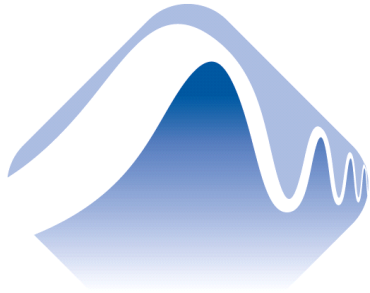
# PCI-CTR05 & PCI-CTR10

## 9513-Based Counter/Timer

## User's Guide



MEASUREMENT COMPUTING™

Document Revision 3, July, 2002

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## Lifetime *Harsh Environment Warranty* ™

Any product manufactured by Measurement Computing Corp. that is damaged (even due to misuse) may be replaced for only 50% of the current list price. I/O boards face some tough operating conditions—some more severe than the boards are designed to withstand. When a board becomes damaged, just return the unit with an order for its replacement at only 50% of the current list price. We don't need to profit from your misfortune. By the way, we honor this warranty for any manufacturer's board that we have a replacement for!

## TABLE OF CONTENTS

# 1 Introduction

## 1.1 General description

The PCI-CTR05 is a high-performance, low-cost counter/timer board for PCI bus-compatible computers. The PCI-CTR10 is a single board with two PCI-CTR05 boards on it. For the balance of this guide we will refer to both boards as the **PCI-CTR**, and will only use the complete board name in instances where information pertains to one board or the other.

The PCI-CTR is based on the 9513 counter/timer device. Each 9513 has five independent 16-bit counters (65,536 counts). An input source, count register, load register, hold register, alarm register, output, and gate are associated with each counter. The PCI-CTR05 has one 9513 counter/timer device on it, and the PCI-CTR10 has two 9513 devices.

The 9513 is software-programmable for event counting, pulse and frequency measurement, alarm comparisons, and other input functions. The 9513 can generate frequencies with either complex duty cycles, or with one-shot and continuous-output modes. You can chain up to five 9513 devices together using software to enable a 32-, 48-, 64-, or 80-bit counter that does not require hardware connections. The gate source and gating functions are software-programmable.

An eight-bit, high-current digital output port provides logic-level control, and can be used to switch solid state relays. An eight-bit digital input port can be used to sense contact closures. The 9513 device also provides access to the PCI bus interrupts.

For more information on the 9513 counter/timer, refer to the 9513 data sheet. This document is available at http://www.measurementcomputing.com/PDFmanuals/9513A.pdf.

Figure 1-1 shows a block diagram of the PCI-CTR05 board and its compatible accessories.

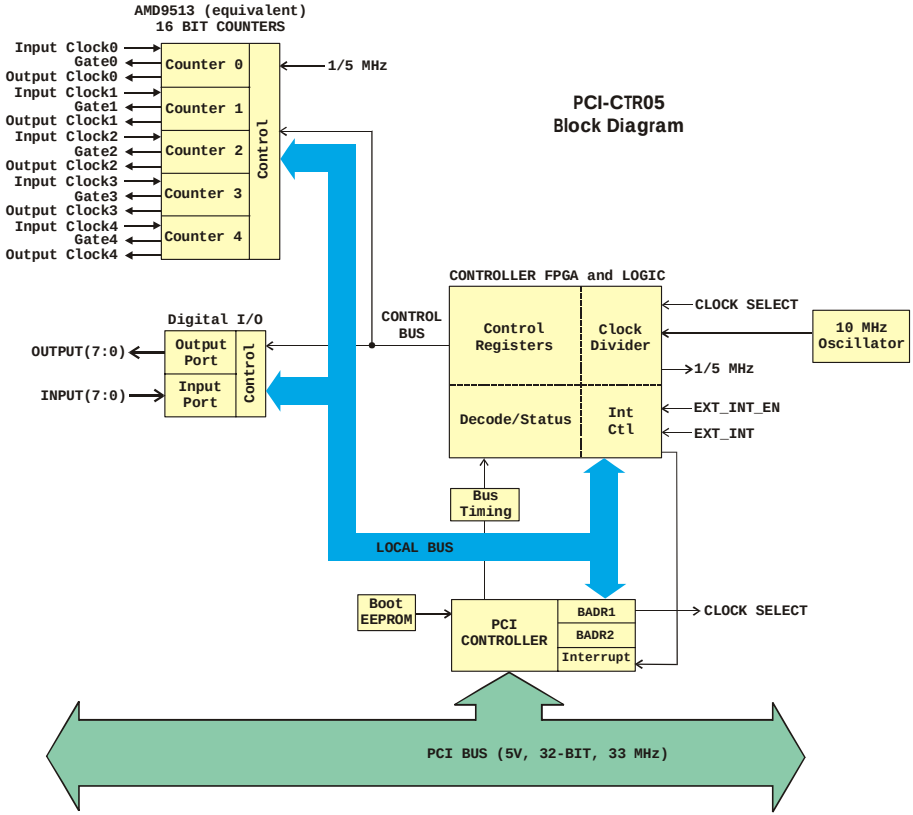


Figure 1-1. PCI-CTR05 Functional Block Diagram

Figure 1-2 shows a block diagram of the PCI-CTR10 board and its compatible accessories.

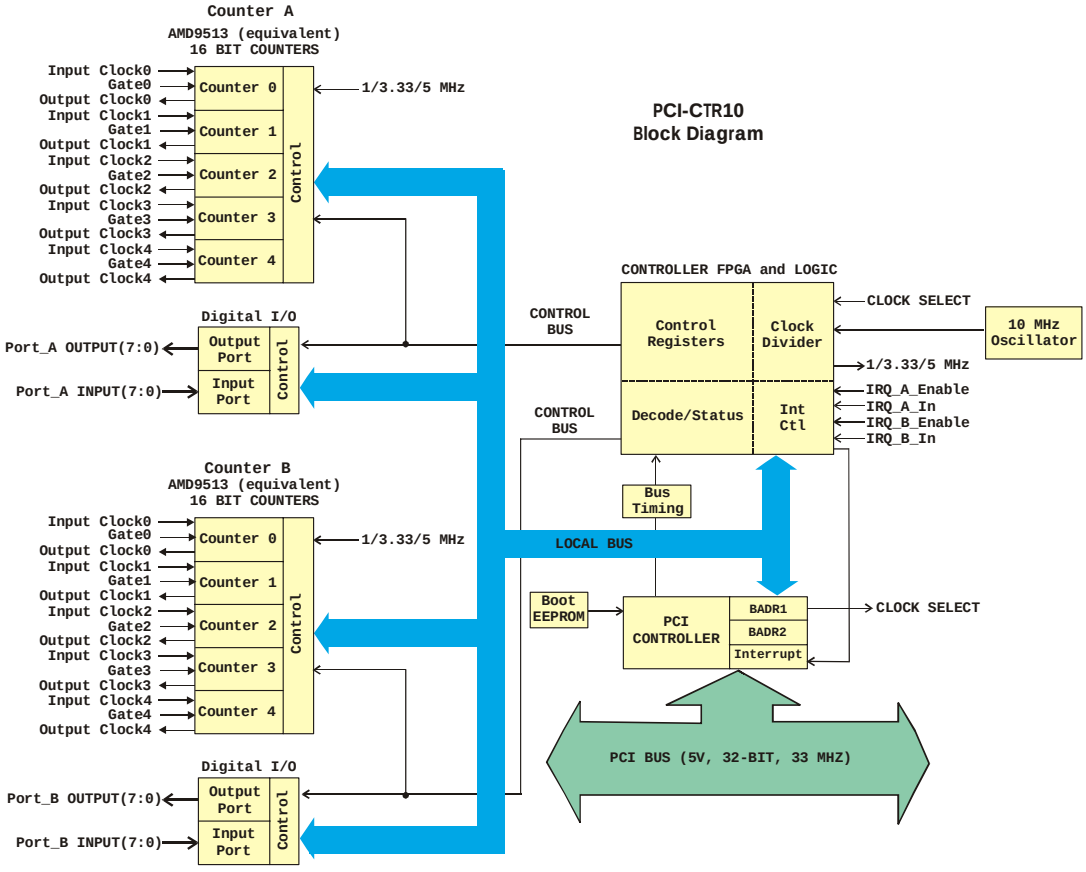


Figure 1-2. PCI-CTR10 Functional Block Diagram

## 1.2 Software features–*Insta*Cal™ and Universal Library™

Each board ships with the *Insta*Cal™ software utility package. *Insta*Cal is a complete installation, calibration and test program for data acquisition and control boards. Complete with extensive error checking, *Insta*Cal guides you through installation and setup of your data acquisition board and creates the board configuration file for use by your program or application software package. The procedure for installing *Insta*Cal is explained in the *Software Installation Manual* (available on our web site at http://www.mccdaq.com/PDFmanuals/sm-installation.pdf.)

The optional Universal Library™ fully supports the PCI-CTR boards. The Universal Library is a complete set of I/O libraries and drivers for all MCC boards, and for all Windows-based languages. When using the Universal Library, you can switch boards or even programming languages and the syntax remains constant.

# 2 Installation

## 2.1 Unpacking the PCI-CTR board

### CAUTION

The PCI-CTR is shipped in an antistatic container to prevent the board from being damaged by an electrostatic discharge. To avoid such damage, follow the steps below when unpacking and handling your board.

1. Before opening the antistatic container, ground yourself with a wrist-grounding strap or by holding onto a grounded object.
2. Touch the antistatic container to the computer chassis before removing the board from the container.
3. Remove the board from the container. Inspect the board for any visible signs of damage (such as loose pins, wires, etc). *Never* touch the exposed pins or circuit connections on the board.

If you see any damage, notify Measurement Computer Corp. immediately. *Do not install* a damaged board in the computer.

- Tel: 508-946-5100
- Fax: 508-946-9500 to the attention of Tech Support
- Email: techsupport@measurementcomputing.com

## 2.2 Installing the software

Install the software included with your board before you install the hardware. This ensures that the information required for proper board detection is installed and available at boot up. The procedure for installing *Insta*Cal is explained in the *Software Installation Manual* (available on our web site at http://www.mccdaq.com/PDFmanuals/sm-installation.pdf.)

The *Insta*Cal™ utility program creates a configuration file that your application software (and the Universal Library) refers to, so your software automatically accesses the exact configuration of the board.

## 2.3 Installing the hardware

The PCI-CTR05 and PCI-CTR10 boards are completely plug-and-play, with no switches or jumpers to set. Configuration is controlled by your system's BIOS. To install your board, follow the steps below.

1. Turn your computer off, open it up, and insert your board into any available PCI slot. Ensure that the board is fully seated, or it may not work correctly, and could short circuit the PC Bus power onto a PC Bus signal. This could damage the motherboard in your PC, as well as damage the PCI-CTR board.

**Note**: If you are installing a PCI-CTR10 board, locate two adjacent PCI expansion slots. From the rear of the computer, place the PCI-CTR10 in the left hand of the two empty slots, so that the empty slot is on the component side of the PCI-CTR. Cabling is easier when there is an empty slot on the component side of the board.

2. Close your computer and turn it on.

   If you are using an operating system with support for plug-and-play (such as Windows 95 or 98), a dialog box pops up as the system loads, indicating that new hardware has been detected. If the information file for this board is not already loaded onto your PC, you will be prompted for the disk containing this file. The *Insta*Cal software supplied with your board contains this file. Insert the disk or CD and click **OK** to load the configuration file.

**Note**: If the board's configuration file is not found on the first attempt, use the browse function and select the drive containing the *Insta*Cal or Universal Library disk. Select the **CBxx.INF** file and click **CONTINUE**. Connecting the board for I/O operations

### 2.3.1 I/O connections

Table 2-1 lists the board connectors and applicable cables for the PCI-CTR.

Table 2-1 Board Connectors, Cables, and Accessory Equipment

| | |
|---|---|
| **Connector type** | PCI-CTR05:<br>J1: 37-pin shielded D-type, right angle<br>PCI-CTR10:<br>P1: 37-pin shielded D-type, right angle<br>P2: 37-pin unshielded, D-type, straight |
| **Compatible Cables** | C37FF-x, unshielded ribbon cable<br>C37FFS-x, shielded round cable |
| **Compatible accessory products** | BP-37/P (PCI-CTR10 only) (see Note 1)<br>CIO-MINI37<br>CIO-MINI37-VERT<br>CIO-TERMINAL<br>SCB-37 |
| Note 1: The BP-37/P is required in order to cable all CTR B signals from P2 to the PC bulkhead. | |

For detailed information on PCI-CTR accessory equipment, visit our web site at http://www.measurementcomputing.com/.

The PCI-CTR has a male, 37-pin D-type connector. The digital input, digital output and interrupt signals from the 9513 are all accessible on this connector. The PCI-CTR05 has one connector, J1 (Figure 2-1.)

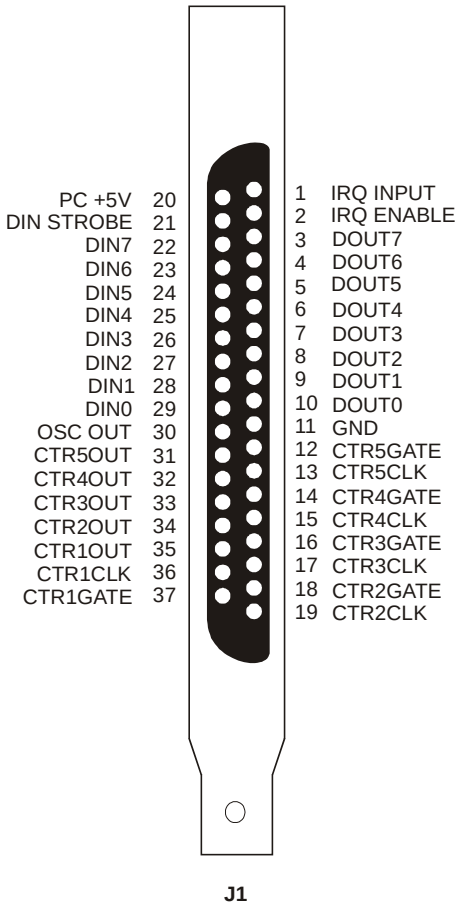


Figure 2-1 PCI-CTR05 Board Connector

The PCI-CTR10 has two connectors, P1 and P2 (see Figure 2-2.) The signals on both connectors are identical. The second 9513 device on the PCI-CTR10 is accessible via connector P2 at the rear of the board, and is wired identically to the 9513 device on connector P1.

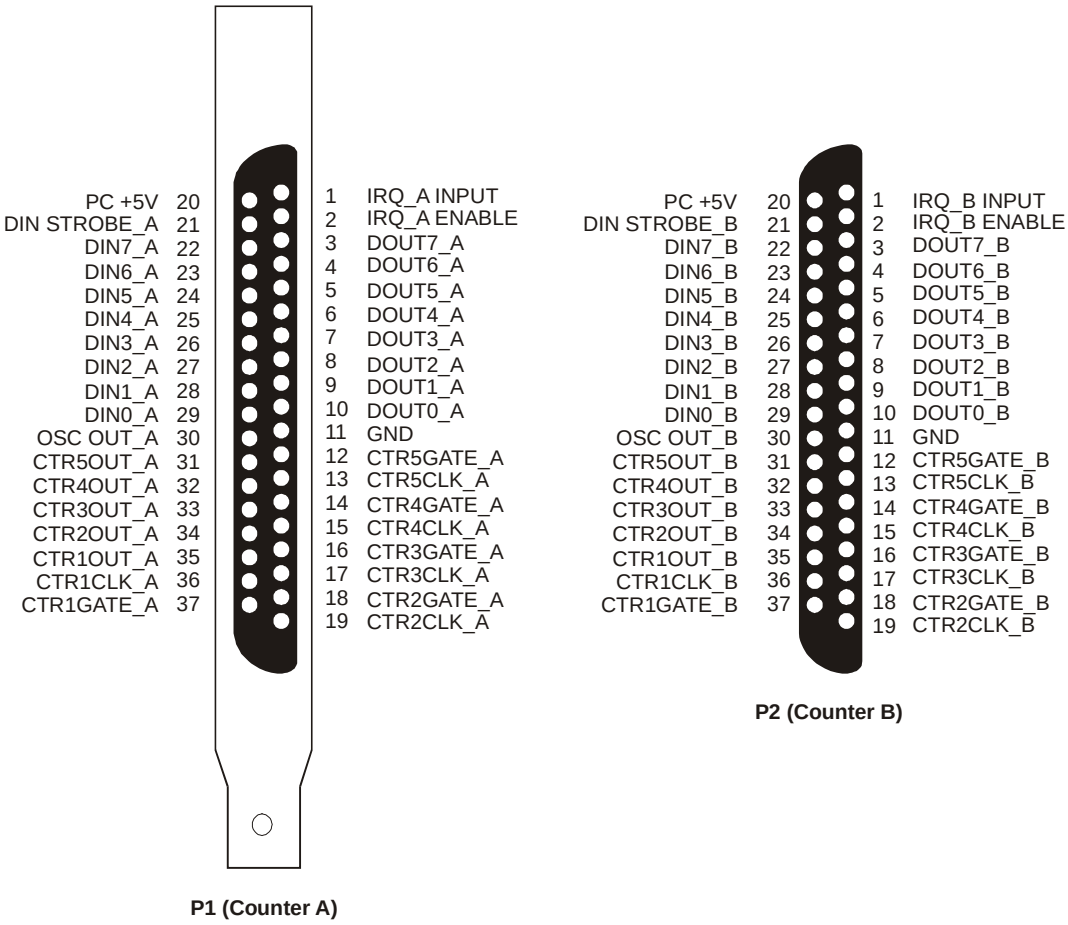


Figure 2-2. PCI-CTR10 Board Connectors

**Note**: For general information regarding digital I/O techniques, including signal conditioning and low pass filters, refer to the *Guide to Signal Connections*. This document is available on our web site at http://www.measurementcomputing.com/signals/signals.pdf.

# 3 Programming and software applications

## 3.1 Programming languages

Measurement Computing's Universal Library™ provides complete access to PCI-CTR functions from the full range of DOS and Windows® programming languages. If you are planning to write programs, or would like to run the example programs for Visual Basic® or any other language, refer to the *Universal Library User's Guide*. This document is available on our web site at http://www.measurementcomputing.com/PDFmanuals/sm-ul-user-guide.pdf.

## 3.2 Packaged applications programs

Many packaged application programs, such as SoftWIRE® and HP-VEE™, have drivers for the PCI-CTR. If your package does not have drivers, phone, fax or e-mail us the package name and the revision number from the install disks. We will research the package and advise you on how to obtain PCI-CTR drivers.

Some application drivers are included with the Universal Library package, but not with the application package. If you have purchased an application package directly from the software vendor, you may need to purchase our Universal Library and drivers. For more information, please contact us by phone, fax or email:

- Tel: 508-946-5100
- Fax: 508-946-9500
- Email: techsupport@measurementcomputing.com

## 3.3 Register-level programming

We recommend that you use the Universal Library or one of the packaged application programs mentioned above for controlling your board. Only experienced programmers should attempt register level-programming.

If you must use register-level programming in your application, refer to the PCI-CTR05 or PCI-CTR10 register map document:

- http://www.measurementcomputing.com/registermaps/RegMapPCI-CTR05.pdf
- http://www.measurementcomputing.com/registermaps/RegMapPCI-CTR10.pdf

# 4 Specifications

## 4.1 PCI-CTR05 specifications

Typical for 25°C unless otherwise specified.

### Digital Input / Output

| | |
|---|---|
| Digital Type | Discrete, 5V/TTL compatible |
| | Output: 74ACT273 |
| | Input: 74LS373 |
| Number of I/O | 8 input, 8 output |
| | |
| Configuration | 1 bank of 8 as output, 1 bank of 8 as strobed input |
| Input high voltage | 2.0V min, 7.0V absolute max |
| Input low voltage | 0.8V max, –0.5V absolute min |
| Output high voltage | 3.94 volts min @ -24 mA (Vcc = 4.5V) |
| Output low voltage | 0.36 volts max @ 24 mA (Vcc = 4.5V) |
| Data Transfer | Programmed I/O |
| Power-up / reset state | Digital outputs reset to TTL low |
| Din Strobe | Active low latch enable input, internally pulled high through 10Kohm resistor |
| Din Strobe pulse width high/low | 15nS min |
| Data setup to Din Strobe | 5nS min |
| Data hold from Din Strobe | 20nS min |

### Interrupt Section

| | |
|---|---|
| Number of User Interrupts | One |
| PCI Interrupt | PCI INTA# - mapped to IRQn via PCI BIOS at boot-time |
| Interrupt enables | External: IRQ ENABLE, active low, disabled by default through internal resistor to TTL high) and programmable through PCI9052-1; 0 = disabled, 1 = enabled (default) |
| Interrupt Sources | External: IRQ IN, polarity programmable through PCI9052-1; 1 = active high, 0 = active low (default). |
| | IRQ IN maps to PLX 9052 LINT1. |

## Counter Section

Please refer to CTS9513-2 data sheet for complete 9513 specifications and operating modes. The SAVE command for the CTS9513 device does not behave predictably when using clocks which are not synchronous with the logic timing.

| | |
|---|---|
| Counter type | CTS9513 |
| Configuration | One 9513 device. Five up/down counters, 16 bits each. |
| Compatibility | 5V/TTL |
| The 9513 device is programmable for: | |
| Clock Source: | Software selectable:<br>• External<br>1. Counter 1-5 clock inputs<br>2. Counter 1-5 gate inputs<br>▪ Internal<br>1. Terminal count of previous counter<br>2. X2 clock frequency scaler |
| Gate: | Software selectable source:<br>• External<br>1. Active high or low level or edge, counter 1 – 5 gate input.<br>2. Active high level previous gate or next gate<br>• Internal<br>1. Active high previous counter terminal count<br>2. No gating. |
| Output: | Software selectable:<br>• Always low<br>• High pulse on terminal count<br>• Low pulse on terminal count<br>• Toggle on terminal count<br>• Inactive, high impedance at user connector counter # output. |
| Osc Out | Software selectable source:<br>• Counter # input<br>• Gate # input<br>• Prescaled clock source (X2 clock frequency scaler)<br>Software selectable divider:<br>• Division by 1-16<br>Software selectable enable:<br>• On or low impedance to ground. |
| Clock Input Frequency | 6.8MHz max (145nS min period) |

| | |
|---|---|
| X2 Clock input sources | Software selectable:<br>• 1.0 MHz (10MHz Xtal divided by 10)<br>• 5.0 MHz (10MHz Xtal divided by 2) |
| X2 clock frequency scaler | BCD scaling (X2 divided by 10, 100, 1000 or 10000) or Binary scaling (X2 divided by 16, 256, 4096 or 65536) |
| High pulse width (clock input) | 70ns min |
| Low pulse width (clock input) | 70ns min |
| Gate width high | 145ns min |
| Gate width low | 145ns min |
| Input low voltage | -0.5V min, 0.8V max |
| Input high voltage | 2.2V min, Vcc max |
| Output low voltage<br>@ $I_{Il}$=3.2mA | 0.4V max |
| Output high voltage<br>@ $I_{IH}$= -200uA | 2.4V min |
| Crystal oscillator frequency | 10MHz |
| Frequency accuracy | 50ppm |

## Power Consumption

| | |
|---|---|
| +5V | 307 mA typical, 549 mA max. Does not include power consumed through the I/O connector. |
| +5V available at connector | 1A max |

## Environmental

| | |
|---|---|
| Operating Temperature Range | 0 to 55°C |
| Storage Temperature Range | -20 to 70°C |
| Humidity | 0 to 90% non-condensing |

## Mechanical

| | |
|---|---|
| Card dimensions | 132.3mm(L) x 106.7mm(W) x14.5mm(H) |

## Main Connector and Pin Out

The J1 connector is compatible with the CIO-CTR05 and the CIO-CTR10.

| | |
|---|---|
| Connector type | 37 pin shielded D-type, right angle. |
| Compatible Cables | C37FF-x, unshielded ribbon cable. |
| | C37FFS-x, shielded round cable |
| Compatible accessory products | CIO-MINI37<br>CIO-MINI37-VERT<br>CIO-TERMINAL<br>SCB-37 |

**J1**

| Pin | Signal Name |
|---|---|
| 1 | IRQ INPUT |
| 2 | IRQ ENABLE |
| 3 | DOUT7 |
| 4 | DOUT6 |
| 5 | DOUT5 |
| 6 | DOUT4 |
| 7 | DOUT3 |
| 8 | DOUT2 |
| 9 | DOUT1 |
| 10 | DOUT0 |
| 11 | GND |
| 12 | CTR5GATE |
| 13 | CTR5CLK |
| 14 | CTR4GATE |
| 15 | CTR4CLK |
| 16 | CTR3GATE |
| 17 | CTR3CLK |
| 18 | CTR2GATE |
| 19 | CTR2CLK |
| 20 | PC +5V |
| 21 | DIN STROBE |
| 22 | DIN7 |
| 23 | DIN6 |
| 24 | DIN5 |
| 25 | DIN4 |
| 26 | DIN3 |
| 27 | DIN2 |
| 28 | DIN1 |
| 29 | DIN0 |
| 30 | OSC OUT |
| 31 | CTR5OUT |
| 32 | CTR4OUT |
| 33 | CTR3OUT |
| 34 | CTR2OUT |
| 35 | CTR1OUT |
| 36 | CTR1CLK |
| 37 | CTR1GATE |

## 4.2 PCI-CTR10 specifications

Typical for 25°C unless otherwise specified.

### Digital Input / Output

| | |
|---|---|
| Digital Type | Discrete, 5V/TTL compatible |
| | Output: 74ACT273 |
| | Input: 74LS373 |
| Number of I/O | 8 input, 8 output per 37D connector |
| | |
| Configuration, per connector | 1 bank of 8 as output, 1 bank of 8 as strobed input |
| Input high voltage | 2.0V min, 7.0V absolute max |
| Input low voltage | 0.8V max, –0.5V absolute min |
| Output high voltage | 3.94 volts min @ -24 mA (Vcc = 4.5V) |
| Output low voltage | 0.36 volts max @ 24 mA (Vcc = 4.5V) |
| Data Transfer | Programmed I/O |
| Power-up / reset state | Digital outputs power on and Reset to TTL low |
| Din Strobe | Active low latch enable input, internally pulled high through 10Kohm resistor |
| Din Strobe pulse width high/low | 15nS min |
| Data setup to Din Strobe | 5nS min |
| Data hold from Din Strobe | 20nS min |

### Interrupt Section

| | |
|---|---|
| Number of User Interrupts | Two |
| PCI Interrupt | PCI INTA# - mapped to IRQn via PCI BIOS at boot-time |
| Interrupt enables | External: IRQ_A ENABLE, IRQ_B ENABLE, active low, disabled by default through internal resistor to TTL high) and programmable through PCI9052-1; 0 = disabled, 1 = enabled (default) |
| Interrupt Sources | External: IRQ_A IN, IRQ_B IN, polarity programmable through PCI9052-1; 1 = active high, 0 = active low (default). |
| | IRQ_A IN maps to PLX 9052 LINT1. |
| | IRQ_B IN maps to PLX 9052 LINT2. |

## Counter Section

Please refer to CTS9513-2 data sheet for complete 9513 specifications and operating modes. The SAVE command for the CTS9513 device does not behave predictably when using clocks which are not synchronous with the logic timing. If the SAVE command must be used, it is strongly recommended that the 3.3MHz clock derived from the 33MHz PCI clock be selected as the clock source.

| | |
|---|---|
| Counter type | CTS9513 |
| Configuration | Two 9513 devices. Five up/down counters per 9513, 16 bits each. |
| Compatibility | 5V/TTL |
| Each 9513 device is programmable for: | |
| Clock Source: | Software selectable:<br>• External<br>1. Counter 1-5 clock inputs<br>2. Counter 1-5 gate inputs<br>• Internal<br>1. Terminal count of previous counter<br>2. X2 clock frequency scaler |
| Gate: | Software selectable source:<br>• External<br>1. Active high or low level or edge, counter 1 - 5 gate input<br>2. Active high level previous gate or next gate<br>• Internal<br>1. Active high previous counter terminal count<br>2. No gating. |
| Output: | Software selectable:<br>• Always low<br>• High pulse on terminal count<br>• Low pulse on terminal count<br>• Toggle on terminal count<br>• Inactive, high impedance at user connector counter # output. |
| Osc Out | Software selectable source:<br>• Counter # input<br>• Gate # input<br>• Prescaled clock source (X2 clock frequency scaler)<br>Software selectable divider:<br>• Division by 1-16<br>Software selectable enable:<br>• On or low impedance to ground. |

| | |
|---|---|
| Clock Input Frequency | 6.8Mhz max (145nS min period) |
| X2 Clock input sources | Software selectable:<br>• 1.0 MHz (10MHz Xtal divided by 10)<br>• 5.0 MHz (10MHz Xtal divided by 2)<br>• 3.3 MHz (33 MHz PCI clock divided by 10) |
| X2 clock frequency scaler | BCD scaling (X2 divided by 10, 100, 1000 or 10000) or Binary scaling (X2 divided by 16, 256, 4096 or 65536) |
| High pulse width (clock input) | 70ns min |
| Low pulse width (clock input) | 70ns min |
| Gate width high | 145ns min |
| Gate width low | 145ns min |
| Input low voltage | -0.5V min, 0.8V max |
| Input high voltage | 2.2V min, Vcc max |
| Output low voltage @ $I_{Il}$=3.2mA | 0.4V max |
| Output high voltage @ $I_{IH}$= -200uA | 2.4V min |
| Crystal oscillator frequency | 10MHz |
| Frequency accuracy | 50ppm |

## Power Consumption

| | |
|---|---|
| +5V | 550 mA typical, 800 mA max. Does not include power consumed through the I/O connector. |
| +5V available at each I/O connector | 1A max, protected with a resettable fuse |
| Resettable Fuse | Raychem type *miniSMDC110*.<br>• Hold Current: 1.1A max<br>• Series resistance: 0.21 Ohms max. |

## Environmental

| | |
|---|---|
| Operating Temperature Range | 0 to 55°C |
| Storage Temperature Range | -20 to 70°C |
| Humidity | 0 to 90% non-condensing |

## Mechanical

| | |
|---|---|
| Card dimensions | PCI half card: 174.4mm(L) x 106.7mm(W) x11.65mm(H) |

## Main Connector and Pin Out

The P1 connector is compatible with the CIO-CTR05 and the PCI-CTR05. Both P1 and P2 are compatible with the CIO-CTR10.

| | |
|---|---|
| Connector types | P1: 37 pin shielded D-type, right angle.<br>P2: 37 pin unshielded D-type, straight. |
| Compatible Cables | C37FF-x, unshielded ribbon cable. |
| | C37FFS-x, shielded round cable |
| Compatible accessory products | BP37/P (Note 1)<br>CIO-MINI37<br>CIO-MINI37-VERT<br>CIO-TERMINAL<br>SCB-37 |

Note 1: BP37/P is required in order to cable all CTR B signals from P2 to the PC bulkhead.

**P1 (Counter A)**

| Pin | Signal Name |
|---|---|
| 1 | IRQ_A INPUT |
| 2 | IRQ_A ENABLE |
| 3 | DOUT7_A |
| 4 | DOUT6_A |
| 5 | DOUT5_A |
| 6 | DOUT4_A |
| 7 | DOUT3_A |
| 8 | DOUT2_A |
| 9 | DOUT1_A |
| 10 | DOUT0_A |
| 11 | GND |
| 12 | CTR5GATE_A |
| 13 | CTR5CLK_A |
| 14 | CTR4GATE_A |
| 15 | CTR4CLK_A |
| 16 | CTR3GATE_A |
| 17 | CTR3CLK_A |
| 18 | CTR2GATE_A |
| 19 | CTR2CLK_A |
| 20 | PC +5V |
| 21 | DIN STROBE_A |
| 22 | DIN7_A |
| 23 | DIN6_A |
| 24 | DIN5_A |
| 25 | DIN4_A |
| 26 | DIN3_A |
| 27 | DIN2_A |
| 28 | DIN1_A |
| 29 | DIN0_A |
| 30 | OSC OUT_A |
| 31 | CTR5OUT_A |
| 32 | CTR4OUT_A |
| 33 | CTR3OUT_A |
| 34 | CTR2OUT_A |
| 35 | CTR1OUT_A |
| 36 | CTR1CLK_A |
| 37 | CTR1GATE_A |

**P2 (Counter B)**

| Pin | Signal Name |
|---|---|
| 1 | IRQ_B INPUT |
| 2 | IRQ_B ENABLE |
| 3 | DOUT7_B |
| 4 | DOUT6_B |
| 5 | DOUT5_B |
| 6 | DOUT4_B |
| 7 | DOUT3_B |
| 8 | DOUT2_B |
| 9 | DOUT1_B |
| 10 | DOUT0_B |
| 11 | GND |
| 12 | CTR5GATE_B |
| 13 | CTR5CLK_B |
| 14 | CTR4GATE_B |
| 15 | CTR4CLK_B |
| 16 | CTR3GATE_B |
| 17 | CTR3CLK_B |
| 18 | CTR2GATE_B |
| 19 | CTR2CLK_B |
| 20 | PC +5V |
| 21 | DIN STROBE_B |
| 22 | DIN7_B |
| 23 | DIN6_B |
| 24 | DIN5_B |
| 25 | DIN4_B |
| 26 | DIN3_B |
| 27 | DIN2_B |
| 28 | DIN1_B |
| 29 | DIN0_B |
| 30 | OSC OUT_B |
| 31 | CTR5OUT_B |
| 32 | CTR4OUT_B |
| 33 | CTR3OUT_B |
| 34 | CTR2OUT_B |
| 35 | CTR1OUT_B |
| 36 | CTR1CLK_B |
| 37 | CTR1GATE_B |

# EC Declaration of Conformity

We, Measurement Computing Corporation, declare under sole responsibility that the product

| Part Number | Description |
|---|---|
| *PCI-CTR05* | *5-Counter board for the PCI bus* |
| *PCI-CTR10* | *10-Counter board for the PCI bus* |

to which this declaration relates, meets the essential requirements, is in conformity with, and CE marking has been applied according to the relevant EC Directives listed below using the relevant section of the following EC standards and other informative documents:

- EU EMC Directive 89/336/EEC: Essential requirements relating to electromagnetic compatibility.
- EN 55022 Class B (1995): Radiated and conducted emission requirements for information technology equipment.
- ENV 50204 (1995): Radio-frequency electromagnetic field immunity
- EN 55024 (1998): EC generic immunity requirements.
- EN 50082-1 (1997): EC generic immunity requirements.
- EN 61000-4-2 (1995): Electrostatic discharge immunity.
- EN 61000-4-3 (1997) ENV 50204 (1996): RF immunity.
- EN 61000-4-4 (1995): Electric fast transient burst immunity.
- EN 61000-4-5 (1995): Surge immunity.
- EN 61000-4-6 (1996): Radio frequency common mode immunity.
- EN 61000-4-8 (1994): Power frequency magnetic field immunity.
- EN 61000-4-11 (1994): Voltage dip and interrupt immunity

Carl Haapaoja, Vice-President of Design Verification

**Measurement Computing Corporation**
**16 Commerce Boulevard,**
**Middleboro, Massachusetts 02346**
**(508) 946-5100**
**Fax: (508) 946-9500**
**E-mail: info@measurementcomputing.com**
**www.measurementcomputing.com**