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OMB-DAQ-2416-4AO
Multi-function I/O
USB Data Acquisition Module

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The information contained in this document is believed to be correct, but OMEGA accepts no liability for any errors it contains, and reserves the right to alter specifications without notice.

WARNING: These products are not designed for use in, and should not be used for, human applications.

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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 OMB-DAQ-2416-4AO so that you get the most out of its analog I/O, thermocouple (TC) input, digital I/O, and counter/timer I/O features.

This user's guide also refers you to related documents available on our web site, and to technical support resources.

Conventions used 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 *InstaCal* installation procedure is explained in the *OMB-DAQ-2416 Series Software User's Guide*.
Never touch the exposed pins or circuit connections on the board.

Where to find more information

For additional information relevant to the operation of your hardware, refer to the *Documents* subdirectory where you installed the software, or search for your device on our website at www.omega.com.

Introducing the OMB-DAQ-2416-4AO

Overview: OMB-DAQ-2416-4AO features

The OMB-DAQ-2416-4AO is supported under popular Microsoft® Windows® operating systems. The OMB-DAQ-2416-4AO is a multifunction measurement and control board designed for the USB bus.

The OMB-DAQ-2416-4AO is a full-speed, multiplexed 24-bit measurement system that provides up to 16 differential and up to 32 single-ended (SE) analog inputs. It offers software-selectable analog input ranges of ±20 V, ±10 V, ±5 V, ±2.5 V, ±1.25 V, ±0.625 V, ±0.312 V, ±0.156 V, and ±0.078 V.

It also protects your computer by providing a minimum of 500 VDC input isolation between field wiring and the USB interface.

You can configure up to 16 of the analog inputs as differential thermocouple (TC) inputs. In thermocouple mode, the OMB-DAQ-2416-4AO includes built-in cold-junction compensation and open thermocouple detection.

You can add up to 32 single-ended or up to 16 differential channels by connecting the OMB-DAQ-2416-4AO to an OMB-AI-EXP32 expansion module. Each channel is software-configurable as single-ended or differential. For each channel pair configured differentially, you lose one SE channel.

The OMB-DAQ-2416-4AO has four 16-bit analog output channels with an update rate of up to1102 S/s and an output range of ±10 V.

The device has eight high-speed lines of digital I/O and two 32-bit counters. You can expand up to 24 DIO channels by connecting the OMB-DAQ-2416-4AO to an OMB-AI-EXP32 expansion module.

Six banks of removable screw-terminal blocks provide connectivity to the analog input channels, digital I/O lines, counter/timer channels, and analog outputs.

Software features

For information on the features of *Insta*Cal and the other software included with your OMB-DAQ-2416-4AO, refer to the *OMB-DAQ-2416 Series Software User's Guide* that shipped with your device.

Installing the OMB-DAQ-2416-4AO

What comes with your OMB-DAQ-2416-4AO shipment?

As you unpack your OMB-DAQ-2416-4AO, verify that the following components are included.

Hardware

- OMB-DAQ-2416-4AO



- USB cable (2-meter length)



- OMB-DAQ-2416-ADAP (+5VDC, 10 Watt regulated power supply)



Optional components

Expansion devices that are compatible with the OMB-DAQ-2416-4AO must be ordered separately. If you ordered any of the following products with your device, they should be included with your shipment:

- OMB-AI-EXP32

Analog input expansion module adds up to 16 differential or 32 single-ended inputs to the OMB-DAQ-2416-4AO.



Additional documentation

In addition to this hardware user's guide, you should also receive the *OMB-DAQ-2416 Series Software User's Guide*. This booklet supplies a brief description of the software you received with your OMB-DAQ-2416-4AO and information regarding installation of that software. Please read this booklet completely before installing any software or hardware.

Unpacking the OMB-DAQ-2416-4AO

As with any electronic device, you should take care while handling to avoid damage from static electricity. Before removing the OMB-DAQ-2416-4AO 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 Omega Engineering immediately by phone, fax, or e-mail.

- Phone: (203) 359-1660
- Fax: (203) 359-7700
- Email: das@omega.com

Installing the software

Refer to the *OMB-DAQ-2416 Series Software User's Guide* for instructions on installing the software on the *OMB-DAQ-2416 Series Data Acquisition Software* CD. This booklet is available in PDF at www.omega.com/manuals.

We recommend that you download the latest Windows Update onto your computer before installing and operating the OMB-DAQ-2416-4AO.

Installing the hardware

To connect the OMB-DAQ-2416-4AO to your system, turn your computer on, and then do the following:

1. Connect the OMB-DAQ-2416-ADAP power supply to the device's external power connector, and plug the other end into a power outlet.
2. Connect the USB cable to the device's USB connector and to a USB port on your computer. A USB2.0 port is recommended.

When you connect the OMB-DAQ-2416-4AO for the first time, a **Found New Hardware** message opens as the OMB-DAQ-2416-4AO is detected. When the message closes, the installation is complete.

The **power LED** (bottom LED) blinks during device detection and initialization, and then remains solid if properly detected. If not, check if the OMB-DAQ-2416-4AO has sufficient power. When the device is first powered on, there is usually a momentary delay before the power LED begins to blink, or come on solid.

Caution! Do not disconnect **any** device from the USB bus while the computer is communicating with the OMB-DAQ-2416-4AO, or you may lose data and/or your ability to communicate with the OMB-DAQ-2416-4AO.

Connecting to an OMB-AI-EXP32 with the DSUB37 expansion connector

Use the 37-pin expansion connector to connect the OMB-DAQ-2416-4AO to an OMB-AI-EXP32 expansion module.

To connect the two devices directly to each other, follow these steps.

1. Disconnect the USB cable from the OMB-DAQ-2416-4AO.
2. Remove the external power cable from the OMB-DAQ-2416-4AO.
3. Connect the two devices together by inserting the OMB-AI-EXP32's DSUB37 connector into the DSUB37 connector on the OMB-DAQ-2416-4AO.



Figure 1. OMB-DAQ-2416-4AO directly connected to an OMB-AI-EXP32

4. Turn the connected modules over and secure the connection by screwing the connection plate to both modules, as shown below.



Figure 2. OMB-DAQ-2416-4AO secured to an OMB-AI-EXP32

5. Connect the external power supply to the OMB-DAQ-2416-4AO's external power connector, and plug the other end into an AC outlet.
6. Connect the USB cable from the OMB-DAQ-2416-4AO 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.

Configuring the hardware

Except for the DIO pull-up selection, all hardware configuration options on the OMB-DAQ-2416-4AO are software controlled. You can select some of the configuration options using *Insta*Cal, such as the analog input configuration (single-ended or differential channels). When measuring from thermocouples, make sure you configure the channels for differential mode.

Caution! Turn off power to all devices connected to the system before making connections. Electrical shock or damage to equipment can result even under low-voltage conditions.

Caution! Always handle components carefully, and never touch connector terminals or circuit components unless you are following ESD guidelines in an appropriate ESD-controlled area. These guidelines include using properly-grounded mats and wrist straps, ESD bags and cartons, and related procedures.

Avoid touching board surfaces and onboard components. Only handle boards by their edges. Make sure the OMB-DAQ-2416-4AO does not come into contact with foreign elements such as oils, water, and industrial particulate.

The discharge of static electricity can damage some electronic components. Semiconductor devices are especially susceptible to ESD damage.

Connecting the board for I/O operations

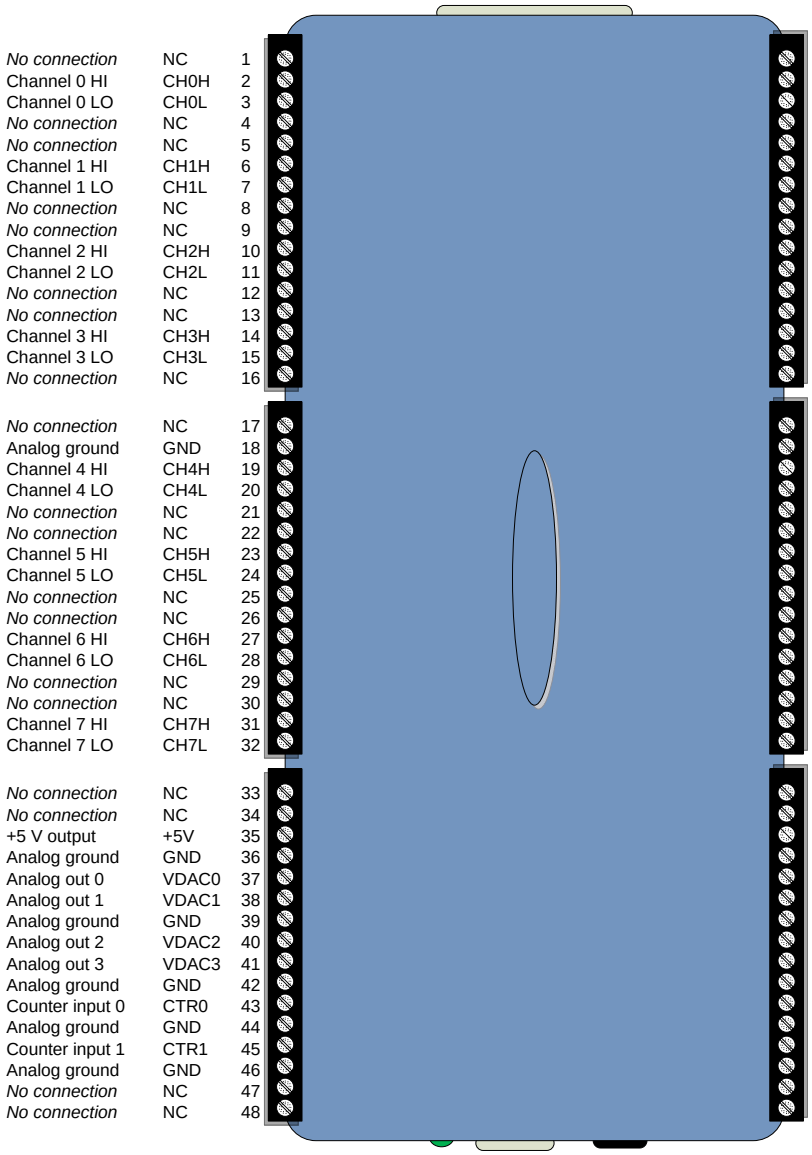
Connectors, cables – main I/O connector

The following table lists the board connectors and compatible accessory products for the OMB-DAQ-2416-4AO.

Main connector specifications

Main connectors	Six banks of detachable screw terminals
Compatible accessory product for the 37-pin expansion connector	OMB-AI-EXP32 expansion board with screw terminals (connects directly to the OMB-DAQ-2416-4AO)

Screw terminal pin out – differential



No connection	NC	1	49	NC	*No connection*
Channel 0 HI	CH0H	2	50	CH15L	Channel 15 LO
Channel 0 LO	CH0L	3	51	CH15H	Channel 15 HI
No connection	NC	4	52	NC	*No connection*
No connection	NC	5	53	NC	*No connection*
Channel 1 HI	CH1H	6	54	CH14L	Channel 14 LO
Channel 1 LO	CH1L	7	55	CH14H	Channel 14 HI
No connection	NC	8	56	NC	*No connection*
No connection	NC	9	57	NC	*No connection*
Channel 2 HI	CH2H	10	58	CH13L	Channel 13 LO
Channel 2 LO	CH2L	11	69	CH13H	Channel 13 HI
No connection	NC	12	60	NC	*No connection*
No connection	NC	13	61	NC	*No connection*
Channel 3 HI	CH3H	14	62	CH12L	Channel 12 LO
Channel 3 LO	CH3L	15	63	CH12H	Channel 12 HI
No connection	NC	16	64	NC	*No connection*
No connection	NC	17	65	NC	*No connection*
Analog ground	GND	18	66	GND	Analog ground
Channel 4 HI	CH4H	19	67	CH11L	Channel 11 LO
Channel 4 LO	CH4L	20	68	CH11H	Channel 11 HI
No connection	NC	21	69	NC	*No connection*
No connection	NC	22	70	NC	*No connection*
Channel 5 HI	CH5H	23	71	CH10L	Channel 10 LO
Channel 5 LO	CH5L	24	72	CH10H	Channel 10 HI
No connection	NC	25	73	NC	*No connection*
No connection	NC	26	74	NC	*No connection*
Channel 6 HI	CH6H	27	75	CH9L	Channel 9 LO
Channel 6 LO	CH6L	28	76	CH9H	Channel 9 HI
No connection	NC	29	77	NC	*No connection*
No connection	NC	30	78	NC	*No connection*
Channel 7 HI	CH7H	31	79	CH8L	Channel 8 LO
Channel 7 LO	CH7L	32	80	CH8H	Channel 8 HI
No connection	NC	33	81	GND	Analog ground
No connection	NC	34	82	NC	*No connection*
+5 V output	+5V	35	83	NC	*No connection*
Analog ground	GND	36	84	GND	Analog ground
Analog out 0	VDAC0	37	85	DIO7	Digital input/output
Analog out 1	VDAC1	38	86	DIO6	Digital input/output
Analog ground	GND	39	87	DIO5	Digital input/output
Analog out 2	VDAC2	40	88	DIO4	Digital input/output
Analog out 3	VDAC3	41	89	DIO3	Digital input/output
Analog ground	GND	42	90	DIO2	Digital input/output
Counter input 0	CTR0	43	91	DIO1	Digital input/output
Analog ground	GND	44	92	DIO0	Digital input/output
Counter input 1	CTR1	45	93	DGND	Digital I/O ground
Analog ground	GND	46	94	DGND	Digital I/O ground
No connection	NC	47	95	NC	*No connection*
No connection	NC	48	96	NC	*No connection*

Figure 3. 16-channel differential mode pin out

Differential connection guidelines

- When connecting differential voltage inputs to a "floating" voltage source, make sure there is a DC return path from each voltage input to ground. You make this path by connecting a resistor from each input to a GND pin (pins 18, 36, 39, 42, 44, 46, 66, 81, 84). A value of approximately 100 kΩ can be used for most applications.

  Leave any unused input channels either floating or tied to GND (pins 18, 36, 39, 42, 44, 46, 66, 81, 84).

  Source impedances should be kept as small as possible to avoid settling time and accuracy errors.
- When configuring thermocouple sensors, keep any stray capacitance as small as possible relative to GND (pins 18, 36, 39, 42, 44, 46, 66, 81, 84) to avoid settling time and accuracy errors. For thermocouple channels, do not provide a return path to ground. This is done internally.

Screw terminal pin out – single-ended

No connection	NC	1	49	NC	*No connection*
Channel 0	CH0H	2	50	CH15L	Channel 31
Channel 16	CH0L	3	51	CH15H	Channel 15
No connection	NC	4	52	NC	*No connection*
No connection	NC	5	53	NC	*No connection*
Channel 1	CH1H	6	54	CH14L	Channel 30
Channel 17	CH1L	7	55	CH14H	Channel 14
No connection	NC	8	56	NC	*No connection*
No connection	NC	9	57	NC	*No connection*
Channel 2	CH2H	10	58	CH13L	Channel 29
Channel 18	CH2L	11	69	CH13H	Channel 13
No connection	NC	12	60	NC	*No connection*
No connection	NC	13	61	NC	*No connection*
Channel 3	CH3H	14	62	CH12L	Channel 28
Channel 19	CH3L	15	63	CH12H	Channel 12
No connection	NC	16	64	NC	*No connection*
No connection	NC	17	65	NC	*No connection*
Analog ground	GND	18	66	GND	Analog ground
Channel 4	CH4H	19	67	CH11L	Channel 27
Channel 20	CH4L	20	68	CH11H	Channel 11
No connection	NC	21	69	NC	*No connection*
No connection	NC	22	70	NC	*No connection*
Channel 5	CH5H	23	71	CH10L	Channel 26
Channel 21	CH5L	24	72	CH10H	Channel 10
No connection	NC	25	73	NC	*No connection*
No connection	NC	26	74	NC	*No connection*
Channel 6	CH6H	27	75	CH9L	Channel 25
Channel 22	CH6L	28	76	CH9H	Channel 9
No connection	NC	29	77	NC	*No connection*
No connection	NC	30	78	NC	*No connection*
Channel 7	CH7H	31	79	CH8L	Channel 24
Channel 23	CH7L	32	80	CH8H	Channel 8
No connection	NC	33	81	GND	Analog ground
No connection	NC	34	82	NC	*No connection*
+5 V output	+5V	35	83	NC	*No connection*
Analog ground	GND	36	84	GND	Analog ground
Analog out 0	VDAC0	37	85	DIO7	Digital input/output
Analog out 1	VDAC1	38	86	DIO6	Digital input/output
Analog ground	GND	39	87	DIO5	Digital input/output
Analog out 2	VDAC2	40	88	DIO4	Digital input/output
Analog out 3	VDAC3	41	89	DIO3	Digital input/output
Analog ground	GND	42	90	DIO2	Digital input/output
Counter input 0	CTR0	43	91	DIO1	Digital input/output
Analog ground	GND	44	92	DIO0	Digital input/output
Counter input 1	CTR1	45	93	DGND	Digital I/O ground
Analog ground	GND	46	94	DGND	Digital I/O ground
No connection	NC	47	95	NC	*No connection*
No connection	NC	48	96	NC	*No connection*

Figure 4. 32-channel single-ended mode pin out

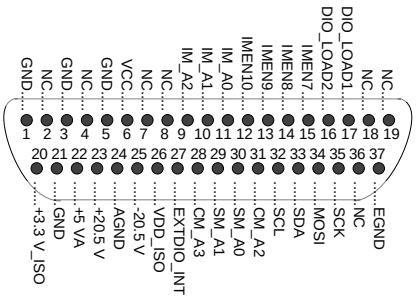


Figure 5. DSUB37 expansion connector pin out

The OMB-AI-EXP32 expansion port is intended to interface directly with the OMB-DAQ-2416-4AO. Do not attempt to use any of the expansion port pins for any other purpose.

Power down the OMB-DAQ-2416-4AO before you connect it the OMB-AI-EXP32 expansion board.

Functional Details

This chapter contains detailed information on all of the features available from the board, including:

- Device components
- Functional block diagram and mechanical drawings
- Signal descriptions
- Signal diagrams using default or conventional device settings

OMB-DAQ-2416-4AO components

These OMB-DAQ-2416-4AO components are shown in Figure 6 and Figure 7.

- One USB connector
- One external power connector
- Two LED indicators ("Power" and "Activity")
- One 37-pin DSUB expansion connector
- Six removable screw terminal blocks

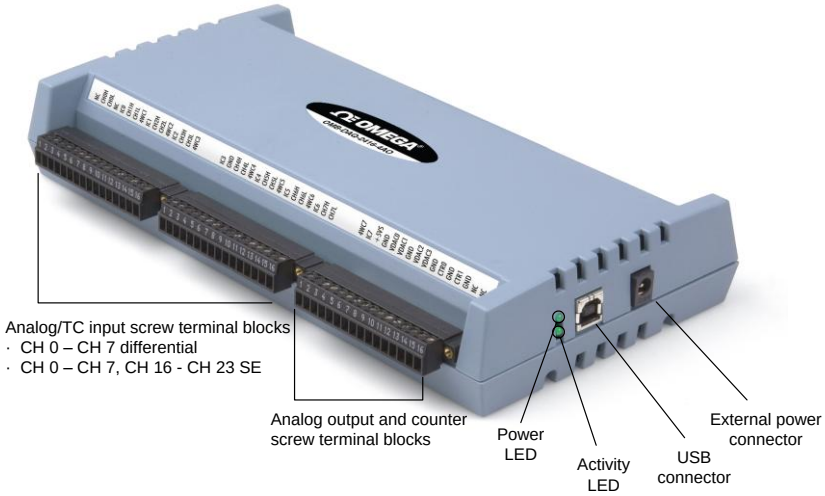


Figure 6. Front view components

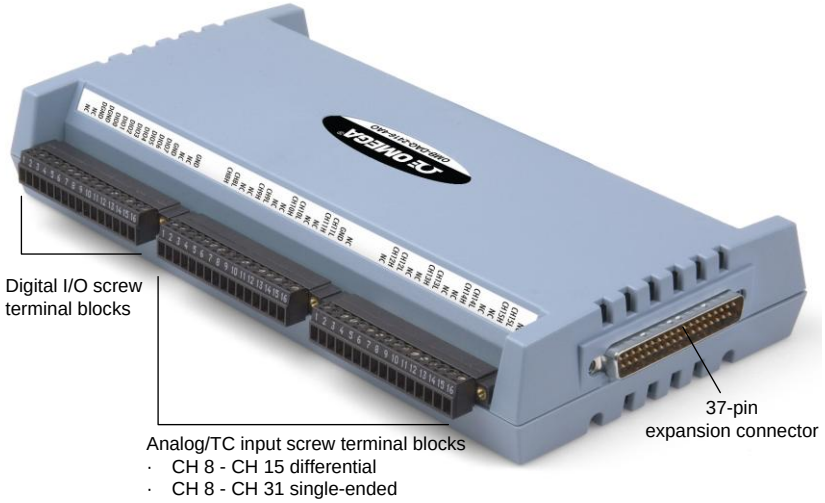


Figure 7. Rear view components

LEDs

When the OMB-DAQ-2416-4AO is connected to a computer, in its normal idle state both LEDs are lit solid green.

Power LED

The Power LED is the top LED on the right side of the OMB-DAQ-2416-4AO housing.

The Power LED blinks when you plug the power supply into the OMB-DAQ-2416-4AO, and continues to blink while the device initializes the hardware. If it continues blinking for more than ½ second, then there is a problem with the OMB-DAQ-2416-4AO and you should cycle the power.

If an application issues a "blink LED" command, then the power LED blinks a few times.

Activity LED

The (USB) Activity LED is the bottom LED on the right side of the OMB-DAQ-2416-4AO housing. It blinks rapidly when both the USB cable and external power cables are plugged in. It continues blinking rapidly while the device is connecting to the computer, and then turns solid.

Whenever the device receives a USB command, the Activity LED blinks off and then returns to solid green. When an analog in or analog out scan is running, the Activity LED blinks continuously.

USB connector

The USB connector provides communication.

External power connector

Connect the OMB-DAQ-2416-ADAP power supply to this connector. The power supply provides 5 VDC, 10W regulated power.

Screw terminal wiring

The OMB-DAQ-2416-4AO has six groups of screw terminals—three on each side of the housing. Each group has 16 connections. Pin numbers are identified in Figure 3 on page 11 and Figure 4 on page 12.

Mechanical drawings

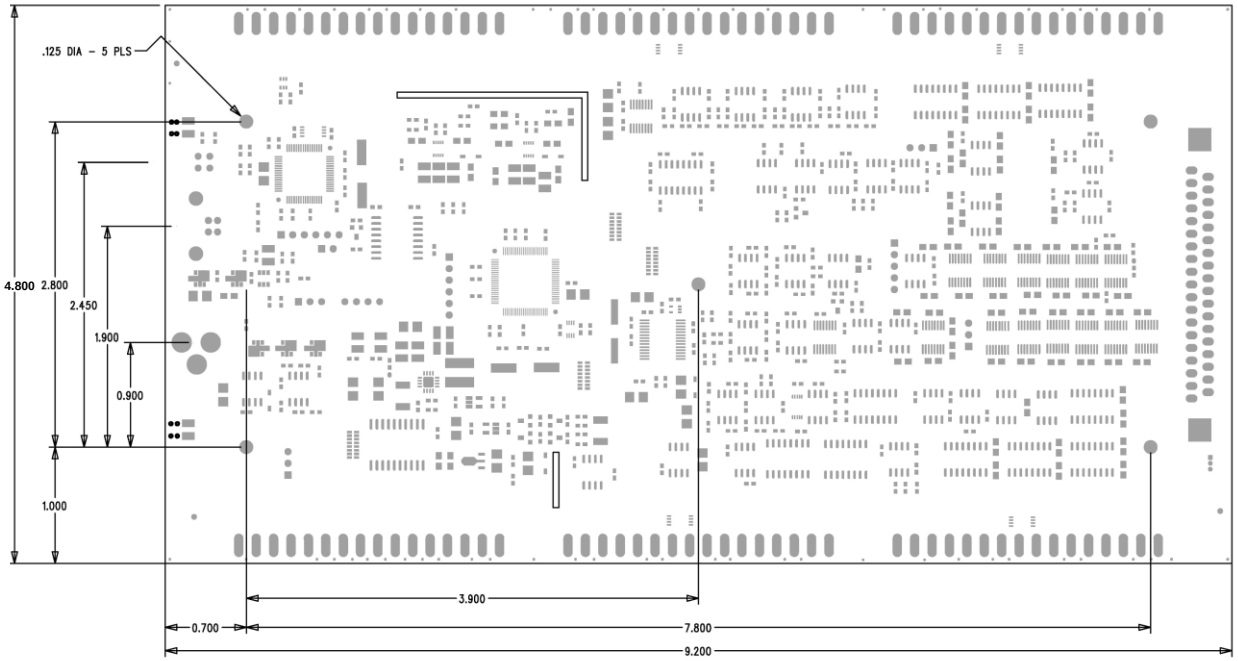


Figure 8. OMB-DAQ-2416-4AO internal dimensions

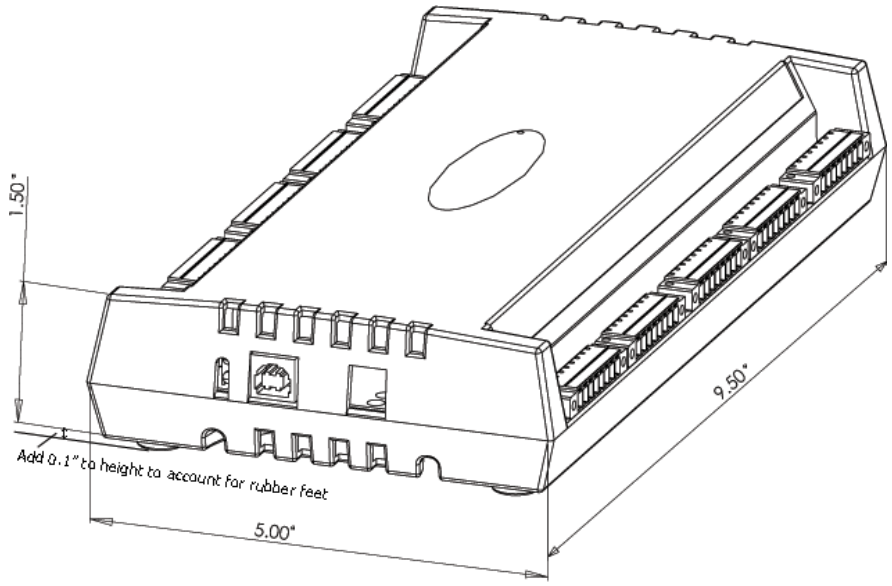


Figure 9. OMB-DAQ-2416-4AO case dimensions

Block diagram

Figure 10 shows a simplified block diagram of the OMB-DAQ-2416-4AO. This device provides all of the functional elements shown in the figure.

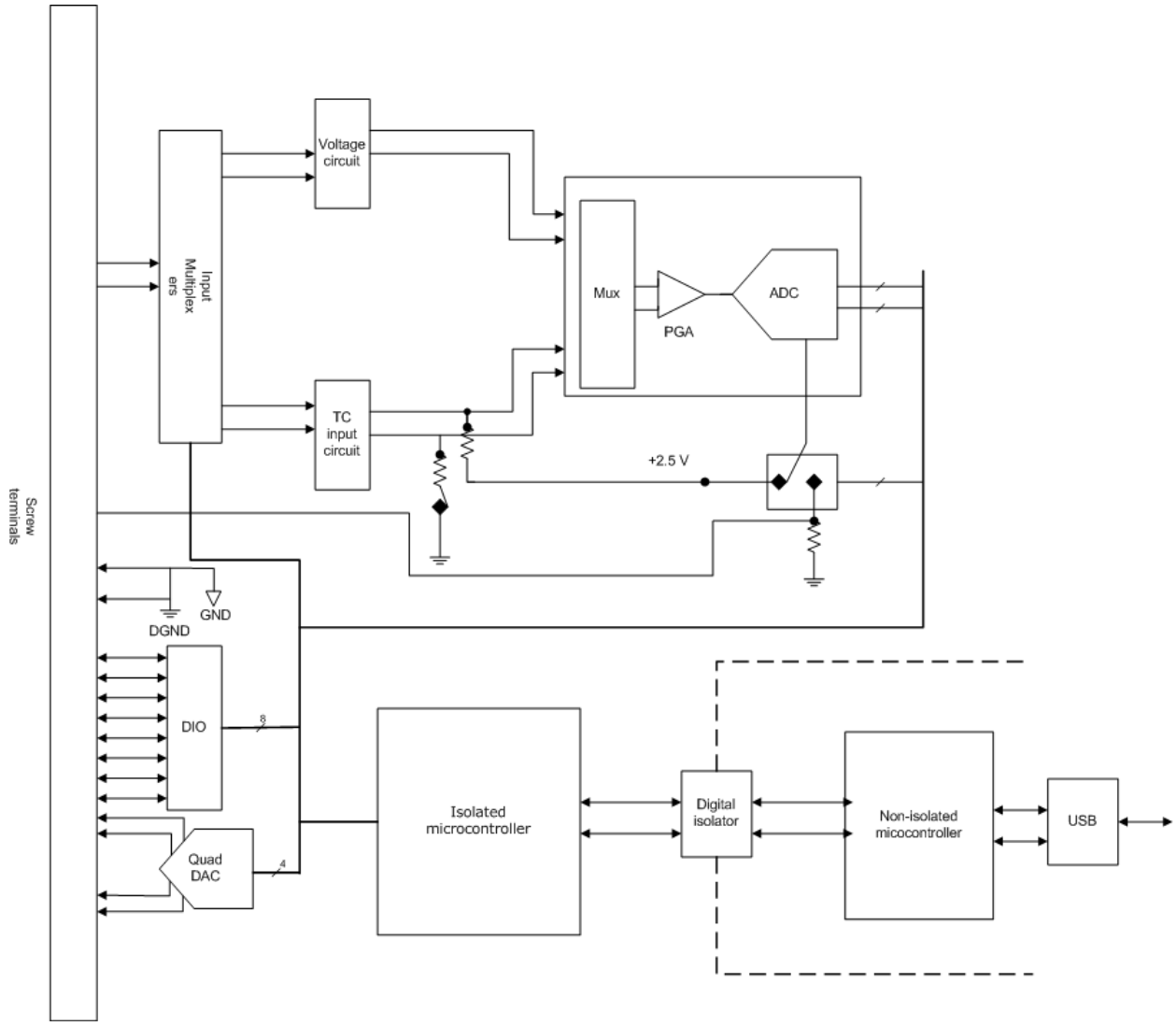


Figure 10. OMB-DAQ-2416-4AO functional block diagram

Analog/TC input terminals

You can connect up to 32 single-ended analog input connections or up to 16 differential analog/TC input connections to these screw terminal pins.

- CH0H and CH0L
- CH1H and CH1L
- CH2H and CH2L
- CH3H and CH3L
- CH4H and CH4L
- CH5H and CH5L
- CH6H and CH6L
- CH7H and CH7L
- CH8H and CH8L
- CH9H and CH9L
- CH10H and CH10L
- CH11H and CH11L
- CH12H and CH12L
- CH13H and CH13L
- CH14H and CH14L
- CH15H and CH15L

You can select a unique input range or signal type for each channel. For example, one channel could be used for volts and another for temperature.

When connecting differential voltage inputs to a "floating" voltage source, make sure there is a DC return path from each voltage input to ground. You make this path by connecting a resistor from each input to a GND pin (pins 18, 36, 39, 42, 44, 46, 66, 81, 84). A value of approximately 100 kΩ can be used for most applications. This does not apply to channels configured for thermocouple input, as they have their own internal reference.

Leave unused input channels either floating or tied to GND (pins 18, 36, 39, 42, 44, 46, 66, 81, 84).

Source impedances should be kept as small as possible to avoid settling time and accuracy errors.

Analog input mode

The OMB-DAQ-2416-4AO makes high-resolution voltage measurements in either a single-ended or fully differential mode. You can configure the OMB-DAQ-2416-4AO for the following voltage input ranges.

- ±20 V
- ±10 V
- ±5 V
- ±2.5 V
- ±1.25 V
- ±0.625 V
- ±0.3125 V
- ±0.15625 V
- ±0.078125 V

Each analog input channel has the following measurement parameters:

- signal type of volts or thermocouple type J, K, T, E, R, S, B, or N
- full scale voltage from -20 to + 20 VDC

Thermocouple inputs

You can make up to 16 high-resolution differential thermocouple measurements with the OMB-DAQ-2416-4AO. Built-in cold-junction sensors are provided for each of the screw-terminal blocks, and any supported TC type can be attached to any of the 16 thermocouple channels.

Do not connect thermocouples as *single-ended*—doing so can cause false readings.

You do not need to use ground-referencing resistors because the analog front-end circuit level-shifts the thermocouple's output into the common-mode input range of the A/D.

When configuring thermocouple sensors, keep any stray capacitance as small as possible relative to GND (pins 18, 36, 39, 42, 44, 46, 66, 81, 84) to avoid settling time and accuracy errors.

The OMB-DAQ-2416-4AO also provides an open thermocouple detection (OTD) feature for each of the analog input channels configured for thermocouple measurement. This feature is automatically enabled as part of the overall acquisition process, and detects if an open-circuit condition exists at the thermocouple sensor.

The OMB-DAQ-2416-4AO provides electrostatic discharge (ESD) protection for each of the thermocouple inputs. However, before handling thermocouple sensors, follow standard ESD practices and discharge any accumulated ESD charge.

The OMB-DAQ-2416-4AO includes an ESD protection device at each of the analog input terminal block pins. If an ESD or transient voltage is coupled into the device, the input protection device(s) clamps the voltage to protect the thermocouple input circuitry from possible damage.

Once the thermocouple sensor is connected to the OMB-DAQ-2416-4AO, the configuration options have been selected, and the recommended 45 minute warm up has elapsed, the OMB-DAQ-2416-4AO is ready to make high-resolution differential voltage measurements.

Cold junction compensation (CJC) is needed to compensate for the additional thermal EMF's generated by connecting the thermocouple leads to the OMB-DAQ-2416-4AO terminal blocks.

CJC is performed using a high-resolution temperature sensor connected close to the OMB-DAQ-2416-4AO's terminal blocks. The OMB-DAQ-2416-4AO includes four separate CJC sensors—two on each side of the PCB. Software corrects for the additional thermocouples created at the terminal.

Once the A/D and CJC data is collected, the application software uses this data to linearize to an accurate temperature reading. The thermocouple linearization uses the latest NIST linearization coefficients for each of the eight thermocouple types supported by the OMB-DAQ-2416-4AO.

Figure 11 below shows a typical thermocouple connection.

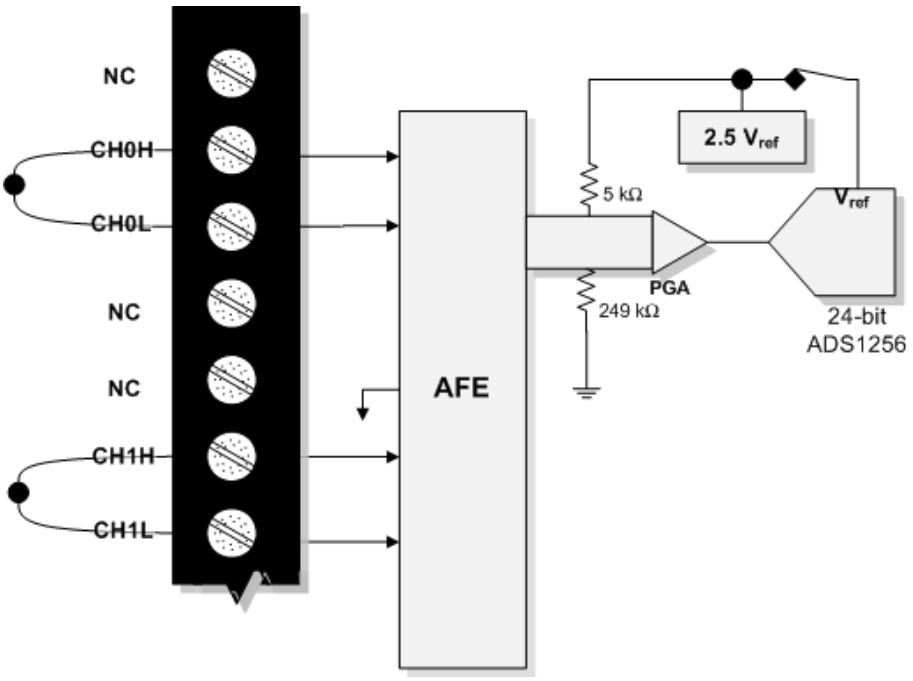


Figure 11. Differential thermocouple connection example

Noise filtering, data rate, and throughput rate

Although the OMB-DAQ-2416-4AO's A/D converter has a maximum data rate of 3,750 samples per second, the actual throughput rate you observe for voltage and temperature data is determined by these formulas.

- Maximum single-channel throughput:

$$\frac{1}{\frac{1}{data\ rate} + 640\,\mu s}$$

- Maximum multiple-channel throughput:

$$\frac{1}{\sum_{n}\left(\frac{1}{data\ rate} + 640\ \mu s\right)}$$

where *n* is the number of channels

Refer to the tables in the *Throughput rate* section of the *Specifications* chapter for details.

This drop-off in throughput rate is due to the OMB-DAQ-2416-4AO's noise filtering feature. You can control the amount of the noise filtering by adjusting the data rate setting. By reducing the data rate, the averaging of samples increases, and noise drops correspondingly.

Figure 12 below illustrates this inverse relationship. This graph applies to the A/D converter only—do not expect this level of performance from the OMB-DAQ-2416-4AO itself.

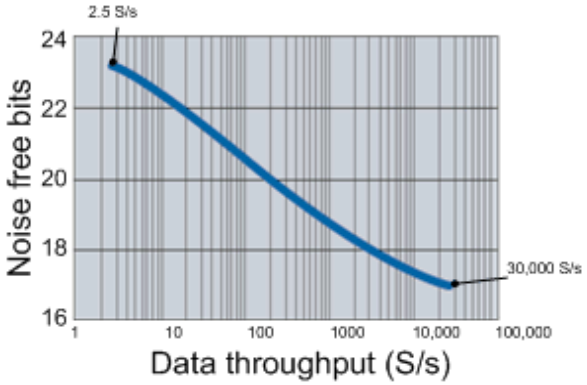


Figure 12. OMB-DAQ-2416-4AO A/D converter data rate vs. noise graph

If low noise is your main concern, you can operate the OMB-DAQ-2416-4AO at very low data rates starting from 2.5 S/s. At low rates, much of the noise is averaged out of the data, and issues such as reference noise become less important.

At higher data rates, higher-frequency noise sources are not averaged out and begin to be troublesome. These noise sources include the noise inherent in the A/D converter itself, which is not reducible.

Since thermocouples can pick up noise in your environment, select a data rate based on the primary noise frequency. For example, to reduce the effect of 60 Hz noise, select a data rate of 60 (or a sub-multiple of 60, such as 10 or 20).

Multiple-channel throughput rates

When setting different sample rates for different channels, be aware that the all channels will be sampled within the same *sample window* based on the channel with the lowest sample rate.

For example, if you set a 10 Hz data rate for channel 0, and a 50 Hz data rate for channel 1, basically, both channels pass the same number of samples per second to the host computer. However, more averaging is performed on channel 0's samples; therefore, channel 0 is sampled at a higher resolution.

The OMB-DAQ-2416-4AO's A/D converter performs averaging, and the number of averages equals *30,000/data rate*.

In this example, channel 0 is sampled 3000 times over 100 ms, and all samples are averaged into one sample. Then, channel 1 is sampled 600 times over 20 ms, and samples are likewise averaged into one sample.

The final samples are available to you at a maximum rate of about 8 Hz (8.245 Hz).

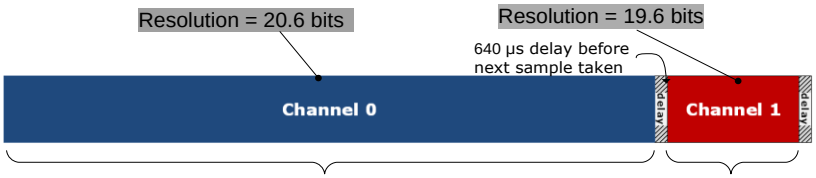


Figure 13. OMB-DAQ-2416-4AO data rate vs. resolution example

Input isolation

The OMB-DAQ-2416-4AO is an isolated data acquisition device. The analog I/O, digital I/O, counters, and all the digital control/timing are referenced to an isolated ground as shown in the figure below. This ground is physically and electrically separate from the ground use by the circuit connected to the system bus interface.

Isolation provides a barrier between the host PC and potentially hazardous voltages by physically and electrically separating two parts of the measurement device.

- The "non-isolated" ground is common to the chassis ground of the PC, while the "isolated" ground is not.
- All analog measurements are made relative to the isolated ground. See Figure 14 for details.

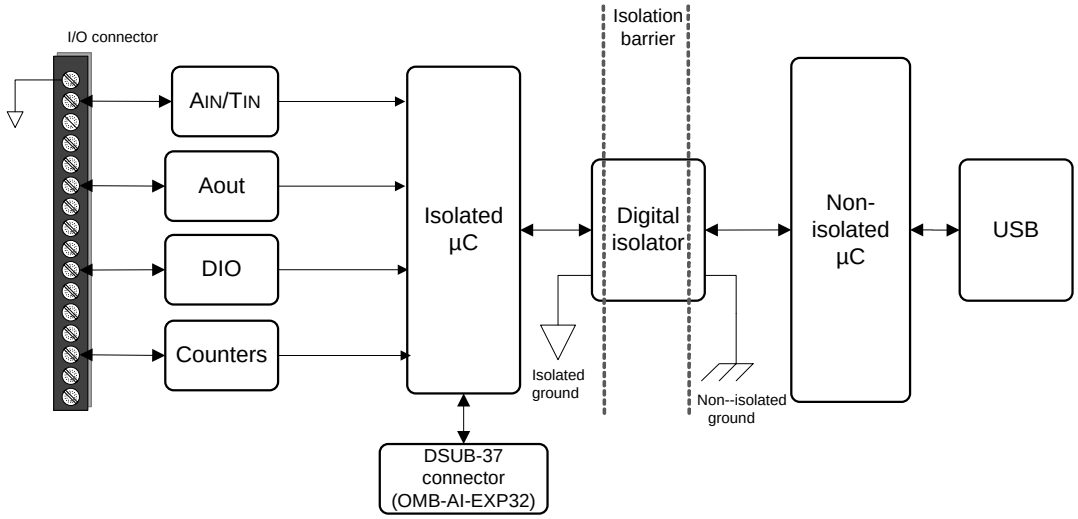


Figure 14. OMB-DAQ-2416-4AO input isolation diagram

When making measurements in industrial environments, DAQ devices can encounter hazardous voltages, transients, large common mode voltages and fluctuating ground potentials. Any one of these issues can seriously degrade the measurement accuracy of the device and possibly damage the measurement instrument. To overcome these issues, some DAQ devices provide physical and electrical isolation. Some of the benefits of isolation include:

- **Safety**: A DAQ device employing physical and electrical isolation helps to keep high voltages and transients from damaging the system-side host PC.
- **Ground loops**: Improper grounding of the signal source that the DAQ device is measuring is one of the most common sources of noise and measurement inaccuracies. Isolation improves the measurement accuracy by physically preventing ground loops. Ground loops—a common source of noise and error—are the results of a measurement system having multiple grounds at different potentials.
- **Common mode rejection**: With isolation, a DAQ device can measure small signals in the presence of large common mode voltages. Isolation increases the measurement system's ability to reject common mode voltages. The common mode voltage is the signal that is common to both the positive and negative inputs of the measurement device, but is not part of the signal to measure.

Analog output terminals (VDAC0 through VDAC3)

The OMB-DAQ-2416-4AO has four 16-bit analog output channels with a ±10 V output range.

Analog outputs can be updated at a maximum rate of 1000 samples per second (S/s).

Digital I/O

Up to eight digital I/O lines are available in each OMB-DAQ-2416-4AO.

Digital input voltage ranges of 0 to +15V are permitted, with thresholds of 0.6 V (low) and 2.6 V (high). Each DIO channel is an *open-drain*, which, when used as an output, is capable of sinking up to 150 mA for direct drive applications. The maximum sink current is 150 mA per 8-channel bank, or if all eight channels are used, 18 mA (maximum) per channel.

Figure 15 represents a typical DIO connection for one channel. The other seven channels are connected in the same manner.

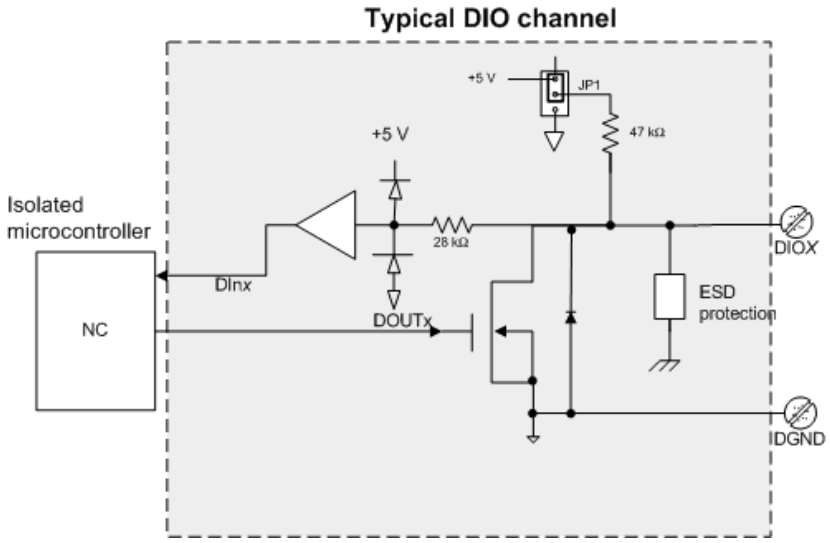


Figure 15. Digital output connection example

Internal pull-up/pull-down capability

Each of the eight DIO bits on the OMB-DAQ-2416-4AO has a 47 kΩ pull-up/pull-down resistor. The pull-up/pull-down voltage is common to all of the internal 47 kΩ resistors.

All pins are pulled up to +5V by default. To configure these bits for the 0V pull-down option, open the OMB-DAQ-2416-4AO case to access the three-pin jumper labeled **JP1**.

To open the case and set the JP1 jumper, do the following.

1. Turn over the OMB-DAQ-2416-4AO and rest it on its top on a flat, stable surface.
2. Remove the five screws shown in Figure 16 from the bottom of the module.
3. Holding both the top and bottom sections of the module, turn it back over, rest it on the surface, and carefully remove the top portion of the case.

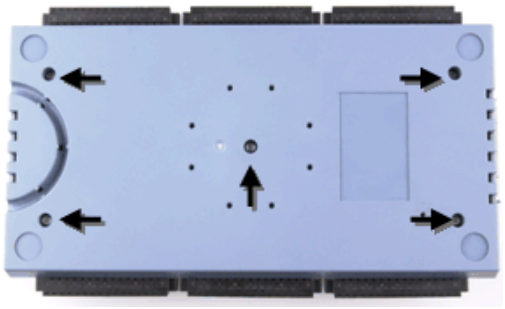


Figure 16. Location of screws connecting bottom and top sections of case

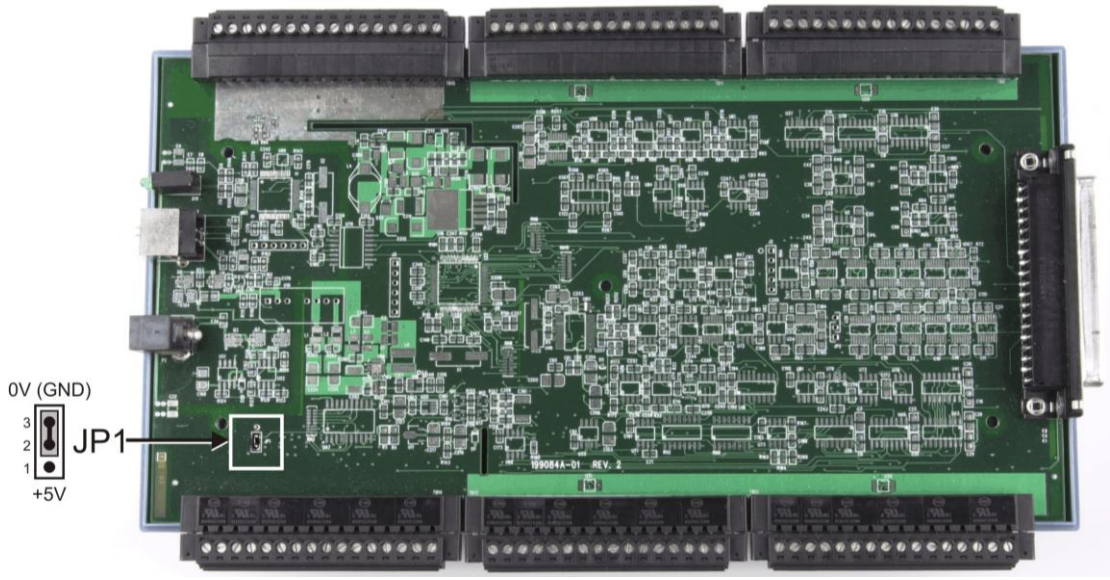


Figure 17. Location of JP1

4. To pull the digital pins down to ground, place the shorting block across pins 2 and 3 (refer to the jumper orientation shown in Figure 17).

To pull the digital pins up to +5V, place the shorting block across pins 1 and 2.

External pull-up/pull-down capability

You can also place an external pull-up resistor on any of the DIO bits, which enables you to pull the DIO bit up to a voltage that exceeds the internal +5 V pull-up voltage.

When using external pull-up resistors, be aware of the following:

- You should either remove the JP1 jumper, or store it by attaching it to one of the three pins.
- When using external pull-up resistors, the internal resistors cause slight impedance shifts to digital lines in the "on" state as the number of lines in the "off" state changes.

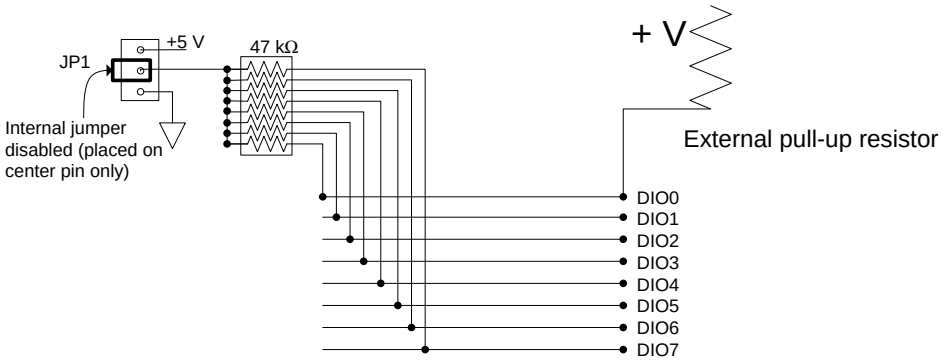


Figure 18. Digital I/O external resistor configuration

Counter input terminals (CTR0, CTR1)

Two 32-bit event counters are built into the OMB-DAQ-2416-4AO. Each counter accepts frequency inputs up to 1 MHz.

Refer to the "Screw terminal pin out" diagrams starting on page 11 for the location of these pins. The internal counter increments when the TTL levels transition from low to high. The counter can count frequencies of up to 1 MHz.

Calibrating the OMB-DAQ-2416-4AO

The OMB-DAQ-2416-4AO is initially calibrated using an NIST-traceable calibration method. This method stores a correction factor for each AIN and AOUT range in non-volatile memory on the device at the time of calibration.

Allow a 45 minute warm-up period before calibrating the OMB-DAQ-2416-4AO.

Calibration methods

Factory calibration

You can return the OMB-DAQ-2416-4AO once a year to Omega Engineering for a new factory calibration and calibration certificate.

Self calibration

Use *Insta*Cal to calibrate the OMB-DAQ-2416-4AO whenever the ambient temperature changes by more than ±10 °C from the last self-calibration

You can perform this procedure with thermocouple and voltage inputs connected to the input terminal blocks.

To calibrate the AOUT circuits, disconnect the analog outputs at the terminal block pins to ensure optimum calibration results.

Specifications

All specifications are subject to change without notice.
Typical for 25 °C unless otherwise specified.
All specifications apply to all temperature and voltage input channels unless otherwise specified.
Specifications in *italic* text are guaranteed by design.

Analog input

Table 1. General analog input specifications

Parameter	Conditions	Specification
A/D converter type		ADS1256, 24-bit Sigma Delta
A/D data rates		3750 samples per second (S/s), 2000 S/s, 1000 S/s, 500 S/s, 100 S/s, 60 S/s, 50 S/s, 25 S/s, 10 S/s, 5 S/s, 2.5 S/s
Throughput		▪ Single channel: 2.5 Hz to 1102.94 Hz, software selectable ▪ Multiple channels: 0.16 Hz to 1102.94 Hz, software selectable See Table 18 and Table 19 for details.
Number of channels		Up to 32 channels individually software-configurable as single-ended or differential Thermocouples require differential mode. For each channel configured as differential, you essentially lose one single-ended channel. You can add channels by connecting to an OMB-AI-EXP32.
Input isolation		*500 VDC minimum between field wiring and USB interface*
Channel configurations		Temperature sensor input, s/w programmable to match sensor type
		Voltage input
Input voltage range	Thermocouple mode	±0.078125 V
	Voltage mode (Note 1)	±20 V, ±10 V, ±5 V, ±2.5 V, ±1.25 V, ±0.625 V, ±0.3125 V, ±0.15625 V, ±0.078125 V, software-configurable
Absolute maximum input voltage	*CxH-CxL relative to GND*	▪ *±30 V maximum (power on)* ▪ *±10 V maximum (power off)*
Input impedance		▪ *2 GΩ (power on)* ▪ *390Ω (power off)*
Input leakage current		*±10.6 nA*
	▪ *Input voltage >±30 V (power on/off)*	*±1 µA maximum*
Input capacitance		590 pf
Maximum working voltage (signal + common mode)	Voltage mode: ±20 V range	±20.01 V maximum
	Voltage mode: all other voltage input ranges	±10.25 V maximum
Common mode rejection ratio (Note 1)	*Thermocouple mode, (f_{IN} = 60 Hz)*	*110 dB*
	Voltage mode,(f_{IN} = 60 Hz, all input ranges)	*90 dB*
ADC resolution		24 bits
Crosstalk	Adjacent channels	100 dB
Input coupling		DC
Channel gain queue	Up to 64 elements	Software-configurable channel and range
Warm-up time		45 minutes minimum
Open thermocouple detect		Automatically enabled when the channel is configured for a thermocouple sensor.

Parameter	Conditions	Specification
CJC sensor accuracy	*15 °C to 35 °C*	*±0.15 °C typical*
	0 °C to 55 °C	*±0.5 °C maximum*

Note 1: Placing a notch of the A/D digital filter at 60 Hz (setting A/D data rate = 60 S/s, 10 S/s, 5 S/s or 2.5 S/s) further improves the common mode rejection of this frequency.

Channel configurations

When any item is changed, the firmware stores channel configurations in the EEPROM of the isolated microcontroller. An external application issues commands over the USB to make changes, and the configuration is made non-volatile through the use of the EEPROM.

When connecting differential voltage inputs to a floating voltage source, provide a DC return path from each voltage input to ground. To do this, connect a resistor from each input to a GND pin (pins 18, 36, 39, 42, 44, 46, 66, 81, 84). A value of approximately 100 kΩ can be used for most applications.

Leave unused input channels either floating or tied to GND (pins 18, 36, 39, 42, 44, 46, 66, 81, 84).

Source impedances should be kept as small as possible to avoid settling time and accuracy errors.

For each voltage/thermocouple channel configured as differential, you essentially lose one single-ended channel. You can add channels by connecting to an OMB-AI-EXP32.

Table 2. Channel configurations

Channel	Category	Specification
CxH/CxL	Thermocouple	16 differential channels
CxH/CxL	Voltage	32 individually-configurable channels that can be configured as either single-ended or differential.
CxH/CxL	Voltage	

Compatible sensors

Table 3. Compatible sensor type specifications

Parameter	Conditions
Thermocouple	J: -210 °C to 1200 °C
	K: -270 °C to 1372 °C
	R: -50 °C to 1768 °C
	S: -50 °C to 1768 °C
	T: -270 °C to 400 °C
	N: -270 °C to 1300 °C
	E: -270 °C to 1000 °C
	B: 0 °C to 1820 °C

Accuracy

Thermocouple measurement accuracy

Thermocouple measurement accuracy specifications include polynomial linearization error, cold-junction compensation measurement error, and system noise. These specs are for one year, or 3000 operating hours, whichever comes first.

There is a CJC sensor for each terminal block of the module. The accuracy listed below assumes the screw terminals are at the same temperature as the CJC sensor.

The accuracy errors shown do not include the inherent accuracy error of the thermocouple sensor itself. Contact your thermocouple supplier for details on the actual thermocouple sensor accuracy limitations.

Connect thermocouples to the OMB-DAQ-2416-4AO such that they are floating with respect to GND (pins 18, 36, 39, 42, 44, 46, 66, 81, 84, 93, and 94).

When configuring thermocouple sensors, keep any stray capacitance relative to GND (pins 18, 36, 39, 42, 44, 46, 66, 81, 84) as small as possible to avoid settling time and accuracy errors.

The OMB-DAQ-2416-4AO GND and DGND pins are isolated from earth ground. You can connect thermocouple sensors to voltages referenced to earth ground as long as isolation between the GND/DGND pins and earth ground is maintained.

Table 4. J type thermocouple accuracy specifications, including CJC measurement error. All specifications are (±).

A/D data rate	Sensor temperature range	Accuracy error maximum	Accuracy error typical	Tempco (°C/°C)
3750 S/s	-210 °C	2.572 °C	1.416 °C	0.022
	0 °C	0.935 °C	0.469 °C	
	1200 °C	1.869 °C	1.456 °C	
2000 S/s	-210 °C	2.572 °C	1.416 °C	0.022
	0 °C	0.935 °C	0.469 °C	
	1200 °C	1.869 °C	1.456 °C	
1000 S/s	-210 °C	2.572 °C	1.416 °C	0.022
	0 °C	0.935 °C	0.469 °C	
	1200 °C	1.869 °C	1.456 °C	
500 S/s	-210 °C	2.442 °C	1.334 °C	0.022
	0 °C	0.881 °C	0.415 °C	
	1200 °C	1.821 °C	1.408 °C	
100 S/s	-210 °C	2.442 °C	1.334 °C	0.022
	0 °C	0.881 °C	0.415 °C	
	1200 °C	1.821 °C	1.408 °C	
60 S/s	-210 °C	2.442 °C	1.334 °C	0.022
	0 °C	0.881 °C	0.415 °C	
	1200 °C	1.821 °C	1.408 °C	
50 S/s	-210 °C	2.442 °C	1.334 °C	0.022
	0 °C	0.881 °C	0.415 °C	
	1200 °C	1.821 °C	1.408 °C	
25 S/s	-210 °C	2.442 °C	1.334 °C	0.022
	0 °C	0.881 °C	0.415 °C	
	1200 °C	1.821 °C	1.408 °C	
10 S/s	-210 °C	2.442 °C	1.334 °C	0.022
	0 °C	0.881 °C	0.415 °C	
	1200 °C	1.821 °C	1.408 °C	
5 S/s	-210 °C	2.442 °C	1.334 °C	0.022
	0 °C	0.881 °C	0.415 °C	
	1200 °C	1.821 °C	1.408 °C	
2.5 S/s	-210 °C	2.442 °C	1.334 °C	0.022
	0 °C	0.881 °C	0.415 °C	
	1200 °C	1.821 °C	1.408 °C	

To achieve the thermocouple accuracies listed above, the OMB-DAQ-2416-4AO should be warmed up for 45 minutes after the initial power on. The accuracies listed above are only guaranteed if the OMB-DAQ-2416-4AO is housed in its plastic enclosure.

Table 5. K type thermocouple accuracy specifications, including CJC measurement error.
All specifications are (±).

A/D data rate	Sensor temperature range	Accuracy error maximum	Accuracy error typical	Tempco (°C/°C)
3750 S/s	-210 °C	2.917 °C	1.699 °C	0.029
	0 °C	1.017 °C	0.526 °C	
	1372 °C	2.478 °C	2.022 °C	
2000 S/s	-210 °C	2.917 °C	1.699 °C	0.029
	0 °C	1.017 °C	0.526 °C	
	1372 °C	2.478 °C	2.022 °C	
1000 S/s	-210 °C	2.917 °C	1.699 °C	0.029
	0 °C	1.017 °C	0.526 °C	
	1372 °C	2.478 °C	2.022 °C	
500 S/s	-210 °C	2.735 °C	1.524 °C	0.029
	0 °C	0.948 °C	0.457 °C	
	1372 °C	2.396 °C	1.941 °C	
100 S/s	-210 °C	2.735 °C	1.524 °C	0.029
	0 °C	0.948 °C	0.457 °C	
	1372 °C	2.396 °C	1.941 °C	
60 S/s	-210 °C	2.735 °C	1.524 °C	0.029
	0 °C	0.948 °C	0.457 °C	
	1372 °C	2.396 °C	1.941 °C	
50 S/s	-210 °C	2.735 °C	1.524 °C	0.029
	0 °C	0.948 °C	0.457 °C	
	1372 °C	2.396 °C	1.941 °C	
25 S/s	-210 °C	2.735 °C	1.524 °C	0.029
	0 °C	0.948 °C	0.457 °C	
	1372 °C	2.396 °C	1.941 °C	
10 S/s	-210 °C	2.735 °C	1.524 °C	0.029
	0 °C	0.948 °C	0.457 °C	
	1372 °C	2.396 °C	1.941 °C	
5 S/s	-210 °C	2.735 °C	1.524 °C	0.029
	0 °C	0.948 °C	0.457 °C	
	1372 °C	2.396 °C	1.941 °C	
2.5 S/s	-210 °C	2.735 °C	1.524 °C	0.029
	0 °C	0.948 °C	0.457 °C	
	1372 °C	2.396 °C	1.941 °C	

To achieve the thermocouple accuracies listed above, the OMB-DAQ-2416-4AO should be warmed up for 45 minutes after the initial power on. The accuracies listed above are only guaranteed if the OMB-DAQ-2416-4AO is housed in its plastic enclosure.

Table 6. N type thermocouple accuracy specifications, including CJC measurement error.
All specifications are (±).

A/D data rate	Sensor temperature range	Accuracy error maximum	Accuracy error typical	Tempco (°C/°C)
3750 S/s	-200 °C	3.480°C	2.030 °C	0.029
	0 °C	1.201 °C	0.659 °C	
	1300 °C	1.991 °C	1.600 °C	
2000 S/s	-200 °C	3.480°C	2.030 °C	0.029
	0 °C	1.201 °C	0.659 °C	
	1300 °C	1.991 °C	1.600 °C	
1000 S/s	-200 °C	3.480°C	2.030 °C	0.029
	0 °C	1.201 °C	0.659 °C	
	1300 °C	1.991 °C	1.600 °C	
500 S/s	-200 °C	3.196°C	1.750 °C	0.029
	0 °C	1.096 °C	0.553 °C	
	1300 °C	1.915 °C	1.524 °C	
100 S/s	-200 °C	3.196°C	1.750 °C	0.029
	0 °C	1.096 °C	0.553 °C	
	1300 °C	1.915 °C	1.524 °C	
60 S/s	-200 °C	3.196°C	1.750 °C	0.029
	0 °C	1.096 °C	0.553 °C	
	1300 °C	1.915 °C	1.524 °C	
50 S/s	-200 °C	3.196°C	1.750 °C	0.029
	0 °C	1.096 °C	0.553 °C	
	1300 °C	1.915 °C	1.524 °C	
25 S/s	-200 °C	3.196°C	1.750 °C	0.029
	0 °C	1.096 °C	0.553 °C	
	1300 °C	1.915 °C	1.524 °C	
10 S/s	-200 °C	3.196°C	1.750 °C	0.029
	0 °C	1.096 °C	0.553 °C	
	1300 °C	1.915 °C	1.524 °C	
5 S/s	-200 °C	3.196°C	1.750 °C	0.029
	0 °C	1.096 °C	0.553 °C	
	1300 °C	1.915 °C	1.524 °C	
2.5 S/s	-200 °C	3.196°C	1.750 °C	0.029
	0 °C	1.096 °C	0.553 °C	
	1300 °C	1.915 °C	1.524 °C	

To achieve the thermocouple accuracies listed above, the OMB-DAQ-2416-4AO should be warmed up for 45 minutes after the initial power on. The accuracies listed above are only guaranteed if the OMB-DAQ-2416-4AO is housed in its plastic enclosure.

Table 7. R type thermocouple accuracy specifications, including CJC measurement error.
All specifications are (±).

A/D data rate	Sensor temperature range	Accuracy error maximum	Accuracy error typical	Tempco (°C/°C)
3750 S/s	-50 °C	4.826 °C	3.133 °C	0.082
	250 °C	2.117 °C	1.424 °C	
	1768 °C	2.842 °C	2.347 °C	
2000 S/s	-50 °C	4.826 °C	3.133 °C	0.082
	250 °C	2.117 °C	1.424 °C	
	1768 °C	2.842 °C	2.347 °C	
1000 S/s	-50 °C	4.826 °C	3.133 °C	0.082
	250 °C	2.117 °C	1.424 °C	
	1768 °C	2.842 °C	2.347 °C	
500 S/s	-50 °C	4.065 °C	2.379 °C	0.082
	250 °C	1.805 °C	1.113 °C	
	1768 °C	2.619 °C	2.123 °C	
100 S/s	-50 °C	4.065 °C	2.379 °C	0.082
	250 °C	1.805 °C	1.113 °C	
	1768 °C	2.619 °C	2.123 °C	
60 S/s	-50 °C	4.065 °C	2.379 °C	0.082
	250 °C	1.805 °C	1.113 °C	
	1768 °C	2.619 °C	2.123 °C	
50 S/s	-50 °C	4.065 °C	2.379 °C	0.082
	250 °C	1.805 °C	1.113 °C	
	1768 °C	2.619 °C	2.123 °C	
25 S/s	-50 °C	4.065 °C	2.379 °C	0.082
	250 °C	1.805 °C	1.113 °C	
	1768 °C	2.619 °C	2.123 °C	
10 S/s	-50 °C	4.065 °C	2.379 °C	0.082
	250 °C	1.805 °C	1.113 °C	
	1768 °C	2.619 °C	2.123 °C	
5 S/s	-50 °C	4.065 °C	2.379 °C	0.082
	250 °C	1.805 °C	1.113 °C	
	1768 °C	2.619 °C	2.123 °C	
2.5 S/s	-50 °C	4.065 °C	2.379 °C	0.082
	250 °C	1.805 °C	1.113 °C	
	1768 °C	2.619 °C	2.123 °C	

To achieve the thermocouple accuracies listed above, the OMB-DAQ-2416-4AO should be warmed up for 45 minutes after the initial power on. The accuracies listed above are only guaranteed if the OMB-DAQ-2416-4AO is housed in its plastic enclosure.

Table 8. S type thermocouple accuracy specifications, including CJC measurement error.
All specifications are (±).

A/D data rate	Sensor temperature range	Accuracy error maximum	Accuracy error typical	Tempco (°C/°C)
3750 S/s	-50 °C	4.510 °C	2.930 °C	0.088
	250 °C	2.165 °C	1.468 °C	
	1768 °C	3.187 °C	2.597 °C	
2000 S/s	-50 °C	4.510 °C	2.930 °C	0.088
	250 °C	2.165 °C	1.468 °C	
	1768 °C	3.187 °C	2.597 °C	
1000 S/s	-50 °C	4.510 °C	2.930 °C	0.088
	250 °C	2.165 °C	1.468 °C	
	1768 °C	3.187 °C	2.597 °C	
500 S/s	-50 °C	3.798 °C	2.226 °C	0.088
	250 °C	1.853 °C	1.156 °C	
	1768 °C	2.922 °C	2.332 °C	
100 S/s	-50 °C	3.798 °C	2.226 °C	0.088
	250 °C	1.853 °C	1.156 °C	
	1768 °C	2.922 °C	2.332 °C	
60 S/s	-50 °C	3.798 °C	2.226 °C	0.088
	250 °C	1.853 °C	1.156 °C	
	1768 °C	2.922 °C	2.332 °C	
50 S/s	-50 °C	3.798 °C	2.226 °C	0.088
	250 °C	1.853 °C	1.156 °C	
	1768 °C	2.922 °C	2.332 °C	
25 S/s	-50 °C	3.798 °C	2.226 °C	0.088
	250 °C	1.853 °C	1.156 °C	
	1768 °C	2.922 °C	2.332 °C	
10 S/s	-50 °C	3.798 °C	2.226 °C	0.088
	250 °C	1.853 °C	1.156 °C	
	1768 °C	2.922 °C	2.332 °C	
5 S/s	-50 °C	3.798 °C	2.226 °C	0.088
	250 °C	1.853 °C	1.156 °C	
	1768 °C	2.922 °C	2.332 °C	
2.5 S/s	-50 °C	3.798 °C	2.226 °C	0.088
	250 °C	1.853 °C	1.156 °C	
	1768 °C	2.922 °C	2.332 °C	

To achieve the thermocouple accuracies listed above, the OMB-DAQ-2416-4AO should be warmed up for 45 minutes after the initial power on. The accuracies listed above are only guaranteed if the OMB-DAQ-2416-4AO is housed in its plastic enclosure.

Table 9. B type thermocouple accuracy specifications, including CJC measurement error.
All specifications are (±).

A/D data rate	Sensor temperature range	Accuracy error maximum	Accuracy error typical	Tempco (°C/°C)
3750 S/s	250 °C	5.489 °C	3.956 °C	0.14
	700 °C	2.283 °C	1.743 °C	
	1820 °C	2.202 °C	1.842 °C	
2000 S/s	250 °C	5.489 °C	3.956 °C	0.14
	700 °C	2.283 °C	1.743 °C	
	1820 °C	2.202 °C	1.842 °C	
1000 S/s	250 °C	5.489 °C	3.956 °C	0.14
	700 °C	2.283 °C	1.743 °C	
	1820 °C	2.202 °C	1.842 °C	
500 S/s	250 °C	4.387 °C	2.885 °C	0.14
	700 °C	1.879 °C	1.340 °C	
	1820 °C	1.962 °C	1.601 °C	
100 S/s	250 °C	4.387 °C	2.885 °C	0.14
	700 °C	1.879 °C	1.340 °C	
	1820 °C	1.962 °C	1.601 °C	
60 S/s	250 °C	4.387 °C	2.885 °C	0.14
	700 °C	1.879 °C	1.340 °C	
	1820 °C	1.962 °C	1.601 °C	
50 S/s	250 °C	4.387 °C	2.885 °C	0.14
	700 °C	1.879 °C	1.340 °C	
	1820 °C	1.962 °C	1.601 °C	
25 S/s	250 °C	4.387 °C	2.885 °C	0.14
	700 °C	1.879 °C	1.340 °C	
	1820 °C	1.962 °C	1.601 °C	
10 S/s	250 °C	4.387 °C	2.885 °C	0.14
	700 °C	1.879 °C	1.340 °C	
	1820 °C	1.962 °C	1.601 °C	
5 S/s	250 °C	4.387 °C	2.885 °C	0.14
	700 °C	1.879 °C	1.340 °C	
	1820 °C	1.962 °C	1.601 °C	
2.5 S/s	250 °C	4.387 °C	2.885 °C	0.14
	700 °C	1.879 °C	1.340 °C	
	1820 °C	1.962 °C	1.601 °C	

To achieve the thermocouple accuracies listed above, the OMB-DAQ-2416-4AO should be warmed up for 45 minutes after the initial power on. The accuracies listed above are only guaranteed if the OMB-DAQ-2416-4AO is housed in its plastic enclosure.

Table 10. E type thermocouple accuracy specifications, including CJC measurement error.
All specifications are (±).

A/D data rate	Sensor temperature range	Accuracy error maximum	Accuracy error typical	Tempco (°C/°C)
3750 S/s	-200 °C	2.413 °C	1.352 °C	0.017
	0 °C	1.069 °C	0.551 °C	
	1000 °C	1.575 °C	1.211 °C	
2000 S/s	-200 °C	2.413 °C	1.352 °C	0.017
	0 °C	1.069 °C	0.551 °C	
	1000 °C	1.575 °C	1.211 °C	
1000 S/s	-200 °C	2.413 °C	1.352 °C	0.017
	0 °C	1.069 °C	0.551 °C	
	1000 °C	1.575 °C	1.211 °C	
500 S/s	-200 °C	2.306 °C	1.244 °C	0.017
	0 °C	1.017 °C	0.499 °C	
	1000 °C	1.539 °C	1.175 °C	
100 S/s	-200 °C	2.306 °C	1.244 °C	0.017
	0 °C	1.017 °C	0.499 °C	
	1000 °C	1.539 °C	1.175 °C	
60 S/s	-200 °C	2.306 °C	1.244 °C	0.017
	0 °C	1.017 °C	0.499 °C	
	1000 °C	1.539 °C	1.175 °C	
50 S/s	-200 °C	2.306 °C	1.244 °C	0.017
	0 °C	1.017 °C	0.499 °C	
	1000 °C	1.539 °C	1.175 °C	
25 S/s	-200 °C	2.306 °C	1.244 °C	0.017
	0 °C	1.017 °C	0.499 °C	
	1000 °C	1.539 °C	1.175 °C	
10 S/s	-200 °C	2.306 °C	1.244 °C	0.017
	0 °C	1.017 °C	0.499 °C	
	1000 °C	1.539 °C	1.175 °C	
5 S/s	-200 °C	2.306 °C	1.244 °C	0.017
	0 °C	1.017 °C	0.499 °C	
	1000 °C	1.539 °C	1.175 °C	
2.5 S/s	-200 °C	2.306 °C	1.244 °C	0.017
	0 °C	1.017 °C	0.499 °C	
	1000 °C	1.539 °C	1.175 °C	

To achieve the thermocouple accuracies listed above, the OMB-DAQ-2416-4AO should be warmed up for 45 minutes after the initial power on. The accuracies listed above are only guaranteed if the OMB-DAQ-2416-4AO is housed in its plastic enclosure.

Table 11. T type thermocouple accuracy specifications, including CJC measurement error. All specifications are (±).

A/D data rate	Sensor temperature range	Accuracy error maximum	Accuracy error typical	Tempco (°C/°C)
3750 S/s	-200 °C	2.821 °C	1.676 °C	0.027
	0 °C	1.050 °C	0.558 °C	
	400 °C	0.957 °C	0.595 °C	
2000 S/s	-200 °C	2.821 °C	1.676 °C	0.027
	0 °C	1.050 °C	0.558 °C	
	400 °C	0.957 °C	0.595 °C	
1000 S/s	-200 °C	2.821 °C	1.676 °C	0.027
	0 °C	1.050 °C	0.558 °C	
	400 °C	0.957 °C	0.595 °C	
500 S/s	-200 °C	2.644 °C	1.505 °C	0.027
	0 °C	0.979 °C	0.487 °C	
	400 °C	0.912 °C	0.551 °C	
100 S/s	-200 °C	2.644 °C	1.505 °C	0.027
	0 °C	0.979 °C	0.487 °C	
	400 °C	0.912 °C	0.551 °C	
60 S/s	-200 °C	2.644 °C	1.505 °C	0.027
	0 °C	0.979 °C	0.487 °C	
	400 °C	0.912 °C	0.551 °C	
50 S/s	-200 °C	2.644 °C	1.505 °C	0.027
	0 °C	0.979 °C	0.487 °C	
	400 °C	0.912 °C	0.551 °C	
25 S/s	-200 °C	2.644 °C	1.505 °C	0.027
	0 °C	0.979 °C	0.487 °C	
	400 °C	0.912 °C	0.551 °C	
10 S/s	-200 °C	2.644 °C	1.505 °C	0.027
	0 °C	0.979 °C	0.487 °C	
	400 °C	0.912 °C	0.551 °C	
5 S/s	-200 °C	2.644 °C	1.505 °C	0.027
	0 °C	0.979 °C	0.487 °C	
	400 °C	0.912 °C	0.551 °C	
2.5 S/s	-200 °C	2.644 °C	1.505 °C	0.027
	0 °C	0.979 °C	0.487 °C	
	400 °C	0.912 °C	0.551 °C	

To achieve the thermocouple accuracies listed above, the OMB-DAQ-2416-4AO should be warmed up for 45 minutes after the initial power on. The accuracies listed above are only guaranteed if the OMB-DAQ-2416-4AO is housed in its plastic enclosure.

Analog input DC voltage measurement accuracy

Table 12. DC Accuracy components and specifications. All values are (±)

Range	A/D data rate	Gain error (% of reading)	Offset error	INL error (% of range)	Absolute accuracy	Gain temperature coefficient (% reading/°C)	Offset temperature coefficient (µV/°C)
±20 V	**3750 S/s**	0.003	98 µV	0.0008	857.600 µV	0.0006	3
	2000 S/s	0.003	61 µV	0.0008	821.185 µV	0.0006	3
	1000 S/s	0.003	27 µV	0.0008	787.226 µV	0.0006	3
	500 S/s	0.003	12 µV	0.0008	772.193 µV	0.0006	3
	100 S/s	0.003	11 µV	0.0008	771.014 µV	0.0006	3
	60 S/s	0.003	15 µV	0.0008	774.689 µV	0.0006	3
	50 S/s	0.003	12 µV	0.0008	771.603 µV	0.0006	3
	25 S/s	0.003	12 µV	0.0008	772.070 µV	0.0006	3
	10 S/s	0.003	13 µV	0.0008	773.400 µV	0.0006	3
	5 S/s	0.003	14 µV	0.0008	773.579 µV	0.0006	3
	2.5 S/s	0.003	14 µV	0.0008	773.537 µV	0.0006	3
±10 V	**3750 S/s**	0.003	42 µV	0.0008	421.600 µV	0.0006	3
	2000 S/s	0.003	36 µV	0.0008	416.004 µV	0.0006	3
	1000 S/s	0.003	15 µV	0.0008	395.252 µV	0.0006	3
	500 S/s	0.003	7 µV	0.0008	387.216 µV	0.0006	3
	100 S/s	0.002	8 µV	0.0008	288.470 µV	0.0006	3
	60 S/s	0.002	10 µV	0.0008	290.090 µV	0.0006	3
	50 S/s	0.002	8 µV	0.0008	287.719 µV	0.0006	3
	25 S/s	0.002	6 µV	0.0008	285.672 µV	0.0006	3
	10 S/s	0.002	6 µV	0.0008	285.982 µV	0.0006	3
	5 S/s	0.002	6 µV	0.0008	286.003 µV	0.0006	3
	2.5 S/s	0.002	6 µV	0.0008	286.086 µV	0.0006	3
±5 V	**3750 S/s**	0.003	21 µV	0.0008	210.800 µV	0.0006	2
	2000 S/s	0.003	21 µV	0.0008	210.712 µV	0.0006	2
	1000 S/s	0.003	8 µV	0.0008	198.254 µV	0.0006	2
	500 S/s	0.002	6 µV	0.0008	146.499 µV	0.0006	2
	100 S/s	0.002	7 µV	0.0008	147.285 µV	0.0006	2
	60 S/s	0.002	8 µV	0.0008	148.216 µV	0.0006	2
	50 S/s	0.002	6 µV	0.0008	146.196 µV	0.0006	2
	25 S/s	0.002	6 µV	0.0008	145.996 µV	0.0006	2
	10 S/s	0.002	6 µV	0.0008	145.820 µV	0.0006	2
	5 S/s	0.002	6 µV	0.0008	145.817 µV	0.0006	2
	2.5 S/s	0.002	6 µV	0.0008	145.810 µV	0.0006	2
±2.5 V	**3750 S/s**	0.002	13 µV	0.0008	83.000 µV	0.0006	1
	2000 S/s	0.002	13 µV	0.0008	83.062 µV	0.0006	1
	1000 S/s	0.002	9 µV	0.0008	79.487 µV	0.0006	1
	500 S/s	0.0015	9 µV	0.0008	66.232 µV	0.0006	1
	100 S/s	0.0015	9 µV	0.0008	66.685 µV	0.0006	1
	60 S/s	0.0015	10 µV	0.0008	67.014 µV	0.0006	1
	50 S/s	0.0015	8 µV	0.0008	65.314 µV	0.0006	1
	25 S/s	0.0015	8 µV	0.0008	65.901 µV	0.0006	1
	10 S/s	0.0015	8 µV	0.0008	65.759 µV	0.0006	1
	5 S/s	0.0015	8 µV	0.0008	65.800 µV	0.0006	1
	2.5 S/s	0.0015	8 µV	0.0008	65.769 µV	0.0006	1
±1.25 V	**3750 S/s**	0.0025	7 µV	0.0008	48.050 µV	0.0006	1

Range	A/D data rate	Gain error (% of reading)	Offset error	INL error (% of range)	Absolute accuracy	Gain temperature coefficient (% reading/°C)	Offset temperature coefficient (µV/°C)
	2000 S/s	0.0025	9 µV	0.0008	50.632 µV	0.0006	1
	1000 S/s	0.0025	8 µV	0.0008	49.359 µV	0.0006	1
	500 S/s	0.0025	8 µV	0.0008	49.709 µV	0.0006	1
	100 S/s	0.0025	8 µV	0.0008	49.604 µV	0.0006	1
	60 S/s	0.0025	8 µV	0.0008	49.417 µV	0.0006	1
	50 S/s	0.0025	8 µV	0.0008	49.610 µV	0.0006	1
	25 S/s	0.0025	8 µV	0.0008	49.584 µV	0.0006	1
	10 S/s	0.0025	8 µV	0.0008	49.482 µV	0.0006	1
	5 S/s	0.0025	8 µV	0.0008	49.489 µV	0.0006	1
	2.5 S/s	0.0025	8 µV	0.0008	49.489 µV	0.0006	1
±0.625 V	**3750 S/s**	0.003	7 µV	0.0005	28.775 µV	0.0006	1
	2000 S/s	0.003	7 µV	0.0005	28.679 µV	0.0006	1
	1000 S/s	0.003	6 µV	0.0005	27.762 µV	0.0006	1
	500 S/s	0.003	6 µV	0.0005	28.167 µV	0.0006	1
	100 S/s	0.003	6 µV	0.0005	28.088 µV	0.0006	1
	60 S/s	0.002	6 µV	0.0005	21.709 µV	0.0006	1
	50 S/s	0.002	6 µV	0.0005	21.773 µV	0.0006	1
	25 S/s	0.002	6 µV	0.0005	21.746 µV	0.0006	1
	10 S/s	0.002	6 µV	0.0005	21.927 µV	0.0006	1
	5 S/s	0.002	6 µV	0.0005	21.803 µV	0.0006	1
	2.5 S/s	0.002	6 µV	0.0005	21.784 µV	0.0006	1
±0.3125 V	**3750 S/s**	0.005	7 µV	0.0006	24.500 µV	0.0006	1
	2000 S/s	0.005	6 µV	0.0006	23.443 µV	0.0006	1
	1000 S/s	0.005	6 µV	0.0006	23.086 µV	0.0006	1
	500 S/s	0.005	6 µV	0.0006	23.094 µV	0.0006	1
	100 S/s	0.005	6 µV	0.0006	23.084 µV	0.0006	1
	60 S/s	0.005	6 µV	0.0006	23.288 µV	0.0006	1
	50 S/s	0.005	6 µV	0.0006	23.232 µV	0.0006	1
	25 S/s	0.005	6 µV	0.0006	23.191 µV	0.0006	1
	10 S/s	0.005	6 µV	0.0006	23.125 µV	0.0006	1
	5 S/s	0.005	6 µV	0.0006	23.182 µV	0.0006	1
	2.5 S/s	0.005	6 µV	0.0006	23.127 µV	0.0006	1
±0.15625 V	**3750 S/s**	0.006	6 µV	0.0005	15.856 µV	0.0006	1
	2000 S/s	0.006	6 µV	0.0005	15.793 µV	0.0006	1
	1000 S/s	0.006	6 µV	0.0005	15.902 µV	0.0006	1
	500 S/s	0.006	6 µV	0.0005	16.118 µV	0.0006	1
	100 S/s	0.006	6 µV	0.0005	15.877 µV	0.0006	1
	60 S/s	0.006	6 µV	0.0005	16.014 µV	0.0006	1
	50 S/s	0.006	6 µV	0.0005	16.122 µV	0.0006	1
	25 S/s	0.006	6 µV	0.0005	15.903 µV	0.0006	1
	10 S/s	0.006	6 µV	0.0005	15.927 µV	0.0006	1
	5 S/s	0.006	6 µV	0.0005	15.981 µV	0.0006	1
	2.5 S/s	0.006	6 µV	0.0005	15.979 µV	0.0006	1
±0.078125 V	**3750 S/s**	0.035	6 µV	0.0009	33.547 µV	0.0006	1
	2000 S/s	0.035	6 µV	0.0009	34.252 µV	0.0006	1
	1000 S/s	0.035	6 µV	0.0009	33.696 µV	0.0006	1
	500 S/s	0.035	6 µV	0.0009	34.002 µV	0.0006	1
	100 S/s	0.035	6 µV	0.0009	34.005 µV	0.0006	1

Range	A/D data rate	Gain error (% of reading)	Offset error	INL error (% of range)	Absolute accuracy	Gain temperature coefficient (% reading/°C)	Offset temperature coefficient (µV/°C)
	60 S/s	0.035	6 µV	0.0009	33.866 µV	0.0006	1
	50 S/s	0.035	6 µV	0.0009	34.026 µV	0.0006	1
	25 S/s	0.035	6 µV	0.0009	33.933 µV	0.0006	1
	10 S/s	0.035	6 µV	0.0009	33.937 µV	0.0006	1
	5 S/s	0.035	6 µV	0.0009	33.969 µV	0.0006	1
	2.5 S/s	0.035	6 µV	0.0009	33.934 µV	0.0006	1

Input bandwidth

Table 13. input bandwidth

A/D data rate	-3 dB Bandwidth (Hz)
3750 S/s	1615
2000 S/s	878
1000 S/s	441
500 S/s	221
100 S/s	44.2
60 S/s	26.5
50 S/s	22.1
25 S/s	11.1
10 S/s	4.42
5 S/s	2.21
2.5 S/s	1.1

Noise performance

For the peak-to-peak noise distribution test, a differential input channel is connected to GND at the input terminal block, and 50,000 samples are acquired at the maximum rate available at each setting.

Table 14. Peak-to-peak noise performance specifications (µV)

	A/D data rate										
Range	**3750 S/s**	**2000 S/s**	**1000 S/s**	**500 S/s**	**100 S/s**	**60 S/s**	**50 S/s**	**25 S/s**	**10 S/s**	**5 S/s**	**2.5 S/s**
±20 V	230.31	186.92	126.84	100.14	57.22	57.22	49.59	47.58	23.84	23.84	14.31
±10 V	126.84	100.14	71.76	45.06	30.52	30.52	26.70	19.07	11.92	9.54	9.54
±5 V	56.74	47.56	34.21	25.87	16.21	14.31	14.31	14.30	5.96	4.77	4.77
±2.5 V	32.96	28.79	17.94	14.19	7.51	7.09	7.09	5.72	3.81	2.86	2.38
±1.25 V	18.57	17.52	13.83	9.30	5.48	5.48	5.01	3.81	3.34	3.34	2.86
±0.625 V	18.88	16.58	8.45	7.41	5.32	4.80	4.38	3.86	2.50	2.61	1.98
±0.3125 V	15.33	14.76	8.19	6.94	4.75	4.69	4.49	3.70	3.34	2.56	2.45
±0.15625 V	13.28	16.84	7.47	6.61	5.70	4.48	4.48	4.24	2.66	3.07	2.29
±0.078125 V	13.47	15.02	9.17	6.88	4.28	4.16	4.00	3.57	2.28	2.13	2.40

Table 15. RMS noise performance specifications (µVRMS)

	A/D data rate										
Range	**3750 S/s**	**2000 S/s**	**1000 S/s**	**500 S/s**	**100 S/s**	**60 S/s**	**50 S/s**	**25 S/s**	**10 S/s**	**5 S/s**	**2.5 S/s**
±20 V	34.90	28.32	19.22	15.17	8.67	8.67	7.51	7.22	3.61	3.61	2.17
±10 V	19.22	15.17	10.87	6.83	4.62	4.62	4.05	2.89	1.81	1.44	1.44
±5 V	8.60	7.21	5.18	3.92	2.46	2.17	2.17	2.16	0.90	0.72	0.72
±2.5 V	4.99	4.36	2.72	2.15	1.14	1.07	1.07	0.87	0.58	0.43	0.36
±1.25 V	2.81	2.66	2.10	1.41	0.83	0.83	0.76	0.58	0.51	0.51	0.43
±0.625 V	2.86	2.51	1.28	1.12	0.81	0.73	0.66	0.58	0.38	0.40	0.30
±0.3125 V	2.32	2.24	1.24	1.05	0.72	0.71	0.68	0.56	0.51	0.39	0.37
±0.15625 V	2.01	2.55	1.13	1.00	0.86	0.68	0.68	0.64	0.40	0.47	0.35
±0.078125 V	2.04	2.28	1.39	1.04	0.65	0.63	0.60	0.54	0.35	0.32	0.36

Table 16. Noise-free resolution specifications (bits)

	A/D data rate										
Range	**3750 S/s**	**2000 S/s**	**1000 S/s**	**500 S/s**	**100 S/s**	**60 S/s**	**50 S/s**	**25 S/s**	**10 S/s**	**5 S/s**	**2.5 S/s**
±20 V	17.4	17.7	18.2	18.6	19.4	19.4	19.6	19.6	20.6	20.6	21.4
±10 V	17.2	17.6	18.1	18.7	19.3	19.3	19.5	20.0	20.6	21.0	21.0
±5 V	17.4	17.6	18.1	18.5	19.2	19.4	19.4	19.4	20.6	21.0	21.0
±2.5 V	17.2	17.4	18.1	18.4	19.3	19.4	19.4	19.7	20.3	20.7	21.0
±1.25 V	17.0	17.1	17.4	18.0	18.8	18.8	18.9	19.3	19.5	19.5	19.7
±0.625 V	16.0	16.2	17.1	17.3	17.8	18.0	18.1	18.3	18.9	18.8	19.2
±0.3125 V	15.3	15.3	16.2	16.4	17.0	17.0	17.0	17.3	17.5	17.9	17.9
±0.15625 V	14.5	14.1	15.3	15.5	15.7	16.1	16.1	16.1	16.8	16.9	17.1
±0.078125 V	14.5	14.3	15.0	15.4	16.1	16.2	16.2	16.4	17.0	17.1	16.9

Channel switching error

Table 17. Step response accuracy specifications

	Accuracy										
Range	**3750 S/s**	**2000 S/s**	**1000 S/s**	**500 S/s**	**100 S/s**	**60 S/s**	**50 S/s**	**25 S/s**	**10 S/s**	**5 S/s**	**2.5 S/s**
±20 V	0.0011%	0.0006%	0.0004%	0.0003%	0.0002%	0.0002%	0.0002%	0.0002%	0.0001%	0.0001%	0.0001%
±10 V	0.0010%	0.0008%	0.0005%	0.0004%	0.0002%	0.0002%	0.0003%	0.0002%	0.0001%	0.0001%	0.0001%
±5 V	0.0009%	0.0008%	0.0004%	0.0004%	0.0003%	0.0002%	0.0002%	0.0002%	0.0001%	0.0001%	0.0001%
±2.5 V	0.0010%	0.0007%	0.0008%	0.0004%	0.0003%	0.0002%	0.0002%	0.0002%	0.0002%	0.0001%	0.0001%
±1.25 V	0.0013%	0.0009%	0.0008%	0.0007%	0.0004%	0.0004%	0.0003%	0.0003%	0.0003%	0.0003%	0.0003%
±0.625 V	0.0022%	0.0016%	0.0011%	0.0011%	0.0007%	0.0007%	0.0005%	0.0005%	0.0004%	0.0005%	0.0003%
±0.3125 V	0.0031%	0.0031%	0.0020%	0.0017%	0.0015%	0.0012%	0.0010%	0.0010%	0.0012%	0.0009%	0.0009%
±0.15625 V	0.0056%	0.0062%	0.0048%	0.0037%	0.0032%	0.0025%	0.0024%	0.0021%	0.0019%	0.0022%	0.0016%
±0.078125 V	0.0114%	0.0123%	0.0076%	0.0070%	0.0041%	0.0051%	0.0046%	0.0036%	0.0032%	0.0030%	0.0034%

Channel switching error is defined as the accuracy that can be expected after one conversion when switching from a channel with a DC input at one extreme of full scale to another channel with a DC input at the other extreme of full scale, expressed in terms of percentage of full scale value.

Throughput rate

The single channel throughput rate is calculated using this formula:

$$Maximum\ throughput = \frac{1}{\frac{1}{data\ rate} + 640\ \mu s}$$

Table 18. Single channel throughput rate specifications

A/D data rate	Maximum throughput (Hz)
3750 S/s	1102.94
2000 S/s	877.19
1000 S/s	609.76
500 S/s	378.79
100 S/s	93.98
60 S/s	57.78
50 S/s	48.45
25 S/s	24.61
10 S/s	9.94
5 S/s	4.98
2.5 S/s	2.50

The multiple-channel throughput rate is calculated using this formula:

$$Maximum\ throughput = \frac{1}{\sum_n \left(\frac{1}{data\ rate} + 640\ \mu s\right)}$$ where *n* is the number of channels

Table 19. Multiple-channel throughput rate specifications (Hz)

	3750 S/s	2000 S/s	1000 S/s	500 S/s	100 S/s	60 S/s	50 S/s	25 S/s	10 S/s	5 S/s	2.5 S/s
Number of input channels											
1	1102.94	877.19	609.76	378.79	93.98	57.78	48.45	24.61	9.94	4.98	2.50
2	551.47	438.60	304.88	189.39	46.99	28.89	24.22	12.30	4.97	2.49	1.25
3	367.65	292.40	203.25	126.26	31.33	19.26	16.15	8.20	3.31	1.66	0.83
4	275.74	219.30	152.44	94.70	23.50	14.45	12.11	6.15	2.48	1.25	0.62
5	220.59	175.44	121.95	75.76	18.80	11.56	9.69	4.92	1.99	1.00	0.50
6	183.82	146.20	101.63	63.13	15.66	9.63	8.07	4.10	1.66	0.83	0.42
7	157.56	125.31	87.11	54.11	13.43	8.25	6.92	3.52	1.42	0.71	0.36
8	137.87	109.65	76.22	47.35	11.75	7.22	6.06	3.08	1.24	0.62	0.31
9	122.55	97.47	67.75	42.09	10.44	6.42	5.38	2.73	1.10	0.55	0.28
10	110.29	87.72	60.98	37.88	9.40	5.78	4.84	2.46	0.99	0.50	0.25
11	100.27	79.74	55.43	34.44	8.54	5.25	4.40	2.24	0.90	0.45	0.23
12	91.91	73.10	50.81	31.57	7.83	4.82	4.04	2.05	0.83	0.42	0.21
13	84.84	67.48	46.90	29.14	7.23	4.44	3.73	1.89	0.76	0.38	0.19
14	78.78	62.66	43.55	27.06	6.71	4.13	3.46	1.76	0.71	0.36	0.18
15	73.53	58.48	40.65	25.25	6.27	3.85	3.23	1.64	0.66	0.33	0.17
16	68.93	54.82	38.11	23.67	5.87	3.61	3.03	1.54	0.62	0.31	0.16

Analog voltage output

Unused VDACx output channels should be left disconnected.

The OMB-DAQ-2416-4AO output voltage level defaults to 0 V whenever the host PC is reset, shut down or suspended, or if a reset command is issued to the device.

The duration of the output transient depends highly on the enumeration process of the host PC. Typically, the output of the OMB-DAQ-2416-4AO is stable after two seconds.

Table 20. Analog voltage output specifications

Parameter	Conditions	Specifications
Digital-to-analog converter		DAC8555
Number of channels		4
Resolution		16 bits
Output ranges	Calibrated	±10 V
	Uncalibrated	±10.05 V, software configurable
Output transient	Host PC is reset, powered on, suspended or a reset command is issued to device (Note 6)	Duration: 2 s Amplitude: 2 V p-p
	Initial power on	Duration: 50 ms Amplitude: 5 V peak
Differential non-linearity		±0.25 LSB typical ±1 LSB maximum
Output current	VDACx pins	±3.5 mA maximum
Output short-circuit protection	VDACx connected to AGND	Unlimited duration
Output coupling		DC
VDACx readback		Each VDAC*x* output can be independently measured by the onboard A/D converter. Software selectable
Power on and reset state		DACs cleared to zero-scale: 0 V, ±50 mV
Output noise		30 µVrms
Settling time	*To rated accuracy, 10 V step*	*45 µs*
Slew rate		*1.0 V/µs*
Throughput	Single-channel	1000 S/s maximum, system-dependent
	Multi-channel	1000 S/s / #ch maximum, system-dependent

Table 21. Calibrated absolute accuracy specifications

Range	Accuracy (±LSB)
±10 V	16.0

Table 22. Calibrated absolute accuracy components specifications

Range	% of reading	Offset (±mV)	Temp drift (%/°C)	Absolute accuracy at FS (±mV)
±10 V	±0.0183	1.831	0.00055	3.661

Table 23. Relative accuracy specifications

Range	Relative accuracy (±LSB)
±10 V	4.0 typical

Analog input/output calibration

Table 24. Analog input/output calibration specifications

Parameter	Specifications
Recommended warm-up time	45 minutes minimum
Calibration	Firmware calibration
Calibration interval	1 year
Calibration reference	+10.000 V, ±5 mV maximum. Actual measured values stored in EEPROM
	Tempco: 5 ppm/°C maximum
	Long term stability: 30 ppm/1000 hours

Digital input/output

Table 25. Digital input specifications

Number of I/O	8 channels
Configuration	Each DIO bit can be independently read from (DIN) or written to (DOUT). The DIN bits can be read at any time whether the DOUT is active or tri-stated.
Input voltage range	0 to +15 V
Input type	CMOS (Schmitt trigger)
Input characteristics	47 kΩ pull-up/pull-down resistor, 28 kΩ series resistor
Maximum input voltage range	*0 to +20 V maximum (power on/off, relative to DGND pins 93 and 94)*
Pull-up/pull-down configuration	All pins pulled up to +5 V via individual 47 kΩ resistors (the JP1 shorting block default position is pins 1 and 2). Pull down capability is available by placing the JP1 shorting block across pins 2 and 3.
Transfer rate (software paced)	500 port reads or single bit reads per second typical.
Input high voltage	1.3 V minimum, 2.2 V maximum
Input low voltage	1.5 V maximum, 0.6 V minimum
Schmitt trigger hysteresis	0.4 V minimum, 1.2 V maximum

Note 2: DGND pins (pins 93, 94) are recommended for use with digital input and digital output pins. The DGND and GND pins are common and are isolated from earth ground.

Table 26. Digital output specifications

Number of I/O	8 channels
Configuration	Each DIO bit can be independently read from (DIN) or written to (DOUT). The DIN bits may be read at any time whether the DOUT is active or tri-stated
Output characteristics	47 kΩ pull-up, open drain (DMOS transistor)
Pull-up configuration	All pins pulled up to +5 V via individual 47 kΩ resistors (the JP1 shorting block default position is pins 1 and 2).
Transfer rate (software paced)	Digital output – 500 port writes or single-bit writes per second typical.
Output voltage range	0 to +5 V (no external pull up resistor, internal 47 kΩ pull-up resistors connected to +5 V by default) 0 to +15 V maximum (Note 5)
Drain to source breakdown voltage	+50 V minimum
Off state leakage current (Note 6)	0.1 µA
Sink current capability	▪ 150 mA maximum (continuous) per output pin ▪ 150 mA maximum (continuous) for all eight channels
DMOS transistor on-resistance (drain to source)	4 Ω

Note 3: Each DMOS transistor's source pin is internally connected to GND.

Note 4: DGND pins (pins 93, 94) are recommended for use with digital input and digital output pins. The DGND and GND pins are common and are isolated from earth ground.

Note 5: The external pull-up is connected to the digital output bit through an external pull-up resistor. Adding an external pull-up resistor connects it in parallel with the internal 47 kΩ pull-up resistor of that particular digital input/output bit. Careful consideration should be made when considering the external pull-up resistor value and the resultant pull-up voltage produced at the load.

Note 6: Does not include the additional leakage current contribution that may occur when using an external pull-up resistor.

Counter

Table 27. CTR specifications

Parameter	Conditions	Specification
Pin name		CTR0, CTR1
Number of channels		2 channels
Resolution		32-bits
Counter type		Event counter
Input type		Schmitt trigger, rising edge triggered
Input source		CTR0 (pin 43) CTR1 (pin 45)
Counter read/writes rates (software paced)	Counter read	System dependent, 500 reads per second.
	Counter write	System dependent, 500 writes per second.
Input characteristics	Each CTRx input pin	562 KΩ pull-up resistor to +5 V, 10 kΩ series resistor
Input voltage range		±15 V maximum
Maximum input voltage range	*CTR0,CTR1 relative to GND and DGND (pins 18,36,39,42,44,46,66,81,84,93,94)*	*±20 V maximum (power on/off)*
Input high voltage		1.3 V minimum, 2.2 V maximum
Input low voltage		1.5 V maximum, 0.6 V minimum
Schmitt trigger hysteresis		0.4 V minimum, 1.2 V maximum
Input bandwidth (-3 dB)		1 MHz
Input capacitance		*25 pf*
Input leakage current		*±120 nA*
Input frequency		1 MHz, maximum
High pulse width		*500 ns, minimum*
Low pulse width		*500 ns, minimum*

Note 7: The DGND and GND pins *(pins 18,36,39,42,44,46,66,81,84,93,94)* are common and are isolated from earth ground.

Memory

Table 28. Memory specifications

EEPROM	4096 bytes isolated micro reserved for sensor configuration 256 bytes USB micro for external application use

Microcontroller

Table 29. Microcontroller specifications

Type	One high-performance 8-bit RISC microcontroller with USB interface (non-isolated) One high-performance 16-bit RISC microcontroller for measurements (isolated)

Power

Table 30. Power specifications

Parameter	Conditions	Specification
Supply current (Note 8)	Quiescent current	340 mA
External power input (Note 9)		+5 V, ±5%
External power supply	OMB-DAQ-2416-ADAP (included)	+5 VDC, 10 W, 5% regulation
Voltage supervisor limits	4.5 V > V_{ext} or V_{ext} > 5.5 V	PWR LED = Off; (power fault)
	4.5 V < V_{ext} < 5.5 V	PWR LED = On
+5 V user output voltage range	Available at terminal block pin 35	4.9 V minimum to 5.1 V maximum
User +5V user output current	Available at terminal block pin 35	10 mA maximum
Isolation	Measurement system to PC	500 VDC minimum

Table 31. AC power requirements

Parameter	Conditions	Specification
Output voltage		+5 V, ±5%
Output wattage		10 watts
Power jack configuration		Two conductor
Power jack barrel diameter		6.3 mm
Power jack pin diameter		2.0 mm
Power jack polarity		Center positive

Note 8: This is the total quiescent current requirement for the OMB-DAQ-2416-4AO which includes up to 10 mA for the status LED. This does not include any potential loading of the digital I/O bits, +5V user terminal or the VDACx outputs.

Note 9: This specification applies to the actual voltage level at the input to the external power connector of the OMB-DAQ-2416-4AO.

USB specifications

Table 32. USB specifications

USB device type	USB 2.0 (full-speed)
Device compatibility	USB 1.1, USB 2.0
USB cable type	*A-B cable, UL type AWM 2527 or equivalent. (minimum 24 AWG VBUS/GND, minimum 28 AWG D+/D–)*
USB cable length	5 meters maximum

Environmental

The environmental specifications listed in Table 33 apply only to the OMB-DAQ-2416-4AO and not to the external power supply.

Table 33. Environmental specifications

Operating temperature range	0 to 50° C maximum
Storage temperature range	-40 to 85 ° C maximum
Humidity	0 to 90% non-condensing maximum

Mechanical

Table 34. Mechanical specifications

Dimensions	245 mm (L) x 146 mm (W) x 50 mm (H)
User connection length	5 meters maximum

Screw terminal connector type and pin-out

Table 35. Screw terminal connector specifications

Connector type	Detachable screw terminal
Wire gauge range	16 AWG to 30 AWG

Screw terminal pin out

For additional channel configurations when using the optional AI-EXP expansion device, refer to the "Optional OMB-AI-EXP32 expansion module" section on page 47.

Table 36. 16-channel differential mode pin out

Do not connect to terminal block pins labeled "NC."

Pin	Signal name	Pin description	Pin	Signal name	Pin description
1	NC	No connect	49	NC	No connect
2	CH0H	Channel 0 HI	50	CH15L	Channel 15 LO
3	CH0L	Channel 0 LO	51	CH15H	Channel 15 HI
4	NC	No connect	52	IC14	No connect
5	IC0	No connect	53	4WC14	No connect
6	CH1H	Channel 1 HI	54	CH14L	Channel 14 LO
7	CH1L	Channel 1 LO	55	CH14H	Channel 14 HI
8	4WC1	No connect	56	IC13	No connect
9	IC1	No connect	57	4WC13	No connect
10	CH2H	Channel 2 HI	58	CH13L	Channel 13 LO
11	CH2L	Channel 2 LO	59	CH13H	Channel 13 HI
12	4WC2	No connect	60	IC12	No connect
13	IC2	No connect	61	4WC12	No connect
14	CH3H	Channel 3 HI	62	CH12L	Channel 12 LO
15	CH3L	Channel 3 LO	63	CH12H	Channel 12 HI
16	4WC3	No connect	64	IC11	No connect
17	IC3	No connect	65	4WC11	No connect
18	GND	Analog ground	66	GND	Analog ground
19	CH4H	Channel 4 HI	67	CH11L	Channel 11 LO
20	CH4L	Channel 4 LO	68	CH11H	Channel 11 HI
21	4WC4	No connect	69	IC10	No connect
22	IC4	No connect	70	4WC10	No connect
23	CH5H	Channel 5 HI	71	CH10L	Channel 10 LO
24	CH5L	Channel 5 LO	72	CH10H	Channel 10 HI
25	4WC5	No connect	73	IC9	No connect
26	IC5	No connect	74	4WC9	No connect
27	CH6H	Channel 6 HI	75	CH9L	Channel 9 LO
28	CH6L	Channel 6 LO	76	CH9H	Channel 9 HI
29	4WC6	No connect	77	IC8	No connect
30	IC6	No connect	78	4WC8	No connect
31	CH7H	Channel 7 HI	79	CH8L	Channel 8 LO
32	CH7L	Channel 7 LO	80	CH8H	Channel 8 HI
33	4WC7	No connect	81	GND	Analog ground
34	IC7	No connect	82	NC	No connect
35	+5V	+5V output	83	NC	No connect
36	GND	Analog ground	84	GND	Analog ground
37	VDAC0	Analog output Ch0	85	DIO7	Digital input/output
38	VDAC1	Analog output Ch1	86	DIO6	Digital input/output
39	GND	Analog ground	87	DIO5	Digital input/output
40	VDAC2	Analog output Ch2	88	DIO4	Digital input/output
41	VDAC3	Analog output Ch3	89	DIO3	Digital input/output
42	GND	Analog ground	90	DIO2	Digital input/output
43	CTR0	Counter input Ch0	91	DIO1	Digital input/output
44	GND	Analog ground	92	DIO0	Digital input/output
45	CTR1	Counter input Ch1	93	DGND	Digital I/O ground
46	GND	Analog ground	94	DGND	Digital I/O ground
47	NC	No connect	95	NC	No connect
48	NC	No connect	96	NC	No connect

Table 37. 32-channel single-ended mode pin out

Do not connect to terminal block pins labeled "NC."

Pin	Signal name	Pin description	Pin	Signal name	Pin description
1	NC	No connect	49	NC	No connect
2	CH0H	Channel 0	50	CH15L	Channel 31
3	CH0L	Channel 16	51	CH15H	Channel 15
4	NC	No connect	52	IC14	No connect
5	IC0	No connect	53	4WC14	No connect
6	CH1H	Channel 1	54	CH14L	Channel 30
7	CH1L	Channel 17	55	CH14H	Channel 14
8	4WC1	No connect	56	IC13	No connect
9	IC1	No connect	57	4WC13	No connect
10	CH2H	Channel 2	58	CH13L	Channel 29
11	CH2L	Channel 18	59	CH13H	Channel 13
12	4WC2	No connect	60	IC12	No connect
13	IC2	No connect	61	4WC12	No connect
14	CH3H	Channel 3	62	CH12L	Channel 28
15	CH3L	Channel 19	63	CH12H	Channel 12
16	4WC3	No connect	64	IC11	No connect
17	IC3	No connect	65	4WC11	No connect
18	GND	Analog ground	66	GND	Analog ground
19	CH4H	Channel 4	67	CH11L	Channel 27
20	CH4L	Channel 20	68	CH11H	Channel 11
21	4WC4	No connect	69	IC10	No connect
22	IC4	No connect	70	4WC10	No connect
23	CH5H	Channel 5	71	CH10L	Channel 26
24	CH5L	Channel 21	72	CH10H	Channel 10
25	4WC5	No connect	73	IC9	No connect
26	IC5	No connect	74	4WC9	No connect
27	CH6H	Channel 6	75	CH9L	Channel 25
28	CH6L	Channel 22	76	CH9H	Channel 9
29	4WC6	No connect	77	IC8	No connect
30	IC6	No connect	78	4WC8	No connect
31	CH7H	Channel 7	79	CH8L	Channel 24
32	CH7L	Channel 23	80	CH8H	Channel 8
33	4WC7	No connect	81	GND	Analog ground
34	IC7	No connect	82	NC	No connect
35	+5V	+5V output	83	NC	No connect
36	GND	Analog ground	84	GND	Analog ground
37	VDAC0	Analog output Ch0	85	DIO7	Digital input/output
38	VDAC1	Analog output Ch1	86	DIO6	Digital input/output
39	GND	Analog ground	87	DIO5	Digital input/output
40	VDAC2	Analog output Ch2	88	DIO4	Digital input/output
41	VDAC3	Analog output Ch3	89	DIO3	Digital input/output
42	GND	Analog ground	90	DIO2	Digital input/output
43	CTR0	Counter input Ch0	91	DIO1	Digital input/output
44	GND	Analog ground	92	DIO0	Digital input/output
45	CTR1	Counter input Ch1	93	DGND	Digital I/O ground
46	GND	Analog ground	94	DGND	Digital I/O ground
47	NC	No connect	95	NC	No connect
48	NC	No connect	96	NC	No connect

Optional OMB-AI-EXP32 expansion module

Use the OMB-AI-EXP32 (sold separately) for applications that need additional analog/thermocouple input and digital I/O channels. See the Omega Engineering web site for product details.

The OMB-AI-EXP32 expansion port is intended to interface with a OMB-DAQ-2416 series product. Do not try to use any of the expansion port pins for any other purpose.

Table 38. OMB-AI-EXP32 37-pin connector pin out

Do not connect to terminal block pins labeled "NC."

Pin	Signal name	Pin description
1	GND	Analog ground
2	NC	No connect
3	GND	Analog ground
4	NC	No connect
5	GND	Analog ground
6	VCC	+12 V power
7	NC	No connect
8	NC	No connect
9	IM_A2	I/O control signal
10	IM_A1	I/O control signal
11	IM_A0	I/O control signal
12	IMEN10	I/O control signal
13	IMEN9	I/O control signal
14	IMEN8	I/O control signal
15	IMEN7	I/O control signal
16	DIO_LOAD2	I/O control signal
17	DIO_LOAD1	I/O control signal
18	NC	No connect
19	NC	No connect
20	+3.3V_ISO	+3.3 V power
21	GND	Analog ground
22	+5 VA	+5 V analog power
23	+20.5V	+20.5 V power
24	GND	Analog ground
25	-20.5V	-20.5 V power
26	VDD_ISO	+5 V digital power
27	EXTDIO_INT	I/O control signal
28	CM_A3	I/O control signal
29	SM_A1	I/O control signal
30	SM_AO	I/O control signal
31	CM_A2	I/O control signal
32	SCL	Serial I/O control signal
33	SDA	Serial I/O control signal
34	MOSI	Serial I/O control signal
35	SCK	Serial I/O control signal
36	NC	No connect
37	NC	No connect

The multiple-channel throughput rate calculation is based on the following formula:

Maximum throughput = $\frac{1}{\sum_n(\frac{1}{data\ rate}+ 640\mu s)}$, where n is the number of channels

Table 39. Multiple-channel throughput rate specifications (Hz),
OMB-DAQ-2416-4AO and optional OMB-AI-EXP32 expansion module

	3750 S/s	**2000 S/s**	**1000 S/s**	**500 S/s**	**100 S/s**	**60 S/s**	**50 S/s**	**25 S/s**	**10 S/s**	**5 S/s**	**2.5 S/s**
Number of input channels											
1	1102.94	877.19	609.76	378.79	93.98	57.78	48.45	24.61	9.94	4.98	2.50
2	551.47	438.60	304.88	189.39	46.99	28.89	24.22	12.30	4.97	2.49	1.25
3	367.65	292.40	203.25	126.26	31.33	19.26	16.15	8.20	3.31	1.66	0.83
4	275.74	219.30	152.44	94.70	23.50	14.45	12.11	6.15	2.48	1.25	0.62
5	220.59	175.44	121.95	75.76	18.80	11.56	9.69	4.92	1.99	1.00	0.50
6	183.82	146.20	101.63	63.13	15.66	9.63	8.07	4.10	1.66	0.83	0.42
7	157.56	125.31	87.11	54.11	13.43	8.25	6.92	3.52	1.42	0.71	0.36
8	137.87	109.65	76.22	47.35	11.75	7.22	6.06	3.08	1.24	0.62	0.31
9	122.55	97.47	67.75	42.09	10.44	6.42	5.38	2.73	1.10	0.55	0.28
10	110.29	87.72	60.98	37.88	9.40	5.78	4.84	2.46	0.99	0.50	0.25
11	100.27	79.74	55.43	34.44	8.54	5.25	4.40	2.24	0.90	0.45	0.23
12	91.91	73.10	50.81	31.57	7.83	4.82	4.04	2.05	0.83	0.42	0.21
13	84.84	67.48	46.90	29.14	7.23	4.44	3.73	1.89	0.76	0.38	0.19
14	78.78	62.66	43.55	27.06	6.71	4.13	3.46	1.76	0.71	0.36	0.18
15	73.53	58.48	40.65	25.25	6.27	3.85	3.23	1.64	0.66	0.33	0.17
16	68.93	54.82	38.11	23.67	5.87	3.61	3.03	1.54	0.62	0.31	0.16
17	64.88	51.60	35.87	22.28	5.53	3.40	2.85	1.45	0.58	0.29	0.15
18	61.27	48.73	33.88	21.04	5.22	3.21	2.69	1.37	0.55	0.28	0.14
19	58.05	46.17	32.09	19.94	4.95	3.04	2.55	1.30	0.52	0.26	0.13
20	55.15	43.86	30.49	18.94	4.70	2.89	2.42	1.23	0.50	0.25	0.12
21	52.52	41.77	29.04	18.04	4.48	2.75	2.31	1.17	0.47	0.24	0.12
22	50.13	39.87	27.72	17.22	4.27	2.63	2.20	1.12	0.45	0.23	0.11
23	47.95	38.14	26.51	16.47	4.09	2.51	2.11	1.07	0.43	0.22	0.11
24	45.96	36.55	25.41	15.78	3.92	2.41	2.02	1.03	0.41	0.21	0.10
25	44.12	35.09	24.39	15.15	3.76	2.31	1.94	0.98	0.40	0.20	0.10
26	42.42	33.74	23.45	14.57	3.61	2.22	1.86	0.95	0.38	0.19	0.10
27	40.85	32.49	22.58	14.03	3.48	2.14	1.79	0.91	0.37	0.18	0.09
28	39.39	31.33	21.78	13.53	3.36	2.06	1.73	0.88	0.35	0.18	0.09
29	38.03	30.25	21.03	13.06	3.24	1.99	1.67	0.85	0.34	0.17	0.09
30	36.76	29.24	20.33	12.63	3.13	1.93	1.61	0.82	0.33	0.17	0.08
31	35.58	28.30	19.67	12.22	3.03	1.86	1.56	0.79	0.32	0.16	0.08
32	34.47	27.41	19.05	11.84	2.94	1.81	1.51	0.77	0.31	0.16	0.08

OMB-AI-EXP32 screw terminal pin out

Table 40. 32-channel differential mode pin out

Do not connect to terminal block pins labeled "NC."

Pin	Signal name	Pin description	Pin	Signal name	Pin description
1	CH16H	Channel 16 HI	49	CH31L	Channel 31 LO
2	CH16L	Channel 16 LO	50	CH31H	Channel 31 HI
3	CH17H	Channel 17 HI	51	CH30L	Channel 30 LO
4	CH17L	Channel 17 LO	52	CH30H	Channel 30 HI
5	CH18H	Channel 18 HI	53	CH29L	Channel 29 LO
6	CH18L	Channel 18 LO	54	CH29H	Channel 29 HI
7	CH19H	Channel 19 HI	55	CH28L	Channel 28 LO
8	CH19L	Channel 19 LO	56	CH28H	Channel 28 HI
9	CH20H	Channel 20 HI	57	CH27L	Channel 27 LO
10	CH20L	Channel 20 LO	58	CH27H	Channel 27 HI
11	CH21H	Channel 21 HI	59	CH26L	Channel 26 LO
12	CH21L	Channel 21 LO	60	CH26H	Channel 26 HI
13	CH22H	Channel 22 HI	61	CH25L	Channel 25 LO
14	CH22L	Channel 22 LO	62	CH25H	Channel 25 HI
15	CH23H	Channel 23 HI	63	CH24L	Channel 24 LO
16	CH23L	Channel 23 LO	64	CH24H	Channel 24 HI
17	GND	Analog ground	65	GND	Analog ground
18	GND	Analog ground	66	GND	Analog ground
19	+5VUSER	+5V output	67	NC	No connect
20	NC	No connect	68	NC	No connect
21	DIO8	Digital input/output	69	DIO23	Digital input/output
22	DIO9	Digital input/output	70	DIO22	Digital input/output
23	DIO10	Digital input/output	71	DIO21	Digital input/output
24	DIO11	Digital input/output	72	DIO20	Digital input/output
25	DIO12	Digital input/output	73	DIO19	Digital input/output
26	DIO13	Digital input/output	74	DIO18	Digital input/output
27	DIO14	Digital input/output	75	DIO17	Digital input/output
28	DIO15	Digital input/output	76	DIO16	Digital input/output
29	DGND	Digital ground	77	DGND	Digital ground
30	DGND	Digital ground	78	DGND	Digital ground
31	NC	No connect	79	NC	No connect
32	NC	No connect	80	NC	No connect

Table 41. 32-channel single-ended mode pin out

Do not connect to terminal block pins labeled "NC."

Pin	Signal name	Pin description	Pin	Signal name	Pin description
1	CH16H	Channel 16	33	CH31L	Channel 63
2	CH16L	Channel 48	34	CH31H	Channel 31
3	CH17H	Channel 17	35	CH30L	Channel 62
4	CH17L	Channel 49	36	CH30H	Channel 30
5	CH18H	Channel 18	37	CH29L	Channel 61
6	CH18L	Channel 50	38	CH29H	Channel 29
7	CH19H	Channel 19	39	CH28L	Channel 60
8	CH19L	Channel 51	40	CH28H	Channel 28
9	CH20H	Channel 20	41	CH27L	Channel 59
10	CH20L	Channel 52	42	CH27H	Channel 27
11	CH21H	Channel 21	43	CH26L	Channel 58
12	CH21L	Channel 53	44	CH26H	Channel 26
13	CH22H	Channel 22	45	CH25L	Channel 57
14	CH22L	Channel 54	46	CH25H	Channel 25
15	CH23H	Channel 23	47	CH24L	Channel 56
16	CH23L	Channel 55	48	CH24H	Channel 24
17	GND	Analog ground	49	GND	Analog ground
18	GND	Analog ground	50	GND	Analog ground
19	+5VUSER	+5V output	51	NC	No connect
20	NC	No connect	52	NC	No connect
21	DIO8	Digital input/output	69	DIO23	Digital input/output
22	DIO9	Digital input/output	70	DIO22	Digital input/output
23	DIO10	Digital input/output	71	DIO21	Digital input/output
24	DIO11	Digital input/output	72	DIO20	Digital input/output
25	DIO12	Digital input/output	73	DIO19	Digital input/output
26	DIO13	Digital input/output	74	DIO18	Digital input/output
27	DIO14	Digital input/output	75	DIO17	Digital input/output
28	DIO15	Digital input/output	76	DIO16	Digital input/output
29	DGND	Digital ground	61	DGND	Digital ground
30	DGND	Digital ground	62	DGND	Digital ground
31	NC	No connect	63	NC	No connect
32	NC	No connect	64	NC	No connect

OMB-DAQ-2416-4AO screw terminal pin out (with OMB-AI-EXP32 attached)

Table 42. OMB-DAQ-2416-4AO single-ended mode pin out with OMB-AI-EXP32 connected

Do not connect to terminal block pins labeled "NC."

Pin	Signal name	Pin description	Pin	Signal name	Pin description
1	NC	No connect	49	NC	No connect
2	CH0H	Channel 0	50	CH15L	Channel 47
3	CH0L	Channel 32	51	CH15H	Channel 15
4	NC	No connect	52	IC14	No connect
5	IC0	No connect	53	4WC14	No connect
6	CH1H	Channel 1	54	CH14L	Channel 46
7	CH1L	Channel 33	55	CH14H	Channel 14
8	4WC1	No connect	56	IC13	No connect
9	IC1	No connect	57	4WC13	No connect
10	CH2H	Channel 2	58	CH13L	Channel 45
11	CH2L	Channel 34	59	CH13H	Channel 13
12	4WC2	No connect	60	IC12	No connect
13	IC2	No connect	61	4WC12	No connect
14	CH3H	Channel 3	62	CH12L	Channel 44
15	CH3L	Channel 35	63	CH12H	Channel 12
16	4WC3	No connect	64	IC11	No connect
17	IC3	No connect	65	4WC11	No connect
18	GND	Analog ground	66	GND	Analog ground
19	CH4H	Channel 4	67	CH11L	Channel 43
20	CH4L	Channel 36	68	CH11H	Channel 11
21	4WC4	No connect	69	IC10	No connect
22	IC4	No connect	70	4WC10	No connect
23	CH5H	Channel 5	71	CH10L	Channel 42
24	CH5L	Channel 37	72	CH10H	Channel 10
25	4WC5	No connect	73	IC9	No connect
26	IC5	No connect	74	4WC9	No connect
27	CH6H	Channel 6	75	CH9L	Channel 41
28	CH6L	Channel 38	76	CH9H	Channel 9
29	4WC6	No connect	77	IC8	No connect
30	IC6	No connect	78	4WC8	No connect
31	CH7H	Channel 7	79	CH8L	Channel 40
32	CH7L	Channel 39	80	CH8H	Channel 8
33	4WC7	No connect	81	GND	Analog ground
34	IC7	No connect	82	NC	No connect
35	+5V	+5V output	83	NC	No connect
36	GND	Analog ground	84	GND	Analog ground
37	VDAC0	Analog output Ch0	85	DIO7	Digital input/output
38	VDAC1	Analog output Ch1	86	DIO6	Digital input/output
39	GND	Analog ground	87	DIO5	Digital input/output
40	VDAC2	Analog output Ch2	88	DIO4	Digital input/output
41	VDAC3	Analog output Ch3	89	DIO3	Digital input/output
42	GND	Analog ground	90	DIO2	Digital input/output
43	CTR0	Counter input Ch0	91	DIO1	Digital input/output
44	GND	Analog ground	92	DIO0	Digital input/output
45	CTR1	Counter input Ch1	93	DGND	Digital I/O ground
46	GND	Analog ground	94	DGND	Digital I/O ground
47	NC	No connect	95	NC	No connect
48	NC	No connect	96	NC	No connect

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2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

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