PCIM-DAS16JR/16

Analog & Digital I/O

User's Guide

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MEASUREMENT COMPUTING™

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Table of Contents

About this User's Guide

This user's guide describes the Measurement Computing PCIM-DAS16JR/16 data acquisition device and lists device specifications.

Conventions in this user's guide

For more information

Text presented in a box signifies additional information related to the subject matter.

Caution! Shaded caution statements present information to help you avoid injuring yourself and others, damaging your hardware, or losing your data.

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

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

Where to find more information

Additional information about PCIM-DAS16JR/16 hardware is available on our website at www.mccdaq.com. You can also contact Measurement Computing Corporation with specific questions.

- Knowledgebase: kb.mccdaq.com
- 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

If you need to program at the register level in your application, refer to the *Register Map for the PCIM-DAS16JR/16* (available at www.mccdaq.com/registermaps/RegMapPCIM-DAS16Jr-16.pdf).

Introducing the PCIM-DAS16JR/16

Overview: PCIM-DAS16JR/16 features

This manual explains how to install and use the PCIM-DAS16JR/16 board. The PCIM-DAS16JR/16 is a multifunction measurement and control board designed to operate in computers with PCI accessory slots. This board can be used for applications such as data acquisition, system timing, and industrial process control.

The PCIM-DAS16JR/16 provides the following features:

- Eight differential or 16 single-ended analog inputs
- 16-bit A/D resolution
- 100 kHz sample rate
- Eight TTL-compatible digital I/O channels
- Three 16-bit down counters
- 37-pin high density I/O connector
- Universal PCI bus (3.3V/5V 32-bit 33 MHz)

The analog input mode is switch-selectable for eight differential or 16 single-ended analog inputs. Analog input ranges are selectable with software as bipolar or unipolar. Bipolar input ranges are ±10V, ±5V, ±2.5V and ±1.25V. Unipolar input ranges are 0 to 10V, 0 to 5V, 0 to 2.5V and 0 to 1.25V.

The PCIM-DAS16JR/16 board is equipped with an 82C54 counter chip. This chip contains three 16-bit down counters that provide clock, gate, and output connections.

Functional block diagram

PCIM-DAS16JR/16 functions are illustrated in the block diagram shown here.

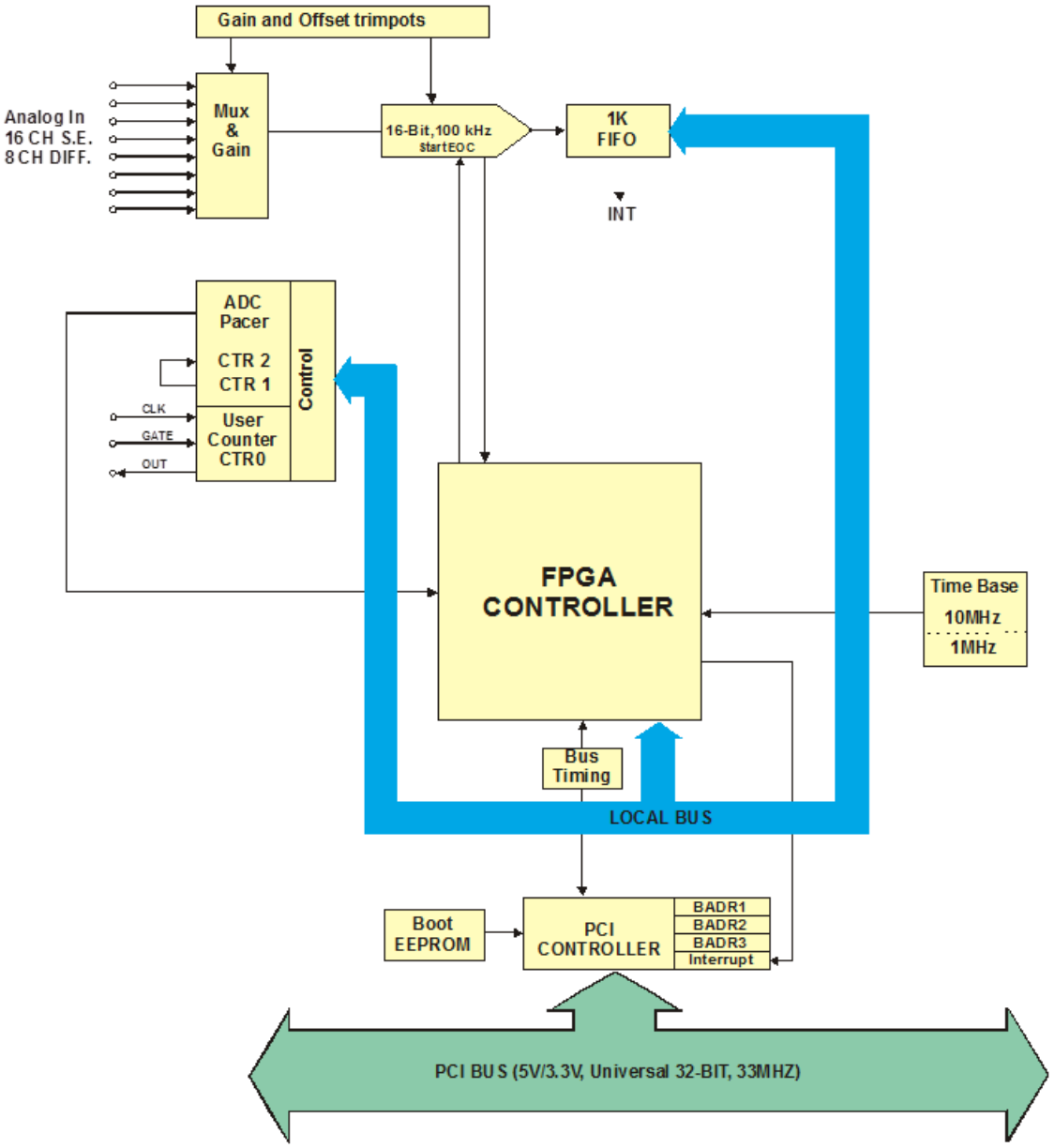

Figure 1. PCIM-DAS16JR/16 block diagram

Installing the PCIM-DAS16JR/16

What comes with your shipment?

The following items are shipped with the PCIM-DAS16JR/16.

Hardware

- PCIM-DAS16JR/16

Software

- MCC DAQ CD

Documentation

In addition to this hardware user's guide, you should also receive the *Quick Start Guide*. This booklet provides an overview of the MCC DAQ software you received with the device, and includes information about installing the 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
- Signal termination and conditioning accessories

  MCC provides signal termination products for use with the PCIM-DAS16JR/16. Refer to the "Field wiring, signal termination and signal conditioning" section on page 13 for a list of compatible accessory products.

Unpacking

As with any electronic device, you should take care while handling to avoid damage from static electricity. Before removing the PCIM-DAS16JR/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, contact us immediately using one of the following methods:

- Knowledgebase: kb.mccdaq.com
- 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

For international customers, contact your local distributor. Refer to the International Distributors section on our website at www.mccdaq.com/International.

Installing the software

Refer to the *Quick Start Guide* for instructions on installing the software on the MCC DAQ CD. This booklet is available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf.

Configuring the hardware

The PCIM-DAS16JR/16 board has one switch and two jumpers mounted on it. Before installing the PCIM-DAS16JR/16 in the computer, verify that the board is configured with the settings that you want. Factory default settings are listed below.

Switch/jumper factory-configured defaults

Board label	Switch/jumper description	Default setting
S1	Channel mode switch	8 channel (diff)
P8	A/D Trigger edge jumper	Rising edge
P2	Clock frequency jumper	1 MHz

The locations of each switch and jumper are shown in Figure 2.

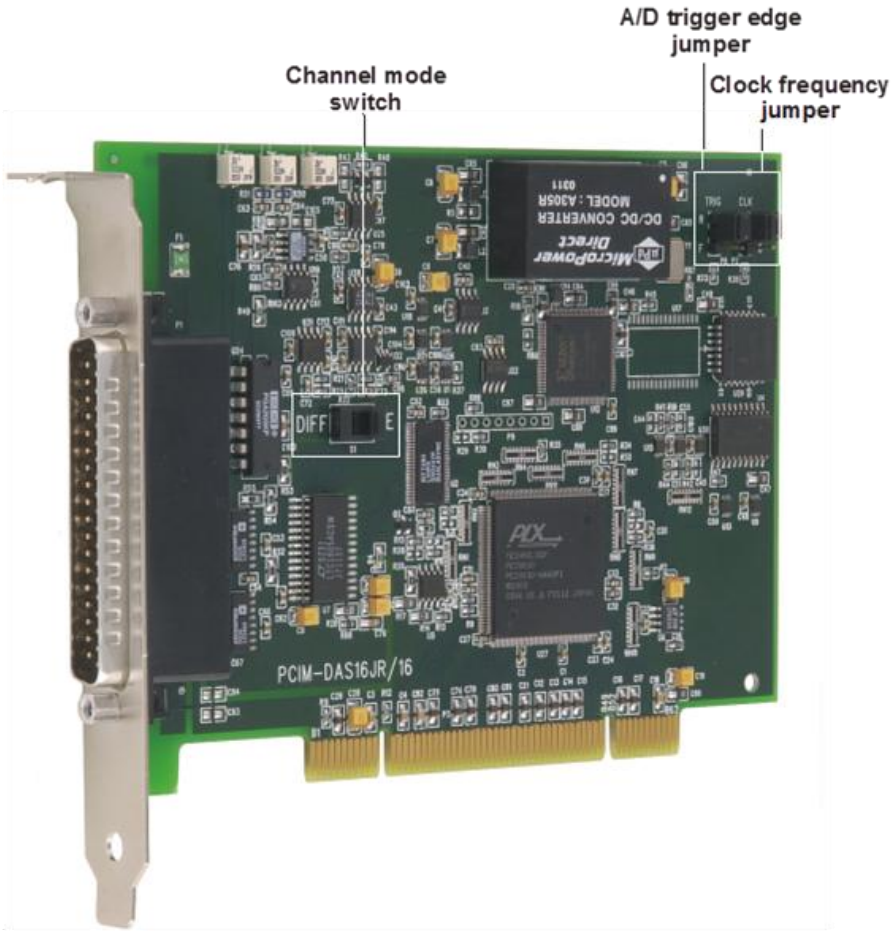

Figure 2. PCIM-DAS16JR/16 switch and jumper locations

Instructions on how to change the configuration of each jumper and switch are shown on the following pages.

Channel mode switch

Switch **S1** configures the analog inputs of the PCIM-DAS16JR/16 as either eight differential channels or 16 single-ended channels. Set the switch to single-ended mode if you have more than eight analog inputs to sample. Setting the switch to differential mode allows up to 10 volts of common mode (ground loop) rejection and provides better noise immunity.

The channel mode switch is factory-configured for eight differential inputs (see Figure 3.) To configure for 16 single-ended channels, set this switch to "**SE**".

Figure 3. Channel mode switch

A/D trigger edge jumper

Jumper **P8** configures the edge to initiate the A/D conversion with. The options are either rising or falling edge. The A/D trigger edge jumper is factory-configured for rising edge. Figure 4 shows the jumper position for each configuration option.

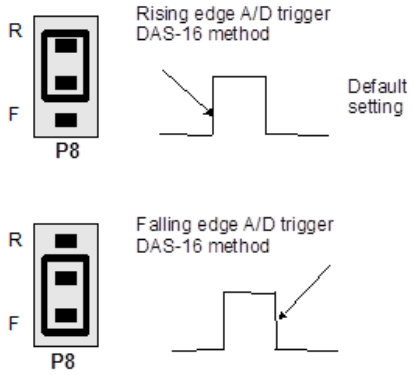

Figure 4. A/D trigger edge jumper

For compatibility with all third-party packages, DAS-16 software, and PCIM-DAS16JR/16 software, leave this jumper set to the default rising edge position.

If you are using the PCIM-DAS16JR/16 board in an application that is designed for compatibility with the Keithley MetraByte DAS-1600 board, configure the trigger edge jumper for falling edge.

Clock frequency jumper

Jumper **P2** configures the frequency of the square wave that is 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 frequency jumper is factory-configured for 1 MHz, as shown in Figure 5.

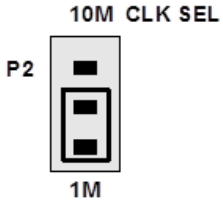

Figure 5. Clock frequency jumper

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

The internal pacer output is also available at pin 20

The internal pacer output that drives the A/D converter is also available at pin 20 (CTR 3 Output) on the board's main I/O connector (see Figure 6).

Installing the hardware

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.

After you configure the board switches and jumpers, install the PCIM-DAS16JR/16 into your computer. To install your board, follow the steps below:

1. Turn your computer off, open it up, and insert your board into any available PCI slot.
2. Close your computer and turn it on.

   If you are using an operating system with support for plug-and-play, a dialog box notifies you 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 MCC DAQ CD and click **OK**.
3. To test your installation and configure your board, run the InstaCal 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 InstaCal.

Board configuration with InstaCal

If you change the board configuration with InstaCal, you may have to also physically change the setting of a corresponding switch or jumper on the board. Refer to the Default hardware configuration section on page 9 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.

Signal connections

I/O connector

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

Board connectors, cables, accessory equipment

Connector type	37 pin male "D" connector
Connector compatibility	Identical to the CIO-DAS16JR/16 connector
Compatible cables	C37FF-x (Figure 7) C37FFS-x (Figure 8)
Compatible accessory products (with the C37FF-x cable or C37FFs-x cable)	CIO-MINI37 SCB-37 CIO-SSH16

The I/O 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 7) or the C37FFS-x 37-pin shielded cable (Figure 8).

Analog connections and configuration

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

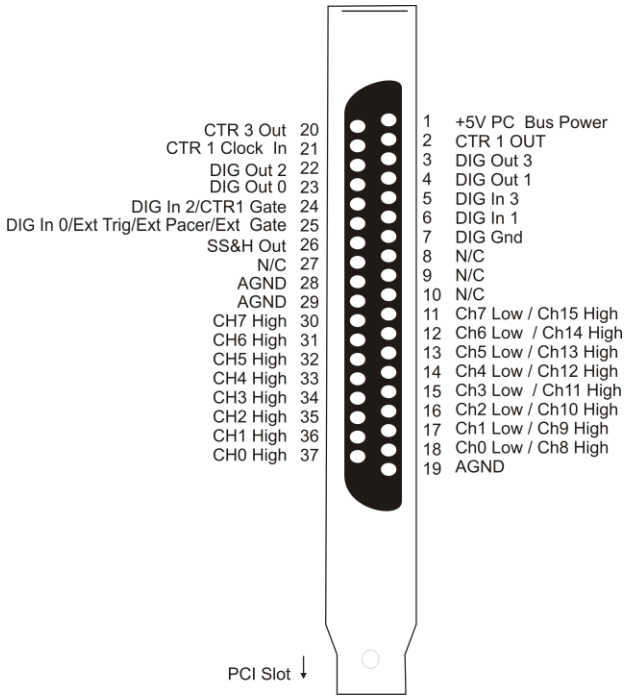

Figure 6. I/O connector pinout

Cabling

You can use the C37FF-x or C37FFS-x 37-pin cable to connect signals to the PCIM-DAS16JR/16 board.

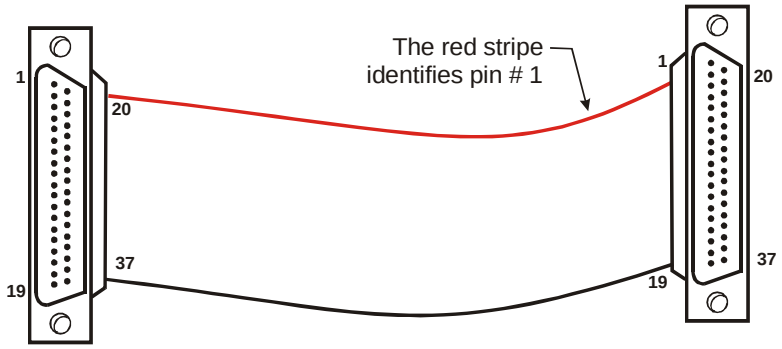

Figure 7. C37FF-x cable

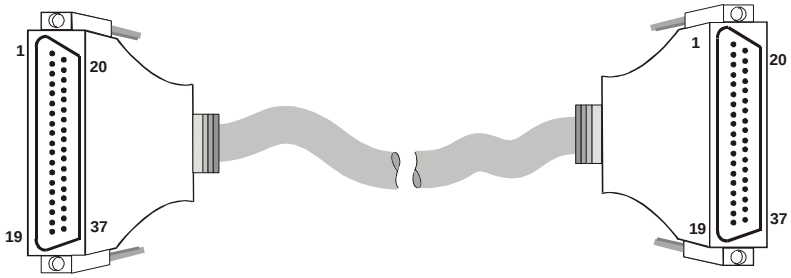

Figure 8. C37FFS-x cable

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-DAS16JR/16 board using a C37FF-x cable or a C37FFS-x cable:

- **CIO-MINI37** – 4 × 4, 37-pin screw terminal board.
- **SCB-37** – 37-conductor, shielded signal connection/screw terminal box that provides two independent 37-pin connections.

For analog signal conditioning, the following signal conditioning board is compatible with the PCIM-DAS16JR/16 board.

- **CIO-SSH16** – 16-channel sample & hold front end board (four channels installed).

Details on these cables are available on our website.

Functional Details

The PCIM-DAS16JR/16 provides the following features:

- Eight differential or 16 single-ended 16-bit analog inputs
- Eight high current digital I/O channels
- Three 16-bit down counters

The block diagram shown here illustrates the functionality of the PCIM-DAS16JR/16.

Analog inputs

The analog input mode is switch-selectable for eight differential or 16 single-ended analog inputs. The board offers a 100 kHz maximum sample rate in single and multi-channel scans at any gain setting. A 1024 sample FIFO assures that data taken from the board is transferred into computer memory without the possibility of missed samples. The board has a digital trigger input with software-selectable trigger edge.

Software selects the bipolar/unipolar input configuration and input range. The table below lists the analog input ranges and resolutions for the available input configurations and gains.

Input range and resolution

Bipolar Range	Resolution	Unipolar Range	Resolution
±10 V	305 µV	0 to 10 V	153 µV
±5 V	153 µV	0 to 5 V	76.3 µV
±2.5 V	76.3 µV	0 to 2.5 V	38.1 µV
±1.25 V	38.1 µV	0 to 1.25 V	19.1 µV

Burst mode

Channel-to-channel skew results from multiplexing the A/D inputs. Channel skew is defined as the time between consecutive samples. For example, if four channels are sampled at a rate of 1 kHz per channel, the channel skew is 250 µs (1 ms/4).

Burst mode minimizes channel-to-channel skew by clocking the A/D at the maximum rate between successive channels. At the 1-ms pulse, channel 0 is sampled. After 10 µs, channel 1 is sampled. Channel 2 is sampled 10 µs after channel 1 is sampled. Channel 3 is sampled 10 µs after channel 2 is sampled. No samples are then taken until the next 1-ms pulse, when channel 0 is sampled again. In this mode, the rate for all channels is 1 kHz, but the channel-to-channel skew (delay) is now 10 µs. The minimum burst mode skew/delay on this board is 10 µs (refer to Figure 9).

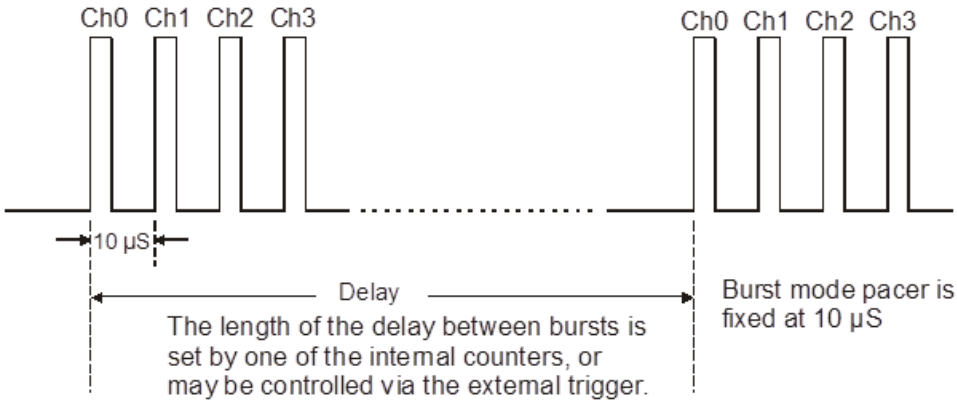

Figure 9. Burst mode timing

Digital I/O

Eight TTL-compatible digital I/O channels are available on the main I/O connector. Four of the digital channels are configured as input. The remaining four are configured as output.

Counter/timer I/O

The PCIM-DAS16JR/16 provides an 82C54 counter chip. This chip contains three 16-bit down counters that provide clock, gate, and output connections. You can connect the counter clock to the on-board 10 MHz crystal oscillator, or leave the counter clock unconnected for user input. For more information on the 82C54, visit our web site at www.mccdaq.com/PDFmanuals/82C54.pdf.

Calibrating the PCIM-DAS16JR/16

The PCIM-DAS16JR/16 is shipped fully calibrated from the factory. For normal environments, you should calibrate your PCIM-DAS16JR/16 board using InstaCal 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 InstaCal.

Calibrating the A/D and 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 the board's trim pots for offset and gain.

Calibrate the PCIM-DAS16JR/16 for the range you intend to use it in. Slight variations in zero and full scale may result when the range is changed. These variations can be measured and removed in software, if necessary.

Required equipment

To calibrate the PCIM-DAS16JR/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.

Specifications

All specifications are subject to change without notice.
Typical for 25 °C unless otherwise specified.
Specifications in *italic* text are guaranteed by design.

Power consumption

Table 1. Power consumption specifications

Parameter	Specification
+5V quiescent	500 mA typical, 750 mA max. Does not include the current consumed through 37-pin I/O connector.
+5V available at 37-pin I/O connector	1 A max, protected with re-settable fuse

Analog input

Table 2. Analog input specifications

Parameter	Specification
A/D converter type	LTC1605ACSW
Resolution	16 bits
Number of channels	16 single-ended / 8 differential, switch selectable
Input ranges ■ Gain is software selectable ■ Unipolar / bipolar polarity is software selectable	±10 V, ±5 V, ±2.5 V, ±1.25 V 0 to 10 V, 0 to 5 V, 0 to 2.5 V, 0 to 1.25 V
A/D Pacing (software programmable)	Internal counter - 82C54. Positive or negative edge, jumper selectable.
	External source (pin 25), 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) Logic 0 = Hold, Logic 1 = Sample Compatible with CIO-SSH16
Burst mode	Software selectable option, burst interval = 10 µS
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 PLX9030
Interrupt polarity	Active high level or active low level, programmable through PLX9030

Parameter	Specification
Interrupt sources (software programmable)	■ End of conversion ■ FIFO not Empty ■ End of Burst ■ End of Acquisition ■ FIFO Half Full
A/D conversion time	*10 µs max*
Throughput	100 kS/s
Input coupling	*DC*
Input bandwidth (all ranges)	*325 kHz*
Common mode range	±10 V min
CMRR @ 60 Hz	–100 dB typ., –80 dB min
Recommended warm-up time	15 minutes
Input bias current	*±3 nA max*
Input impedance	*10 M Ohms min*
Absolute maximum input voltage	*+55/–40V fault protected via input mux.*

Accuracy

Table 3. Accuracy specifications

Parameter	Specification
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-DAS16JR/16 is tested at the factory to ensure the board's overall accuracy 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

Table 4. Analog input drift specifications

Range	Analog input full-scale gain drift (max)	Analog input zero drift (max)	Overall analog input drift (max)
±10.00 V	2.2 LSB/°C max	1.8 LSB/°C	4.0 LSB/°C
±5.000 V	2.2 LSB/°C	1.9 LSB/°C	4.1 LSB/°C
±2.500 V	2.2 LSB/°C	2.0 LSB/°C	4.2 LSB/°C
±1.250 V	2.2 LSB/°C	2.3 LSB/°C	4.5 LSB/°C
0 V to 10.00 V	4.1 LSB/°C	1.9 LSB/°C	6.0 LSB/°C
0 V to 5.000 V	4.1 LSB/°C	2.1 LSB/°C	6.2 LSB/°C
0 V to 2.500 V	4.1 LSB/°C	2.4 LSB/°C	6.5 LSB/°C
0 V to 1.250 V	4.1 LSB/°C	3.0 LSB/°C	7.1 LSB/°C

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 are causing error in the same direction.

Noise performance

The following table summarizes the worst case noise performance for the PCIM-DAS16JR/16. Noise distribution is determined by gathering 50000 samples with inputs tied to ground at the PCIM-DAS16JR/16 main connector. Data represents both single-ended and differential modes of operation.

Table 5. Noise performance specifications

Range	LSBrms	Typical Counts
±10.00 V	1.30	12
±5.000 V	1.30	12
±2.500 V	1.30	12
±1.250 V	1.30	13
0 V to 10.00 V	1.80	15
0 V to 5.000 V	1.80	15
0 V to 2.500 V	1.80	15
0 V to 1.250 V	1.80	16

Settling time

Settling time is defined here as the time required for a channel to settle to within a specified accuracy in response to a full-scale (FS) step. Two channels are scanned at a specified rate with a –FS DC signal presented to channel 1 and a +FS DC signal presented to channel 0.

Table 6. Settling time specifications

Condition	Range	Accuracy (typ)		
		±0.00076% (±4 LSB)	±0.0015% (±8 LSB)	±0.0061% (±16 LSB)
Same range to same range	±10 V	400 µS	100 µS	10 µS
	±5 V	100 µS	20 µS	10 µS
	±2.5 V	60 µS	12 µS	10 µS
	±1.25 V	50 µS	10 µS	
	0 V to 10 V	400 µS	100 µS	10 µS
	0 V to 5 V	100 µS	20 µS	10 µS
	0 V to 2 V	60 µS	12 µS	10 µS
	0 V to 1.25 V	50 µS	10 µS	

Digital I/O

Table 7. DIO specifications

Digital output type	5V/TTL compatible
Digital input type	5V/TTL compatible, pulled to logic high via 10 kΩ resistor network
Number of I/O	8
Configuration	4 fixed input, 4 fixed output
Output high voltage	*3.8 volts min @ –32 mA*
Output low voltage	*0.55 volts max @ 32 mA*
Input high voltage	*2.0 volts min, 7 volts absolute max*
Input low voltage	*0.8 volts max, –0.5 volts absolute min*
Data transfer	Programmed I/O
Power-up / reset state	DIG OUT [3:0] - TTL logic low state

Counter

Table 8. Counter specifications

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 at P2)	■ 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 V min, 5.5 volts absolute max*
Input low	*0.8 V max, –0.5 volts absolute min*
Output high	*3.0 V min @ –2.5 mA*
Output low	*0.4 V max @ 2.5 mA*
Crystal oscillator frequency	10 MHz
Frequency accuracy	50 ppm

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

Environmental

Table 9. Environmental specifications

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

Mechanical

Table 10. Mechanical specifications

Card dimensions (L× W × H)	PCI half card: 136.5 × 106.9 × 11.65 mm
Form factor	Universal PCI keying. Compatible with 3.3 V/5 V 32-bit, 33 MHz back planes.

Signal connector

Table 11. Signal connector specifications

Connector type	37-pin male "D" connector
Connector compatibility	Identical to the CIO-DAS16JR/16 connector
Compatible accessory products	CIO-MINI37 CIO-SCB37 CIO-SSH-16
Compatible cables	C37FF-x C37FFS-x

8-channel differential mode pinout

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	SS&H OUT
8	NC	27	NC
9	NC	28	AGND
10	NC	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 pinout

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	SS&H OUT
8	NC	27	NC
9	NC	28	AGND
10	NC	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		

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-DAS16JR/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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