

ARTISAN®
TECHNOLOGY GROUP

Your **definitive** source for quality pre-owned equipment.

Artisan Technology Group
(217) 352-9330 | sales@artisantg.com | artisantg.com

Full-service, independent repair center
with experienced engineers and technicians on staff.

We buy your excess, underutilized, and idle equipment
along with credit for buybacks and trade-ins.

Custom engineering
so your equipment works exactly as you specify.

- Critical and expedited services
- In stock / Ready-to-ship
- Leasing / Rentals / Demos
- ITAR-certified secure asset solutions

Expert team | Trust guarantee | 100% satisfaction

All trademarks, brand names, and brands appearing herein are the property of their respective owners.

Visit our website - *Click HERE*

PC104-CTR10HD

User's Manual



Revision 2
October, 2000

MEGA-FIFO, the CIO prefix to data acquisition board model numbers, the PCM prefix to data acquisition board model numbers, PCM-DAS08, PCM-D24C3, PCM-DAC02, PCM-COM422, PCM-COM485, PCM-DMM, PCM-DAS16D/12, PCM-DAS16S/12, PCM-DAS16D/16, PCM-DAS16S/16, PCI-DAS6402/16, Universal Library, *Insta*Cal, *Harsh Environment Warranty* and Measurement Computing Corporation are registered trademarks of Measurement Computing Corporation.

IBM, PC, and PC/AT are trademarks of International Business Machines Corp. Windows is a trademark of Microsoft Corp. All other trademarks are the property of their respective owners.

Information furnished by Measurement Computing Corp. is believed to be accurate and reliable. However, no responsibility is assumed by Measurement Computing Corporation neither for its use; nor for any infringements of patents or other rights of third parties, which may result from its use. No license is granted by implication or otherwise under any patent or copyrights of Measurement Computing Corporation.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form by any means, electronic, mechanical, by photocopying, recording or otherwise without the prior written permission of Measurement Computing Corporation.

Notice

Measurement Computing Corporation does not authorize any Measurement Computing Corporation product for use in life support systems and/or devices without the written approval of the President of Measurement Computing Corporation Life support devices/systems are devices or systems which, a) are intended for surgical implantation into the body, or b) support or sustain life and whose failure to perform can be reasonably expected to result in injury. Measurement Computing Corp. products are not designed with the components required, and are not subject to the testing required to ensure a level of reliability suitable for the treatment and diagnosis of people.

(C) Copyright 2000 Measurement Computing Corporation

HM PC104-CTR10HD.lwp

Table of Contents

1.0 SOFTWARE INSTALLATION 1
2.0 HARDWARE INSTALLATION 1
2.1 BASE ADDRESS 1
2.2 INTERRUPT LEVEL SELECT 3
2.3 CLOCK SOURCE SELECT 3
2.4 INSTALLING THE BOARD 4
3.0 CONTROL & DATA REGISTERS 6
4.0 SPECIFICATIONS 9
5.0 ELECTRONICS AND INTERFACING 10
5.1 VOLTAGE DIVIDERS 10
5.2 LOW-PASS FILTERS DE-BOUNCE INPUTS 12

This page is blank.

1.0 SOFTWARE INSTALLATION

The board has switches to set before installing the board in your computer. By far the simplest way to configure your board is to use the *Insta*Cal™ program provided as part of your software package. *Insta*Cal™ will show you all available options, how to configure the switches to match your application requirements, and will create a configuration file that your application software (and the Universal Library) will refer to so the software you use will automatically know the exact configuration of the board.

Please refer to the *Extended Software Installation Manual* regarding the installation and operation of *Insta*Cal™. The following hard copy information is provided as a matter of completeness, and will allow you to set the hardware configuration of the board if you do not have immediate access to *Insta*Cal™ and/or your computer.

2.0 HARDWARE INSTALLATION

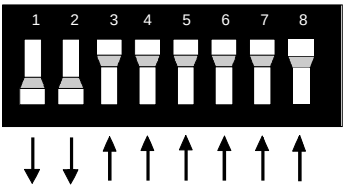
The PC104-CTR10HD has one bank of base address switches to set before installing the board in your computer. The InstaCal program included with the PC104-CTR10HD shows how to set these switches.

2.1 BASE ADDRESS

Unless there is already a board in your system which uses address 300h (768 decimal), leave the switches as they are set at the factory.

In the example shown in Figure 2-1, the PC104-CTR is set for base address 300h (768 decimal).

Certain addresses are used by the PC, others are free and may be used by the PC104-CTR and other expansion boards. Refer to Table 2-1 for PC I/O addresses. We recommend trying BASE = 300h (768 decimal) first.



SWITCH	HEX
1	200
2	100
3	80
4	40
5	20
6	10
7	08
8	04

BASE ADDRESS SWITCH - Address 300h shown

Figure 2-1. Base Address Switch

Table 2-1. 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-3BF	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 PC104-CTR BASE switch may be set for address in the range of 000-3F8 so it should not be hard to find a free address area for you PC104-CTR. Once again, if you are not using IBM prototype cards or some other board which occupies these addresses, then 300-31Fh are free to use.
Address not specifically listed, such as 390-39F, are free.

2.2 INTERRUPT LEVEL SELECT

A single interrupt input (IR INPUT) allows you to initiate an interrupt service routine with an external pulse. The interrupt level is selected via software.

2.3 CLOCK SOURCE SELECT

The source of the pulses supplied to each of the AM9513 chips for timing operations is individually programmable. The on-board 1 MHz or 5 MHz source may be selected or an external source (EXT SRCx) may be selected.

2.4 INSTALLING THE BOARD

1. Turn the power off.
2. Push the board firmly down into the expansion bus connector. If it is not seated fully it may fail to work.
3. The connector is a 50-pin header type connector (Figure 2-2). All the signals from the 9513 and interrupt are accessible.
4. Cables C50FF-2 and the CIO-MINI50 allow easy connection to all of the counter signals through 12-22 AWG screw terminals.

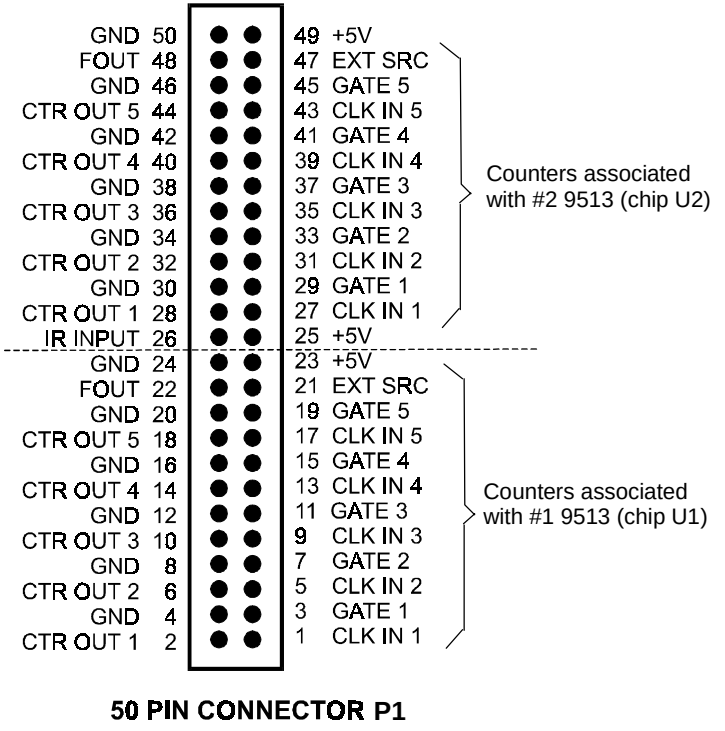


Figure 2-2. 50-Pin Connector

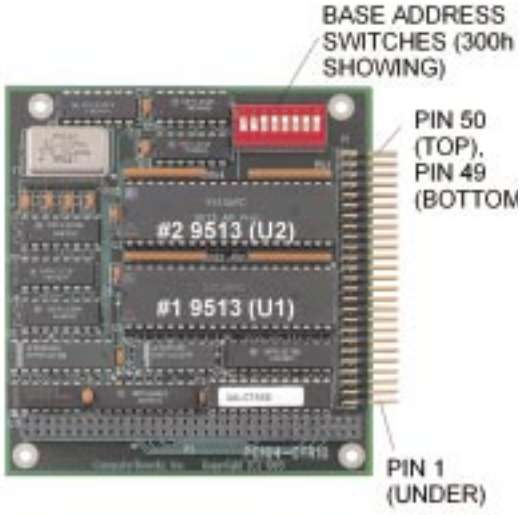


Figure 2-3. Address Switches, Counters and Connector P1 Pin Locations

3.0 CONTROL & DATA REGISTERS

The PC104-CTR10HD has two AM9513 counter/timer chips, “#1” and “#2” (refer back to Figure 2-3). Each AM9513 contains five counters of 16 bits each. Associated with each counter are:

1. an input source,
2. a count register,
3. a load register,
4. a hold register,
5. an output
6. a gate.

Unlike an Intel 8254 which has a single source, single gate and unique I/O address for each counter, the AM9513 is fully programmable and any counter may be internally connected to any gate and receive it's counts from a number of sources. In addition, each counter does not have a unique I/O address. The AM9513 takes only two addresses per chip, one of which is a data path to the counter's load and hold registers.

There is no AM9513 register information in this manual. If you wish to know more about programming the AM9513, please call Technical Support.

We suggest that you use the Universal Library, rather than resort to programming the AM9513 directly. Since programming support is available through the Universal Library, we do not supply help with other AM9513 programming.

The PC104-CTR10HD is an I/O-mapped expansion board which occupies four addresses plus a control address.

The first address, or BASE ADDRESS, is determined by setting a bank of switches on the board.

A register is easy to read and write to. Most often, register manipulation is best left to experienced programmers as most of the PC104-CTR10HD possible functions are implemented in the easy to use Universal Library routines.

The register descriptions follow the format:

7	6	5	4	3	2	1	0
A7	A6	A5	A4	A3	A2	A1	A0

Numbers along the top row are the bit positions within the 8-bit byte and the numbers and symbols in the bottom row are the functions associated with that bit.

To write to or read from a register in decimal or HEX, the weights in Table 3-1 apply:

Table 3-1. Bit Weights

BIT POSITION	DECIMAL VALUE	HEX VALUE
0	1	1
1	2	2
2	4	4
3	8	8
4	16	10
5	32	20
6	64	40
7	128	80

To write control or data to a register, the individual bits must be set to 0 or 1 then combined to form a byte. Data read from registers must be analyzed to determine which bits are on or off.

The method of programming required to set/read bits from bytes is beyond the scope of this manual. It will be covered in most Introduction To Programming books, available from a bookstore.

In summary form, the registers and their function are listed on the following table. Each register has eight bits which may constitute a byte of data or eight individual bit functions.

Table 2-2. Register Functions

ADDRESS	READ FUNCTION	WRITE FUNCTION
BASE + 0h	Data from 9513 #1	Data for 9513 #1
BASE + 1h	Status of 9513 #1	Commands to 9513 #1
BASE + 2h	Data from 9513 #2	Data for 9513 #2
BASE + 3h	Status of 9513 #2	Commands to 9513 #2
BASE + 400h	None	Interrupt & CTR source

Base +400 hex

7	6	5	4	3	2	1	0
WS_ENB	CLK11	CLK10	CLK01	CLK00	L2	L1	L0

L2 - L0: selects the interrupt level

L2	L1	L0	Interrupt Level
0	1	0	2
0	1	1	3
1	0	0	4
1	0	1	5
1	1	0	6
1	1	1	7

CLK01 - CLK00: selects the clock source for the internal oscillator for 9513, #1
CLK11 - CLK10: selects the clock source for the internal oscillator for 9513, #2

CLK00 CLK01(9513, #1) CLK10 CLK11(9513, #2)	Source selected
0 0	1 MHz
1 0	5 MHz
0 1	EXT SRC
1 1	N/A

WS_ENB: Wait state enable. 1 = wait state active, 0 = wait state disabled

4.0 SPECIFICATIONS

POWER CONSUMPTION

+5V	225 mA typical, 300 mA max

COUNTER SECTION

Counter type	9513
Configuration	Two 9513 devices. 5 counters per 9513, 16 bits each
Clock input frequency	7 MHz max
X2 Clock input source	1 MHz (10 MHz crystal divided by 10), 5 MHz (10 MHz crystal divided by 2) or external; software-selectable
High pulse width (clock input)	70 ns min
Cycle time (clock input)	145 ns min
Gate pulse duration	145 ns min
Input low voltage	–0.5V min, 0.8V max
Input high voltage	2.2V min, 5V max
Output low voltage	0.4V max @ 3.2 mA
Output high voltage	2.4V min @ –200 µA
Crystal oscillator clock source	10 MHz
Frequency accuracy	
PC104-CTR10HD	100 PPM
PC104-CTR10HD/H50	50 ppm

DIGITAL INPUT / OUTPUT

Interrupts	2 to 7, software-selectable
Interrupt enable	Programmable
Interrupt sources	External

ENVIRONMENTAL

Operating temperature range	0 to 50°C
Storage temperature range	–20 to 70°C
Humidity	0 to 90% non-condensing
Weight	5 oz (~140g)

5.0 ELECTRONICS AND INTERFACING

5.1 VOLTAGE DIVIDERS

If you wish to measure a signal which varies over a range greater than the input range of a digital input, a voltage divider can drop the voltage of the input signal to the level the digital input can measure.

A voltage divider takes advantage of Ohm's law, which states,

> Voltage = Current * Resistance

and Kirkoff's voltage law which states,

> The sum of the voltage drops around a circuit will be equal to the voltage drop for the entire circuit.

Implied in the above is that any variation in the voltage drop for the circuit as a whole will have a proportional variation in all the voltage drops in the circuit.

A voltage divider takes advantage of the fact that the voltage across one of the resistors in a circuit is proportional to the voltage across the total resistance in the circuit (Figure 4-1).

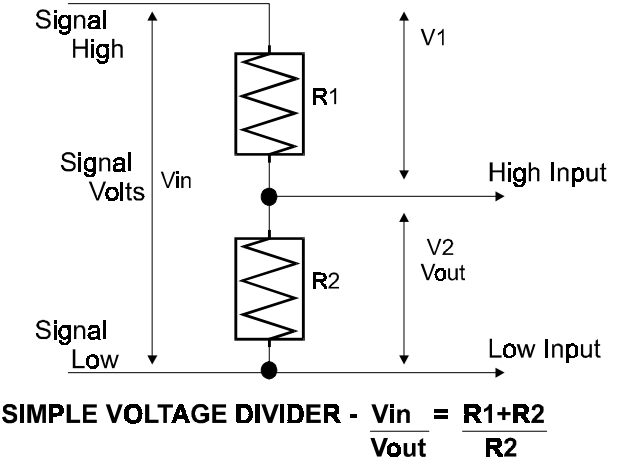


Figure 4-1. Voltage Divider

The object in using a voltage divider is to choose two resistors with the proper proportions relative to the full scale of the digital input and the maximum signal voltage.

Dropping the voltage proportionally is often called attenuation. The formula for attenuation is:

$$\text{Attenuation} = \frac{R1 + R2}{R2}$$

The variable Attenuation is the proportional difference between the signal voltage max and the full scale of the analog input.

$$2 = \frac{10K + 10K}{10K}$$

For example, if the signal varies between 0 and 20 volts and you wish to measure that with an analog input with a full scale range of 0 to 10 volts, the Attenuation is 2:1 or just 2.

$$R1 = (A-1) * R2$$

For a given attenuation, pick a handy resistor and call it R2, the use this formula to calculate R1.

Digital inputs also make use of voltage dividers, for example, if you wish to measure a digital signal that is at 0 volts when off and 24 volts when on, you cannot connect that directly to the PC104-CTR digital inputs. The voltage must be dropped to 5 volts maximum when on. The Attenuation is 24:5 or 4.8. Use the equation above to find an appropriate R1 if R2 is 1K. Remember that a TTL input is 'on' when the input voltage is greater than 2.5 volts.

IMPORTANT NOTE

The resistors, R1 and R2, are going to dissipate all the power in the divider circuit according to the equation Current = Voltage / Resistance and Power = Current-squared x Resistance ($P_{watts} = I^2*R$). The higher the value of the resistance (R1 + R2) the less power dissipated by the divider circuit. Here is a simple rule:

For Attenuation of 5:1 or less, no resistor should be less than 10K.

For Attenuation of greater than 5:1, no resistor should be less than 1K.

The CIO-TERM100 has the circuitry on board to create custom voltage dividers. The CIO-TERM100 is a 16" by 4" screw terminal board with two 37-pin D-type connectors and 56 screw terminals (12 to 22 AWG). Designed for table top, wall or rack mounting, the board provides prototype, divider circuit, filter circuit and pull-up resistor positions which you may complete with the proper value components for your application.

5.2 LOW-PASS FILTERS DE-BOUNCE INPUTS

A low-pass filter is placed on the signal wires between a signal and an A/D board. It stops frequencies greater than the cut-off frequency from entering the board's inputs.

The key term in a low-pass filter circuit is cut-off frequency. The cut-off frequency is that frequency above which no variation of voltage with respect to time may enter the circuit. For example, if a low-pass filter had a cut-off frequency of 30 Hz, the kind of interference associated with line voltage (60 Hz) would be filtered out but a signal of 25 Hz would be allowed to pass.

In a digital circuit, a low-pass filter can be used to filter an input from a switch or relay. See Figure 4-2 for the circuit configuration

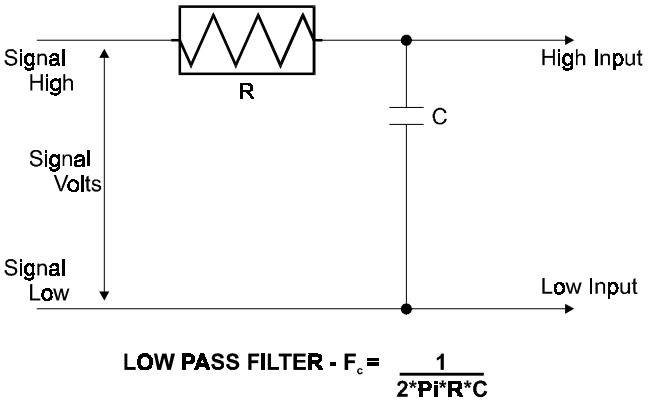


Figure 4-2. Low-Pass Filter

A simple low-pass filter can be made from one resistor (R) and one capacitor (C). The cut off frequency is determined according to the formula:

$$Fc = \frac{1}{2 * \pi * R * C}$$

$$R = \frac{1}{2*\pi* C * Fc}$$

Where $\pi = 3.14...$
Fc = frequency in cycles per second
R = resistance in Ohms
C = capacitance in Farads

For your notes.

For your notes.

EC Declaration of Conformity

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

PC104-CTR10HD	Ten-Counter Board for PC104 Bus Sys.
Part Number	Description

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 normative documents:

EU EMC Directive 89/336/EEC: Essential requirements relating to electromagnetic compatibility.

EU 55022 Class B: Limits and methods of measurements of radio interference characteristics of information technology equipment.

EN 50082-1: EC generic immunity requirements.

IEC 801-2: Electrostatic discharge requirements for industrial process measurement and control equipment.

IEC 801-3: Radiated electromagnetic field requirements for industrial process measurements and control equipment.

IEC 801-4: Electrically fast transients for industrial process measurement and control equipment.

Carl Haapaoja, Director of Quality Assurance

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

Artisan Technology Group is an independent supplier of quality pre-owned equipment

Gold-standard solutions

Extend the life of your critical industrial, commercial, and military systems with our superior service and support.

We buy equipment

Planning to upgrade your current equipment? Have surplus equipment taking up shelf space? We'll give it a new home.

Learn more!

Visit us at **artisantg.com** for more info on price quotes, drivers, technical specifications, manuals, and documentation.

Artisan Scientific Corporation dba Artisan Technology Group is not an affiliate, representative, or authorized distributor for any manufacturer listed herein.

We're here to make your life easier. How can we help you today?

(217) 352-9330 | sales@artisantg.com | artisantg.com

ARTISAN® TECHNOLOGY GROUP