control Council for Interference (VCCI). If this equipment is used in a domestic environment, radio interference may occur, in which case the user may be required to take corrective actions.

この装置は、クラス A 情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。

VCCI-A

Korea Communications Commission (KCC) Class A Statement

This equipment is Industrial (Class A) electromagnetic wave suitability equipment and seller or user should take notice of it, and this equipment is to be used in the places except for home.

이 기기는 업무용(A급) 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바랍니다. 가정외의 지역에서 사용하는 것을 목적으로 합니다.

CE Compliance

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)

电子信息产品污染控制管理办法（中国 RoHS）



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关于National Instruments 中国 RoHS合规性信息, 请登录 ni.com/environment/rohs_china
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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.

CONTENTS

1	Presentation	4
1.1	Description	4
2	Components	5
2.1	Q1-cRIO Component Nomenclature	5
2.2	Component Description	6
3	Q1-cRIO Specifications	7
4	Installation	9
4.1	Hardware Installation	9
4.2	Software Installation	9
5	Troubleshooting	10
6	Technical Support	11

1 PRESENTATION

1.1 Description

The Quanser Q1-cRIO, pictured in Figure 1.1, is a data acquisition module for the National Instruments cRIO devices. It is designed to easily interface into Quanser amplifiers and experiments. The Q1-cRIO provides a single analog output, a single analog input, and two encoder inputs. With a single module combined with an amplifier and cRIO chassis and processor, almost half of the Quanser products can be utilized. With two modules, the majority of Quanser experiments can be used.



Figure 1.1: Quanser Q1-cRIO



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 COMPONENTS

The Q1-cRIO components are identified in Section 2.1. Some of those components are then described in Section 2.2.

2.1 Q1-cRIO Component Nomenclature

The Q1-cRIO components listed in Table 2.1 below are labeled in Figure 2.1.

ID	Component
1	Analog Output connector
2	Analog Input connector
3	Encoder Input 0 connector
4	Encoder Input 0 connector
5	Power Input connector

Table 2.1: Q1-cRIO Components

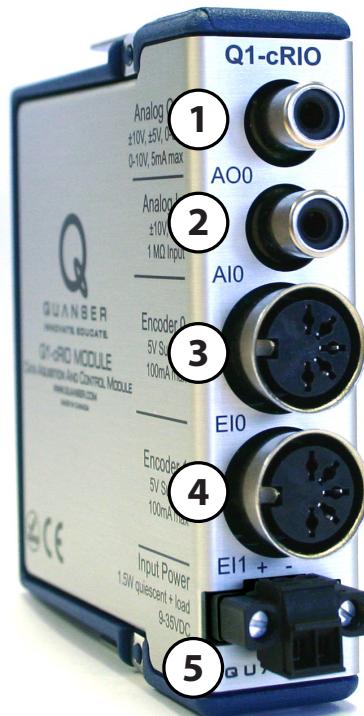


Figure 2.1: Q1-cRIO Components - Front Panel

2.2 Component Description

2.2.1 Analog Output

The *Analog Output* RCA connector is shown in Figure 2.1 with ID #1. Upon applying power to the cRIO, the analog output will default to the ± 10 V range. The available ranges are listed in Section 3.

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 Q1-cRIO, 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.

2.2.2 Analog Input

The Q1-cRIO has an RCA *Analog Input* connector, shown in Figure 2.1 with ID #2. The available ranges are listed in Section 3.

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

2.2.3 Encoder Inputs

The Q1-cRIO has two 5-pin DIN *Encoder Input* connectors, shown in Figure 2.1 with ID #3 and #4. Each encoder can provide a 24-bit position, a 24-bit velocity, and a 24-bit index position of the last index position recorded. The initial encoder count can be specified. The encoder can also be configured to reload the intial encoder count on an index pulse, define on what edges of A, B, and Z (index) are used for the index pulse, utilize encoder filtering, set the count direction, and change between 4x quadrature and non-quadrature modes.

The encoder pin-out on the Q1-cRIO is shown in Figure 2.2 when facing the front of the module.

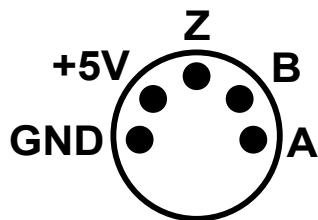


Figure 2.2: Encoder pin-out as seen from the front of the Q1-cRIO module.

2.2.4 Power Input

The Q1-cRIO has a 2-pin *Power Input* terminal connector, shown in Figure 2.1 with ID #5. The recommended mating terminal connector is a Phoenix Contact part number 1714977 (shown in Figure 2.3) using wiring in the range of 26 to 16 AWG.



Figure 2.3: Phoenix terminal connector

Within the voltage range listed in Section 3, the inputs provide reverse input protection. The input power will be isolated from the rest of the module until the correct polarity is applied (the correct polarity is indicated on the case just above the power connector). It is recommended that all connections be made to the module prior to powering.

3 Q1-CRIO SPECIFICATIONS

Table 3.1 lists the environmental specifications and Table 3.2 lists the DC power input requirements for the Q1-cRIO. The analog input specifications are given in Table 3.4, the analog output specifications are given in Table 3.5, and the encoder specifications are listed in Table 3.3.

Environmental Specifications	Value
Indoor use only	
Maximum Altitude	2000 m
Temperature	-40 - 55 °C
Poluton Degree	2

Table 3.1: Environmental Specifications

DC Input Specifications	Value
Input Voltage Range	9.0 VDC - 30 VDC
Input Power (Unloaded)	500mW
Input Power (Fully Loaded)	2000mW
Module Thermal Dissipation (Fully Loaded)	800mW

Table 3.2: DC Input Specifications

Encoder Input Specifications	Value
Encoder Counter Size	24 bits
Encoder Velocity Counter Size	24 bits
Maximum Signal Voltage	+5.3 V
Typical Source Voltage	5.0 V
Maximum Current per Encoder	100 mA
Positive-Going Threshold	1.4 V - 2.4 V
Negative-Going Threshold	0.7 V - 1.4 V
Maximum A and B Frequency (No Filtering) in Quadrature	2.5 MHz
Maximum A and B Frequency (Filtering) in Quadrature	1.25 MHz
Maximum 4x Quadrature Frequency (No Filtering)	10 MHz
Maximum 4x Quadrature Frequency (Filtering)	5 MHz
ESD Protection	±8 kV

Table 3.3: Encoder Input

Analog Output Specifications	Value
Resolution	16 bits
Maximum Total Unadjusted Error	$\pm 0.3\%$ FSR
Maximum Integral Nonlinearity	± 16 LSB
Maximum Differential Nonlinearity	± 1 LSB
Maximum Gain Error ($\pm 10V$ range)	5 mV
Maximum Gain Error ($\pm 5V$ range)	80 mV
Maximum Gain Error ($+10V$ range)	13 mV
Maximum Gain Error ($+5V$ range)	6.5 mV
Maximum DC Output Impedance	0.5Ω
Maximum Capacitive Load Stability	4000 pF
Maximum Output Current	10 mA
Short Circuit Current (Clamped)	20 mA
Maximum Output Voltage Settling Time	$12 \mu s$
Typical Slew Rate	$3.5 V/\mu s$
Typical Output Noise	80 μV RMS
Configurable Voltage Ranges	$\pm 5V, \pm 10V, \pm 10.8V, +5V, +10V, +10.8V$
Default Voltage Range	$\pm 10V$
Output Glitch on Power Up	-0.04V, 40 μs
ESD Protection	$\pm 8 kV$

Table 3.4: Analog Output Specifications

Analog Input Specifications	Value
Resolution	16 bits
Typical Signal to Noise Ratio ($\pm 5V$)	89 dB
Typical Signal to Noise Ratio ($\pm 10V$)	90 dB
Typical Total harmonic Distortion	-107 dB
Typical Input Filter -3dB ($\pm 10V$)	23 kHz
Typical Input Filter -3dB ($\pm 5V$)	15 kHz
Typical Input Filter -0.1dB ($\pm 10V$)	10 kHz
Typical Input Filter -0.1dB ($\pm 5V$)	5 kHz
Typical Total Unadjusted Error ($\pm 10V$)	± 6 LSB
Typical Total Unadjusted Error ($\pm 5V$)	± 12 LSB
Maximum Integral Nonlinearity	± 2 LSB
Maximum Differential Nonlinearity	± 1 LSB
Track and Hold Acquisition Time	1 μs
Conversion Time	4 μs
Typical Input Impedance	$1 M\Omega$
Configurable Voltage Ranges	$\pm 5 V, \pm 10 V$
Default Voltage Range	$\pm 10 V$
Maximum Input Voltage	$\pm 15 V$
ESD Protection	$\pm 8 kV$

Table 3.5: Analog Input Specifications

4 INSTALLATION

4.1 Hardware Installation

The Q1-cRIO consists of the DAQ module and a pluggable terminal block.

1. Read all instructions before proceeding.
2. Touch any metal part of the computer to discharge any static electricity.
3. Remove the pluggable terminal block from the Q1-cRIO module. If it does not pull straight out, you may need to use a flat-head screw driver to loosen the two screws on either side of the power connector.
4. After removing the insulation from the ends of two wires, connect the wires from a power supply to the pluggable terminal block. A flat-head screw driver should be used on the screws on the top of the terminal block to tighten the wires in place. The screws should only be tightened enough to ensure that the wires will not pull out easily. Also ensure that the connected power supply is within the voltage range specified in Section 3 and provides sufficient power to meet your load requirements. (Note that you may use a common power supply to power both the cRIO and the Q1-cRIO module.)
5. Insert the Q1-cRIO module into the cRIO chassis.
6. Attach the analog input, analog output, and encoder connections as required.
7. Attach the pluggable terminal connector.
8. Apply power either 1) to the cRIO chassis and the Q1-cRIO module at the same time, or 2) to the cRIO chassis first, followed by the Q1-cRIO module.

The Q1-cRIO modules can utilize a single power supply by daisy-chaining them with the cRIO power supply as shown in Figure 4.1.

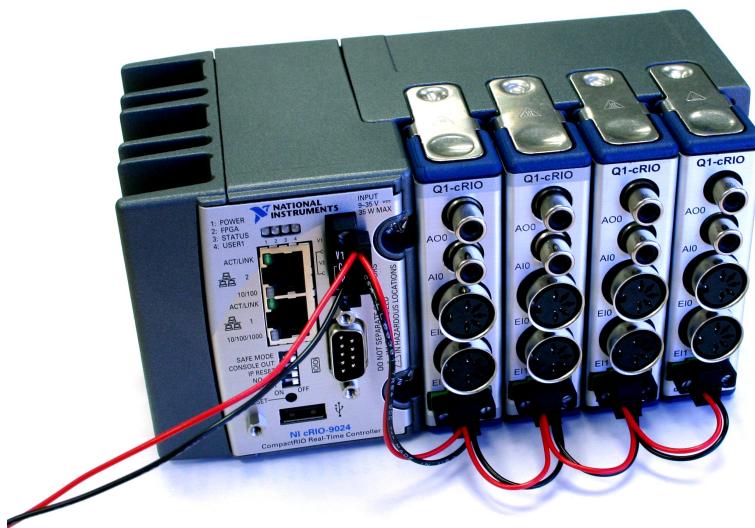


Figure 4.1: Four Q1-cRIO's with daisy-chained power supplies.

For complete regulatory compliance, the power supply should make use of the recommended ferrite from NI and the chassis should be earth grounded. Ensure each Q1-cRIO module is firmly seated in the chassis. Each attached encoder cable should pass through the center of a Laird-Signal Integrity Products 28A2024-0A2 snap-on ferrite twice. Try to place the ferrite on the encoder cable as close to the cRIO end as possible.

4.2 Software Installation

Follow the Quanser Rapid Control Prototyping Toolkit 2012 Quick Start Guide to install RCP onto both Windows and the target cRIO chassis. This will install the driver and all necessary support VI's to use the Q1-cRIO.

5 TROUBLESHOOTING

Please review the following before contacting Quanser technical support.

Make sure you have setup and tested the Q1-cRIO as outlined in the **Quick Start Guide**.

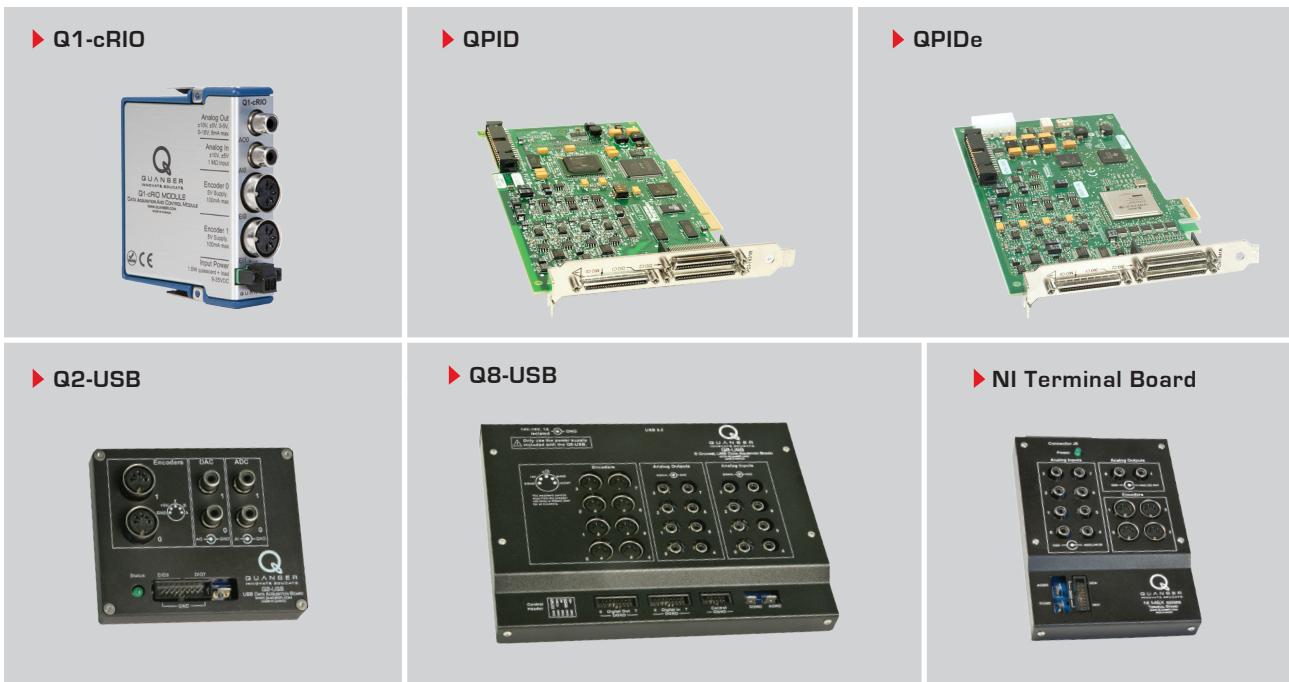
If the analog output fails to respond to your command:

- Cycle the power on the Q1-cRIO module and try running your VI again.
- Ensure you are not exceeding the maximum current rating of the analog output.

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.

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