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# **Ω OMEGA<sup>®</sup>** **User's Guide**

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## **OMB-DAQ-TC-RACK-EXP32** **32-Channel Expansion Module for** **OMB-DAQ-TC-RACK USB/Ethernet** **Based Thermocouple Input** **Data Acquisition System**



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## About this User's Guide

### What you will learn from this user's guide

This user's guide describes the Measurement Computing OMB-DAQ-TC-RACK-EXP32 data acquisition device and lists device specifications.

### Conventions in this user's guide

**For more information**

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

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

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

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

### Where to find more information

Additional information about OMB-DAQ-TC-RACK-EXP32 hardware is available on our website at [www.omega.com](http://www.omega.com). You can also contact Omega Engineering by phone, fax, or email with specific questions.

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

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## Introducing the OMB-DAQ-TC-RACK-EXP32

The OMB-DAQ-TC-RACK-EXP32 is a dual-interface data acquisition device that provides the following features:

- Adds 32 differential thermocouple (TC) inputs to OMB-DAQ-TC-RACK for a total of 64 TC channels (includes 40-pin ribbon cable for connecting to OMB-DAQ-TC-RACK))
- Two 24-bit ADCs (one ADC per 16 inputs)
- TC channels field-to-host isolation
- 3 S/s per update rate
- Support for type J, K, R, S, T, N, E, and B thermocouples, software-selectable per channel
- One integrated cold junction compensation (CJC) sensor per TC input
- Open thermocouple detection (OTD) to detect faulty TC connections
- 8 digital inputs, isolated from TC and host
- 32 digital outputs/alarms isolated from TC inputs and host
- DIO connections are made to 50-pin header connector
- Powered by host OMB-DAQ-TC-RACK

## Functional block diagram

Device functions are illustrated in the block diagram shown here:

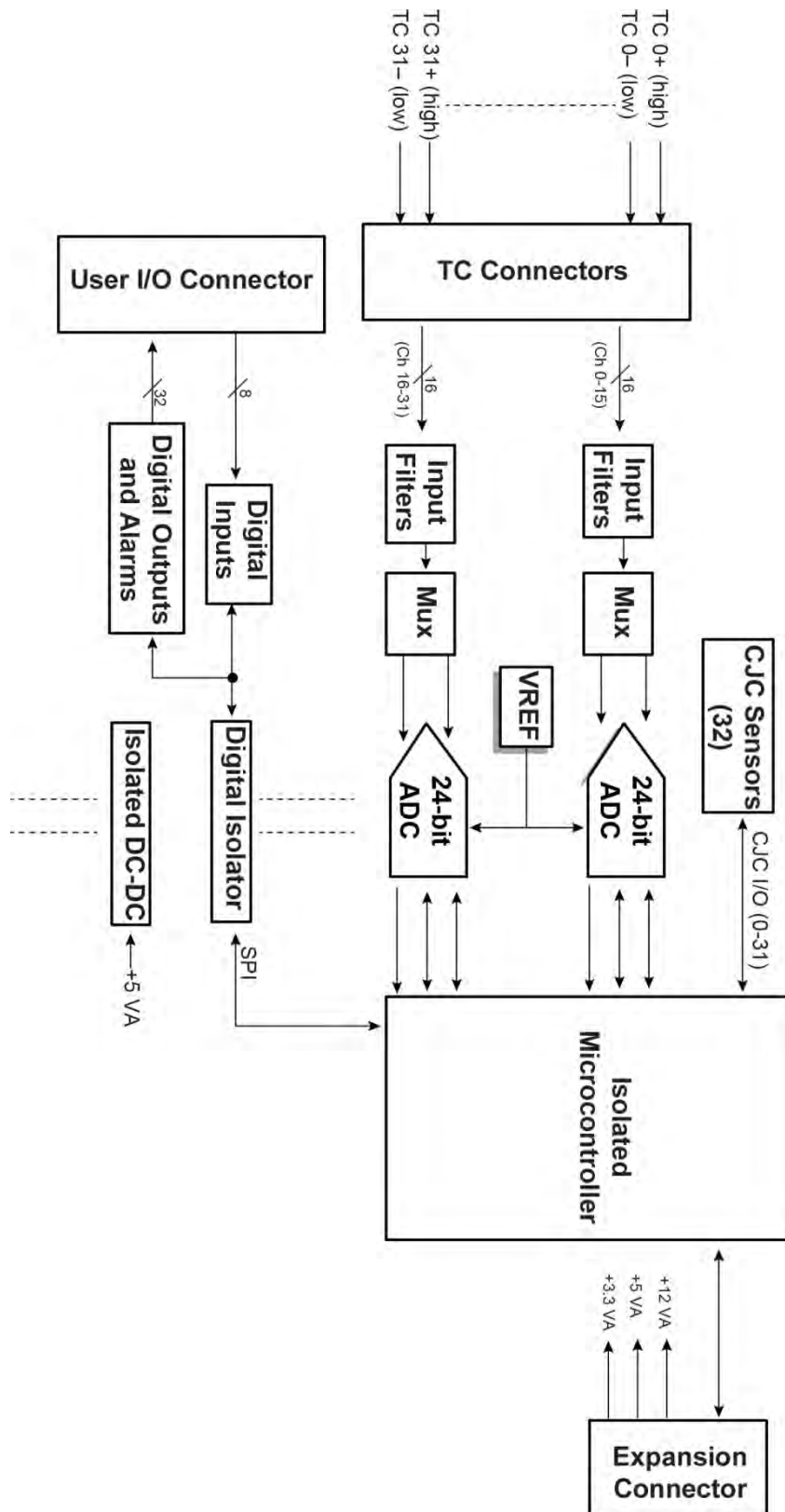


Figure 1. OMB-DAQ-TC-RACK-EXP32 functional block diagram

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# Installing the OMB-DAQ-TC-RACK-EXP32

## Unpacking

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

## Installing the software

Refer to the *Software User's Guide* for instructions on installing the software on the CD. This booklet is available in PDF at [www.omega.com/manuals/manualpdf/M4803.pdf](http://www.omega.com/manuals/manualpdf/M4803.pdf).

## Installing the hardware

The OMB-DAQ-TC-RACK-EXP32 must be connected to a host OMB-DAQ-TC-RACK in order to communicate with a computer and receive power. Refer to the *OMB-DAQ-TC-RACK User's Guide* for instructions on installing, configuring, and calibrating the host OMB-DAQ-TC-RACK.

Complete the following steps to connect the OMB-DAQ-TC-RACK-EXP32 to a host OMB-DAQ-TC-RACK:

1. Power off the host OMB-DAQ-TC-RACK and connect the OMB-DAQ-TC-RACK-EXP32 (connector labeled **CONNECTOR (OMB-DAQ-TC-RACK)**) to the OMB-DAQ-TC-RACK (connector labeled **EXPANSION**) using the 40-pin cable provided.
2. Connect the chassis ground connector on the rear of the OMB-DAQ-TC-RACK-EXP32 (refer to [Figure 3](#) on page 8) to the chassis ground connector on the rear of the OMB-DAQ-TC-RACK.

**Caution!** If using both the OMB-DAQ-TC-RACK chassis ground screw connection and a USB or shielded Ethernet cable, a ground loop could be created if the two grounds are not at the same voltage potential. You should avoid creating a ground loop situation which could affect measurement accuracy.

3. Connect the OMB-DAQ-TC-RACK-EXP32 to its TC and digital I/O signal sources, and then power on the host OMB-DAQ-TC-RACK.

## Functional Details

### External components

OMB-DAQ-TC-RACK-EXP32 front panel components are shown in Figure 2.

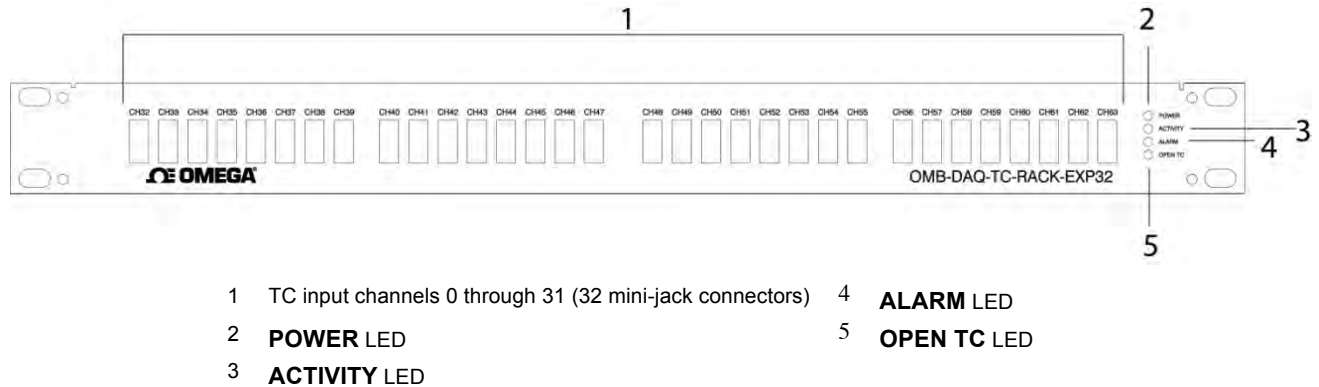


Figure 2. OMB-DAQ-TC-RACK-EXP32 front panel components

OMB-DAQ-TC-RACK-EXP32 rear panel components are shown in Figure 3.

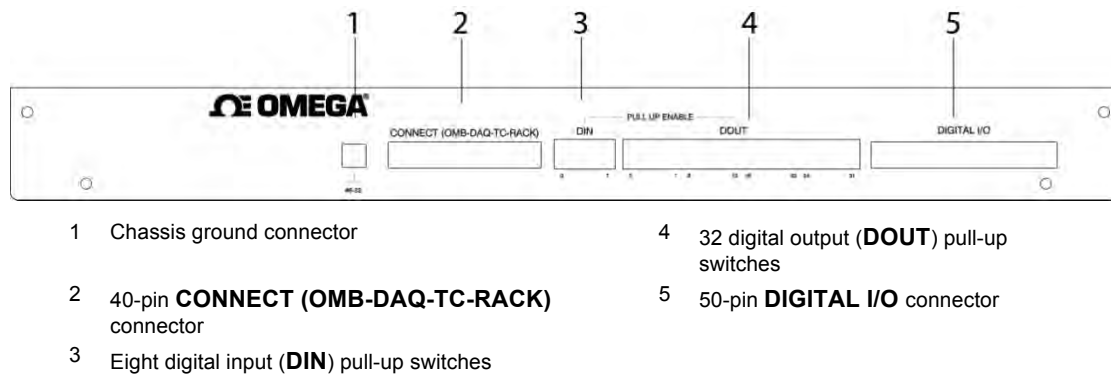


Figure 3. OMB-DAQ-TC-RACK-EXP32 rear panel components

### TC input connectors, measurements, and LED

A thermocouple consists of two dissimilar metals that are joined together at one end. When the junction of the metals is heated or cooled, a voltage is produced that correlates to temperature.

You can add another 32 differential TC input connections to mini-jack connectors labeled CH32 through CH63 (refer to Figure 2).

The device supports type J, K, S, R, B, E, T, N thermocouples.

**Caution!** Omega Engineering strongly recommends that you ground yourself using a wrist strap before handling the thermocouple sensors.

#### Connecting TCs to common-mode voltage sources

You can connect a thermocouple to a common voltage source (AC or DC) as long as the magnitude of the voltage is within the common mode voltage range specification of 48V (DC) or 3.5V p-p (AC).

Each applied common mode voltage must be less than or equal to the *average* common mode voltage  $\pm 1.4$  V.

For example, in Figure 4, there are three TCs connected to three different common mode voltage sources and two thermocouples that are not connected to anything (floating).

In this example, the average common mode voltage is calculated as follows:  $(11.4 \text{ V} + 10 \text{ V} + 8.6 \text{ V})/3 = 10 \text{ V}$



- Each TC channel becomes biased to the average common mode voltage of 10 V.
- Each common mode voltage must then be within the 10 V  $\pm$ 1.4 V limits or 8.6 V to 11.4 V.

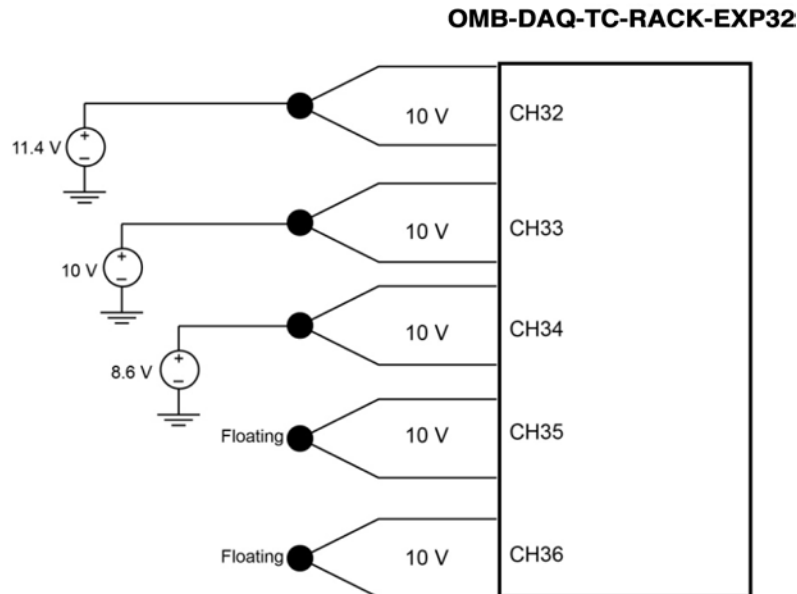


Figure 4. OMB-DAQ-TC-RACK-EXP32 common mode voltage connections example

### Cold junction compensation (CJC)

Each TC input on the OMB-DAQ-TC-RACK has a high-resolution CJC sensor. When you connect the thermocouple sensor leads to the sensor input channel, the dissimilar metals at the OMB-DAQ-TC-RACK-EXP32 terminal blocks produce an additional thermocouple junction. This junction creates a small voltage error component which must be removed from the overall sensor measurement using a CJC technique.

The measured voltage includes both the thermocouple voltage and the cold junction voltage. To compensate for the additional cold junction voltage, the OMB-DAQ-TC-RACK-EXP32 subtracts the cold junction voltage from the thermocouple voltage.

### Increasing the thermocouple length

If you need to increase the length of your thermocouple, use the same type of TC wires to minimize the error introduced by thermal EMFs.

### Data linearization

After the CJC correction is performed on the measurement data, an on-board microcontroller automatically linearizes the thermocouple measurement data using National Institute of Standards and Technology (NIST) linearization coefficients for the selected thermocouple type.

The measurement data is then output as a 32-bit floating point value in the configured format (voltage or temperature).

### Open-thermocouple detection (OTD)

The OMB-DAQ-TC-RACK-EXP32 is equipped with OTD for all analog input channel. With OTD, any open-circuit condition at the TC sensor is detected by the software. An open channel is detected by the use of a pull up and pull down resistors on the thermocouple inputs. An open thermocouple condition forces the input differential voltage outside of the valid thermocouple voltage range. The software recognizes this as an invalid reading and flags the appropriate channel. The software continues to sample all channels when OTD is detected.

### Input leakage current

With OTD enabled, 75 nA (max) of input leakage current is injected into the TC. This current can cause an error voltage to develop across the lead resistance of the TC that is indistinguishable from the thermocouple voltage you are measuring. You can estimate this error voltage with the following formula:

$$\text{error voltage} = \text{resistance of the thermocouple} \times 75 \text{ nA}$$

To reduce the error, reduce the length of the TC to lower its resistance, or lower the AWG of the wire by using a wire with a larger diameter. With open-thermocouple detection disabled, 2 nA (max) of input leakage current is injected into the TC.

### Digital I/O

The OMB-DAQ-TC-RACK-EXP32 provides eight digital inputs and 32 digital outputs that are electrically isolated from the host computer and from the OMB-DAQ-TC-RACK-EXP32 analog circuits.

All DIO bits have internal pull

-up resistors to 5 V that can be disconnected with the rear panel slide switches.

The recommended maximum length of the 50-pin cable used to connect the **DIGITAL I/O** connector to the digital I/O signal source is 1 foot.

#### Digital inputs

The OMB-DAQ-TC-RACK-EXP32 provides eight digital inputs with rates of 500 port reads or single bit reads per second.

Digital input voltage ranges of 0 V to 15 V are permitted, with thresholds of 0.6 V (low) and 2.2 V (high).

Each digital input has a 100 k $\Omega$  pull-up resistor. Use the eight **PULL-UP ENABLE – DIN** slide switches to enable or disable the 5 V pull-up option.

#### Digital outputs/temperature alarms

Each digital output is *open-drain*, which can sink up to 100 mA for direct drive applications.

Each output has a 100 k $\Omega$  pull-up resistor. Use the eight **PULL-UP ENABLE – DOUT** slide switches to enable or disable the 5 V pull-up option.

Optionally, you can configure each digital output as an alarm for each TC input. When an alarm is enabled, its associated output line is driven to the appropriate state determined by the alarm options and input temperature.

You can also use the alarm outputs to control a device or application that indicates when a temperature threshold has been exceeded.

The alarm configurations are stored in non-volatile memory and loaded at power up.

Alarm settings are applied when changed and at power on. Temperatures are constantly converted on enabled channels and processed for alarm conditions regardless of the communications connectivity.

Each available alarm mode and setting is explained below.

<p><b>Alarm input modes</b> Set independent temperature thresholds T1 and T2 for each alarm.</p>	<ul style="list-style-type: none"> <li>■ Trigger alarm when input temperature <math>\geq T1</math>; reset alarm when input temperature <math>&lt; T2</math></li> <li>■ Trigger alarm when input temperature <math>\leq T1</math>; reset alarm when input temperature <math>&gt; T2</math></li> <li>■ Trigger alarm when input temperature is <math>&lt; T1</math> or <math>&gt; T2</math></li> </ul>
<p><b>Alarm error modes</b></p>	<ul style="list-style-type: none"> <li>■ Alarm on temperature reading only</li> <li>■ Alarm on temperature reading, open thermocouple, or common-mode voltage error</li> <li>■ Alarm on open thermocouple or common-mode voltage error only</li> </ul>
<p><b>Alarm output modes</b></p>	<ul style="list-style-type: none"> <li>■ Alarm disabled; digital output line can be used for normal operation</li> <li>■ Alarm enabled; active low output (output line goes low when alarm condition is met)</li> <li>■ Alarm enabled; active high output (output line goes high when alarm condition is met)</li> <li>■ Alarm output may be latched and will not clear unless explicitly cleared by the user</li> </ul>

The OMB-DAQ-TC-RACK-EXP32 provides three alarm indicators – the [ALARM LED](#), the [OPEN TC LED](#) on the front panel and, optionally, the user-configurable digital outputs associated with each channel.

Because the digital alarm outputs are user-configurable, they can be used to supply additional information (visually, if the digital outputs are used to drive LEDs), such as the channel associated with the alarm condition or differentiating between threshold and CMV alarms.

### Pull-up configuration

By default, pull-up is enabled for all eight digital inputs and all 32 digital outputs. Slide switches on the rear of the housing can disable pull-up for each digital input bit and digital output bit.

### LED indicators

The OMB-DAQ-TC-RACK-EXP32 has four LEDs that indicate the power, communication, alarm, and open TC status

#### POWER LED

The **POWER** LED turns on when you plug the power adapter into the OMB-DAQ-TC-RACK-EXP32. If a Flash LED command is sent from an application, the **Power** LED blinks five times.

#### ACTIVITY LED<sup>2</sup>

The **ACTIVITY** LED turns on when there is a valid connection (USB or Ethernet) and blinks when a command is sent to the OMB-DAQ-TC-RACK-EXP32.

#### ALARM LED

The **ALARM** LED turns on when an alarm condition occurs.

#### OPEN TC LED

The **OPEN TC** LED turns on when there is an open thermocouple condition.

### CONNECT (OMB-DAQ-TC-RACK) connector

Use the **CONNECT (OMB-DAQ-TC-RACK)** connector to connect the OMB-DAQ-TC-RACK-EXP32 to a host OMB-DAQ-TC-RACK device (sold separately). Refer to [Installing the hardware](#) on page 7.

### Chassis ground connector

Provides a connection point (#6-32 screw) for chassis ground. Connect this to the chassis ground connector on the host OMB-DAQ-TC-RACK.

# Mechanical drawings

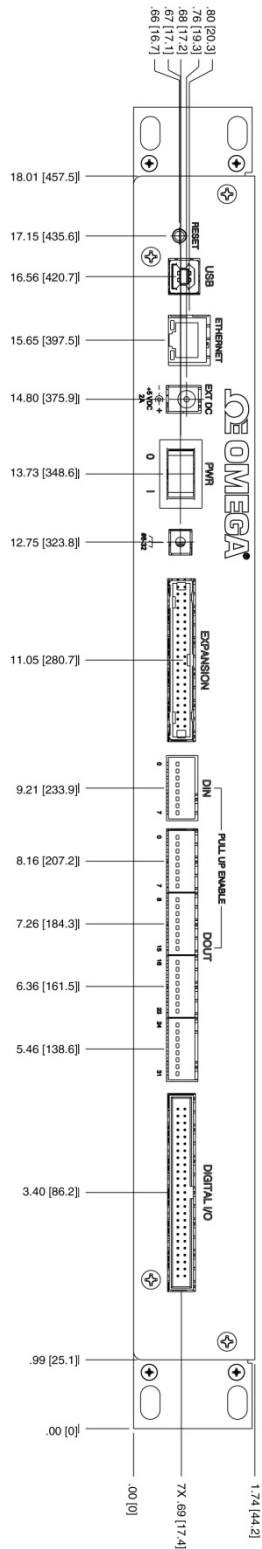


Figure 5. Enclosure dimensions - front

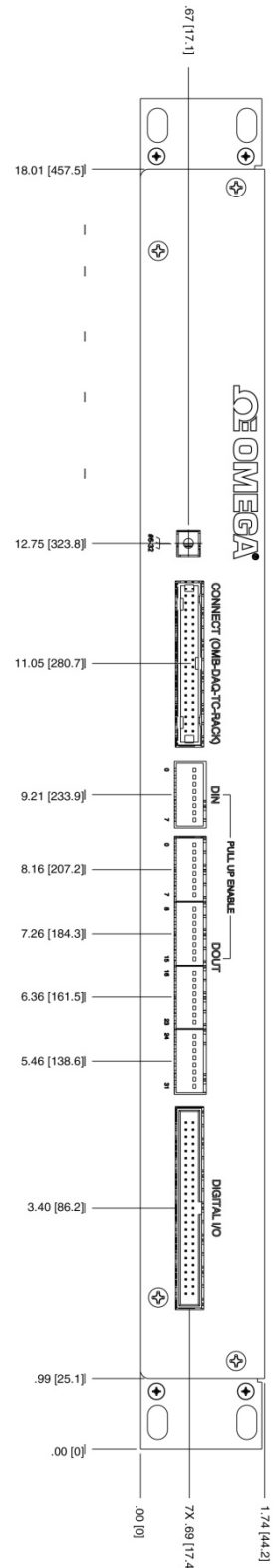


Figure 6. Enclosure dimensions - rear

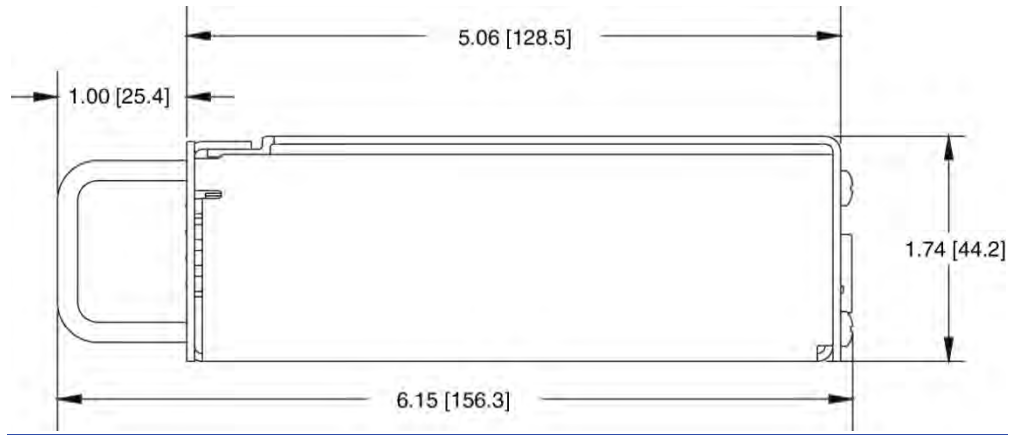


Figure 7. Enclosure dimensions – side



# Specifications

All specifications are subject to change without notice.

Typical for 25°C unless otherwise specified.

Specifications in *italic text* are guaranteed by design.

## Thermocouple input

Table 1. Generic analog input specifications

Parameter	Condition	Specification
A/D converter type		Delta-Sigma
A/D resolution		24-bit
Number of channels		32
<i>Filtering options</i>		<i>50 Hz or 60 Hz noise filtering, software-selectable</i>
<i>Isolation</i>	<i>Between any TCx channel and chassis ground.</i>	<i>500 VDC absolute max.</i>
Channel configuration		Software-selectable to match thermocouple sensor type
Differential input voltage range		±78.125 mV
<i>Absolute maximum input voltage</i>	<i>Between any two TCx inputs</i>	<i>±25 V (power on) ±25 V (power off)</i>
<i>Differential input impedance</i>	<i>50 Hz filtering, power on</i>	<i>26 MΩ</i>
	<i>60 Hz filtering, power on</i>	<i>20 MΩ</i>
<i>Input current</i>	<i>Open thermocouple detect disabled</i>	<i>2 nA</i>
	<i>Open thermocouple detect enabled</i>	<i>75 nA</i>
<i>Common mode rejection</i>	<i>50 Hz filtering, at DC and <math>f_{in}=50</math> Hz</i>	<i>110 dB</i>
	<i>60 Hz filtering at DC and <math>f_{in}=60</math> Hz</i>	<i>110 dB</i>
<i>Noise rejection</i>	<i>50 Hz filtering at <math>f_{in}=50</math> Hz</i>	<i>80 dB typ.</i>
	<i>60 Hz filtering at <math>f_{in}=60</math> Hz</i>	<i>80 dB typ.</i>
Input bandwidth	<i>50 Hz filtering</i>	<i>22 Hz</i>
	<i>60 Hz filtering</i>	<i>26 Hz</i>
Crosstalk	<i>Between any two TCx inputs</i>	<i>-90 dB</i>
Sample rate (Note 1)		3 Hz max (per channel)
Common mode voltage range (Note 2)	TCx channel to TCx channel	±1.40 V
	TCx channel relative to chassis ground, $f_{in} = 60$ Hz	±3.5 VAC p-p
	TCx channel relative to chassis ground	±48 V DC
Input noise	<i>50 Hz or 60 Hz filtering</i>	510 nV rms
Gain error	<i>50 Hz or 60 Hz filtering</i>	0.004% FSR
Offset error	<i>50 Hz or 60 Hz filtering</i>	3 μV
Measurement sensitivity (Note 3)	Thermocouple type J,K,T,E,N	0.07°C
	Thermocouple type R,S	0.18°C
	Thermocouple type B	0.60°C
Warm-up time		20 minutes min
Open thermocouple detect response time		1 second
<i>CJC sensor accuracy</i>	<i>0°C to 45°C</i>	<i>±0.20°C typ ±0.40°C max</i>

**Note 1:** The enabled thermocouple inputs are continuously converted at the maximum A/D converter rate.

**Note 2:** When thermocouple sensors are connected to different common mode voltages, the channels with floating thermocouples sensors will be biased to approximately the average value of the applied common mode voltages. Each of the applied common mode voltages must then be less than or equal to the average common mode voltage ±1.40 V or  $[CMV_{applied} \leq (CMV_{average} \pm 1.4 V)]$ .

**Note 3:** Measurement sensitivity is the smallest change in temperature that can be detected.

## Channel configuration

Table 2. Channel configuration specification

Sensor Category	Condition	Specification
Thermocouple	J, K, S, R, B, E, T, N	32 differential channels

**Note 4:** Channel configuration is stored on EEPROM external to the isolated microcontroller by the firmware whenever any item is modified. Modification is performed by commands issued from an external application, and the configuration is made non-volatile through the use of the EEPROM.

## Compatible thermocouple sensors

Table 3. Compatible sensor type specifications

Parameter	Specification
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

Table 4. Thermocouple accuracy specifications, including CJC measurement error. All specifications are ( $\pm$ ).

Sensor Type	Sensor Temperature (°C)	Accuracy Error Maximum (°C), 15°C to 35°C	Accuracy Error Typical (°C), 15°C to 35°C	Accuracy Error Maximum (°C), 0°C to 45°C	Accuracy Error Typical (°C), 0°C to 45°C
J	-210	1.965	0.910	2.167	0.989
	0	0.787	0.361	0.816	0.375
	1200	0.752	0.371	1.148	0.508
K	-210	2.295	1.061	2.520	1.152
	0	0.821	0.376	0.852	0.392
	1372	1.029	0.504	1.560	0.688
S	-50	2.467	1.111	2.655	1.223
	250	1.835	0.825	1.961	0.904
	1768	0.893	0.361	1.519	0.590
R	-50	2.609	1.174	2.810	1.293
	250	1.862	0.837	1.992	0.918
	1768	0.754	0.305	1.346	0.520
B	250	2.450	1.090	2.707	1.254
	700	0.937	0.424	1.136	0.520
	1820	0.610	0.300	1.056	0.467
E	-200	1.754	0.811	1.933	0.880
	0	0.775	0.355	0.806	0.369
	1000	0.657	0.323	0.989	0.437
T	-200	2.005	0.923	2.207	1.005
	0	0.836	0.382	0.874	0.400
	400	0.544	0.255	0.659	0.297
N	-200	2.255	1.038	2.481	1.134
	0	0.908	0.415	0.949	0.437
	1300	0.718	0.357	1.157	0.510



Thermocouple measurement accuracy specifications include polynomial linearization, cold-junction compensation, and system noise. The accuracy specifications assume the device is operated within its enclosure and with the enclosure in a horizontal, upright orientation. The board should also be warmed up for the recommended 20 minutes. If the maximum digital output load of 3.2 amps is applied, add an additional 0.30°C to the typical and maximum accuracy specifications listed above. Errors shown do not include inherent thermocouple error. Contact your thermocouple supplier for details on the actual thermocouple accuracy error.

## Digital input/output

Table 5. Digital input specifications

Parameter	Specification
Number of inputs	8 channels
Configuration	Fixed input
Input voltage range	0 V to +15 V
Input type	CMOS (Schmitt trigger)
Input characteristics	100 k $\Omega$ pull-up resistor, 28.7 k $\Omega$ series resistor
<i>Maximum input voltage range</i>	<i>0 V to +20 V max (power on/off, relative to IGND pins)</i>
Pull-up configuration	All pins pulled up to +5 V via individual 100 k $\Omega$ resistors using slide switch SW5. SW5 default positions are on (pulled up.)
Transfer rate (software paced)	500 port reads per second typ.
Input high voltage	1.3 V min, 2.2 V max
Input low voltage	1.5 V max, 0.6 V min
Schmitt trigger hysteresis	0.4 V min, 1.2 V max

Table 6. Digital output specifications

Parameter	Specification
Number of outputs	32 channels, shared with alarms
Configuration	Open drain output
Output characteristics	100 k $\Omega$ pull-up, open drain (DMOS transistor)
Pull-up configuration	All pins pulled up to +5 V through individual 100 k $\Omega$ resistors using slide switches SW1-SW4. The default positions for SW1-4 are on (pulled up.)
Transfer rate (software paced)	Digital output – 500 port writes per second typ.
Output voltage range	0 V to +5 V (internal 100 k $\Omega$ pull-up resistors connected to +5 V by default) 0 V to +15 V max (using external pull up resistor)
Off state leakage current	0.1 $\mu$ A
Sink current capability	100 mA max (continuous) per output pin
DMOS transistor on-resistance (drain to source)	4 $\Omega$

**Note 5:** Ground pins labeled IGND are isolated from AGND and chassis ground.

## Temperature alarms

Table 7. Temperature alarm specifications

Parameter	Specification
Number of alarms	32, shared with digital output
Alarm functionality	Each alarm controls its associated digital output line as an alarm output. When an alarm is enabled, its associated output line is driven to the appropriate state determined by the alarm options and input temperature. The alarm configurations are stored in non-volatile memory and loaded at power on.

Parameter	Specification
Alarm input modes	<ul style="list-style-type: none"> <li>■ Alarm when input temperature <math>\geq T1</math>, reset alarm when input temperature <math>&lt; T2</math></li> <li>■ Alarm when input temperature <math>\leq T1</math>, reset alarm when input temperature <math>&gt; T2</math></li> <li>■ Alarm when input temperature is <math>&lt; T1</math> or <math>&gt; T2</math></li> </ul> Note: T1 and T2 may be independently set for each alarm.
Alarm error modes	<ul style="list-style-type: none"> <li>■ Alarm on temperature reading only</li> <li>■ Alarm on temperature reading, open thermocouple, or common-mode voltage error</li> <li>■ Alarm on open thermocouple or common-mode voltage error only</li> </ul>
Alarm output modes	<ul style="list-style-type: none"> <li>■ Disabled, digital output line may be used for normal operation</li> <li>■ Enabled, active high output (output line goes high when alarm condition is met)</li> <li>■ Enabled, active low output (output line goes low when alarm condition is met)</li> <li>■ Alarm output may be latched and will not clear unless explicitly cleared by the user</li> </ul>
Alarm latency (Note 6)	1 second, max

**Note 6:** Alarm settings are applied when changed and at power-on. Temperatures are constantly converted on enabled channels and processed for alarm conditions regardless of the communications connectivity.

## Memory

Table 8. Memory specifications

Parameter	Specification
EEPROM	4,096 bytes

## Microcontroller

Table 9. Microcontroller specifications

Parameter	Specification
Type	One high-performance 32-bit RISC microcontroller

## LED displays

Table 10. LED and button configurations

Parameter	Specification
<b>POWER</b> LED (top)	Indicates power on. Blinks when blink command is sent. Both the <b>POWER</b> and <b>ACTIVITY</b> LEDs blink in firmware upgrade mode.
<b>ACTIVITY</b> LED	On when there is a valid connection and blinks when a command is sent to the OMB-DAQ-TC-RACK-EXP32. Both the <b>POWER</b> and <b>ACTIVITY</b> LEDs blink in firmware upgrade mode.
<b>ALARM</b> LED	Indicates that an alarm condition is met.
<b>OPEN TC</b> LED (bottom)	Indicates that there is an open thermocouple condition.

## Environment

Table 11. Environmental specifications

Parameter	Specification
Operating temperature range	0 °C to 45 °C
Storage temperature range	-40 °C to 85 °C
Humidity	0 °C to 90% non-condensing

## Mechanical

Table 12. Mechanical specifications

Parameter	Specification
Dimensions (L × W × H)	482.6 × 128.6 × 43.18 mm (19 × 6.15 × 1.74 in.)

## Signal I/O connectors

Table 13. Connector specifications

Parameter	Specification
User accessible I/O connectors (excluding USB and Ethernet)	Thermocouple inputs, digital I/O connector, expansion connector, chassis ground
Thermocouple connector type	Thermocouple Mini-Jack (Omega PCC-SMP-V-U-100)
Digital I/O connector type	50-pin IDC header
Compatible cable for the 50-pin DIO connector	C50FF-2, C50FF-15
Compatible accessory products with the C50FF-2 and C50FF-15 cables	CIO-MINI50
Expansion connector type	40-pin IDC header
Compatible cables for the 40-pin expansion connector	C40FF-2
Chassis ground connector	6-32 threaded screw

Table 14. Thermocouple connector pinout

Pin	Signal Name	Pin Description	Pin	Signal Name	Pin Description
J1	TC32(+)	CH32 sensor input (+)	J17	TC48(+)	CH48 sensor input (+)
	TC32(-)	CH32 sensor input (-)		TC48(-)	CH48 sensor input (-)
J2	TC33(+)	CH33 sensor input (+)	J18	TC49(+)	CH49 sensor input (+)
	TC33(-)	CH33 sensor input (-)		TC49(-)	CH49 sensor input (-)
J3	TC34(+)	CH34 sensor input (+)	J19	TC50(+)	CH50 sensor input (+)
	TC34(-)	CH34 sensor input (-)		TC50(-)	CH50 sensor input (-)
J4	TC35(+)	CH35 sensor input (+)	J20	TC51(+)	CH51 sensor input (+)
	TC35(-)	CH35 sensor input (-)		TC51(-)	CH51 sensor input (-)
J5	TC36(+)	CH36 sensor input (+)	J21	TC52(+)	CH52 sensor input (+)
	TC36(-)	CH36 sensor input (-)		TC52(-)	CH52 sensor input (-)
J6	TC37(+)	CH37 sensor input (+)	J22	TC53(+)	CH53 sensor input (+)
	TC37(-)	CH37 sensor input (-)		TC53(-)	CH53 sensor input (-)
J7	TC38(+)	CH38 sensor input (+)	J23	TC54(+)	CH54 sensor input (+)
	TC38(-)	CH38 sensor input (-)		TC54(-)	CH54 sensor input (-)
J8	TC39(+)	CH39 sensor input (+)	J24	TC55(+)	CH55 sensor input (+)
	TC39(-)	CH39 sensor input (-)		TC55(-)	CH55 sensor input (-)
J9	TC40(+)	CH40 sensor input (+)	J25	TC56(+)	CH56 sensor input (+)
	TC40(-)	CH40 sensor input (-)		TC56(-)	CH56 sensor input (-)
J10	TC41(+)	CH41 sensor input (+)	J26	TC57(+)	CH57 sensor input (+)
	TC41(-)	CH41 sensor input (-)		TC57(-)	CH57 sensor input (-)
J11	TC42(+)	CH42 sensor input (+)	J27	TC58(+)	CH58 sensor input (+)
	TC42(-)	CH42 sensor input (-)		TC58(-)	CH58 sensor input (-)
J12	TC43(+)	CH43 sensor input (+)	J28	TC59(+)	CH59 sensor input (+)
	TC43(-)	CH43 sensor input (-)		TC59(-)	CH59 sensor input (-)
J13	TC44(+)	CH44 sensor input (+)	J29	TC60(+)	CH60 sensor input (+)
	TC44(-)	CH44 sensor input (-)		TC60(-)	CH60 sensor input (-)
J14	TC45(+)	CH45 sensor input (+)	J30	TC61(+)	CH61 sensor input (+)
	TC45(-)	CH45 sensor input (-)		TC61(-)	CH61 sensor input (-)
J15	TC46(+)	CH46 sensor input (+)	J31	TC62(+)	CH62 sensor input (+)
	TC46(-)	CH46 sensor input (-)		TC62(-)	CH62 sensor input (-)
J16	TC47(+)	CH47 sensor input (+)	J32	TC63(+)	CH63 sensor input (+)
	TC47(-)	CH47 sensor input (-)		TC63(-)	CH63 sensor input (-)

Table 15. Digital I/O connector (J33) pinout

Pin	Signal Name	Pin Description	Pin	Signal Name	Pin Description
1	DOUT0	Digital Output 0 / Alarm Output 32	2	DOUT1	Digital Output 1 / Alarm Output 33
3	DOUT2	Digital Output 2 / Alarm Output 34	4	DOUT3	Digital Output 3 / Alarm Output 35
5	DOUT4	Digital Output 4 / Alarm Output 36	6	DOUT5	Digital Output 5 / Alarm Output 37
7	DOUT6	Digital Output 6 / Alarm Output 38	8	DOUT7	Digital Output 7 / Alarm Output 39
9	DOUT8	Digital Output 8 / Alarm Output 40	10	DOUT9	Digital Output 9 / Alarm Output 41
11	DOUT10	Digital Output 10 / Alarm Output 42	12	DOUT11	Digital Output 11 / Alarm Output 43
13	DOUT12	Digital Output 12 / Alarm Output 44	14	DOUT13	Digital Output 13 / Alarm Output 45
15	DOUT14	Digital Output 14 / Alarm Output 46	16	DOUT15	Digital Output 15 / Alarm Output 47
17	IGND	Isolated Digital GND	18	IGND	Isolated Digital GND
19	IGND	Isolated Digital GND	20	IGND	Isolated Digital GND
21	DOUT16	Digital Output 16 / Alarm Output 48	22	DOUT17	Digital Output 17 / Alarm Output 49
23	DOUT18	Digital Output 18 / Alarm Output 50	24	DOUT19	Digital Output 19 / Alarm Output 51
25	DOUT20	Digital Output 20 / Alarm Output 52	26	DOUT21	Digital Output 21 / Alarm Output 53
27	DOUT22	Digital Output 22 / Alarm Output 54	28	DOUT23	Digital Output 23 / Alarm Output 55
29	DOUT24	Digital Output 24 / Alarm Output 56	30	DOUT25	Digital Output 25 / Alarm Output 57
31	DOUT26	Digital Output 26 / Alarm Output 58	32	DOUT27	Digital Output 27 / Alarm Output 59
33	DOUT28	Digital Output 28 / Alarm Output 60	34	DOUT29	Digital Output 29 / Alarm Output 61
35	DOUT30	Digital Output 30 / Alarm Output 62	36	DOUT31	Digital Output 31 / Alarm Output 63
37	IGND	Isolated Digital GND	38	IGND	Isolated Digital GND
39	IGND	Isolated Digital GND	40	IGND	Isolated Digital GND
41	DIN0	Digital Input 0	42	DIN1	Digital Input 1
43	DIN2	Digital Input 2	44	DIN3	Digital Input 3
45	DIN4	Digital Input 4	46	DIN5	Digital Input 5
47	DIN6	Digital Input 6	48	DIN7	Digital Input 7
49	IGND	Isolated Digital GND	50	IGND	Isolated Digital GND

Table . Expansion connector (J34) pinout

Pin	Signal Name	Pin Description	Pin	Signal Name	Pin Description	
1	+12VA	+12 VA power input	Note 7	2	AGND	Isolated Analog GND
3	+12VA	+12 VA power input		4	AGND	Isolated Analog GND
5	+5VA	+5 VA power input		6	AGND	Isolated Analog GND
7	+5VA	+5 VA power input		8	AGND	Isolated Analog GND
9	+5VA	+5 VA power input		10	AGND	Isolated Analog GND
11	+5VA	+5 VA power input		12	AGND	Isolated Analog GND
13	+3.3VA	+3.3 VA power input		14	AGND	Isolated Analog GND
15	+3.3VA	+3.3 VA power input		16	AGND	Isolated Analog GND
17	+3.3VA	+3.3 VA power input		18	AGND	Isolated Analog GND
19	+3.3VA	+3.3 VA power input		20	AGND	Isolated Analog GND
21	CS	Chip select	22	AGND	Isolated Analog GND	
23	SCK	Serial clock	24	AGND	Isolated Analog GND	
25	MOSI	Master output data	26	AGND	Isolated Analog GND	
27	MISO	Master input data	28	AGND	Isolated Analog GND	
29	IRQ	Interrupt request	30	AGND	Isolated Analog GND	
31	RSVD	Reserved	32	AGND	Isolated Analog GND	
33	RSVD	Reserved	34	AGND	Isolated Analog GND	
35	RSVD	Reserved	36	AGND	Isolated Analog GND	
37	RSVD	Reserved	38	AGND	Isolated Analog GND	
39	AGND	Isolated Analog GND	40	AGND	Isolated Analog GND	

**Note 7:** Power supplies (+12 VA, +5 VA, 3.3 VA) located at connector J34 are intended for use with the OMB-DAQ-TC-RACK EXP32 expansion device only.

**NOTES:**

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