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CIO-CTR05

5-Channel, 16-bit Counter/Timer (9513), 16 Digital Channels

User's Guide



MEASUREMENT COMPUTING™

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CIO-CTR05

Counter/Timer Board

User's Guide

Document Revision 6, March, 2010
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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 CIO-CTR05 board so that you get the most out of its counter/timer features. 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

The following conventions are used in this manual to convey special information:

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.

<#:#> Angle brackets that enclose numbers separated by a colon signify a range of numbers, such as those assigned to registers, bit settings, etc.

bold text **Bold** text is used for the names of objects on the screen, such as buttons, text boxes, and check boxes. For example:

1. Insert the disk or CD and click the **OK** button.

italic text *Italic* text is used for the names of manuals and help topic titles, and to emphasize a word or phrase. For example:

The *Insta*Cal installation procedure is explained in the *Quick Start Guide*.

Never touch the exposed pins or circuit connections on the board.

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.

If you need to program at the register level in your application, refer to the *Register Map for the CIO-CTR05 and CIO-CTR10*. This document is available on our website at www.mccdaq.com/registermaps/RegMapCIO-CTR05_10.pdf.

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Introducing the CIO-CTR05

Overview: CIO-CTR05 features

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

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 counters 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 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 and other TTL level signals.

Software features

For information on the features of *Insta*Cal and the other software included with your CIO-CTR05, refer to the *Quick Start Guide* that shipped with your device.

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Installing the CIO-CTR05

What comes with your CIO-CTR05 shipment?

The following items are shipped with the CIO-CTR05.

Hardware

- CIO-CTR05



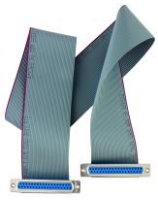
Additional documentation

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 CIO-CTR05 and information regarding installation of that software. Please read this booklet completely before installing any software or hardware.

Optional components

You can also order the following MCC products to use with your CIO-CTR05.

- C37FF-x cable



- Signal termination and conditioning accessories

  MCC provides signal conditioning and termination products for use with the CIO-CTR05. Refer to Field wiring, signal termination, and conditioning on page 13 for a complete list of compatible accessory products.

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Unpacking the CIO-CTR05

As with any electronic device, you should take care while handling to avoid damage from static electricity. Before removing the CIO-CTR05 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.

Configuring the CIO-CTR05

The CIO-CTR05 has a base address switch, an interrupt level select jumper, and a wait state jumper which you must set before installing the board in your computer. The *Insta*Cal calibration and test program included with the CIO-CTR05 will show you how to configure the board. Run *Insta*Cal before you open your computer and install the board. The CIO-CTR05 is shipped with the factory-default settings listed below.

Factory-configured default settings

Jumper/Switch	Description	Default setting
Base address	DIP switch for setting the base address	300h (768 decimal)
Interrupt Level	Jumper to set the IRQ number you want the interrupt pulse on	X position (no interrupt set)
Wait State	Jumper to enable a wait state	OFF position

Before installing the CIO-CTR05 in the computer, verify that the board is configured with the settings that you want. Review the following information to change the default configuration of a jumper or switch on the CIO-CTR05 board.

Base address switch

Before you install the CIO-CTR05 in your computer, set the base address by using the dip switch labeled **ADDRESS** located on the board.

The easiest way to set the base address switch is to let *Insta*Cal show you the correct settings. However, if are already familiar with setting ISA base addresses, you may use the base address switch description below to guide your base address selection.

Unless there is already another board in your system using address 300 hex (768 decimal), leave the switches as they are set at the factory. The example shown in Figure 1 shows the settings for the factory-default base address of 300 hex.

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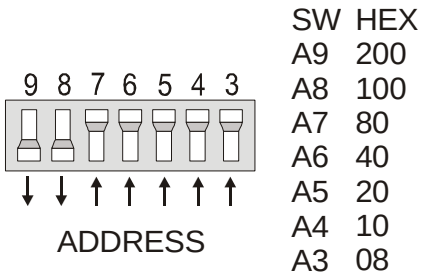


Figure 1. Base address switches

In the default configuration shown in Figure 1, addresses 9 and 8 are DOWN, and all others are UP. Address 9 = 200 hex (512 decimal) and address 8 = 100 hex (256 decimal); when added together they equal 300 hex (768 decimal).

Disregard the numbers printed on the switch

When setting the base address, refer to the numbers printed in white on the printed circuit board.

PC I/O addresses

Hex Range	Function	Hex Range	Function
000-00F	8237 DMA #1	2C0-2CF	EGA
020-021	8259 PIC#1	2D0-2DF	EGA
040-043	8253 Timer	2E0-2E7	GPIB (AT)
060-063	8255 PPI (XT)	2E8-2EF	Serial Port
060-064	8742 Controller (AT)	2F8-2FF	Serial Port
070-071	CMOS RAM & NMI mask (AT)	300-30F	Prototype card
080-08F	DMA page registers	310-31F	Prototype card
0A0-0A1	8259 PIC #2 (AT)	320-32F	Hard disk (XT)
0A0-0AF	NMI mask (XT)	378-37F	Parallel printer
0C0-0DF	8237 #2 (AT)	380-38F	SDLC
0F0-0FF	80287 numeric CO-P (AT)	3A0-3AF	SDLC
1F0-1FF	Hard disk (AT)	3B0-3BB	MDA
200-20F	Game control	3BC-3BB	Parallel printer
210-21F	Expansion unit (XT)	3C0-3CF	EGA
238-23B	Bus mouse	3D0-3DF	CGA
23C-23F	ALT bus mouse	3E8-3EF	Serial port
270-27F	Parallel printer	3F0-3F7	Floppy disk
2B0-2BF	EGA	3F8-3FF	Serial port

The CIO-CTR05 Base switch can be set for an address in the range of 000-3E0, so it should not be hard to find a free address area for your CIO-CTR05. If you are not using IBM prototyping cards, or some other board which occupies these addresses, then 300-31F HEX are free to use. Addresses not specifically listed, such as 390-39F, are free.

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Interrupt level select jumper

Use the Interrupt Level Select jumper located above the PC bus interface (gold pins) to set the IRQ number you want the interrupt pulse on.

This jumper is set by default with no interrupt level set ("X" position). Interrupts are hardware initiated software routines and are described in the section on programming.

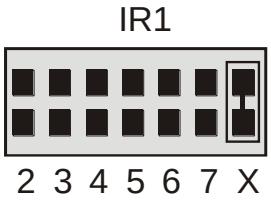


Figure 2. Interrupt Level Select jumper

Pin 1 (IR INPUT) of the 37-pin connector is an input jumper which maps the interrupt directly onto the PC bus. The signal to the bus is buffered. The buffer is enabled by a TTL low level on Pin 2 (IR ENABLE).

Hardware interrupts assigned by the PC may be available; refer to the following table. Note that IRQ8 to IRQ15 are AT only.

Name	Description	Name	Description
NMI	Parity	IRQ8	Real Time Clock (AT)
IRQ0 (AT)	Timer	IRQ9	Re-Directed To IRQ2
IRQ1	Keyboard	IRQ10	Unassigned
IRQ2	RESERVED (XT) INT 8-15 (AT)	IRQ11	Unassigned
IRQ3	COM OR SDLC	IRQ12	Unassigned
IRQ4	COM OR SDLC	IRQ13	80287 Numeric CO-P
IRQ5	Hard Disk (AT) LPT (AT)	IRQ14	Hard Disk
IRQ6	Floppy Disk	IRQ15	Unassigned
IRQ7	LPT		

Wait state jumper

The CIO-CTR05 board has a wait state jumper which you can set to enable an on-board wait state generator. A wait state is an extra delay injected into the processor's clock via the bus. This delay slows down the processor when the processor addresses the CIO-CTR05 board so that signals from slow devices (chips) will be valid. The jumper is shown in Figure 3 configured for OFF (wait state is disabled).

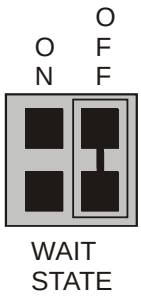


Figure 3. Wait State jumper

The wait state generator on the CIO-CTR05 is only active when the CIO-CTR05 is being accessed. Your PC will not be slowed down in general by using the wait state.

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Installing the CIO-CTR05

After you configure the board's switches and jumpers, you can install the CIO-CTR05 into your computer. To install your board, follow the steps below.

Install the MCC DAQ software before you install your board

The driver needed to run your board is installed with the MCC DAQ software. Therefore, you need to install the MCC DAQ software before you install your board. Refer to the *Quick Start Guide* for instructions on installing the software.

1. Turn your computer off, open it up, and insert your board into an available ISA slot.
2. Close your computer and turn it on.
3. To test your installation and configure your board, run the *Insta*Cal utility you installed in the previous section. Refer to the *Quick Start Guide* that came with your board www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf for information on how to initially set up and load *Insta*Cal.

Connecting the board for I/O operations

Connectors, cables – main I/O connector

The table below lists the board connector, applicable cables, and compatible accessory products.

Board connector, cables, and accessory equipment

Connector type	37-pin male D type
Compatible cables	C37FF-x
Compatible accessory products with the C37FF-x cable or C37FFS-x cable	CIO-MINI37 CIO-TERMINAL

Information on signal connections

General information regarding signal connection and configuration is available in the *Guide to Signal Connections* (available at www.mccdaq.com/signals/signals.pdf).

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Pin out – main I/O connector

The CIO-CTR05 I/O connector is a standard 37-pin male D connector that is accessible through the PC/AT expansion bracket.

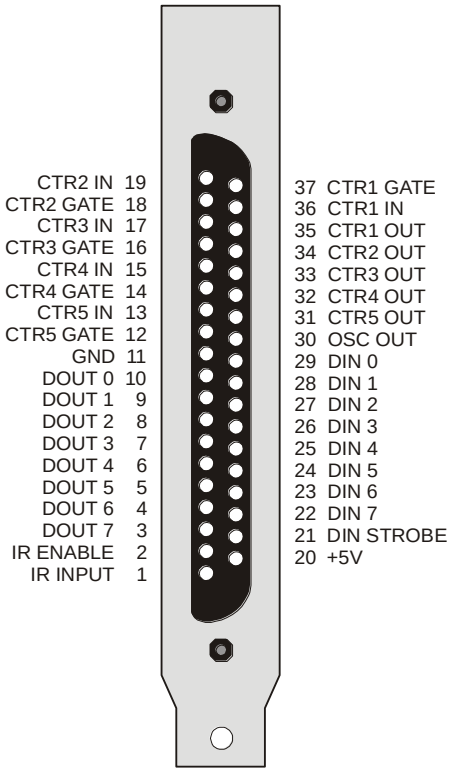


Figure 4. I/O connector pin out

Cabling

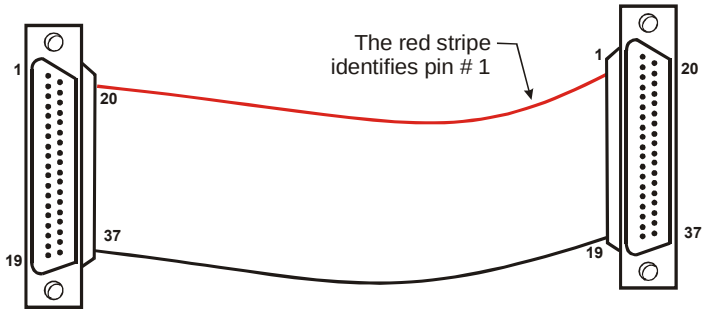


Figure 5. C37FF-*x* cable

Field wiring, signal termination, and conditioning

You can use the following screw terminal boards with the CIO-CTR05.

- CIO-MINI37 – 37-pin screw terminal board.
- CIO-TERMINAL – 37-pin screw terminal board with on-board prototyping area.

Details on these products are available on our web site at www.mccdaq.com/products/screw_terminal_bnc.aspx.

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Specifications

All specifications are subject to change without notice.

Typical for 25 °C unless otherwise specified.

Specifications in *italic* text are guaranteed by design.

Counter

Refer to the CTS9513-2 data sheet for complete 9513 specifications and operating modes. The data sheet is available on our web site at www.mccdaq.com/PDFmanuals/9513A.pdf.

Table 1. Counter specifications

Parameter	Conditions
Counter type	9513
Configuration	One 9513 device. Five up/down counters, 16-bits each.
Clock input frequency	7 MHz max
X2 clock input source	1 MHz (10 MHz Xtal divided by 10)
High pulse width (clock input)	70 ns min
Cycle time (clock input)	145 ns min
Gate pulse duration	145 ns min
Input low voltage	–0.5 V min, 0.8 V max
Input high voltage	2.2 V min, 5 V max
Output low voltage	0.4 V max @ 3.2 mA
Output high voltage	2.4 V min @ –200 µA
Crystal oscillator frequency	10 MHz
Frequency accuracy	100 ppm

Interrupts

Table 2. Interrupt specifications

Number of interrupts	2 to 7, jumper selectable
Interrupt enable	External, enabled with TTL low level
Interrupt sources	External

Digital input / output

Table 3. Digital I/O specifications

Digital type	Output: 74ACT273
	Input: 74LS373
Configuration	1 bank of 8 as output, 1 bank of 8 as strobed input
Number of I/O	8 input, 8 output
Output high	2.7 volts min @ –0.4 mA
Output low	0.5 volts max @ 8 mA
Input high	2.0 volts min, 7 volts absolute max
Input low	0.8 volts max, –0.5 volts absolute min

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Power consumption

Table 4. Power consumption specifications

+5 V	190 mA typical, 320 mA max.

Environmental

Table 5. Environmental specifications

Operating temperature range	0 to 55 °C
Storage temperature range	-20 to 70 °C
Humidity	0 to 90% non-condensing

Main connector and pin out

Table 6. Main connector specifications

Connector type	37 pin D-type
Compatible cables	C37FF-x, unshielded ribbon cable
Compatible accessory products	CIO-MINI37 CIO-TERMINAL

P1 pin out

Table 7. P1 pin out

Pin	Signal Name	Pin	Signal Name
1	IR INPUT	20	+5V
2	IR ENABLE	21	DIN STROBE
3	DOUT 7	22	DIN 7
4	DOUT 6	23	DIN 6
5	DOUT 5	24	DIN 5
6	DOUT 4	25	DIN 4
7	DOUT 3	26	DIN 3
8	DOUT 2	27	DIN 2
9	DOUT 1	28	DIN 1
10	DOUT 0	29	DIN 0
11	GND	30	OSC OUT
12	CTR5 GATE	31	CTR5 OUT
13	CTR5 IN	32	CTR4 OUT
14	CTR4 GATE	33	CTR3 OUT
15	CTR4 IN	34	CTR2 OUT
16	CTR3 GATE	35	CTR1 OUT
17	CTR3 IN	36	CTR1 IN
18	CTR2 GATE	37	CTR1 GATE
19	CTR2 IN		

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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

CIO-CTR05

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, EN55022 (1987), EN50082-1

Emissions: Group 1, Class B

- EN55022 (1987): Radiated and Conducted emissions.

Immunity: EN50082-1

- IEC 801-2 (1987): Electrostatic Discharge immunity, Criteria A.
- IEC 801-3 (1984): Radiated Electromagnetic Field immunity Criteria A.
- IEC 801-4 (1988): Electric Fast Transient Burst immunity Criteria A.

Declaration of Conformity based on tests conducted by Chomerics Test Services, Woburn, MA 01801, USA in November, 1995. Test records are outlined in Chomerics Test Report #EMI0168A.95.

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



Carl Haapaoja, Director of Quality Assurance

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