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PCI-DAS08

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1.0 INTRODUCTION

The PCI-DAS08 is a low cost analog input board for PCI bus compatible computers. Offering 8 single-ended 12-bit analog inputs with sample rates up to 50 KHz and A/D resolution of 2.44 mV. The board also provides 4 digital output bits, 3 digital input bits and three 16-bit down counters (in the form of a single 82C54). The PCI-DAS08 is connector and software compatible with the highly popular ISA based CIO-DAS08 board and is supported by the same wide variety of external signal conditioning products.

The PCI-DAS08 is completely plug-and-play. There are no switches, jumpers or potentiometers on the board. All board addresses, interrupt channels etc. are set by your computers plug-and-play software.

The PCI-DAS08 is fully supported by the powerful Universal Library software driver library as well as a wide variety of application software packages including DAS Wizard and HP VEE.

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2.0 INSTALLATION

2.1 HARDWARE INSTALLATION

The PCI-DAS08 is completely plug and play. Simply follow the steps shown below to install your PCI hardware.

1. Turn your computer off, unplug it, open it up and insert the PCI board into any available PCI slot.

2. Close your computer up, plug it back in and turn it on.

3. Windows will automatically detect the board as it starts up. If the board's configuration file is already on the system, it will load without user interaction. If the configuration file is not detected, you will be prompted to insert the disk containing it. The required file is on the InstaCal or Universal Library disk you received with your board. Simply insert the CD (or Disk 1 if your software is on floppy disk) into an appropriate drive and click on *CONTINUE*. The appropriate file should then be automatically loaded and the PCI board will appear in the Device Manager under DAS Component.

   If the file is not found on the first attempt, use the browse function to select the drive that contains the InstaCAL or Univesal Library disk, select the CBxx.INF file and then click on *CONTINUE.*

2.2 SOFTWARE INSTALLATION, *WINDOWS* 95, 98 & NT

2.2.1 INTRODUCTION

*Insta*Cal is the installation, calibration and test software supplied with your data acquisition hardware. The complete *Insta*-Cal package is also included with the Universal Library. If you have ordered the Universal Library, the Universal Library CD/disks install both the library and *Insta*Cal. The installation will create all required files and unpack the various pieces of compressed software. To install *Insta*Cal (and the Universal Library if applicable), simply run the SETUP.EXE file contained on your CD, (or Disk 1 of the floppy disk set) and follow the on-screen instructions.

2.2.2 INSTALLATION OPTIONS

If you are installing on a Windows 95 or 98 operating system, the "Installation Options" dialog box will allow you to install the 16-bit, the 32-bit, or both versions of InstCAL. Please select the 32-bit installation unless you are using a 16-bit application or library to control your hardware. Please note that the PCI-DAS08 is not currently supported by the 16-bit library. If you need 16-bit support, please contact us for options.

If your are installing the Universal Library, the "Installation Options" dialog box also presents options to install libraries and example programs for each language supported. Please select the appropriate library versions and example programs for the language(s) you will be using.

2.2.3 INSTALLATION COMPLETION

After the installation of *Insta*Cal is complete you should restart your computer to take advantage of changes made to the system.

2.3 RUN *Insta*Cal

Run the *Insta*Cal program in order to test your board and configure it for run-time use. By configuring the board, you add information to the configuration file, cb.cfg, that is used by the Universal Library and other third-party data acquisition packages that use the Universal Library to access the board.

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2.3.1 LAUNCHING InstaCAL

Launch *Insta*Cal by going to your Start Menu then to Programs, then to CB, and finally choosing *Insta*Cal.
You may also launch the program by going to START>RUN and typing INSCAL32, or by finding the file named "inscal32.exe" in your installation directory and double clicking it.

*Insta*Cal will display a dialog box indicating the boards that have been detected in the system. If there are no other boards currently installed by *Insta*Cal, then the PCI-DAS08 board will be assigned board number 0. Otherwise it will be assigned the next available board number.

You can now view and change the board configuration by clicking the properties icon or selecting the Install\Configure menu.

2.3.2 TESTING THE INSTALLATION

After you have run the install program, it is time to test the installation. The following section describes the *Insta*Cal procedure to test that your board is properly installed.

With *Insta*Cal running:

1. Select the board you just installed.

2. Select the "Test" function.

Follow the instructions provided to test for proper board operation.

2.4 DOS and/or WINDOWS 3.1

Most users are now installing PCI Bus boards in systems with 32-bit operating systems (e.g., Windows 95, 98 or NT). The PCI-CTR05 is not currently supported by the 16-bit library required to run under DOS or Windows 3.x.

Please contact us if your application is running under DOS or Windows 3.x.

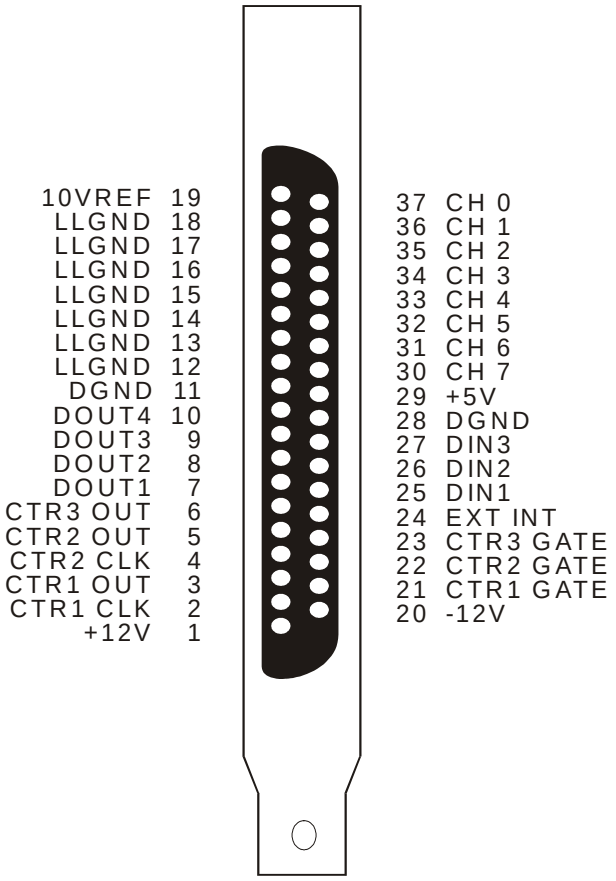
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3.0 HARDWARE CONNECTIONS

3.1 CONNECTOR PIN DIAGRAM

The PCI-DAS08 board employs a male 37 pin "D" I/O connector. The PCI-DAS08 is fully connector compatible with the CIO-DAS08, and is easily connected to the same wide variety of external signal conditioning products. The pinout of the connector is shown below.

Please make accurate notes and pay careful attention to wire connections. In a large system a misplaced wire may create hours of work 'fixing' problems that do not exist before the wiring error is found.



PCI-DAS08 Connector Diagram

3.2 CONNECTING SIGNALS TO THE PCI-DAS08

The simplest way to connect signals to the PCI-DAS08 is via the C37FF-x series cable and the CIO-MINI37 screw terminal board. The PCI-DAS08 (via the C37FF-X cable) is also compatible with a wide variety of external signal conditioning boards. These include the CIO-EXP16, CIO-EXP32, CIO-EXP-RTD16, CIO-EXP-BRIDGE16 and ISO-RACK08.

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4.0 ANALOG CONNECTIONS

4.1 ANALOG INPUTS

Analog signal connection is one of the most challenging aspects of applying a data acquisition board. If you are an Analog Electrical Engineer then this section is not for you, but if you are like most PC data acquisition users, the best way to connect your analog inputs may not be obvious. Though complete coverage of this topic is well beyond the scope of this manual, the following section provides some explanations and helpful hints regarding these analog input connections. This section is designed to help you achieve the optimum performance from your PCI-DAS08 series board.

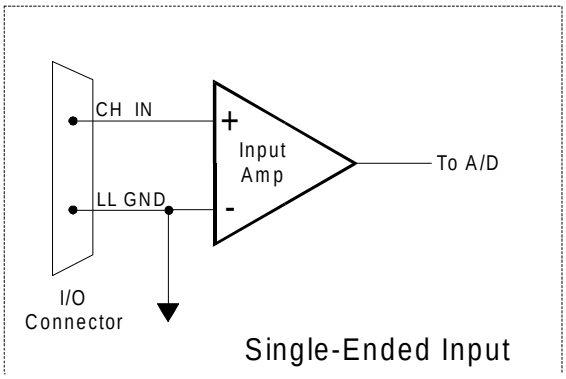
Please note that the PCI-DAS08 inputs are single-ended only. In some applications, this may make the PCI-DAS08 less suitable than a board that provides differential inputs. Prior to jumping into actual connection schemes, you should have at least a basic understanding of Single-Ended/Differential inputs and system grounding/isolation. If you are already comfortable with these concepts you may wish to skip to the next section (on wiring configurations).

4.1.1 Single-Ended and Differential Inputs

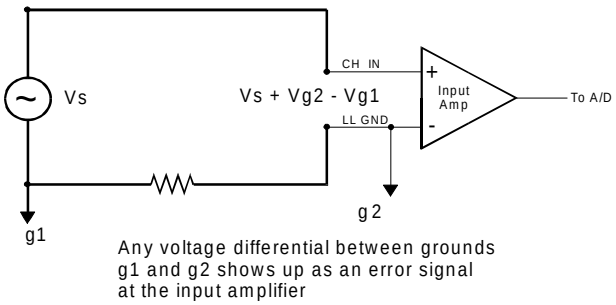
The PCI-DAS08 provides 8 single-ended input channels. The concepts of single-ended and differential inputs are discussed in the following section.

Single-Ended Inputs

A single-ended input measures the voltage between the input signal and ground. In this case, in single-ended mode the PCI-DAS08 measures the voltage between the input channel and LLGND. The single-ended input configuration requires only one physical connection (wire) per channel and allows the PCI-DAS08 to monitor more channels than the (2-wire) differential configuration using the same connector and onboard multiplexor. However, since the PCI-DAS08 is measuring the input voltage relative to its own low level ground, single-ended inputs are more susceptible to both EMI (Electro Magnetic Interference) and any ground noise at the signal source. The following diagrams show the single-ended input configuration.



Single-Ended Input

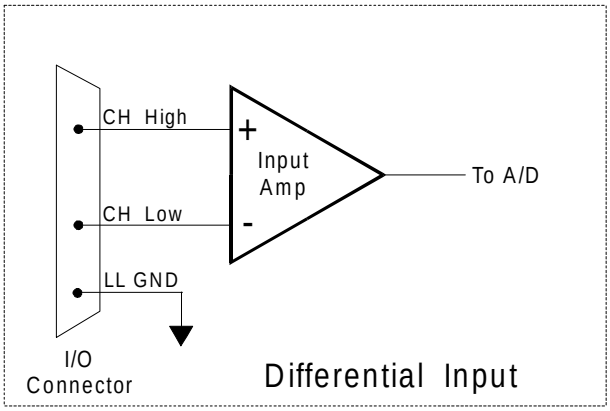


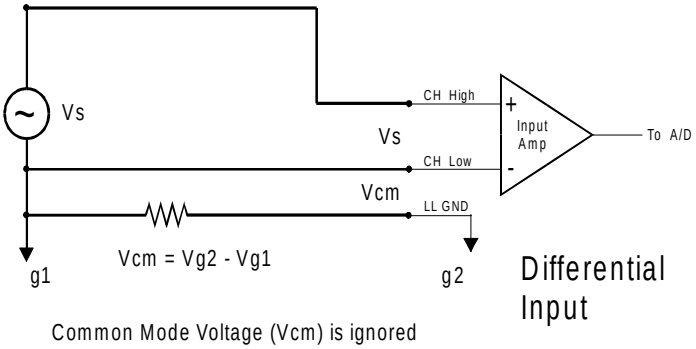
Single-ended input with Common Mode Voltage

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Differential Inputs

Differential inputs measure the voltage between two distinct input signals. Within a certain range (referred to as the common mode range), the measurement is almost independent of signal source to A/D input ground variations. A differential input is also much more immune to EMI than a single-ended one. Most EMI noise induced in one lead is also induced in the other, the input only measures the difference between the two leads, and the EMI common to both is ignored. This effect is a major reason there is twisted pair wire as the twisting assures that both wires are subject to virtually identical external influence. The diagram below shows a typical differential input configuration.





Common Mode Voltage (Vcm) is ignored by differential input configuration. However, note that Vcm + Vs must remain within the amplifier's common mode range of ±10V

If the inputs you are monitoring have a significant common mode voltage, the PCI-DAS08 board may not be suitable without the addition of some type of external signal conditioning (e.g. CIO-EXP32 or ISO-RACK08). However, as long at the common mode voltage is small (typically less than 1 volt), you can try the board without risk of damaging the board, and depending on the application, you may receive acceptable results.

WARNING

If either the AC or DC voltage is greater than 5 volts, do not connect the PCI-DAS08 to this signal source. You are beyond the boards usable input range and will need to either adjust your grounding system or add special Isolation signal conditioning to take useful measurements. A ground offset voltage of more than 30 volts will likely damage the PCI-DAS08 board and possibly your computer. Note that an offset voltage much greater than 30 volts will not only damage your electronics, but it may also be hazardous to your health.

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5.0 PROGRAMMING & SOFTWARE APPLICATIONS

Your PCI-DAS08 is supported by the powerful Universal Library. We strongly recommend that you take advantage of the Universal Library as your software interface. The complexity of the the registers required for automatic calibration combined with the PCI BIOS's dynamic allocation of addresses and internal resources makes the PCI-DAS08 series very challenging to program via direct register I/O operations. Direct I/O programming should be attempted only by very experienced programmers.

Except for the registers required to implement plug-and-play, the PCI-DAS08 is register compatible with the CIO-DAS08 board. However, due to the dynamic nature of base addresses on the PCI bus, software written at the register level for the CIO-DAS08 board may not work reliably on the PCI-DAS08. However, software written based on the Universal Library will work with the PCI-DAS08 with few or no changes.

5.1 PROGRAMMING LANGUAGES

The Universal Library provides complete access to the PCI-DAS08 functions from the full range of 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, please turn now to the UniversalLibrary manual.

The optional VIX Components package may greatly simplify your programming effort. VIX Components is a set of programming tools based on a DLL interface to Windows languages. A set of VBX, OCX or ActiveX interfaces allows point and click construction of graphical displays, analysis and control structures. Please see the catalog for a complete description of the package.

5.2 PACKAGED APPLICATION PROGRAMS

Many packaged application programs, such as DAS Wizard and HP-VEE now have drivers for the PCI-DAS08. If the package you own does not appear to have drivers for the PCI-DAS08 please fax or e-mail the package name and the revision number from the install disks. We will research the package for you and advise how to obtain PCI-DAS08 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. Please contact us for more information on this topic.

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6.0 PCI-DAS08 REGISTER DESCRIPTION

6.1 REGISTER OVERVIEW

PCI-DAS08 operation registers are mapped into I/O address space. Unlike ISA bus designs, this board has *several* base addresses each corresponding to a reserved block of addresses in I/O space. As we mention in our programming chapter, we highly recommend customers use the Universal Library package. Direct register level programming should be attempted only by extremely experienced register level programmers.

Of six Base Address Regions (BADR) available in the PCI 2.1 specification, two are implemented in this design and are summarized as follows:

I/O Region	**Function**	**Operations**
BADR0	PCI Controller Operation Registers	32-Bit DWORD
BADR1	General Control/Status Registers	16-Bit WORD

BADR1 will likely be different on different machines. Assigned by the PCI BIOS, these Base Address values cannot be guaranteed to be the same even on subsequent power-on cycles of the same machine. All software must interrogate BADR0 at run-time with a READ_CONFIGURATION_WORD instruction to determine the BADRn values.

6.2 BADR0

BADR0 is reserved for the 9052 PCI Controller operations. There is no reason to access this region of I/O space for most PCI-DAS08 users. The installation procedures and Universal Library access all required information in this area. Unless you are writing direct register level software for the PCI-DAS08, you will not need to be concerned with BADR0 address.

PCI9052 REGISTER FUNCTION

CNTRL; Local 50h

This register, as with all the 9050 registers, is 32-bits in length. Therefore the remaining bits will need to be masked off in order to access on the OUT0 general purpose I/O bit.

Bit 0 enables the OUT0 function (0-enabled, 1-disabled) and should be set to 0
Bit 1 selects the OUT0 bit direction (0-input, 1-output) and should be set to 1

OUT0 selects the source for the interrupt latch.
OUT0 = 0, Interrupt input = user connector
OUT0 = 1, Interrupt input = counter 2 output.

7	6	5	4	3	2	1	0
x	x	x	x	x	OUT0	1	0

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6.3 BADR1

In addition to the BADR0 registers, the PCI-DAS08 uses 8 consecutive addresses in the PCI I/O space. The table below summarizes this address map, while the remainder of this chapter provides details on the function and usage of each of the registers. *Note that these registers are identical to those of the CIO-DAS08.*

REGISTER	READ FUNCTION	WRITE FUNCTION
BADR1 + 0	A/D bits 9 - 12 (LSB)	Start 8 bit A/D Conversion
BADR1+ 1	A/D bits (MSB) 1 - 8	Start 12 bit A/D Conversion
BADR1 + 2	EOC, IP1-3, IRQ, Mux address	OP1-4, INTE, Mux address
BADR1 + 3	Not Used	Not Used
BADR1 + 4	Read Counter 0 Data	Write Counter 0 Data
BADR1 + 5	Read Counter 1 Data	Write Counter 1 Data
BADR1 + 6	Read Counter 2 Data	Write Counter 2 Data
BADR1 + 7	No Readback	Control Register

6.3.1 A/D DATA REGISTERS

BADR1 + 00hex

READ/WRITE

7	6	5	4	3	2	1	0
A/D9	A/D10	A/D11	A/D12	0	0	0	0

READ

Contains the least significant 4 bits of the Analog input data.

WRITE

Writing any data to this register causes an immediate 8 bit A/D conversion.

BADR1 + 01hex

READ/WRITE

7	6	5	4	3	2	1	0
A/D1	A/D2	A/D3	A/D4	A/D5	A/D6	A/D7	A/D8

READ
Contains the most significant byte of the Analog input data.

The A/D bits code correspond to the voltage on the input according to the table below:

DECIMAL	HEX	VOLTAGE INPUT
4095	FFF	+ 5 Volts
2048	800	0 Volts
0	0	- 5 Volts

WRITE

Writing any data to this register causes an immediate 12 bit A/D conversion.

6.3.2 STATUS AND CONTROL REGISTER

BADR1 + 02hex

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READ

7	6	5	4	3	2	1	0
EOC	IP3	IP2	IP1	IRQ	MUX2	MUX1	MUX0

EOC End of conversion. 0 = A/D is not busy and data may be read, 1 = A/D is busy.
IP3:1 Digital input bits.
IRQ Interrupt status. 1 = positive edge detected on INT line. 0 = cleared, by writing to BADR+2hex.

MUX2:0 Current Multiplexor channel, binary coded between 0 and 7.

WRITE

7	6	5	4	3	2	1	0
OP4	OP3	OP2	OP1	INTE	MUX2	MUX1	MUX0

OP4:1 Digital output bits.
INTE Interrupt enable to the PC bus. 1 = interrupts are enabled, 0 = disabled.
MUX2:0 Sets current Multiplexor channel, binary coded between 0 and 7.

6.3.3 8254 COUNTER 0 (user COUNTER 1) DATA

BADR1 + 04hex

READ/WRITE

7	6	5	4	3	2	1	0
D7	D6	D5	D4	D3	D2	D1	D0

6.3.4 8254 COUNTER 1 (user COUNTER 2) DATA

BADR1 + 05hex

READ/WRITE

7	6	5	4	3	2	1	0
D7	D6	D5	D4	D3	D2	D1	D0

6.3.5 8254 COUNTER 2 (user COUNTER 3) DATA

BADR1 + 06hex

READ/WRITE

7	6	5	4	3	2	1	0
D7	D6	D5	D4	D3	D2	D1	D0

6.3.6 8254 CONTROL REGISTER

BADR1 + 07hex

WRITE ONLY

7	6	5	4	3	2	1	0
D7	D6	D5	D4	D3	D2	D1	D0

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The control register is used to set the operating Modes of 8254 Counters 0,1 & 2. A counter is configured by writing the correct Mode information to the Control Register, then the proper count data must be written to the specific Counter Register. The Counters on the 8254 are 16-bit devices. Since the interface to the 8254 is only 8-bits wide, Count data is written to the Counter Register as two successive bytes. First the low byte is written, then the high byte. The Control Register is 8-bits wide. Further information can be obtained on the 8254 data sheet, available from Intel or Harris.

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7 SPECIFICATIONS

Typical specifications for 25 DegC unless otherwise specified. Any specification in bold italic is guaranteed by design.

7.1 POWER CONSUMPTION

+5V Operating (A/D converting to FIFO)	251 mA typical, 436 mA max
+12V	13 mA typical, 19 mA max
-12V	17 mA typical, 23 mA max

7.2 ANALOG INPUT SECTION

A/D converter type	AD1674J
Resolution	12 bits
Ranges	±5V
A/D pacing	Software polled
A/D Triggering Modes	
Digital	Gated pacer (DIN1), software polled. (Gate must be disabled by software after trigger event.)
Data transfer	Software polled
Polarity	Bipolar
Number of channels	8 single-ended
A/D conversion time	10µs
Throughput	40KHz typical, PC dependent
Relative Accuracy	±1LSB
Differential Linearity error	No Missing Codes guaranteed
Integral Linearity error	±1 LSB
No missing codes guaranteed	12 bits
Gain drift (A/D specs)	±180ppm/°C
Zero drift (A/D specs)	±60ppm/°C
Input leakage current	±60 nA max over temperature
Input impedance	10Meg Ohms min
Absolute maximum input voltage	±35V
Noise Distribution	(Rate = 1-50KHz, Average % +/- 2 bins, Average % +/- 1 bin, Average # bins)
Bipolar (5V)	100% / 100% / 3 bins

7.3 DIGITAL INPUT/OUTPUT

Digital Type (Main connector)	
Output	74ACT273
Input	74LS244
Configuration	3 fixed input, 4 fixed output
Number of channels	7
Output High	3.94 volts min @ -24mA (Vcc = 4.5V)
Output Low	0.36 volts max @ 24mA (Vcc = 4.5V)

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Input High	2.0 volts min, 7 volts absolute max
Input Low	0.8 volts max, -0.5 volts absolute min
Interrupts	INTA# - mapped to IRQn via PCI BIOS at boot-time
Interrupt enable	Programmable through PCI controller; 0 = disabled, 1 =enabled (default)
Interrupt sources	External source (INT IN), polarity programmable through PCI controller; 1 = active high, 0 = active low (default)

7.4 COUNTER SECTION

Counter type	82C54
Configuration	82C54 device. 3 down counters per 82C54, 16 bits each 82C54: Counter 0 - User Counter 1 Source: Available at user connector (CTR1CLK) Gate: Available at user connector (CTR1GATE) Output: Available at user connector (CTR1OUT) Counter 1 - User Counter 2 Source: Available at user connector (CTR2CLK) Gate: Available at user connector (CTR2GATE) Output: Available at user connector (CTR2OUT) Counter 2 - User Counter 3 or Interrupt Pacer Source: Buffered PCI Clock (33MHz) divided by 8 Gate: Available at user connector (CTR3GATE) Output: Available at user connector (CTR3OUT) and may be software configured as Interrupt Pacer.
Clock input frequency	10Mhz max
High pulse width (clock input)	30ns min
Low pulse width (clock input)	50ns min
Gate width high	50ns min
Gate width low	50ns min
Input low voltage	0.8V max
Input high voltage	2.0V min
Output low voltage	0.4V max
Output high voltage	3.0V min

7.5 ENVIRONMENTAL

Operating temperature range	0 to 50 °C
Storage temperature range	-20 to 70 °C
Humidity	0 to 90% non-condensing

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EC Declaration of Conformity

PCI-DAS08	Low Cost analog input board for the PCI bus
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

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