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PCI-QUAD04

Quadrature Encoder Input

User's Guide

June 2016. Rev 8A
© Measurement Computing Corporation

MEASUREMENT COMPUTING™

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About this User's Guide

What you will learn from this user's guide

This user's guide describes the Measurement Computing PCI-QUAD04 data acquisition device and lists device specifications.

Conventions in this user's guide

For more information

Text presented in a box signifies additional information related to the subject matter.

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 a 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

Additional information about PCI-QUAD04 hardware is available on our website at www.mccdaq.com. You can also contact Measurement Computing Corporation with specific questions.

- Knowledgebase: kb.mccdaq.com
- Tech support form: www.mccdaq.com/support/support_form.aspx
- Email: techsupport@mccdaq.com
- Phone: 508-946-5100 and follow the instructions for reaching Tech Support

For international customers, contact your local distributor. Refer to the International Distributors section on our website at www.mccdaq.com/International.

Introducing the PCI-QUAD04

Overview: PCI-QUAD04 features

The PCI-QUAD04 is a PCI plug-in board that provides inputs and decoding for up to four incremental quadrature encoders. The PCI-QUAD04 can also be used as a high speed pulse counter for general counting applications.

Incremental quadrature encoders are used to provide feedback signals from motors, that is, to count rotations and convert the physical movement into a series of electrical signals. These signals are sent to the computer which then decides whether or not to trigger signals that control the motor's movement and what those control signals should be. The PCI-QUAD04 is the link between up to four incremental quadrature encoders and the computer.

The PCI-QUAD04 is a plug-in board that uses one PCI slot and a 37 pin D-type connector for up to four channels. Each incremental quadrature encoder connects to an input channel on the board through a DB37 female connector on the board's rear panel. Channels 1 through 4 connect to the DB37 connector on the rear panel bracket.

For each channel, the signals provided at the DB37 connectors are:

- Phase A+, A-
- Phase B+, B-
- Index ±
- +5 VDC and GND (optional power for +5 V encoders)

Pinout diagrams are shown on page 9.

The PCI-QUAD04 provides inputs for three basic signals, Phase A, Phase B, and Index. Phase A and Phase B are generated at a 90° phase shift with respect to each other. Using these signals, a computer can determine system position (counts), velocity, (counts per second), and direction of rotation.

The Index signal is used to establish an absolute reference position within one count of the encoder rotation (360°). Therefore, the Index signal is often used to reset or preset the position counter, particularly upon system startup when the incremental encoder cannot determine the starting position of the motor. The Index signal can also be used to generate an interrupt signal to the computer.

The Phase A, Phase B, and Index inputs are jumper-selectable for differential or single-ended input mode. These signals, after being routed through differential receivers, offer various paths to the LS7266 inputs through the FPGA. The inputs are register-programmable for the following:

- Individual incremental encoder inputs to allow up to four channels
- Cascadable counters to allow non-quadrature counting up to 96-bits
- Routing the Index input to either the Load Counter/Load Latch input or the Reset Counter/Gate input with quarter cycle and half cycle signals
- Routing the Compare or Carry/Borrow output signals to the 8259 Interrupt controller

The heart of the PCI-QUAD04 is the LSI Computer Systems, Inc., LS7266R1 24-bit Dual-Axis Quadrature Counter IC. This component contains:

- Two 24-bit counters with associated 24-bit preset and 24-bit output latch registers
- Integrated digital filtering with 8-bit counter prescalers
- Programmable index functionality and programmable count modes including non-quadrature modes

The PCI-QUAD04 can operate as a high-speed pulse and general purpose counter, cascadable to 96-bits. The 24-bit counters can count either in binary or BCD through register programming.

The PCI-QUAD04 also includes an 82C59 Programmable Interrupt Controller which accepts the four Index inputs directly and the Carry/Borrow outputs from the LS7266 (counter overflow/underflow or count value match) to generate interrupts to the PC bus. The interrupt controller operates in Polled Mode and allows for masking and priority setting of the interrupt inputs.

Functional block diagram

PCI-QUAD04 functions are illustrated in the block diagram shown here.

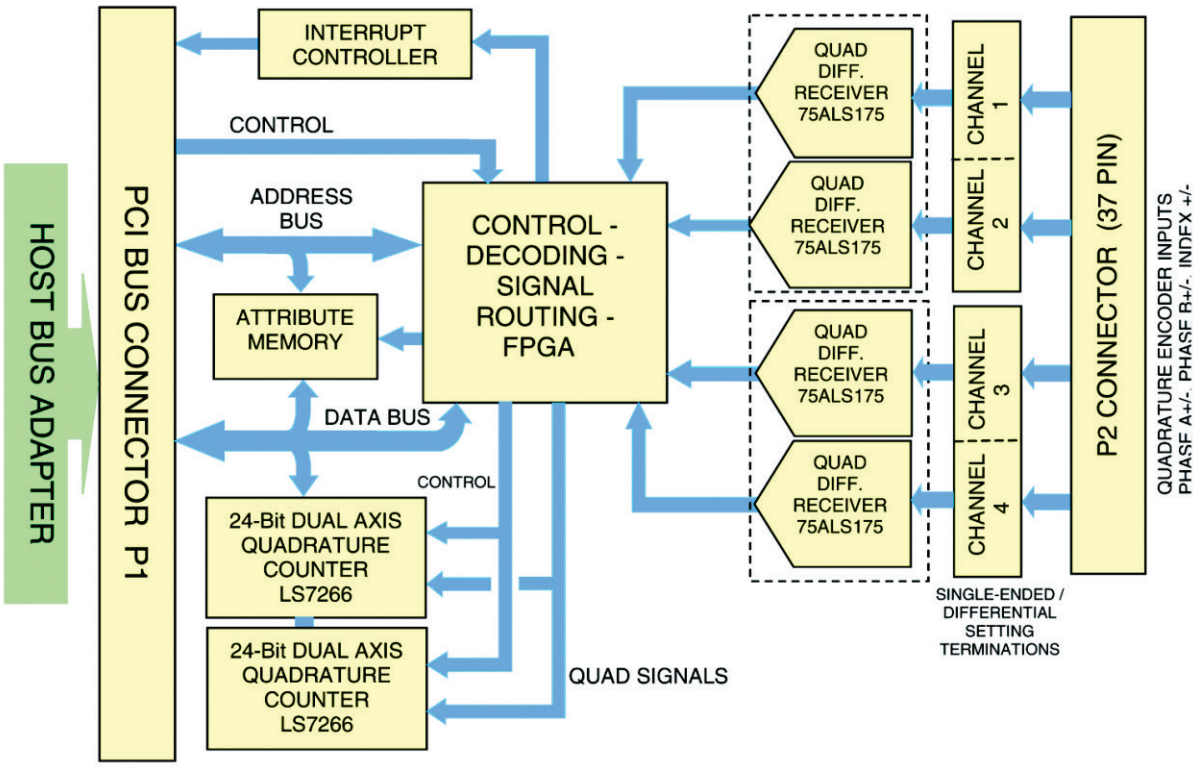


Figure 1. PCI-QUAD04 functional block diagram

Installing the PCI-QUAD04

Unpacking

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

Contact us immediately if any components are missing or damaged.

Installing the software

Refer to the MCC DAQ Quick Start and the PCI-QUAD04 product page on our website for information about the available software.

Install the software before you install your device

The driver needed to run the PCI-QUAD04 is installed with the software. Therefore, you need to install the software package you plan to use before you install the hardware.

Configuring the PCI-QUAD04

Before installing the board, configure the channel input mode for either single-ended or differential. You set the channel configuration with a set of jumper blocks on the board. Each jumper is labeled for its functionality. By default, the board is shipped with the channels configured for single-ended operation, with no termination resistors installed.

Channel input mode

To configure the board for single-ended operation, place a jumper between pin 2 and pin 3 (labeled **SE**). To configure for differential operation, place a jumper between pin 1 (labeled **DIFF**) and pin 2. A single-ended configuration is shown in Figure 2.

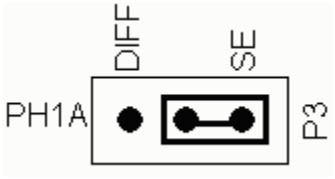


Figure 2. Channel input mode configured for SE operation

Input mode jumper settings are listed in the table below.

Channel input mode jumper settings

	Input channel			
Input	**1**	**2**	**3**	**4**
Phase A	P3	P8	P14	P11
Phase B	P4	P7	P13	P10
Index	P5	P6	P12	P9

Termination resistors

Although termination resistors typically are not required, SMT pads on the PCI-QUAD04 are open and labeled to allow you to install terminating resistors from the various inputs to ground.

Termination resistor settings

	Channel			
Input	**1**	**2**	**3**	**4**
Phase A+	R9	R22	R38	R30
Phase A-	R10	R23	R39	R31
Phase B+	R11	R20	R36	R28
Phase B-	R12	R21	R37	R29
Index+	R14	R19	R35	R27
Index-	R13	R18	R34	R26

Installing the hardware

The PCI-QUAD04 board is completely plug-and-play. There are no switches or jumpers to set on the board. Configuration is controlled by your system's BIOS.

Complete the following steps to install the board:

1. Turn your computer off, open it up, and insert the board into an available PCI slot.
2. Close your computer and turn it on.

Windows finds and installs the device driver automatically, and notifies you that the device is ready to use.

Signal connections

The table below lists the board connector type, compatible cables, and compatible accessory products for the PCI-QUAD04.

Board connectors, cables, and accessory equipment

I/O connector type	37-pin connector
Compatible cables	C37F-4X9F-1M
	C37FF-x
	C37FFS-x
Compatible accessory products	CIO-MINI37 CIO-MINI37-VERT CIO-TERMINAL SCB-37

Connector pinout

Pin assignments of the 37-pin connector **P2** are shown in Figure 3.

Important

Be sure to correctly phase the encoder according to the manufacturer's instructions.

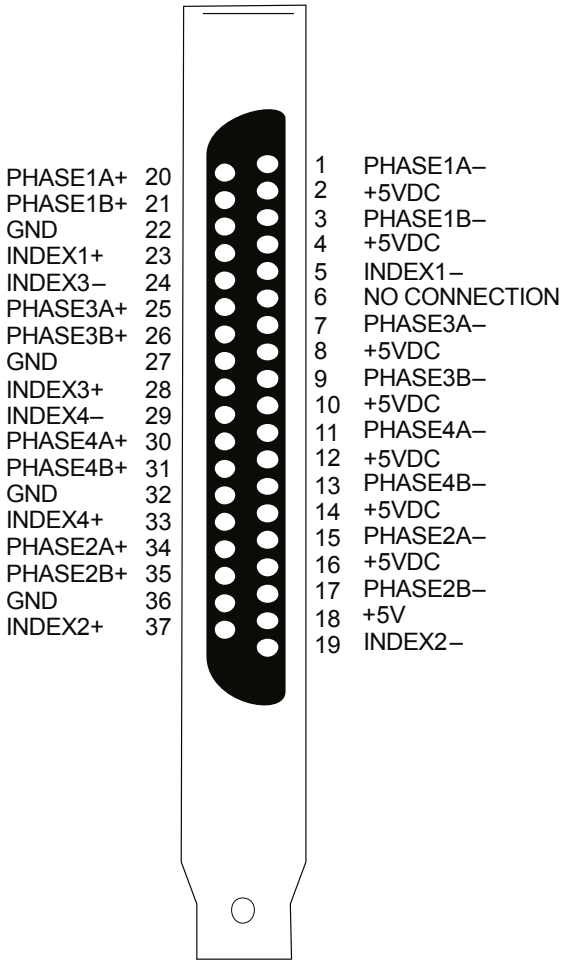


Figure 3. Connector pinout

Board connector-to-C37F-4X9F-1M cable pinout

Connections from the board connector to the C37F-4X9F-1M cable are shown in Figure 4. The C37F-4X9F-1M cable can be purchased separately.

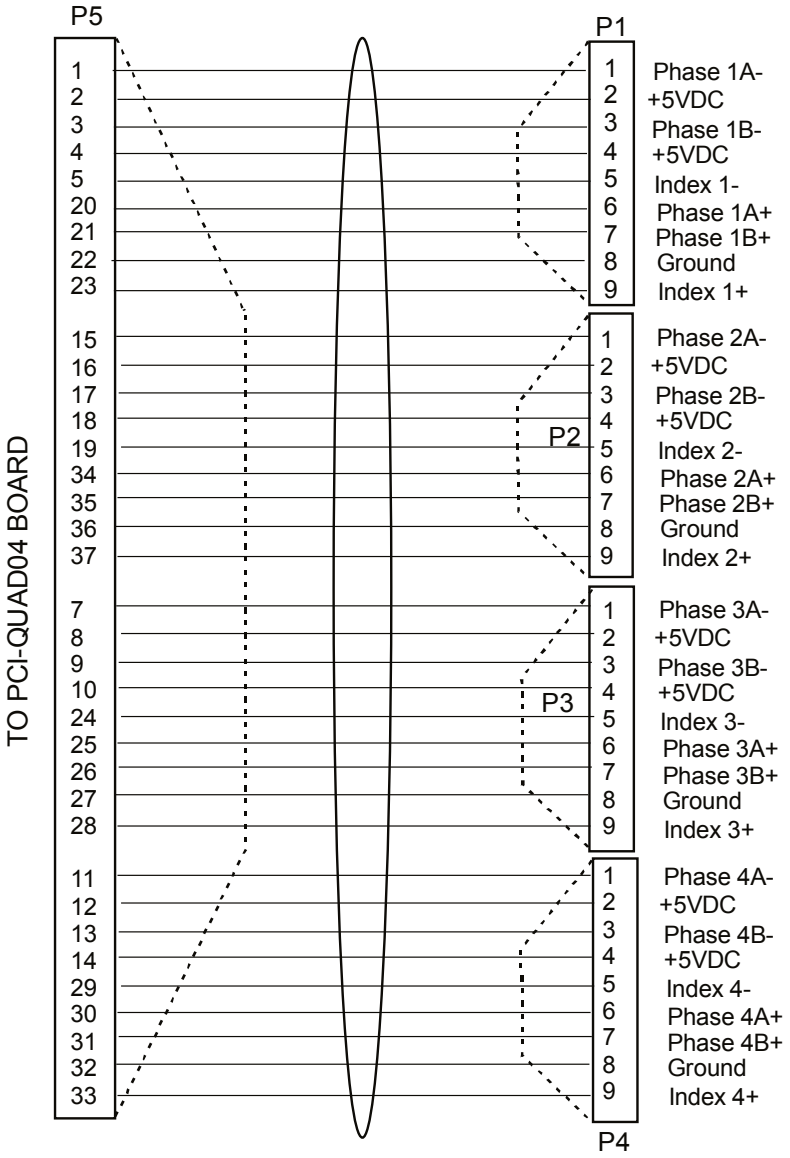


Figure 4. Board connector-to-cable C37F-4X9F-1M pinout

Details on the C37F-4X9F-1M cable are available on our website

Specifications

All specifications are subject to change without notice.
Typical for 25°C unless otherwise specified.
Specifications in *italic text* are guaranteed by design.

Power consumption

Table 1. Power consumption specifications

Parameter	Specification
+5 V	■ Not supplying power to external encoders: 325 mA typ, 460 mA max ■ Typical supplying 1 Dynamics Research Incremental Optical Rotary Encoder part number M21AAFOBB2E-2500: 1058 mA typ, 1479 mA max

Input

Table 2. Input specifications

Parameter	Specification
Receiver type	SN75ALS175 quad differential receiver
Configuration	Each channel consists of PhaseA input, PhaseB input and Index input; each input switch / jumper selectable as single-ended or differential.
	Differential: ■ PhaseA, PhaseB and Index (+) inputs at user connector routed to (+) inputs of differential receiver. ■ PhaseA, PhaseB and Index (–) inputs at user connector routed to (–) inputs of differential receiver.
	Single-ended: ■ PhaseA, PhaseB and Index (+) inputs at user connector routed to (+) inputs of differential receiver. ■ PhaseA, PhaseB and Index (-) inputs at user connector routed to ground. (–) inputs of differential receiver routed to +3 V reference.
Number of channels	4
Common mode input voltage range	±12 V max
Differential input voltage range	±12 V max
Input sensitivity	±200 mV
Input hysteresis	50 mV typ
Input impedance	12 kΩ min
Propagation delay	27 ns max (tpLH, tpHL)
Absolute maximum input voltage:	Differential: ±14 V max
Miscellaneous	■ Meets or exceeds ANSI EIA/TIA-422-B, EIA/TIA-423-B, and RS-485 ■ Meets ITU recommendations V.10, V.11, X.26, and X.27. ■ Designed for multipoint busses on long lines and in noisy environments

Counter

Table 3. Counter specifications

Parameter	Specification
Counter type	LS7266R1 24-bit Dual-axis Quadrature Counter
Quadrature mode	■ Clock frequency: 1.2 MHz max ■ Separation: 100 ns min ■ Clock pulse width: 400 ns min ■ Index pulse width: 300 ns min
Count mode	■ Clock frequency: 30 MHz max, (25 MHz max Mod-N mode) ■ Clock A - high pulse width: 14 ns min ■ Clock A - low pulse width: 14 ns min ■ Filter clock (FCK): 10 MHz
Digital filter rate	10 MHz, software selectable divider (1 to 256 in single steps)
Crystal oscillator (FCK source):	■ Frequency: 10 MHz ■ Frequency accuracy: 100 ppm

Interrupt controller

Table 4. Interrupt controller specifications

Parameter	Specification
Controller type	8259 Programmable Interrupt Controller
Configuration	Polled mode only
Interrupts	2, 3, 5, 7, 10, 11, 12 and 15
Interrupt enable	Programmable
Interrupt sources	All Carry/Borrow outputs from LS7266R1, all Index inputs

Environmental

Table 5. Environmental specifications

Parameter	Specification
Operating temperature range	0 °C to 70 °C
Storage temperature range	-40 to 100 °C
Humidity	0 to 90% non-condensing

CE Declaration of Conformity

Manufacturer: Measurement Computing Corporation
Address: 10 Commerce Way
Norton, MA 02766
USA
Category: Electrical equipment for measurement, control and laboratory use.
Measurement Computing Corporation declares under sole responsibility that the product
PCI-QUAD04
to which this declaration relates is in conformity with the relevant provisions of the following standards or other documents:

EC EMC Directive 2004/108/EC: General Requirements, EN 61326-1:2006 (IEC 61326-1:2005).

Emissions:

- EN 55011 (2007) / CISPR 11(2003): Radiated emissions: Group 1, Class A
- EN 55011 (2007) / CISPR 11(2003): Conducted emissions: Group 1, Class A

Immunity: EN 61326-1:2006, Table 3.

- IEC 61000-4-2 (2001): Electrostatic Discharge immunity.
- IEC 61000-4-3 (2002): Radiated Electromagnetic Field immunity.
- IEC 61000-4-4 (2004): Electric Fast Transient Burst Immunity.
- IEC 61000-4-5 (2001): Surge Immunity.
- IEC 61000-4-6 (2003): Radio Frequency Common Mode Immunity.
- IEC 61000-4-11 (2004): Voltage Interrupts.

To maintain compliance to the standards of this declaration, the following conditions must be met.

- The host computer, peripheral equipment, power sources, and expansion hardware must be CE compliant.
- All I/O cables must be shielded, with the shields connected to ground.
- I/O cables must be less than 3 meters (9.75 feet) in length.
- The host computer must be properly grounded.
- Equipment must be operated in a controlled electromagnetic environment as defined by Standards EN 61326-1:2006, or IEC 61326-1:2005.

Declaration of Conformity based on tests conducted by Chomerics Test Services, Woburn, MA 01801, USA in March, 2009. Test records are outlined in Chomerics Test Report #EMI5299.09.

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



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