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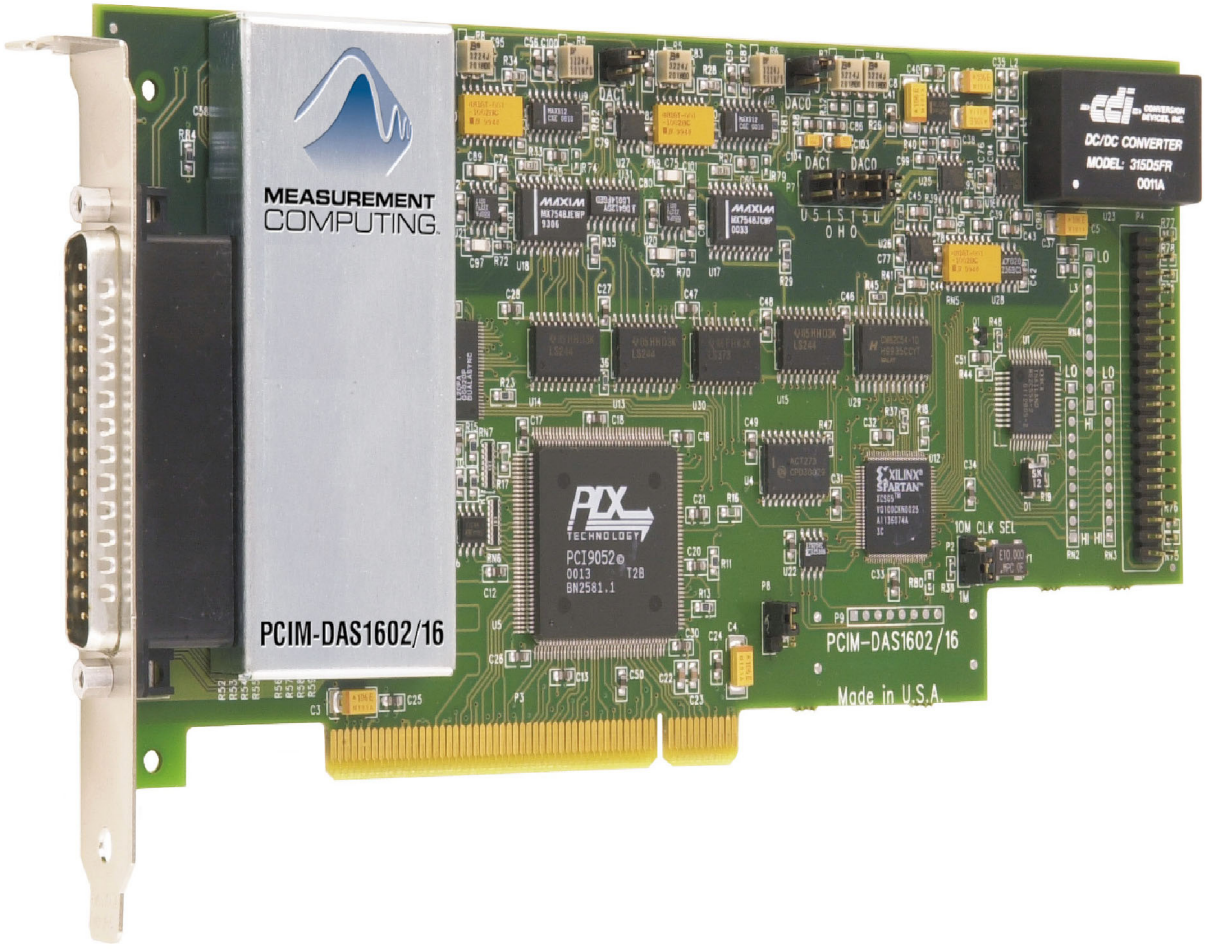
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PCIM-DAS1602/16

Analog & Digital I/O Board

User's Guide



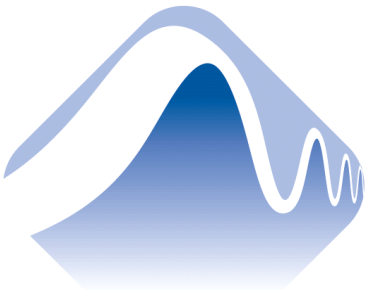
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PCIM-DAS1602/16

Analog & Digital I/O Board

User's Guide



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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 PCIM-DAS1602/16 device so that you get the most out of its analog input and digital I/O 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

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

The following electronic documents provide information that can help you get the most out of your PCIM-DAS1602/16.

- MCC's *Specifications: PCIM-DAS1602/16* (the PDF version of the Electrical Specification Chapter in this guide) is available on our web site at www.mccdaq.com/pdfs/PCIM-DAS1602-16.pdf.
- MCC's *Quick Start Guide* is available on our web site at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf.
- MCC's *Guide to Signal Connections* is available on our web site at www.mccdaq.com/signals/signals.pdf.
- MCC's *Universal Library User's Guide* is available on our web site at www.mccdaq.com/PDFmanuals/sm-ul-user-guide.pdf.
- MCC's *Universal Library Function Reference* is available on our web site at www.mccdaq.com/PDFmanuals/sm-ul-functions.pdf.
- MCC's *Universal Library for LabVIEW™ User's Guide* is available on our web site at www.mccdaq.com/PDFmanuals/SM-UL-LabVIEW.pdf.

PCIM-DAS1602/16 User's Guide (this document) is also available on our web site at www.mccdaq.com/PDFmanuals/PCIM-DAS1602-16.pdf.

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Introducing the PCIM-DAS1602/16

Overview: PCIM-DAS1602/16 features

This manual explains how to configure, install, and use your PCIM-DAS1602/16 board.

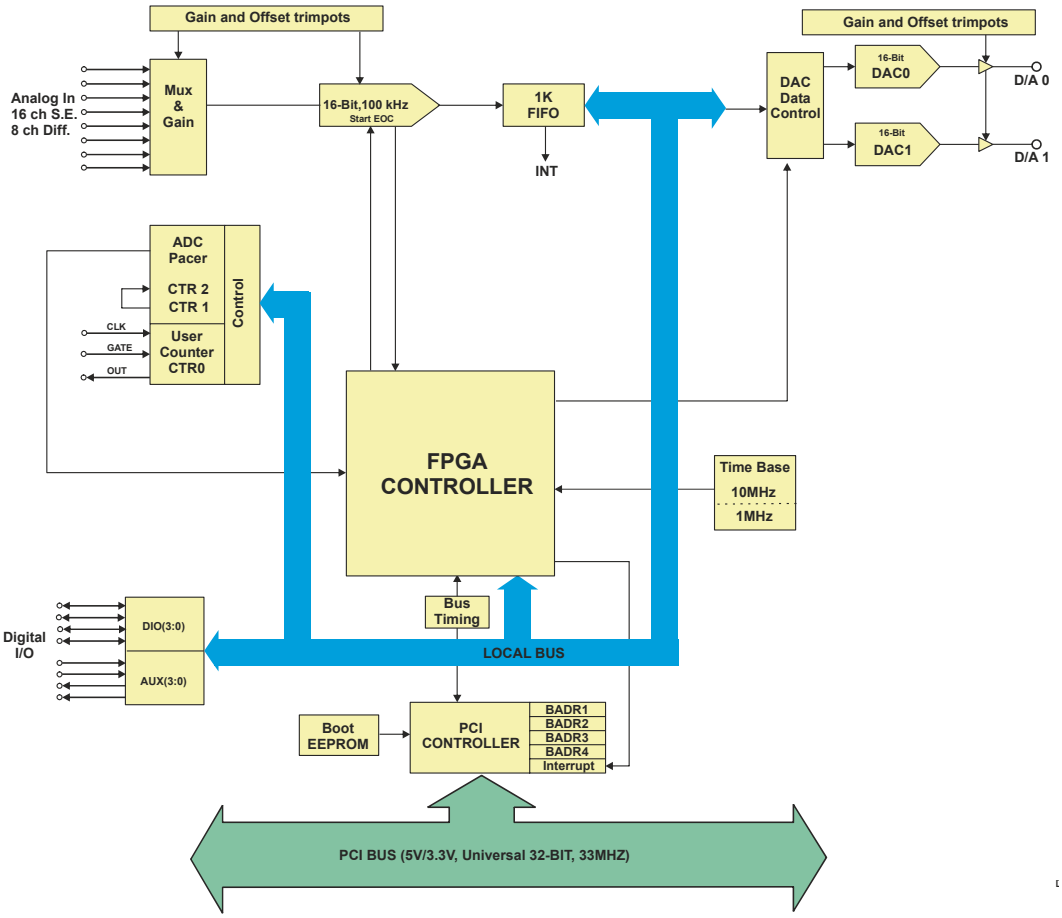
The PCIM-DAS1602/16 is a multifunction measurement and control board designed to operate in computers with PCI bus accessory slots.

The PCIM-DAS1602/16 provides the following:

- Eight differential or 16 single-ended input channels
- 16-bit A/D resolution
- 100 kHz sample rate
- Dual 12-bit analog outputs
- 32 DIO channels
- Three 16-bit counters

PCIM-DAS1602/16 block diagram

PCIM-DAS1602/16 functions are illustrated in the block diagram shown here.



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Software features

For information on the features of *Insta*Cal and the other software included with your PCIM-DAS1602/16, refer to the *Quick Start Guide* that shipped with your device. The *Quick Start Guide* is also available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf.

Check www.mccdaq.com/download.htm for the latest software version or versions of the software supported under less commonly used operating systems.

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Installing the PCIM-DAS1602/16

What comes with your PCIM-DAS1602/16 shipment?

As you unpack your PCIM-DAS1602/16, make sure that the following components are included.

Hardware

- PCIM-DAS1602/16



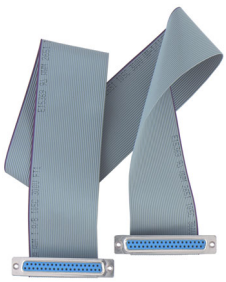
Additional documentation

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 PCIM-DAS1602/16 and information regarding installation of that software. Please read this booklet completely before installing any software or hardware.

Optional components

If you ordered any of the following products with your board, they should be included with your shipment.

- Cables



C37FF-x



C37FFS-x



BP40-37

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- Signal termination and conditioning accessories

  MCC provides signal termination and signal conditioning products for use with the PCIM-DAS1602/16. Refer to the "Field wiring, signal termination and signal conditioning" section for a complete list of compatible accessory products.

Unpacking the board

As with any electronic device, you should take care while handling to avoid damage from static electricity. Before removing the PCIM-DAS1602/16 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.

Default hardware configuration

The PCIM-DAS1602/16 board has several switches and jumpers mounted on it that you must set before installing into your computer if you are not using the default settings. The factory-configured default settings are listed in Table 2-1. The locations of each switch and jumper are shown in Figure 2-1.

Table 2-1. Switch/jumper factory-configured defaults

Board Label	Switch/Jumper description	Default Setting
S1	Channel Select switch	8
S2	A/D Range Select switch	Bipolar
P2	Clock Select jumper - 1/10 MHz XTAL jumper	1 MHz
P5 and P6	DAC0/DAC1 Bipolar/Unipolar Select jumpers	Bipolar
P7	DAC0 and DAC1 Range jumper	−5 V to +5 V
P8	Trigger Edge Select jumper	Rising Edge

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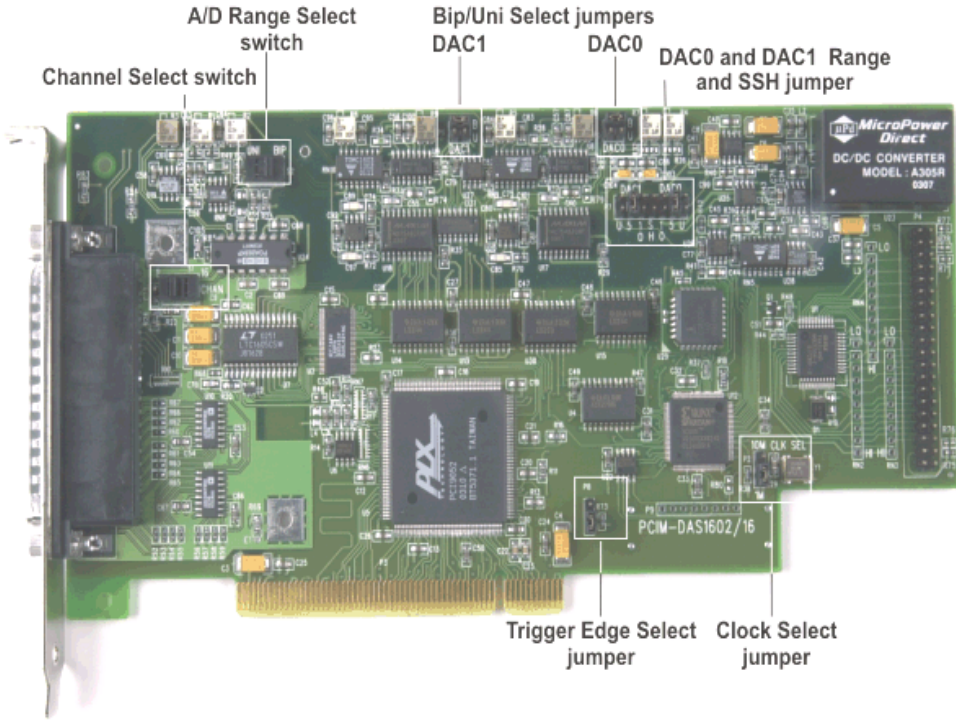


Figure 2-1. PCIM-DAS1602/16 switch and jumper locations

Before installing the PCIM-DAS1602/16 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 PCIM-DAS1602/16 board.

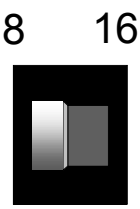
Board switches are covered by a metal nameplate

To access the Channel Select switch and the A/D Range Select switch, remove the metal nameplate that covers them. This plate is secured to the board with two screws.

Channel Select switch

Set the channel mode configuration with switch S1. The analog inputs of the PCIM-DAS1602/16 can be configured as eight differential channels or 16 single-ended channels. Use the single-ended input mode if you have more than eight analog inputs to sample. Using the differential input mode allows up to 10 volts of common mode (ground loop) rejection and will provide better noise immunity.

This switch is factory-configured for eight differential inputs. The Channel Select switch shown in Figure 2-2 is set to the "8" position. To configure for 16 channels, set this switch to 16.



8/16 CHANNEL SELECT SWITCH

(8 Channels, Differential Input Mode Shown)

Figure 2-2. 8/16 Channel Select switch

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A/D Range Select switch

The A/D converter range is set by switch S2. This switch controls all A/D channels.

Although you cannot run some channels bipolar and some unipolar, you can measure a unipolar input in the bipolar mode (for example, you can monitor a 0 to 5V input with a channel set to the ±5 V range). This switch is factory-configured for bipolar. The A/D Range Select switch shown in Figure 2-3 is configured for unipolar.

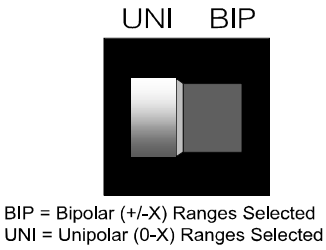


Figure 2-3. A/D Range Select switch

Trigger Edge Select jumper

The original Keithley MetraByte DAS-1600 was designed such that A/D conversion initiates on the falling edge of the convert signal. Neither the original DAS-16, nor any of the other DAS-16 derivative converts on the falling edge of the signal. In fact, we are not aware of any A/D board that uses the falling edge to initiate the A/D conversion.

When using the falling edge to start the conversion, the A/D may be falsely triggered by 8254 pacer clock initialization glitching. False triggering is easy to avoid, but may occur in the DAS-1600. Since initiating conversions on the falling edge is undesirable, but initiating on the rising edge may lead to timing differences if the PCIM-DAS1602/16 board is used as a replacement for an older DAS16 series board, the PCIM-DAS1602/16 is equipped with a jumper that you can use to select the edge that initiates the A/D conversion.

The Trigger Edge Select mode is configured by jumper **P8**. This jumper is factory-configured for rising edge. Figure 2-4 shows the edge selection options.

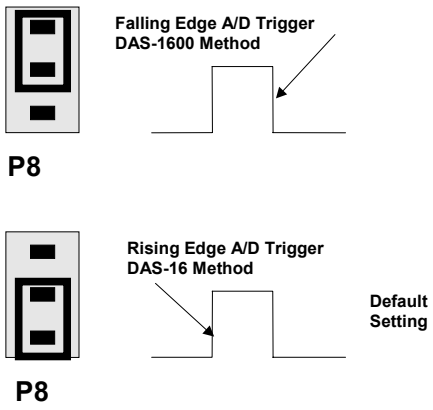


Figure 2-4. Trigger Edge Select jumper

For compatibility with all third party packages, with all DAS-16 software, and with PCIM-DAS1602/16 software, leave this jumper in the default rising edge position.

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DAC0 and DAC1 Range Select jumper (D/A Converter Reference)

The PCIM-DAS1602/16 has an on-board precision voltage reference at jumper P7 that you can use to select the output ranges of the digital to analog converters. Both of the board's D/A outputs are factory-configured with a range of –5 to +5 volts (Figure 2-5.)

Analog output is provided by two 12-bit multiplying D/A converters (DAC1 and DAC). This type of converter accepts an input reference voltage, and provides an output voltage which is both inverse to the reference voltage and proportional to the digital value in the output register. The proportion is controlled by the D/A output code (0 to 4095). Each bit represents 1/4096 of full scale. For example, in unipolar mode, the supplied reference of –5 V provides a +5V output (actually 4.9988 V) when the value in the output register is 4095 (full scale at 12 bits of resolution). It provides a value of 2.5 V when the value in the output register is 2048.

A precision –5 V and –10 V reference provides onboard D/A ranges of 0 to 5 V, 0 to 10 V, ±5 V, ±10 V. Other ranges between 0V and 10V are available when you provide a precision voltage reference at pin 10 (D/A0) or pin 26 (D/A1) of the board's main connector.

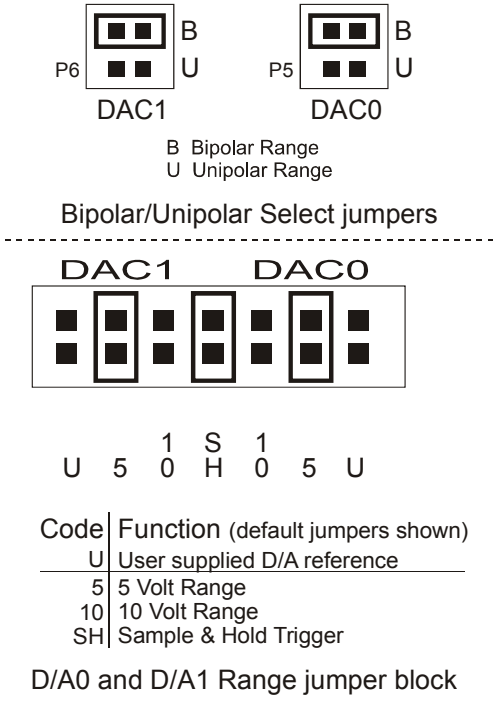


Figure 2-5. D/A0 and D/A1 Range jumper

Simultaneous sample and hold (SSH) trigger

When the DAC1 reference is supplied on-board, pin 26 of the 37-pin connector is unused (Figure 2-7). You can enable this pin as a SSH (simultaneous sample & hold) trigger for use with the CIO-SSH16 board. To configure this, place the jumper between the two pins labeled SH, as shown in Figure 2-5.

Clock Select jumper

Jumper P2 configures the frequency of the square wave used as a clock by the A/D pacer circuitry. This pacer circuitry controls the sample timing of the A/D.

You can configure the frequency for 10 MHz or 1 MHz. The Clock Select jumper is factory-configured for 1 MHz, as shown in Figure 2-6.

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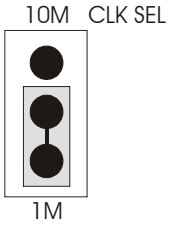


Figure 2-6. Clock Select jumper

Configure this jumper for 10 MHz, unless you have reason to do otherwise.

Internal pacer output is also available at pin 20

The internal pacer output driving the A/D converter is also available at pin 20 (CTR 3 Output) on the board's main I/O connector (see Figure 2-7).

Installing the PCIM-DAS1602/16

After you configure the board's switches and jumpers, install the PCIM-DAS1602/16 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 any available PCI slot.
2. Close your computer and turn it on.
3. If you are using an operating system with support for plug-and-play (such as Windows 2000 or Windows XP), 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 MCC DAQ software contains this file. If required, insert the *Measurement Computing Data Acquisition Software* CD and click **OK**.
4. To test your installation and configure your board, run the *Insta*Cal utility installed in the previous section. Refer to the *Quick Start Guide* that came with your board for information on how to initially set up and load *Insta*Cal.

Board configuration with *Insta*Cal

If you change the board configuration with *Insta*Cal, you may have to also physically change the setting of a corresponding switch or jumper on the board. Refer to Default hardware configuration on page 2-2 for specific jumper and switch information.

Allow your computer to warm up for at least 15 minutes before acquiring data. The high speed components used on the board generate heat, and it takes this amount of time for a board to reach steady state if it has been powered off for a significant amount of time.

Connecting the board for I/O operations

Connectors, cables – main I/O connector

The PCIM-DAS1602/16 board has a 37-pin connector for analog connections and a 40-pin connector for digital I/O connections. Table 2-2 lists the board connectors, applicable cables, and compatible accessory products for the PCIM-DAS1602/16.

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Table 2-2. Board connectors, cables, accessory equipment

Analog connector type	37-pin male "D" connector
Digital connector type	40-pin header connector
Compatible cables	C37FF-x (Figure 2-10) C37FFS-x (Figure 2-11) BP40-37 (Figure 2-12)
Compatible accessory products (with the C37FF-x cable or C37FFs-x cable)	CIO-MINI37 SCB-37 ISO-RACK16 ISO-DA02
Compatible accessory products (with the C37FF-x cable or C37FFs-x cable connected to the BP40-37 cable)	CIO-ERB08 CIO-ERB24 SSR-RACK08 SSR-RACK24

Analog connector

The PCIM-DAS1602/16 board's analog connector is a 37-pin "D" connector that is accessible from the rear of the PC on the expansion back plate. This connector accepts female 37-pin D-type connectors, such as the C37FF-x 37-pin cable (Figure 2-10) or the C37FFS-x 37-pin shielded cable (Figure 2-11).

An additional signal, SS&H OUT (Simultaneous Sample and Hold Output), is available at pin 26 of the analog connector. This pin is required when the CIO-SSH16 board is used with a PCIM-DAS1602/16. Refer to Simultaneous sample and hold (SSH) trigger on page 2-5 for information on how to configure this pin.

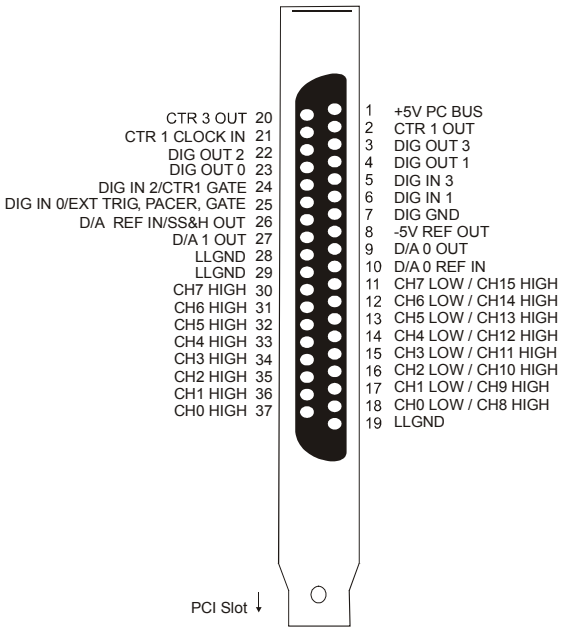


Figure 2-7. Main I/O connector pin out

Digital connector

The board's digital I/O connector is a 40-pin connector that is mounted at the rear of the PCIM-DAS1602/16. This connector accepts a 40-pin header connector (Figure 2-12).

The optional BP40-37 cable assembly brings the signals to a back plate with a 37-pin male connector mounted in it. When connected through the BP40-37 cable, the PCIM-DAS1602/16 board's digital connector is identical to the CIO-DIO24 connector.

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Analog and digital connections and configuration

General information on analog and digital signal connections and configuration is contained in the *Guide to Signal Connections* (available on our web site at http://www.mccdaq.com/signals/signals.pdf).

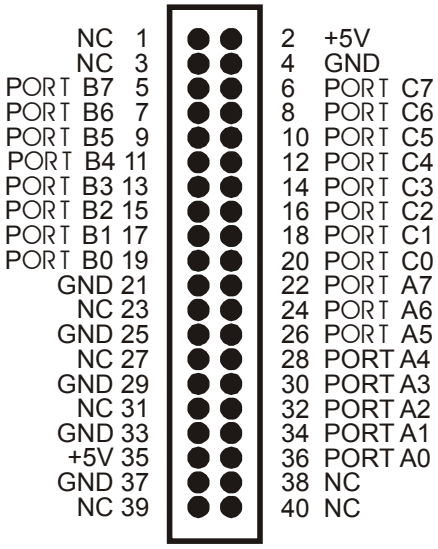


Figure 2-8. Digital I/O connector pin out

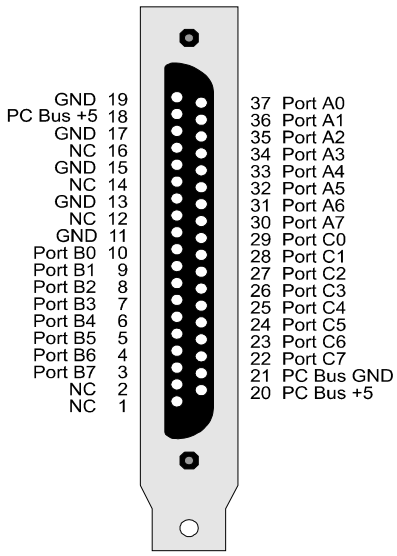


Figure 2-9. BP40-37 connector pin out

Cabling

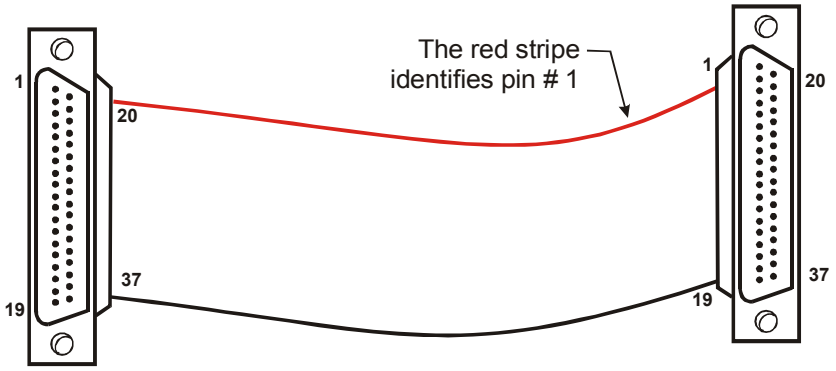


Figure 2-10. C37FF-*x* cable

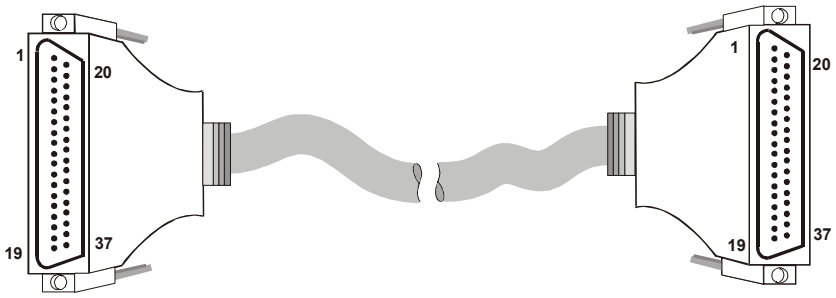


Figure 2-11. C37FFS-*x* cable

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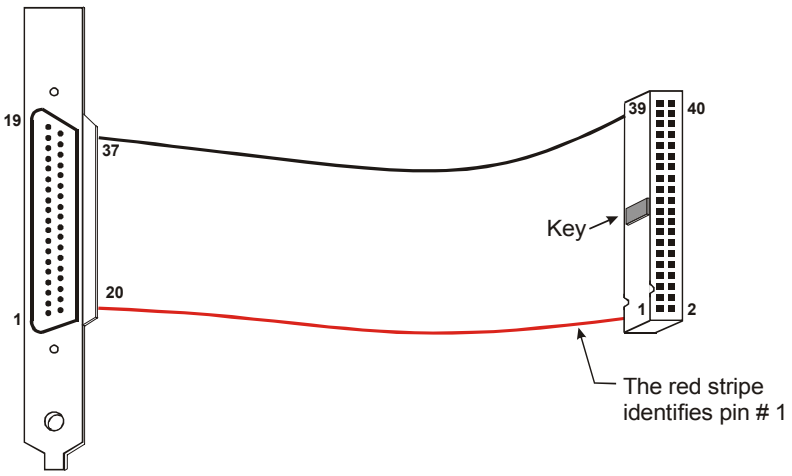


Figure 2-12. BP40-37 cable

Field wiring, signal termination and signal conditioning

You can use the following MCC screw terminal boards to terminate field signals and route them into the PCIM-DAS1602/16 board using the C37FF-*x* or C37FFS-*x* cable:

- CIO-MINI37 – 37-pin screw terminal board. Details on this product are available at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=102&pf_id=255.
- SCB-37 – 37 conductor, shielded signal connection/screw terminal box that provides two independent 50-pin connections. Details on this product are available at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=196&pf_id=1166.

MCC provides the following analog signal conditioning products for use with the PCIM-DAS1602/16 board:

- ISO-RACK16 – Isolated 16-channel, 5B module rack for analog signal conditioning and expansion. Details on this product are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=127&pf_id=450.
- ISO-DA02 – Isolated 2-channel, 5B module rack for analog signal conditioning and expansion. Details on this product are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=128&pf_id=703.

MCC provides the following digital signal conditioning products for use with the PCIM-DAS1602/16 board:

- CIO-ERB08 – 8-channel, Form C relay accessory board for digital signal conditioning. Details on this product are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=123&pf_id=240.
- CIO-ERB24 – 24-channel, Form C relay accessory board for digital signal conditioning. Details on this product are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=123&pf_id=241.
- SSR-RACK08 – 8-channel, solid-state relay mounting rack for digital signal conditioning. Details on this product are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=122&pf_id=620.
- SSR-RACK24 – 24-channel, solid-state relay mounting rack for digital signal conditioning. Details on this product are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=122&pf_id=1193.

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Programming and Developing Applications

After following the installation instructions in Chapter 2, your board should now be installed and ready for use. Although the board is part of the larger DAS family, in general there may be no correspondence among registers for different boards. Software written at the register level for other DAS models will not function correctly with your board.

Programming languages

Measurement Computing's Universal Library™ provides access to board functions from a variety 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 refer to the *Universal Library User's Guide* (available on our web site at www.mccdaq.com/PDFmanuals/sm-ul-user-guide.pdf).

Packaged applications programs

Many packaged application programs, such as SoftWIRE® and HP-VEE™, now have drivers for your board. If the package you own does not have drivers for the board, 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 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 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

Register-level programming

You should use the Universal Library or one of the packaged application programs mentioned above to control your board. Only experienced programmers should try register-level programming. If you need to program at the register level in your application, refer to the *Register Map for the PCIM-DAS1602/16* (available at www.mccdaq.com/registermaps/RegMapPCIM-DAS1602-16.pdf).

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Calibrating the PCIM-DAS1602/16

The PCIM-DAS1602/16 is shipped fully calibrated from the factory. For normal environments, you should calibrate your PCIM-DAS1602/16 board using *Insta*Cal's calibration procedures every six months–to-a year. If frequent variations in temperature or humidity are common, recalibrate at least every three months. It requires less than 20 minutes to calibrate the board using *Insta*Cal.

The *Insta*Cal calibration procedure is explained in the *DAQ Software Quick Start* that was shipped with your board.

Calibrating the A/D & D/A converters

*Insta*Cal provides step-by-step on-screen instructions to guide you in calibrating your board. You calibrate the board's A/D converters by applying a known voltage to an analog input channel and adjusting trim pots for offset and gain. There are three trim pots that require adjustment to calibrate the analog input section of the board. There are also three pots associated with each of the analog output channels.

Calibrate the PCIM-DAS1602/16 for the range you intend to use it in. When the range is changed, slight variation in Zero and Full Scale may result. These variations can be measured and removed in software if necessary.

Required equipment

To calibrate the PCIM-DAS1602/16, you need a precision voltage source, or a non precision source and a 5½ digit digital voltmeter and a few pieces of wire. Use a jeweler’s screwdriver to adjust the trim pots. An extender card is not required to calibrate the board.

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Specifications

Typical for 25 °C unless otherwise specified.

Specifications in *italic text* are guaranteed by design.

Power consumption

+5V quiescent	820mA typical, 1.4A max

Analog input

A/D converter type	LTC1605CSW
Resolution	16 bits
Number of channels	16 single-ended / 8 differential, switch selectable
Input ranges ▪ Gain is software selectable ▪ Unipolar/Bipolar polarity is switch selectable	±10V, ±5V, ±2.5V, ±1.25V 0 to 10V, 0 to 5V, 0 to 2.5V, 0 to 1.25V
A/D Pacing (software programmable)	Internal counter - 82C54. Positive or negative edge, jumper selectable.
	External source (pin25), positive or negative edge, software selectable.
	Software polled
A/D Trigger (only available when internal pacing selected, software enable/disable)	External edge trigger (pin 25), Positive or negative edge, software selectable.
A/D Gate (only available when internal pacing selected, software enable/disable)	External gate (pin 25), High or Low level, software selectable.
Simultaneous Sample and Hold Trigger	TTL output (pin 26), jumper enabled. Logic 0 = Hold, Logic 1 = Sample Compatible with CIO-SSH16
Burst Mode	Software selectable option, burst interval = 10uS
Data Transfer	From 1024 sample FIFO via interrupt w/ REPINSW
	Interrupt
	Software polled
Interrupt	INTA# - mapped to IRQn via PCI BIOS at boot-time
Interrupt enable	Programmable through PLX9052
Interrupt polarity	Active high level or active low level, programmable through PLX9052
Interrupt Sources (software programmable)	End of Conversion
	FIFO not Empty
	End of Burst
	End of Acquisition
	FIFO Half Full
A/D conversion time	*10µs max*
Throughput	100KHz
Common Mode Range	±10V min
CMRR @ 60Hz	-100dB typ, -80dB min
Input leakage current	*±3nA max*
Input impedance	*10 MOhms min*
Absolute maximum input voltage	*+55/-40V fault protected via input mux*

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Accuracy

Typical Accuracy	±2.3 LSB
Absolute Accuracy	±5.0 LSB
Accuracy Components	
Gain Error	Trimmable by potentiometer to 0
Offset Error	Trimmable by potentiometer to 0
PGA Linearity Error	*±1.3 LSB typ , ±10.0 LSB max*
Integral Linearity Error	±0.5 LSB typ , ±3.0 LSB max
Differential Linearity Error	*±0.5 LSB typ, ±2.0 LSB max*

Each PCIM-DAS1602/16 is tested at the factory to assure the board's overall error does not exceed ±5 LSB.

Total board error is a combination of gain, offset, differential linearity and integral linearity error. The theoretical absolute accuracy of the board may be calculated by summing these component errors. Worst case error is realized only in the unlikely event that each of the component errors are at their maximum level, and causing error in the same direction.

Analog input drift

Range	Analog Input Full-Scale Gain drift	Analog Input Zero drift	Overall Analog Input drift
±10.00V	2.2 LSB/°C max	1.8 LSB/°C max	4.0 LSB/°C max
±5.000V	2.2 LSB/°C max	1.9 LSB/°C max	4.1 LSB/°C max
±2.500V	2.2 LSB/°C max	2.0 LSB/°C max	4.2 LSB/°C max
±1.250V	2.2 LSB/°C max	2.3 LSB/°C max	4.5 LSB/°C max
0 - 10.00V	4.1 LSB/°C max	1.9 LSB/°C max	6.0 LSB/°C max
0 - 5.000V	4.1 LSB/°C max	2.1 LSB/°C max	6.2 LSB/°C max
0 - 2.500V	4.1 LSB/°C max	2.4 LSB/°C max	6.5 LSB/°C max
0 - 1.250V	4.1 LSB/°C max	3.0 LSB/°C max	7.1 LSB/°C max

Absolute error change per °C Temperature change is a combination of the gain and offset drift of many components. The theoretical worst case error of the board may be calculated by summing these component errors. Worst case error is realized only in the unlikely event that each of the component errors are at their maximum level, and causing error in the same direction.

Noise performance

The following table summarizes the worst case noise performance for the PCIM-DAS1602/16. Noise distribution is determined by gathering 50000 samples with inputs tied to ground at the PCIM-DAS1602/16 main connector. Data is for both Single-Ended and Differential modes of operation.

Range	±2 counts	±1 count	Max Counts	LSBrms*
±10.00V	97%	80%	11	1.7
±5.000V	97%	80%	11	1.7
±2.500V	96%	79%	11	1.7
±1.250V	96%	79%	11	1.7
0 - 10.00V	88%	65%	15	2.3
0 - 5.000V	88%	65%	15	2.3
0 - 2.500V	83%	61%	15	2.3
0 - 1.250V	83%	61%	16	2.4

* Input noise is assumed to be Gaussian. An RMS noise value from a Gaussian distribution is calculated by dividing the peak-to-peak bin spread by 6.6

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Crosstalk

Crosstalk is defined here as the influence of one channel upon another when scanning two channels at the specified per channel rate for a total of 50000 samples. A full scale 100Hz triangle wave is input on channel 1. channel 0 is tied to analog ground at the 100 pin user connector. The table below summarizes the influence of channel 1 on channel 0 and does not include the effects of noise.

Range	1 kHz Crosstalk (LSB pk-pk)	10 kHz Crosstalk (LSB pk-pk)	50 kHz Crosstalk (LSB pk-pk)
±10.000 V	4	13	24
±5.000 V	2	7	18
±2.500 V	2	5	16
±1.250 V	3	4	14
0 V to +10.000 V	4	8	23
0 V to +5.000 V	2	5	16
0 V to +2.500 V	2	4	16
0 V to +1.250 V	3	3	16

Analog output

D/A converter type	MX7548
Resolution	12 bits
Number of channels	2
Channel type	Single-ended voltage output
Output range (jumper selectable per output)	±10 V, ±5 V, 0 to 10 V, or 0 to 5 V using on-board references, or user defined using external reference
Reference voltage (jumper selectable)	On-board, -10 V and –5 V
	External Independent (D/A0 pin 10 and D/A1 pin 26)
External reference voltage range	±10 V max
External reference input impedance	*10 KOhm min*
Data transfer	Programmed I/O
Throughput	System dependent. Using the Universal Library programmed output function (`cbAOut()`) in a loop, in Visual Basic, a typical update rate of 400 Khz can be expected on a 300 MHz Pentium II based PC.
Monotonicity	*Guaranteed monotonic over temperature*
Slew rate	2.0 V/µs min
Settling time	30 µS max to ±½ LSB for a 20 V step
Current drive	±5 mA min
Output short-circuit duration	*Indefinite @ 25 mA*
Output coupling	*DC*
Output impedance	0.1 ohms max
Output stability	Any passive load
Coding	Offset binary Bipolar mode: 0 code = Vref 4095 code = -Vref – 1LSB, Vref < 0V -Vref + 1LSB, Vref >0V Unipolar mode: 0 code = 0V, 4095 code = -Vref – 1LSB, Vref < 0V -Vref + 1LSB, Vref >0V
Output voltage on power up and reset	0 V ± 10 mV

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Accuracy

Typical accuracy	±1 LSB
Absolute accuracy	±2 LSB
Accuracy Components	
Gain error	Trimmable by potentiometer to 0
Offset error	Trimmable by potentiometer to 0
Integral linearity error	±0.5 LSB typ, ±1 LSB max
Differential linearity error	*±0.5 LSB typ, ±1 LSB max*

Total board error is a combination of gain, offset, differential linearity and integral linearity error. The theoretical absolute accuracy of the board may be calculated by summing these component errors. Worst case error is realized only in the unlikely event that each of the component errors are at their maximum level, and causing error in the same direction.

Analog output drift

Analog output full-scale gain drift	±0.22 LSB/°C max
Analog output zero drift	±0.22 LSB/°C max
Overall analog output drift	±0.44 LSB/°C max

Absolute error change per °C temperature change is a combination of the gain and offset drift of many components. The theoretical worst case error of the board may be calculated by summing these component errors. Worst case error is realized only in the unlikely event that each of the component errors are at their maximum level, and causing error in the same direction.

Digital input / output

Digital I/O connector

Digital type	82C55
Number of I/O	24
Configuration per 82C55	2 banks of 8 and 2 banks of 4 or
	3 banks of 8 or
	2 banks of 8 with handshake
Input high	*2.0 volts min, 5.5 volts absolute max*
Input low	*0.8 volts max, -0.5 volts absolute min*
Output high	*3.0 volts min @ -2.5 mA*
Output low	*0.4 volts max @ 2.5 mA*
Power-up / reset state	Input mode (high impedance)
Pull-up/pull-down resistors	User installed. Dual footprint allows pull-up or pull-down configuration

Main connector

Digital output type	74LS244, power up / reset to LOW logic level
Digital input type	74LS373, pulled to logic high via 10 K resistors
Number of I/O	8
Configuration	4 fixed input, 4 fixed output
Output high	*2.7 volts @ -0.4 mA min*
Output low	*0.5 volts @ 8 mA max*
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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Counter

Counter type	82C54
Configuration	3 down counters, 16 bits each
Counter 1 source (software selectable)	▪ External source from main connector (pin 21*) ▪ 100 kHz internal source
Counter 1 gate	External gate from main connector (pin 24*)
Counter 1 output	Available at main connector (pin 2)
Counter 2 source (jumper selectable)	▪ Internal 1 MHz ▪ Internal 10 MHz
Counter 2 gate (software enable/disable)	External source from main connector (pin 25*)
Counter 2 output	Internal only, chained to counter 3 source
Counter 3 source	Counter 2 output
Counter 3 gate (software enable/disable)	External source from main connector (pin 25*)
Counter 3 output	Available at main connector (pin 20) Programmable as ADC Pacer clock.
Clock input frequency	*10 MHz max*
High pulse width (clock input)	*30 ns min*
Low pulse width (clock input)	*50 ns min*
Gate width high	*50 ns min*
Gate width low	*50 ns min*
Input high	*2.0 volts min, 5.5 volts absolute max*
Input low	*0.8 volts max, -0.5 volts absolute min*
Output high	*3.0 volts min @ -2.5 mA*
Output low	*0.4 volts max @ 2.5 mA*
Crystal oscillator frequency	10 MHz
Frequency accuracy	50 ppm

* Pins 21, 24, and 25 are pulled to logic high via 10K resistors.

Environmental

Operating temperature range	0 to 70°C
Storage temperature range	-40 to 100°C
Humidity	0 to 95% non-condensing

Mechanical

Card dimensions	PCI custom type card: 107 mm (H) x 18.5 mm (W) x 216 mm (L)

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Main connector and pin out

Connector type	37 pin male "D" connector
Connector Compatibility	Identical to CIO-DAS1602/16 Connector

8-channel differential mode pin out

Pin	Signal Name	Pin	Signal Name
1	+5V PC BUS POWER	20	CTR 3 OUT
2	CTR 1 OUT	21	CTR 1 CLOCK IN
3	DIG OUT 3	22	DIG OUT 2
4	DIG OUT 1	23	DIG OUT 0
5	DIG IN 3	24	DIG IN 2 / CTR1 GATE
6	DIG IN 1	25	DIG IN 0 / EXT TRIG / EXT PACER / EXT GATE
7	DIG GND	26	D/A1 REF IN / SS&H OUT
8	-5V REF OUT	27	D/A 1 OUT
9	D/A 0 OUT	28	AGND
10	D/A0 REF IN	29	AGND
11	CH7 LO	30	CH7 HIGH
12	CH6 LO	31	CH6 HIGH
13	CH5 LO	32	CH5 HIGH
14	CH4 LO	33	CH4 HIGH
15	CH3 LO	34	CH3 HIGH
16	CH2 LO	35	CH2 HIGH
17	CH1 LO	36	CH1 HIGH
18	CH0 LO	37	CH0 HIGH
19	AGND		

16-channel single-ended mode pin out

Pin	Signal Name	Pin	Signal Name
1	+5V PC BUS POWER	20	CTR 3 OUT
2	CTR 1 OUT	21	CTR 1 CLOCK IN
3	DIG OUT 3	22	DIG OUT 2
4	DIG OUT 1	23	DIG OUT 0
5	DIG IN 3	24	DIG IN 2 / CTR1 GATE
6	DIG IN 1	25	DIG IN 0 / EXT TRIG / EXT PACER / EXT GATE
7	DIG GND	26	D/A1 REF IN / SS&H OUT
8	-5V REF OUT	27	D/A 1 OUT
9	D/A 0 OUT	28	AGND
10	D/A0 REF IN	29	AGND
11	CH15 HIGH	30	CH7 HIGH
12	CH14 HIGH	31	CH6 HIGH
13	CH13 HIGH	32	CH5 HIGH
14	CH12 HIGH	33	CH4 HIGH
15	CH11 HIGH	34	CH3 HIGH
16	CH10 HIGH	35	CH2 HIGH
17	CH9 HIGH	36	CH1 HIGH
18	CH8 HIGH	37	CHO HIGH
19	AGND		

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Digital input / output connector and pin out

Connector type	40 pin header
Connector Compatibility	Identical to CIO-DAS1602/16 Connector

Pin	Signal Name	Pin	Signal Name
1	NC	2	+5V PC BUS POWER
3	NC	4	DIG GND
5	PORT B 7	6	PORT C 7
7	PORT B 6	8	PORT C 6
9	PORT B 5	10	PORT C 5
11	PORT B 4	12	PORT C 4
13	PORT B 3	14	PORT C 3
15	PORT B 2	16	PORT C 2
17	PORT B 1	18	PORT C 1
19	PORT B 0	20	PORT C 0
21	DIG GND	22	PORT A 7
23	NC	24	PORT A 6
25	DIG GND	26	PORT A 5
27	NC	28	PORT A 4
29	DIG GND	30	PORT A 3
31	NC	32	PORT A 2
33	DIG GND	34	PORT A 1
35	+5V PC BUS POWER	36	PORT A 0
37	DIG GND	38	NC
39	NC	40	NC

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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

PCIM-DAS1602/16

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 (1995), EN55024 (1998)

Emissions: Group 1, Class B

- EN55022 (1995): Radiated and Conducted emissions.

Immunity: EN55024

- EN61000-4-2 (1995): Electrostatic Discharge immunity, Criteria A.
- EN61000-4-3 (1997): Radiated Electromagnetic Field immunity Criteria A.
- EN61000-4-4 (1995): Electric Fast Transient Burst immunity Criteria A.
- EN61000-4-5 (1995): Surge immunity Criteria A.
- EN61000-4-6 (1996): Radio Frequency Common Mode immunity Criteria A.
- EN61000-4-8 (1994): Power Frequency Magnetic Field immunity Criteria A.
- EN61000-4-11 (1994): Voltage Dip and Interrupt immunity Criteria A.

Declaration of Conformity based on tests conducted by Chomerics Test Services, Woburn, MA 01801, USA in September, 2001. Test records are outlined in Chomerics Test Report #EMI3053.01.

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



Carl Haapaoja, Director of Quality Assurance

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