PCIe-DAS1602/16

Analog and Digital I/O

User's Guide

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Table of Contents

About this User's Guide

What you will learn from this user's guide

This user's guide describes the Measurement Computing PCIe-DAS1602/16 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 PCIe-DAS1602/16 hardware is available on our website at www.mccdaq.com. You can also contact Measurement Computing Corporation with specific questions.

- Knowledgebase: kb.mccdaq.com
- Tech support form: www.mccdaq.com/support/support_form.aspx
- Email: techsupport@mccdaq.com
- Phone: 508-946-5100 and follow the instructions for reaching Tech Support

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

Introducing the PCIe-DAS1602/16

The PCIe-DAS1602/16 is a multifunction measurement and control board designed for the PCI Express (PCIe) bus. The device is fully compatible with software written for the PCIM-DAS1602/16.

The PCIe-DAS1602/16 provides the following features:

- 16 single-ended (SE) or eight differential (DIFF) input channels
- 16-bit A/D resolution
- 100 kS/s sample rate
- Dual 12-bit analog outputs
- 32 DIO channels
- Three 16-bit counters

Functional block diagram

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

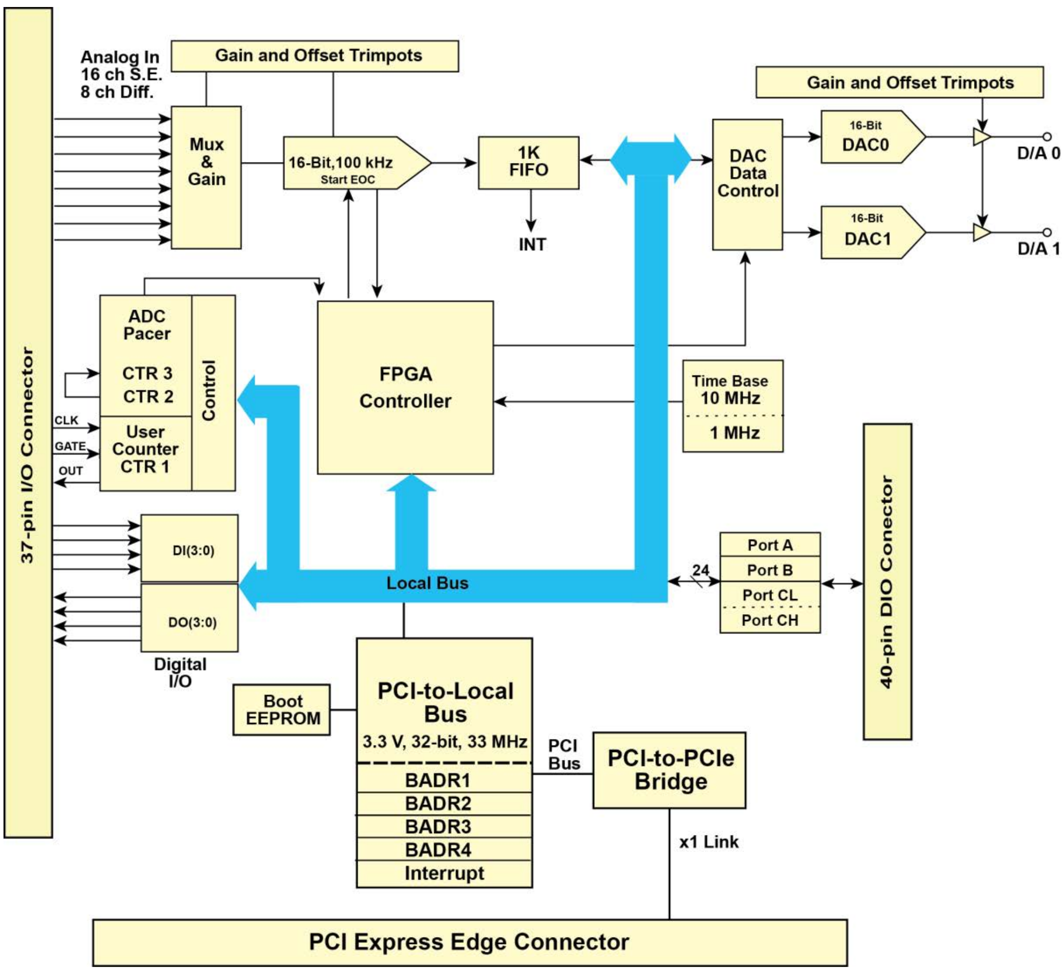

Figure 1. PCIe-DAS1602/16 functional block diagram

Installing the PCIe-DAS1602/16

Unpacking

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

Contact us immediately if any components are missing or damaged.

Installing the software

Refer to the MCC DAQ Quick Start for instructions on installing the software on the MCC DAQ CD. Refer to the device product page on the Measurement Computing website for information about the included and optional software supported by the PCIe-DAS1602/16.

Install the software before you install your device

The driver needed to run the PCIe-DAS1602/16 is installed with the software. Therefore, you need to install the software package you plan to use before you install the hardware.

Configuring the hardware

If you are using the PCIe-DAS1602/16 with its default settings, the board is completely plug-and-play. You can skip these configuration sections and refer to *Installing the hardware.*

If you are not using the PCIe-DAS1602/16 default settings, you will set one or more switches and jumpers mounted on it before installing it into your computer. The factory-configured default settings are listed below. The location of each switch and jumper are shown in Figure 2.

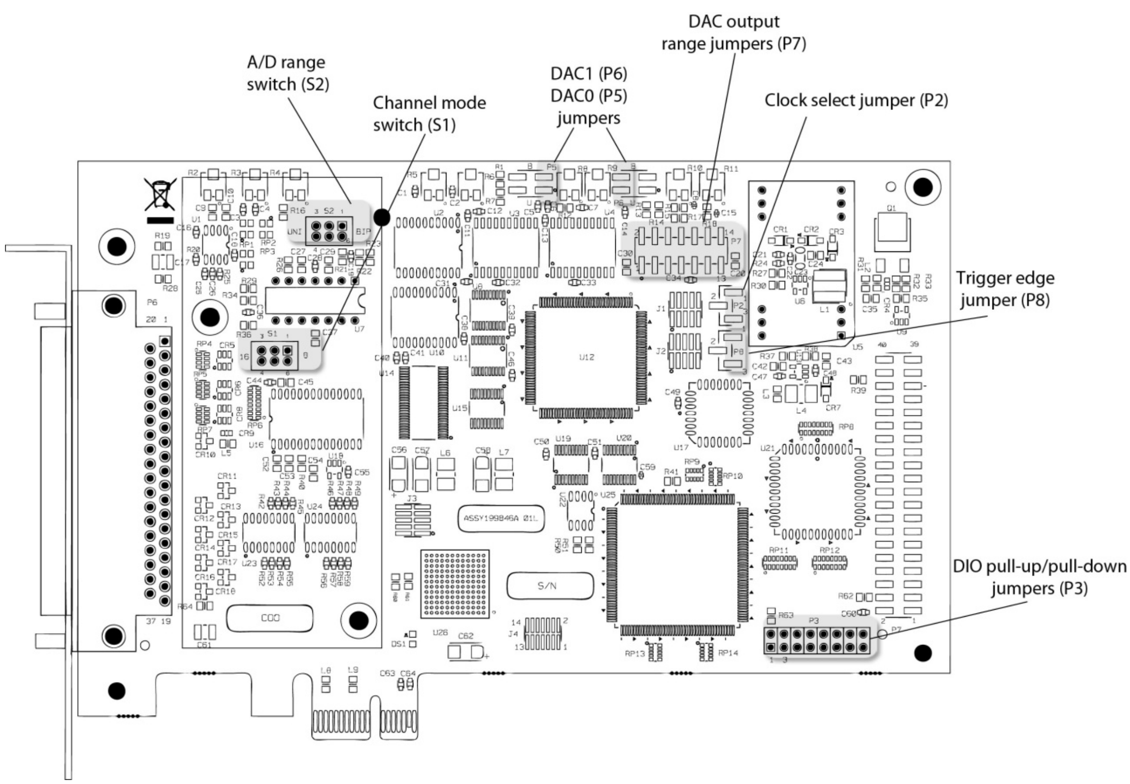

Figure 2. PCIe-DAS1602/16 switch and jumper locations

Before installing the PCIe-DAS1602/16 in the computer, make sure 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 PCIe-DAS1602/16 board.

Board switches are covered by analog input shield

To access the channel mode switch (*S1*) and the A/D range select switch (*S2*), remove the metal analog input shield that covers them. This shield is secured to the board with two screws.

Channel mode (S1 switch)

Use the *S1* switch to set the channel mode configuration. Configure the PCIe-DAS1602/16 analog inputs for either 8 DIFF channels or 16 SE channels.

- Use SE input mode if you have more than eight analog inputs to sample.
- Use DIFF input mode to allow for up to 10 V of common mode rejection. This mode provides better noise immunity.

The *S1* switch is factory-configured for 8 DIFF inputs, as shown in Figure 3. To configure for 16 SE channels, set this switch to *16*.

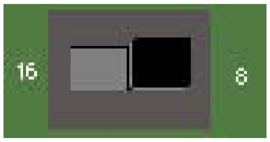

Figure 3. 16/8 channel select switch (S1) default setting (8)

A/D converter range (S2 switch)

Use the *S2*switch to set the A/D converter range. This switch controls all A/D channels.

Switch *S2* is factory-configured for bipolar. To configure for unipolar, set this switch to *UNI*.

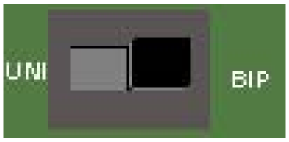

Figure 4. A/D range select switch (S2)

Trigger edge (P8 jumper)

Use the *P8* jumper to set the A/D pacer clock trigger edge. This jumper selects the edge that initiates the A/D conversion when using the internal pacer clock.

Jumper *P8* is factory-configured for rising edge.

When using the falling edge to start the conversion, the A/D may be falsely triggered by glitches in the 8254 pacer clock initialization. If the PCIe-DAS1602/16 is replacing an older series MCC board, using the rising edge to start the conversion may lead to timing differences.

For compatibility with MCC software and third-party packages, leave jumper *P8* in the default rising edge position.

Figure 5 and Figure 6 show the edge selection options for jumper *P8*.

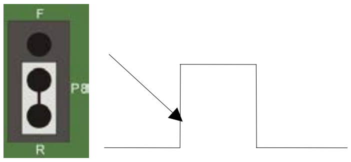

Figure 5. Jumper P8 set for rising edge

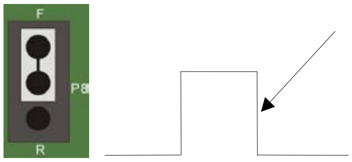

Figure 6. Jumper P8 set for falling edge

D/A converter (DAC) output range (P5, P6, and P7 jumpers)

Use the *P7* jumpers to set the PCIe-DAS1602/16 onboard precision voltage reference and select the output ranges of the DACs. Both DACs are factory-configured for a range of –5 V to +5 V (Figure 7.)

Two 12-bit multiplying DACs (DAC0 and DAC1) provide analog output. These DACs accept an input reference voltage, and provide 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 (FS). For example, in unipolar mode, the supplied reference of 5 V provides a +5 V output (actually 4.9988 V) when the value in the output register is 4095 (FS 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 V to 5 V, 0 V to 10 V, ±5 V, ±10 V. Other ranges between 0 V and 10 V are available when you provide a precision voltage reference at pin 10 (DAC0 REF IN) or pin 26 (DAC1 REF IN) of the main connector.

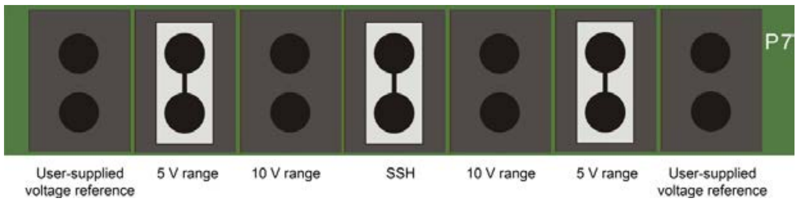

Figure 7. DAC0 and DAC1 range jumpers (P7)

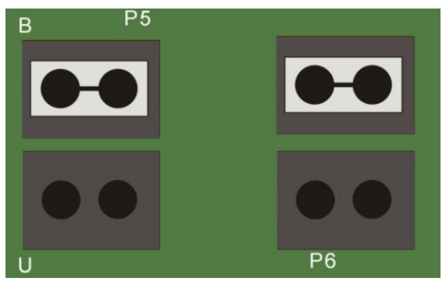

Figure 8. DAC0 (P5) and DAC1 (P6) unipolar/bipolar jumpers

Simultaneous sample and hold (SSH) trigger

When the DAC1 reference is supplied onboard, pin 26 on the 37-pin connector is unused (Figure 11). You can enable this pin as a SSH trigger for use with the CIO-SSH16 board. To enable SSH, place the jumper between the two pins labeled *SSH* in Figure 7.

Clock select (P2 jumper)

Use the *P2* jumper to configure 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.

The clock select jumper is factory-configured for 1 MHz, as shown in Figure 9. You can set the clock source to 10 MHz if needed for the sample rates you plan to use.

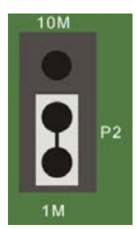

Figure 9. Clock select (P2)

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 main I/O connector (see Figure 11 on page 11).

Pull-up/down configuration (P3 jumpers)

Use the *P3* jumpers to set the digital bits for pull-up (+5 V) or pull down (0 V) when the PCIe-DAS1602/16 is powered on and reset. Ports A, B, CH, and CL are factory configured for pull-up.

These jumpers establish either a high (pull-up) or low (pull-down) logic level at each of the eight DIO lines on ports A and B, and at each of the four DIO lines on ports CL and CH. The default pull-up configuration for all ports is shown in Figure 10.

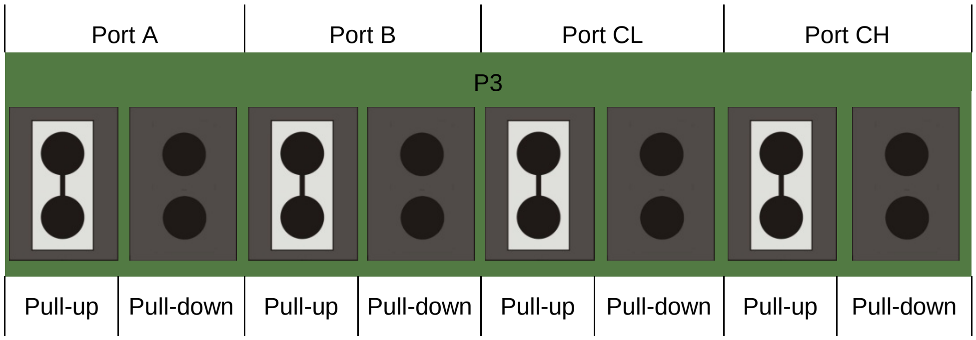

Figure 10. Pull-up/pull-down jumpers (P3)

Installing the hardware

Install the software before you install your device

The driver needed to run the PCIe-DAS1602/16 is installed when you install the software. Therefore, you need to install the software before you install the hardware.

The PCIe-DAS1602/16 is susceptible to radiated emissions

The PCIe-DAS1602/16 is susceptible to radiated emissions from other devices in the chassis such as video adapters or other PCI/PCIe devices in adjacent PCI/PCIe slots. This can result in AI input noise levels that are out of specification and is noted in the product electrical specification.

After you configure the board switches and jumpers (if any), install the PCIe-DAS1602/16 into your computer. To install your board, follow the steps below:

1. Power off and unplug the computer, and remove the cover to expose the expansion slots.
2. Touch any metal part of the computer to discharge static electricity. Static electricity can damage the board.
3. Insert the PCIe-DAS1602/16 into an unused x1 PCIe expansion slot.

   The PCIe-DAS1602/16 is designed to install into an x1 slot. However, you can also install the board into an unused x4, x8, or x16 PCIe slot.

Caution! Make sure that you install the board into a PCIe slot. Installing the PCIe-DAS1602/16 into a non-PCIe slot can damage both the board and the computer's motherboard.

4. Close your computer and turn it on.

   A dialog box opens as the system loads, indicating that new hardware has been detected. The information file for this board should have already been loaded onto your PC when you installed the software CD supplied with your board, and should be detected automatically by Windows. If you have not installed this software, cancel the dialog, install the software, and restart your computer.
5. Run InstaCal to test your installation and to configure the board. Refer to the *Quick Start Guide* that came with your board for information on how to initially set up InstaCal.

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

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

Board connectors, cables, accessory equipment

Connectors, cables, and accessories	Description
Analog connector type	37-pin male D connector
Digital connector type	40-pin header connector
Compatible cables	C37FF-x (Figure 14) C37FFS-x (Figure 15) BP40-37 (Figure 16)
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 PCIe-DAS1602/16 board's analog connector is a 37-pin "D" connector that is accessible from the rear of the computer on the expansion back plate. This connector accepts female 37-pin D-type connectors, such as the C37FF-x 37-pin cable (Figure 14) or the C37FFS-x 37-pin shielded cable (Figure 15).

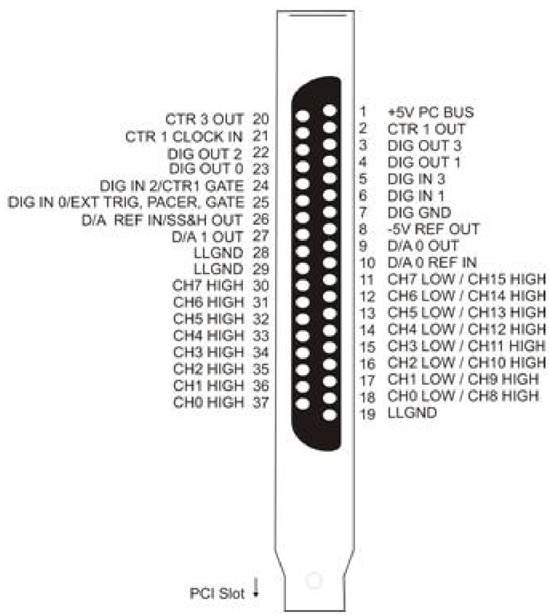

Figure 11. Main I/O connector pin out

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

Digital connector

The PCIe-DAS1602/16 digital I/O connector is a 40-pin connector that is mounted at the rear of the PCIe-DAS1602/16. This connector accepts a 40-pin header connector (Figure 16).

The optional BP40-37 cable assembly brings the signals to a back plate with a 37-pin male connector mounted in it.

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).

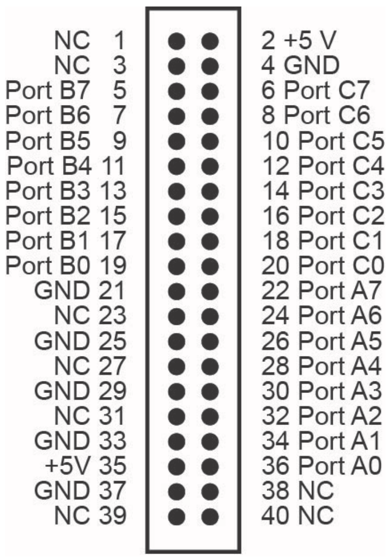

Figure 12. Digital I/O connector pin out

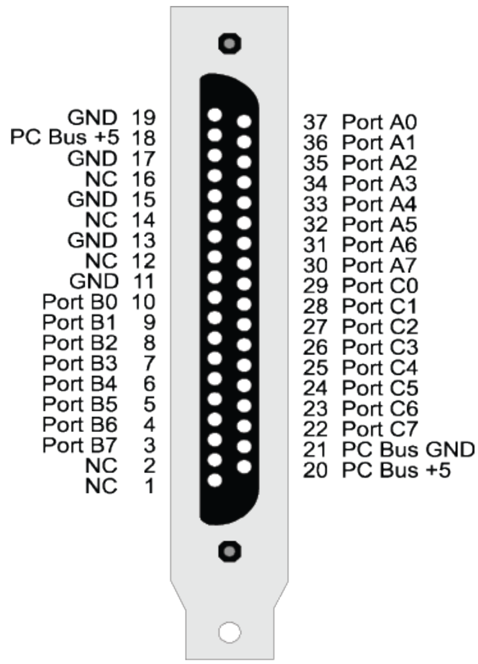

Figure 13. BP40-37 connector pin out

Cabling

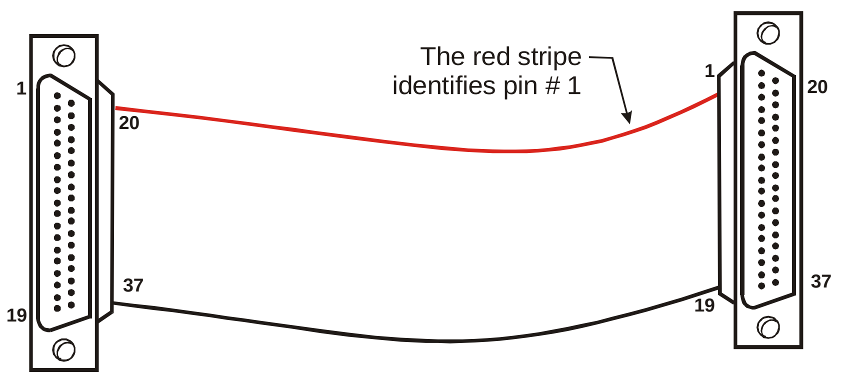

Figure 14. C37FF-x cable

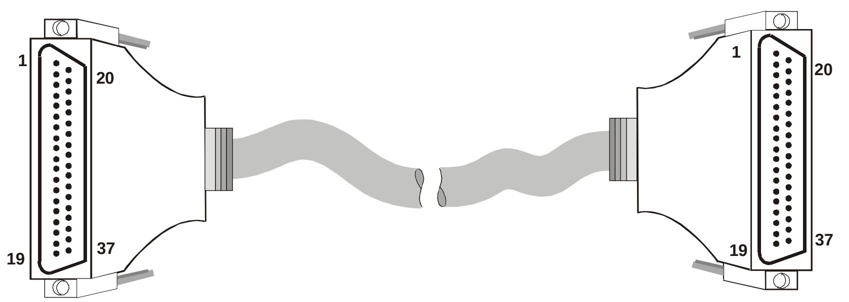

Figure 15. C37FFS-x cable

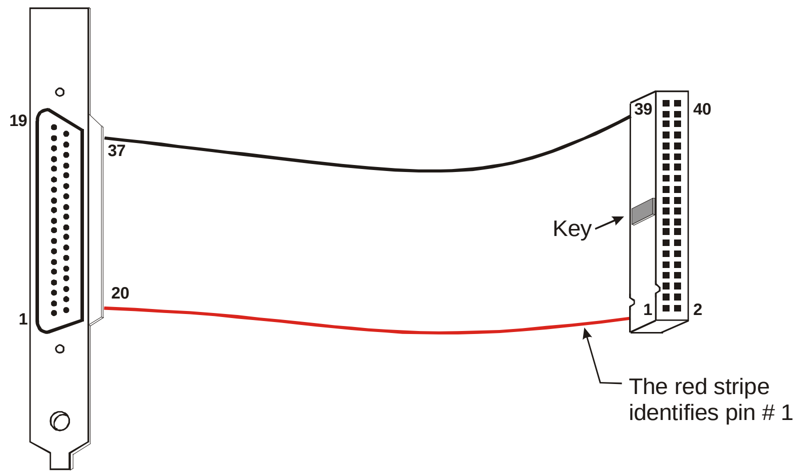

Figure 16. BP40-37 cable

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 PCIe-DAS1602/16 using the C37FF-*x* or C37FFS-*x* cable:

- **CIO-MINI37** – 37-pin screw terminal board
- **SCB-37** – 37-conductor, shielded signal connection/screw terminal box that provides two independent 50-pin connections

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

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

- **CIO-EXP16** - Analog multiplexor expands 16 differential inputs to one single-ended output with multiple gains and CJC
- **CIO-EXP32** - Analog multiplexor expands 32 differential inputs to two single-ended outputs (such as two 16 to 1 multiplexers) 2 gain amps and CJC
- **ISO-5B30-01** - Analog isolation module, voltage/current input, 4 Hz ±10 mV input, ±5 V output
- **ISO-RACK16** – Isolated 16-channel, 5B module rack for analog signal conditioning and expansion
- **ISO-DA02** – Isolated 2-channel, 5B module rack for analog signal conditioning and expansion.

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

- **CIO-ERB08** – 8-channel, Form C relay accessory board for digital signal conditioning
- **CIO-ERB24** – 24-channel, Form C relay accessory board for digital signal conditioning
- **SSR-RACK08** – 8-channel, solid-state relay mounting rack for digital signal conditioning
- **SSR-RACK24** – 24-channel, solid-state relay mounting rack for digital signal conditioning

Details on these analog and digital signal conditioning products are available on our web site at www.mccdaq.com/products/signal_conditioning.aspx.

Mechanical drawing

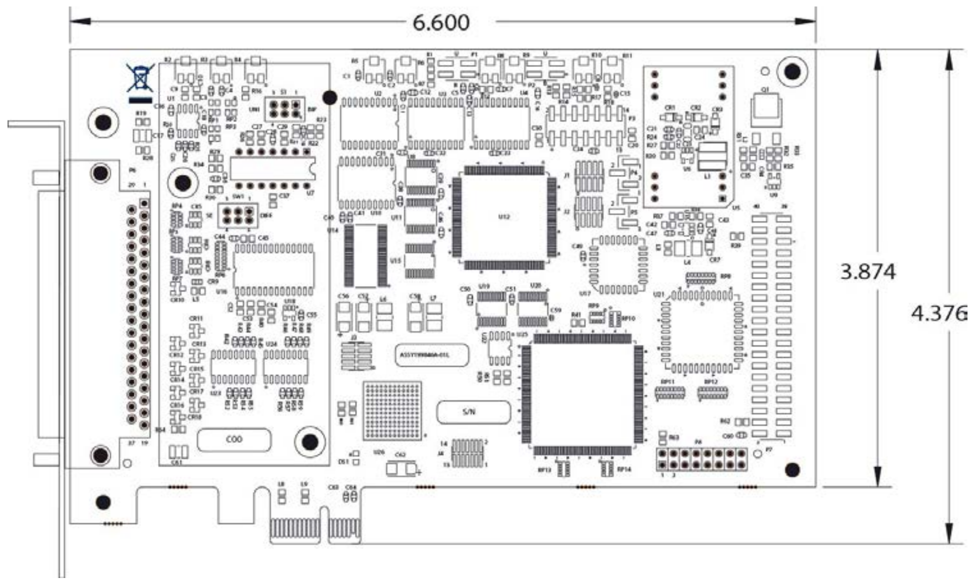

Figure 17. PCIe-DAS1602/16 circuit board dimensions (inches)

Calibrating

Required equipment

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

Field calibration

The PCIe-DAS1602/16 is shipped fully calibrated from the factory, and supports field calibration. For normal environments, you should calibrate your PCIe-DAS1602/16 every six months to a year using InstaCal. Calibrating with InstaCal takes less than 20 minutes.

You calibrate the A/D converters by applying a known voltage to an analog input channel and adjusting trim pots for offset and gain. Three trim pots 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 PCIe-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.

If frequent variations in temperature or humidity are common, recalibrate at least every three months. Refer to the *Quick Start Guide* that shipped with your board for information about InstaCal.

Factory calibration

The Measurement Computing Manufacturing Test department performs the initial factory calibration. Contact Measurement Computing for details about how to return your device and have it calibrated to the factory specifications.

Specifications

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

Analog input

Table 1. Analog input specifications

Parameter	**Specification**
A/D converter type	LTC1605CSW
Resolution	16 bits
Number of channels (switch-selectable)	16 SE/8 DIFF
Input ranges ■ Gain (software-selectable) ■ Unipolar/bipolar polarity (switch-selectable)	±10 V, ±5 V, ±2.5 V, ±1.25 V 0 V to 10 V, 0 V to 5 V, 0 to 2.5 V, 0 V to 1.25 V
A/D pacing (software-selectable)	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-selectable)	External edge trigger: pin 25 Positive or negative edge (software-selectable)
A/D gate (only available when internal pacing selected, software-selectable)	External gate: pin 25 High or low level (software-selectable)
Simultaneous sample and hold trigger	TTL output: pin 26 (jumper-selectable) Logic 0 = Hold, Logic 1 = Sample Compatible with CIO-SSH16
Burst mode (software-selectable)	Burst interval = 10 us
Data transfer	From 1024 sample FIFO via interrupt with REPINSW
	Interrupt
	Software polled
Interrupt	INTA# - mapped to IRQ*n* through PCI BIOS at boot-time
Interrupt enable	Programmable through PCI9030
Interrupt polarity	Active high level or active low level, programmable through PLX9030
Interrupt sources (software-selectable)	End of conversion
	FIFO not empty
	End of burst
	End of acquisition
	FIFO half full
A/D conversion time	*10 µs max*
Throughput	■ Single channel: 100 kS/s ■ Multi-channel: (100 kS/s)/(# of channels)
Common mode range	±10 V min
CMRR @ 60 Hz	–100 dB typ, –80 dB min
Input leakage current	*±3 nA max*
Input impedance	*10 MΩ min*
Absolute maximum input voltage	*55 V/–40 V fault protected via input mux*

Accuracy

Table 2. AI 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 PCIe-DAS1602/16 is tested at the factory to assure the overall error of the board 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 is at their maximum level, and causes error in the same direction.

Analog input drift

Table 3. Analog input drift specifications

Range	Analog Input FS Gain Drift	Analog Input Zero drift	Overall Analog Input Drift
±10.00 V	2.2 LSB/°C max	1.8 LSB/°C max	4.0 LSB/°C max
±5.000 V	2.2 LSB/°C max	1.9 LSB/°C max	4.1 LSB/°C max
±2.500 V	2.2 LSB/°C max	2.0 LSB/°C max	4.2 LSB/°C max
±1.250 V	2.2 LSB/°C max	2.3 LSB/°C max	4.5 LSB/°C max
0 V to 10.00 V	4.1 LSB/°C max	1.9 LSB/°C max	6.0 LSB/°C max
0 V to 5.000 V	4.1 LSB/°C max	2.1 LSB/°C max	6.2 LSB/°C max
0 V to 2.500 V	4.1 LSB/°C max	2.4 LSB/°C max	6.5 LSB/°C max
0 V to 1.250 V	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 is at their maximum level, and causes error in the same direction.

Noise performance

Table 4. Noise performance specifications

The following table summarizes the worst case noise performance for the PCIe-DAS1602/16. Noise distribution is determined by gathering 50,000 samples with inputs tied to ground at the PCIe-DAS1602/16 main connector. Data is for both SE and DIFF modes of operation.

Range	±2 counts	±1 count	Max Counts	LSBrms (Note 1)
±10.00 V	97%	80%	11	1.7
±5.000 V	97%	80%	11	1.7
±2.500 V	96%	79%	11	1.7
±1.250 V	96%	79%	11	1.7
0 V to 10.000 V	88%	65%	15	2.3
0 V to 5.000 V	88%	65%	15	2.3
0 V to 2.500 V	83%	61%	15	2.3
0 V to 1.250 V	83%	61%	16	2.4

Note 1: 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.

Note 2: Noise performance may be affected by input cabling and/or excessive noise from adjacent PCBs within the PC enclosure.

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 50,000 samples. A full-scale (FS) 100 Hz triangle wave is input on channel 1, with channel 0 tied to analog ground at the 37 pin user connector. The table below summarizes the influence of channel 1 on channel 0 and does not include the effects of noise.

Table 5. Crosstalk specifications

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	3	7	18
±2.5000 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	3	5	16
0 V to 2.500 V	2	4	16
0 V to 1.250 V	3	3	16

Analog output

Table 6. Analog output specifications

Parameter	Specification
D/A converter type	MX7548
Resolution	12 bits
Number of channels	2
Channel type	SE voltage output
Output range (jumper-selectable per output)	±10 V, ±5 V, 0 to 10 V, or 0 V to 5 V using onboard references, or user-defined using external reference
Reference voltage (jumper-selectable)	On-board, –10 V and –5 V
	External; independent (D/A0 REF IN pin 10 and D/A1 REF IN/SSH OUT pin 26)
External reference voltage range	±10 V max
External reference input impedance	*10 kΩ min*
Data transfer (system-dependent)	Programmed I/O
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 Ω max
Output stability	Any passive load
Coding	Offset binary ■ Bipolar mode 0 code = Vref 4095 code = –Vref – 1LSB, Vref < 0 V –Vref + 1LSB, Vref >0 V ■ Unipolar mode 0 code =0 V 4095 code = –Vref – 1LSB, Vref < 0 V –Vref + 1LSB, Vref >0 V
Output voltage on power up and reset	0 V ± 10 mV

Accuracy

Table 7. AO accuracy specifications

Parameter	Specification
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 is at their maximum level, and causes error in the same direction.

Analog output drift

Table 8. Analog output drift specifications

Parameter	**Specification**
Analog output FS 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 is at their maximum level, and causing error in the same direction.

Digital input/output

Table 9. Digital I/O specifications

Parameter	**Specification**
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 V min, 5.5 V absolute max*
Input low	*0.8 V max, –0.5 V absolute min*
Output high	*3.0 V min @ –2.5 mA*
Output low	*0.4 V max @ 2.5 mA*
Power-up/reset state	Input mode (high impedance)
Pull-up/pull-down resistors	All pins pulled up to +5 V via individual 47 kΩ resistors, by default. Selectable at jumper P8
Main connector	
Digital output type	74ACT244, power up/reset to LOW logic level
Digital input type	74AHCT373, pulled to logic high via 47 K resistors
Number of I/O	8
Configuration	4 fixed input, 4 fixed output
Output high	*2.7 V @ –0.4 mA min*
Output low	*0.5 V @ 8 mA max*
Input high	*2.0 V min, 7 V absolute max*
Input low	*0.8 V max, –0.5 V absolute min*

Counter

Table 10. Counter specifications

Parameter	Specification
Counter type	82C54
Configuration	3 down counters, 16 bits each
Counter 1 source (software-selectable)	■ External source from main connector: pin 21 (Note 3) ■ 100 kHz internal source
Counter 1 gate	External gate from main connector: pin 24 (Note 3)
Counter 1 output	Available at main connector: pin 2
Counter 2 source (jumper-selectable)	■ Internal 1 MHz ■ Internal 10 MHz
Counter 2 gate (software-selectable)	External source from main connector: pin 25 (Note 3)
Counter 2 output	Internal only, chained to counter 3 source
Counter 3 source	Counter 2 output
Counter 3 gate (software-selectable)	External source from main connector: pin 25 (Note 3)
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 V absolute max*
Input low	*0.8 V max, –0.5 V 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

Note 3: Pins 21, 24, and 25 are pulled to logic high via 47 K resistors.

Power consumption

Table 11. Power consumption specifications

Parameter	Specification
3.3 V quiescent	500 mA typ, 750 mA max
12 V quiescent	100 mA typ, 150 mA max
User 5 V outputs	10 mA

Environmental

Table 12. Environmental specifications

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

Mechanical

Table 13. Mechanical specifications

Parameter	Specification
Dimensions (L × W × H)	168 × 111 × 19 mm (6.6 × 4.4 × 0.7 in.)

Bus

Table 14. Bus specifications

Parameter	Specification
Bus type	PCI Express 1.0a
Bus width	x1 lane PCI Express

Main connector and pin out

Table 15. Connector specifications

Connector type	37 pin male *D* connector
Connector compatibility	Identical to PCIM-DAS1602/16 connector

8-channel differential mode pin out

Table 16. Differential mode pinout

Pin	Signal Name	Pin	Signal Name
1	+5V Out	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

Table 17. Single-ended mode pinout

Pin	Signal Name	Pin	Signal Name
1	+5V Out	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	DAC1 REF IN/SS&H OUT
8	-5V REF OUT	27	DAC1 OUT
9	DAC0 OUT	28	AGND
10	DAC0 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		

Digital input/output connector and pin out

Parameter	Specification
Connector type	40-pin header
Connector Compatibility	Identical to PCIM-DAS1602/16 connector

Pin	Signal Name	Pin	Signal Name
1	NC	2	+5V Out
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 Out	36	PORT A 0
37	DIG GND	38	NC
39	NC	40	NC

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

PCIe-DAS1602/16

to which this declaration relates is in conformity with the relevant provisions of the following standards or other documents:

EC EMC Directive 2004/108/EC: General Requirements, EN 61326-1:2006 (IEC 61326-1:2005).

Emissions:

- EN 55011 (2007) / CISPR 11(2003): Radiated emissions: Group 1, Class A
- EN 55011 (2007) / CISPR 11(2003): Conducted emissions: Group 1, Class A

Immunity: EN 61326-1:2006, Table 3.

- IEC 61000-4-2 (2001): Electrostatic Discharge immunity.
- IEC 61000-4-3 (2002): Radiated Electromagnetic Field immunity.
- IEC 61000-4-4 (2004): Electric Fast Transient Burst Immunity.
- IEC 61000-4-5 (2001): Surge Immunity.
- IEC 61000-4-6 (2003): Radio Frequency Common Mode Immunity.
- IEC 61000-4-11 (2004): Voltage Interrupts.

To maintain compliance to the standards of this declaration, the following conditions must be met.

- The host computer, peripheral equipment, power sources, and expansion hardware must be CE compliant.
- All I/O cables must be shielded, with the shields connected to ground.
- I/O cables must be less than 3 meters (9.75 feet) in length.
- The host computer must be properly grounded.
- Equipment must be operated in a controlled electromagnetic environment as defined by Standards EN 61326-1:2006, or IEC 61326-1:2005.

Declaration of Conformity based on tests conducted by Chomerics Test Services, Woburn, MA 01801, USA in November, 2011. Test records are outlined in Chomerics Test Report #EMI5995.11.

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

Carl Haapaoja, Director of Quality Assurance

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