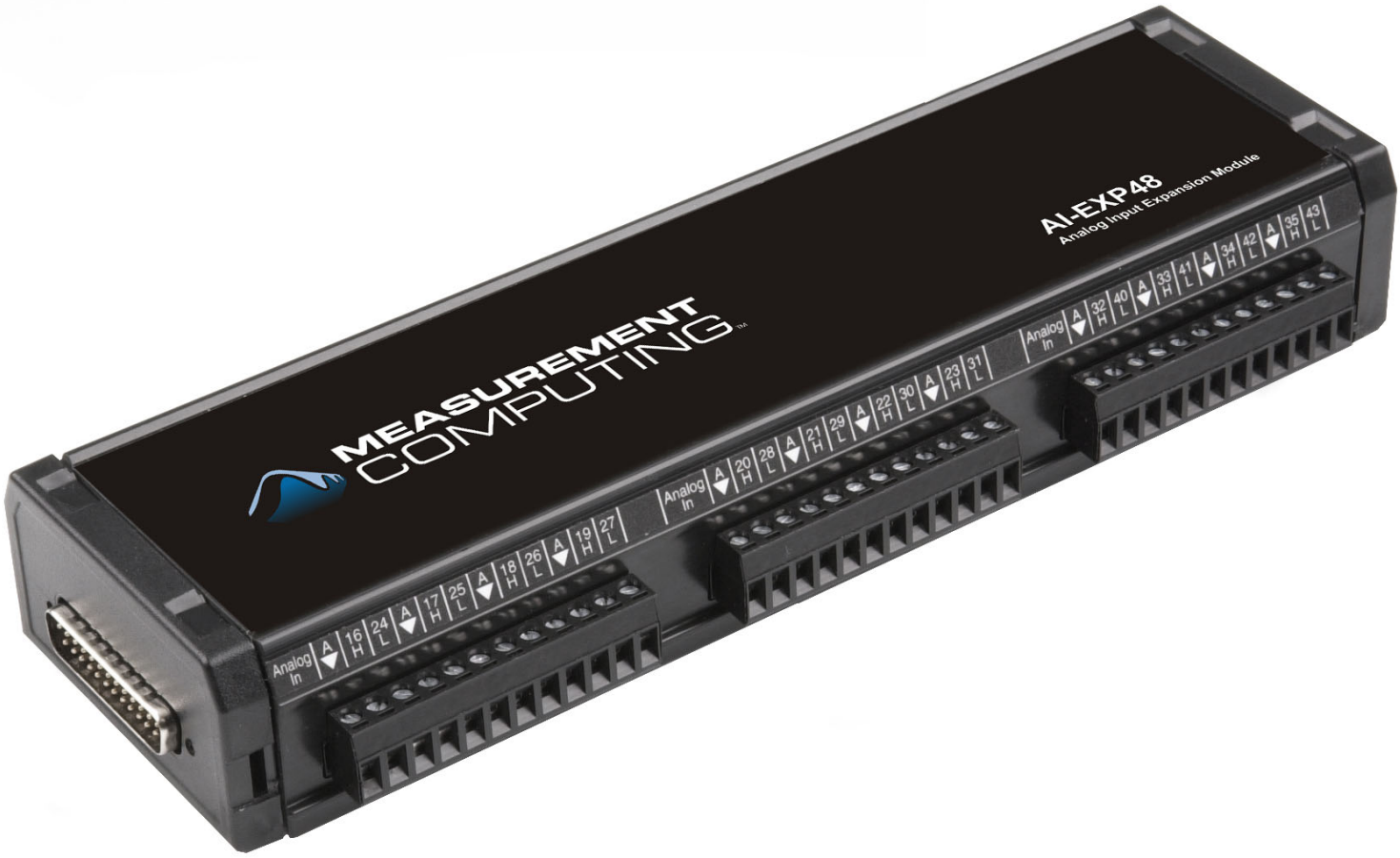
AI-EXP48

Analog Input Expansion Module

User's Guide



MEASUREMENT COMPUTING

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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 explains how to install, configure, and use the AI-EXP48 so that you get the most out of its analog input 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 helpful information relevant to the operation of the AI-EXP48.

- MCC's *Specifications: AI-EXP48* (the PDF version of the *Specifications* chapter in this guide) is available on our web site at www.mccdaq.com/pdfs/AI-EXP48.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.

AI-EXP48 User's Guide (this document) is also available on our web site at www.mccdaq.com/PDFmanuals/AI-EXP48.pdf.

Introducing the AI-EXP48

Overview: AI-EXP48 features

The AI-EXP48 is an expansion module used to add 48 single-ended or 24 differential analog inputs to compatible hardware, such as the USB-1616HS Series devices.

The AI-EXP48 connects to the parent device via a 25-pin expansion connector. The AI-EXP48 supports all of the analog input and temperature input capabilities of the parent device.

The AI-EXP48 can measure up to 48 channels of voltage or up to 24 channels of temperature. Each input channel is software configurable for either voltage or thermocouple. The analog inputs are provided on six rows of removable screw terminals.

The voltage measurement speed is the same as the parent device. When measuring thermocouples, the parent device must be configured for differential inputs.

The AI-EXP48 receives power from the parent device. An external power supply may be required to supply sufficient power to both devices.

Software features

For information on the features of *Insta*Cal and the other software included with your AI-EXP48, 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.

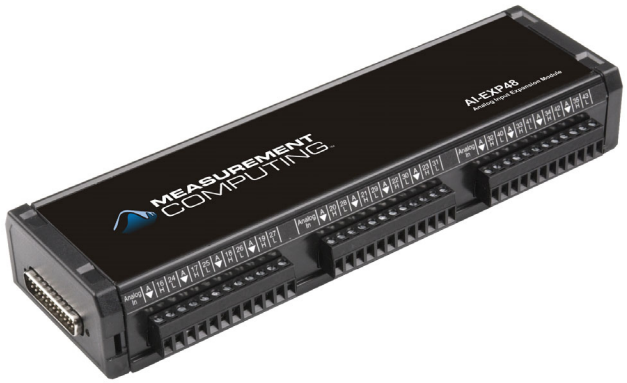
Installing the AI-EXP48

What comes with your AI-EXP48 shipment?

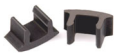
The following items are shipped with the AI-EXP48.

Hardware

- AI-EXP48



- Clips (2) used to lock the AI-EXP48 and parent device together when connected directly



Optional components

You can connect the AI-EXP48 to a USB-1616HS series parent device using the optional CA-96A cable.

- CA-96 cable

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 AI-EXP48 and information regarding installation of that software. Please read this booklet completely before installing any software or hardware.

Unpacking the AI-EXP48

As with any electronic device, you should take care while handling to avoid damage from static electricity. Before removing the AI-EXP48 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

Connecting to the parent A/D device with the DSUB25 expansion connector

You can use the 25-pin expansion connector to connect to a compatible parent device, such as a USB-1616HS Series device.

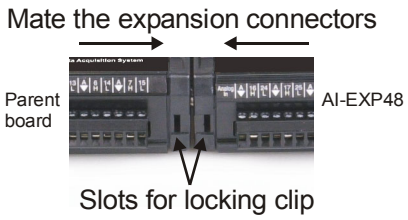
You can either mate the expansion connectors directly or use the optional expansion cable to connect the two devices. Do the following:

1. Disconnect the USB cable from the parent device.

   If the parent device is connected to an external power supply, remove the external power cable from the device.

2. Connect the two devices together by one of the following methods:

   - **Direct connect method**: The parent device must have a female DSUB25 expansion connector to use this method. Push the expansion module's DSUB25 connector into the DSUB25 connector on the parent device. Lock the two devices together by inserting the two clips provided (one per side).



   The image below shows the AI-EXP48 directly connected a USB-1616HS-4.

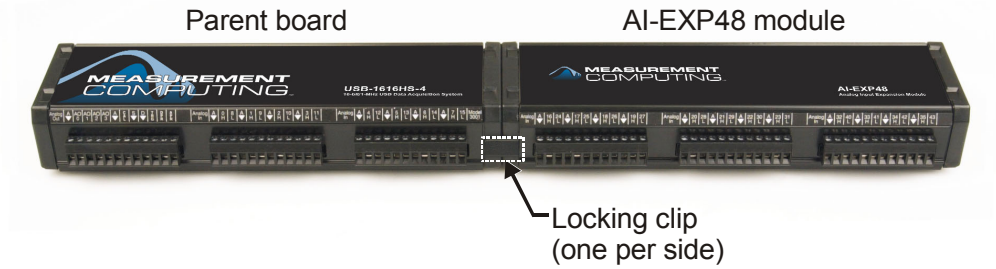


Figure 1. Direct connect method

   - **Cable method**: Connect the appropriate cable (not included) from the DSUB25 connector on the AI-EXP48 to the expansion connector on the parent device. The image below shows the AI-EXP48 connected to a USB-1616HS-4 via the CA-96A cable.

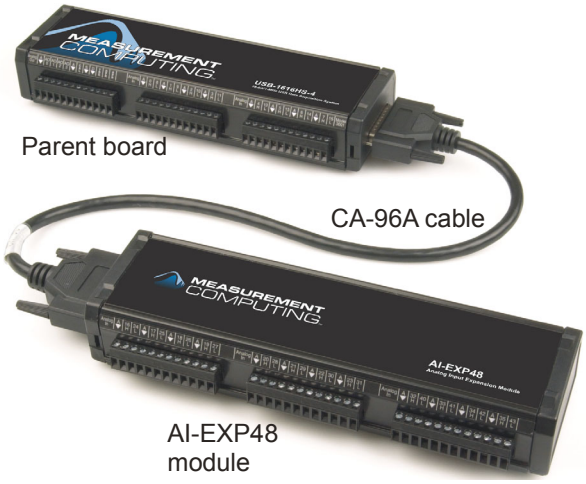


Figure 2. Cable method

3. Connect the external power supply, if used, to the power input port of the parent device, and then plug it into an AC outlet.

   Note: Connecting external power to the device before connecting the USB cable to the computer allows the parent device to inform the host computer upon connection of the USB cable that the device requires minimum power from the computer's USB port.

4. Connect the USB cable from the parent device to the host computer's USB port.

   Connect to a USB 2.0 high speed hub to achieve the highest transfer rate (480 Mbps). When connected to a USB 1.1 full-speed port, the transfer rate is limited to 12 Mbps.

Connecting the device for I/O operations

User connectors

The following table lists the device connectors and compatible hardware for the AI-EXP48.

User connectors and hardware

Connector type	▪ Six banks of removable screw-terminal blocks ▪ 25-pin male DSUB connector (for connection to parent device)
Wire gauge range (screw terminals)	14 AWG to 30 AWG

Screw terminal pin out

Single-ended mode pin out

Terminal block	Device label	(Signal description)		Device label	(Signal description)	Terminal block
Analog In TB1	A▼	(Analog common)		63L	(CH 63)	Analog In TB6
	16H	(CH 16)		55H	(CH 55)	
	24L	(CH 24)		A▼	(Analog common)	
	A▼	(Analog common)		62L	(CH 62)	
	17H	(CH 17)		54H	(CH 54)	
	25L	(CH 25)		A▼	Analog common	
	A▼	(Analog common)		61L	(CH 61)	
	18H	(CH 18)		53H	(CH 53)	
	26L	(CH 26)		A▼	(Analog common)	
	A▼	(Analog common)		60L	(CH 60)	
	19H	(CH 19)		52H	(CH 52)	
	27L	(CH 27)		A▼	(Analog common)	
Analog In TB2	A▼	(Analog common)		59L	(CH 59)	Analog in TB5
	20H	(CH 20)		51H	(CH 51)	
	28L	(CH 28)		A▼	(Analog common)	
	A▼	(Analog common)		58L	(CH 58)	
	21H	(CH 21)		50H	(CH 50)	
	29L	(CH 29)		A▼	(Analog common)	
	A▼	(Analog common)		57L	(CH 57)	
	22H	(CH 22)		49H	(CH 49)	
	30L	(CH 30)		A▼	(Analog common)	
	A▼	(Analog common)		56L	(CH 56)	
	23H	(CH 23)		48H	(CH 48)	
	31L	(CH 31)		A▼	(Analog common)	
Analog In TB3	A▼	(Analog common)		47L	(CH 47)	Analog In TB4
	32H	(CH 32)		39H	(CH 39)	
	40L	(CH 40)		A▼	(Analog common)	
	A▼	(Analog common)		46L	(CH 46)	
	33H	(CH 33)		38H	(CH 38)	
	41L	(CH 41)		A▼	(Analog common)	
	A▼	(Analog common)		45L	(CH 45)	
	34H	(CH 34)		37H	(CH 37)	
	42L	(CH 42)		A▼	(Analog common)	
	A▼	(Analog common)		44L	(CH 44)	
	35H	(CH 35)		36H	(CH 36)	
	43L	(CH 43)		A▼	(Analog common)	

Differential mode pin out

Terminal block	Device label	(Signal description)		Device label	(Signal description)	Terminal block
Analog In TB1	A▾	(Analog common)		63L	(CH 31 LO)	Analog In TB6
	16H	(CH 8 HI)		55H	(CH 31 HI)	
	24L	(CH 8 LO)		A▾	(Analog common)	
	A▾	(Analog common)		62L	(CH 30 LO)	
	17H	(CH 9 HI)		54H	(CH 30 HI)	
	25L	(CH 9 LO)		A▾	Analog common	
	A▾	(Analog common)		61L	(CH 29 LO)	
	18H	(CH 10 HI)		53H	(CH 29 HI)	
	26L	(CH 10 LO)		A▾	(Analog common)	
	A▾	(Analog common)		60L	(CH 28 LO)	
	19H	(CH 11 HI)		52H	(CH 28 HI)	
	27L	(CH 11 LO)		A▾	(Analog common)	
Analog In TB2	A▾	(Analog common)		59L	(CH 27 LO)	Analog in TB5
	20H	(CH 12 HI)		51H	(CH 27 HI)	
	28L	(CH 12 LO)		A▾	(Analog common)	
	A▾	(Analog common)		58L	(CH 26 LO)	
	21H	(CH 13 HI)		50H	(CH 26 HI)	
	29L	(CH 13 LO)		A▾	(Analog common)	
	A▾	(Analog common)		57L	(CH 25 LO)	
	22H	(CH 14 HI)		49H	(CH 25 HI)	
	30L	(CH 14 LO)		A▾	(Analog common)	
	A▾	(Analog common)		56L	(CH 24 LO)	
	23H	(CH 15 HI)		48H	(CH 24 HI)	
	31L	(CH 15 LO)		A▾	(Analog common)	
Analog In TB3	A▾	(Analog common)		47L	(CH 23 LO)	Analog In TB4
	32H	(CH 16 HI)		39H	(CH 23 HI)	
	40L	(CH 16 LO)		A▾	(Analog common)	
	A▾	(Analog common)		46L	(CH 22 LO)	
	33H	(CH 17 HI)		38H	(CH 22 HI)	
	41L	(CH 17 LO)		A▾	(Analog common)	
	A▾	(Analog common)		45L	(CH 21 LO)	
	34H	(CH 18 HI)		37H	(CH 21 HI)	
	42L	(CH 18 LO)		A▾	(Analog common)	
	A▾	(Analog common)		44L	(CH 20 LO)	
	35H	(CH 19 HI)		36H	(CH 20 HI)	
	43L	(CH 19 LO)		A▾	(Analog common)	

Expansion connector

The AI-EXP48 has a 25-pin male DSUB connector that connects directly to the 25-pin female DSUB connector on compatible hardware or through the appropriate cable to compatible hardware.

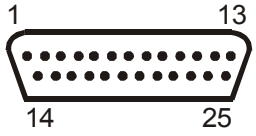


Figure 3. 25-pin male DSUB expansion connector

Cabling

If the parent device has a 25-pin expansion connector, you can use the CA-96A cable to connect with the AI-EXP48.

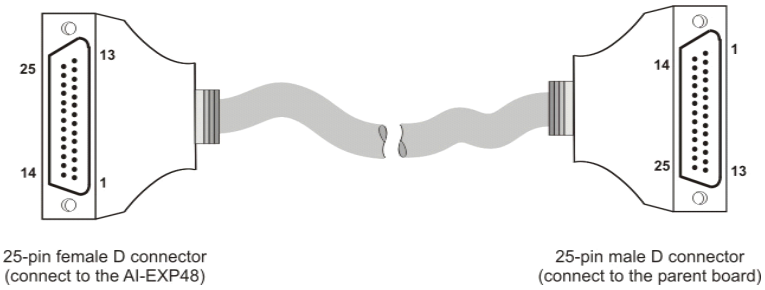


Figure 4. CA-96A cable

Information on signal connections

General information regarding signal connection and configuration is available in the *Guide to Signal Connections* (available at www.mccdaq.com/signals/signals.pdf).

Associating CJC channels with thermocouple channels

TC channels must immediately follow their associated CJC channels in the channel array. For accurate thermocouple measurements, associate CJC channels with the TC channels as listed below.

CJC channels	TC channels
CJC6	TC8 through TC11
CJC7	TC12 through TC15
CJC8	TC16 through TC19
CJC9	TC20 through TC23
CJC10	TC24 through TC27
CJC11	TC28 through TC31

When measuring thermocouples, the parent device must be configured for differential inputs.

Specifications

Typical for 25 °C unless otherwise specified.
Specifications in *italic text* are guaranteed by design.

Analog input

Table 1. Analog input specifications

Number of channels	48 single-ended/24 differential inputs
Voltage measurement speed	1 µs per channel
Input ranges, software or sequencer programmable	Bipolar: ±10 V, ±5 V, ±2 V, ±1 V , ±0.5 V, ±0.2 V, ±0.1 V, universal thermocouple
Signal to noise and distortion	*72 dB typical for ±10 V range, 1 kHz fundamental*
Total harmonic distortion	*-80 dB typical for ±10 V range, 1 kHz fundamental*
Bias current	*40 pA typical (0 °C to 35 °C)*
Crosstalk	*-75 dB DC to 60 Hz; -65 dB @ 10 kHz, typical*
Input impedance	*10 MΩ single-ended, 20 MΩ differential*
Over-voltage protection	*±30 V*

Accuracy

Table 2. Analog input accuracy specifications

Voltage range (note 1)	Accuracy ±(% of reading + % range) 23°C ±10 °C, 1 year	Temperature coefficient ±(ppm of reading + ppm range)/°C	Noise (cts RMS) (note 2)
-10 V to 10 V	0.031% + 0.008%	14 + 8	*2.0*
-5 V to 5 V	0.031% + 0.009%	14 + 9	*3.0*
-2 V to 2 V	0.031% + 0.010%	14 + 10	*2.0*
-1 V to 1 V	0.031% + 0.02%	14 + 12	*3.5*
-500 mV to 500 mV	0.031% + 0.04%	14 + 18	*5.5*
-200 mV to 200 mV	0.036% + 0.05%	14 + 12	*8.0*
-100 mV to 100 mV	0.042% + 0.10%	14 + 18	*14.0*

Note 1: Specifications assume differential input single-channel scan, 1 MHz scan rate, unfiltered, CMV=0.0 V, 30 minute warm-up, exclusive of noise, -FS to +FS.

Note 2: Noise reflects 10,000 samples at 1 MHz, typical, differential short

Thermocouples

Table 3. TC types and accuracy (Note 3)

TC type	Temperature range (°C)	Accuracy (±°C)	Noise typical (±°C)
J	-200 to + 760	1.7	0.2
K	-200 to + 1200	1.8	0.2
T	-200 to + 400	1.8	0.2
E	-270 to + 650	1.7	0.2
R	-50 to + 1768	4.8	1.5
S	-50 to + 1768	4.7	1.5
N	-270 to + 1300	2.7	0.3
B	+300 to + 1400	3.0	1.0

Note 3: Assumes 16384 oversampling applied, CMV = 0.0V, 60 minute warm-up, still environment, and 25 °C ambient temperature; excludes thermocouple error; TC_{in} = 0° C for all types except B (1000 °C)

Power consumption

Table 4. Power consumption specifications

Power consumption (per board)	400 mW maximum (supplied by parent product, such as USB-1616HS series)

Environmental

Table 5. Environmental specifications

Operating temperature range	-30 °C to +70 °C
Storage temperature range	-40 °C to +80 °C
Relative humidity	0 to 95% non-condensing

Mechanical

Table 6. Mechanical specifications

Vibration	MIL STD 810E, category 1 and 10
Dimensions	269 mm (W) x 92 mm (D) x 45 mm (H) (10.6" x 3.6" x 1.6")
Weight	400 g (0.88 lbs)

User connectors

Table 7. Screw terminal connector specifications

Connector type	Six banks of removable screw-terminal blocks
Wire gauge range	14 AWG to 30 AWG

Table 8. Expansion connector specifications

Communications connector	25-pin DSUB, male
Compatible cable	CA-96A (also mates directly with USB-1616HS series products)

Table 9. Single-ended mode pin out

Terminal block	Device label	(Signal description)		Device label	(Signal description)	Terminal block
Analog In	A▼	(Analog common)		63L	(CH 63)	
	16H	(CH 16)		55H	(CH 55)	
	24L	(CH 24)		A▼	(Analog common)	
	A▼	(Analog common)		62L	(CH 62)	
	17H	(CH 17)		54H	(CH 54)	
	25L	(CH 25)		A▼	Analog common	**Analog In**
	A▼	(Analog common)		61L	(CH 61)	
	18H	(CH 18)		53H	(CH 53)	
	26L	(CH 26)		A▼	(Analog common)	
	A▼	(Analog common)		60L	(CH 60)	
	19H	(CH 19)		52H	(CH 52)	
	27L	(CH 27)		A▼	(Analog common)	
Analog In	A▼	(Analog common)		59L	(CH 59)	
	20H	(CH 20)		51H	(CH 51)	
	28L	(CH 28)		A▼	(Analog common)	
	A▼	(Analog common)		58L	(CH 58)	
	21H	(CH 21)		50H	(CH 50)	
	29L	(CH 29)		A▼	(Analog common)	**Analog in**
	A▼	(Analog common)		57L	(CH 57)	
	22H	(CH 22)		49H	(CH 49)	
	30L	(CH 30)		A▼	(Analog common)	
	A▼	(Analog common)		56L	(CH 56)	
	23H	(CH 23)		48H	(CH 48)	
	31L	(CH 31)		A▼	(Analog common)	
Analog In	A▼	(Analog common)		47L	(CH 47)	
	32H	(CH 32)		39H	(CH 39)	
	40L	(CH 40)		A▼	(Analog common)	
	A▼	(Analog common)		46L	(CH 46)	
	33H	(CH 33)		38H	(CH 38)	
	41L	(CH 41)		A▼	(Analog common)	**Analog In**
	A▼	(Analog common)		45L	(CH 45)	
	34H	(CH 34)		37H	(CH 37)	
	42L	(CH 42)		A▼	(Analog common)	
	A▼	(Analog common)		44L	(CH 44)	
	35H	(CH 35)		36H	(CH 36)	
	43L	(CH 43)		A▼	(Analog common)	

Table 10. Differential mode pin out

Terminal block	Device label	(Signal description)		Device label	(Signal description)	Terminal block
Analog In	A▼	(Analog common)		63L	(CH 31 LO)	**Analog In**
	16H	(CH 8 HI)		55H	(CH 31 HI)	
	24L	(CH 8 LO)		A▼	(Analog common)	
	A▼	(Analog common)		62L	(CH 30 LO)	
	17H	(CH 9 HI)		54H	(CH 30 HI)	
	25L	(CH 9 LO)		A▼	Analog common	
	A▼	(Analog common)		61L	(CH 29 LO)	
	18H	(CH 10 HI)		53H	(CH 29 HI)	
	26L	(CH 10 LO)		A▼	(Analog common)	
	A▼	(Analog common)		60L	(CH 28 LO)	
	19H	(CH 11 HI)		52H	(CH 28 HI)	
	27L	(CH 11 LO)		A▼	(Analog common)	
Analog In	A▼	(Analog common)		59L	(CH 27 LO)	**Analog in**
	20H	(CH 12 HI)		51H	(CH 27 HI)	
	28L	(CH 12 LO)		A▼	(Analog common)	
	A▼	(Analog common)		58L	(CH 26 LO)	
	21H	(CH 13 HI)		50H	(CH 26 HI)	
	29L	(CH 13 LO)		A▼	(Analog common)	
	A▼	(Analog common)		57L	(CH 25 LO)	
	22H	(CH 14 HI)		49H	(CH 25 HI)	
	30L	(CH 14 LO)		A▼	(Analog common)	
	A▼	(Analog common)		56L	(CH 24 LO)	
	23H	(CH 15 HI)		48H	(CH 24 HI)	
	31L	(CH 15 LO)		A▼	(Analog common)	
Analog In	A▼	(Analog common)		47L	(CH 23 LO)	**Analog In**
	32H	(CH 16 HI)		39H	(CH 23 HI)	
	40L	(CH 16 LO)		A▼	(Analog common)	
	A▼	(Analog common)		46L	(CH 22 LO)	
	33H	(CH 17 HI)		38H	(CH 22 HI)	
	41L	(CH 17 LO)		A▼	(Analog common)	
	A▼	(Analog common)		45L	(CH 21 LO)	
	34H	(CH 18 HI)		37H	(CH 21 HI)	
	42L	(CH 18 LO)		A▼	(Analog common)	
	A▼	(Analog common)		44L	(CH 20 LO)	
	35H	(CH 19 HI)		36H	(CH 20 HI)	
	43L	(CH 19 LO)		A▼	(Analog common)	

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

AI-EXP48

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, EN 61326 (1997) Amendment 1 (1998)

Emissions: Group 1, Class A

- EN 55022 (1993)/CISPR 22: Radiated and Conducted emissions.

Immunity: EN61326, Annex A

- IEC 61000-4-2 (1995): Electrostatic Discharge immunity, Criteria B.
- IEC 61000-4-3 (1995): Radiated Electromagnetic Field immunity Criteria A.
- IEC 61000-4-4 (1995): Electric Fast Transient Burst immunity Criteria A.
- IEC 61000-4-6 (1996): Radio Frequency Common Mode immunity Criteria A.
- IEC 61000-4-11 (1994): Voltage Dips, Interruption immunity.

To maintain the safety, emission, and immunity standards of this declaration, the following conditions must be met.

- The host computer, peripheral equipment, power sources, and expansion hardware must be CE compliant.
- Equipment must be operated in a controlled electromagnetic environment as defined by Standards EN 61326:1998, or IEC 61326:1998.
- Shielded wires must be used for all I/Os and must be less than 3 meters (9.75 feet) in length. Clips must be used with the AI-EXP48.
- The host computer must be properly grounded.
- The host computer must be USB2.0 compliant and IOtech USB cables (CA-179-x) must be used.
- If using the USB-1616HS Series device in a high RF environment (3 to 10 V/m), then a clamp-on ferrite (IOtech p/n L-8-1) may be needed on the USB cable, otherwise communication may be disrupted.
- A protective ESD wrist strap should be used when connecting or disconnecting leads from screw terminal blocks. Alternatively, unplug the unit from the host computer when making connections. Protective housings (IOtech p/n CN-241-12) can be placed over the removable terminal blocks to protect signals from ESD during operation.
- If external DC power is needed, a TR-2U power supply must be used.

Note: Data acquisition equipment may exhibit noise or increased offsets when exposed to high RF fields (>3V/m) or transients.

Declaration of Conformity based on tests conducted by Smith Electronics, Inc., Cleveland, OH 44141, USA in December, 2005. Test records are outlined in Smith Electronics Test Report “Personal Daq/3000 Series with PDQ30 Expansion Module” and “PDAQ3000-PDQ30 Addenda”.

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

Paul Wittibschlager
Director of Hardware Engineering

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