32-Channel USB/Ethernet Based Thermocouple Input Data Acquisition System

OMB-DAQ-TC-RACK

1 YEAR WARRANTY

- USB and 10/100 Ethernet Interface
- 32 Differential Thermocouple Inputs
- Expandable to 64 Thermocouple Inputs with OMB-DAQ-TC-RACK-EXP32 Expansion Module
- Thermocouple Channel-to-Host Isolation
- Inputs Connect Easily to Built-In Miniature Thermocouple Jacks
- 24-Bit Resolution
- 3 S/s Per Channel Maximum Sample Rate
- Supports Types J, K, T, E, R, S, B, and N Thermocouples (Software-Selectable Per Channel)
- Per Channel Out-of-Range Alarm Configuration
- Cold-Junction Compensation (CJC) Sensor Per Channel
- Open Thermocouple Detection
- 8 Digital Inputs and 32 Digital Outputs/ Alarms
  - Expandable to 16 Digital Inputs, and 64 Digital Outputs/Alarms with OMB-DAQ-TC-RACK-EXP32 Expansion Module
  - Isolated from Thermocouple Inputs and Host
  - 50-pin Header Connector (Cable Sold Separately)
- 19" Rack Mountable
- Requires External Power (Power Adaptor Included with OMB-DAQ-TC-RACK)
  - OMB-DAQ-TC-RACK-EXP32 is Powered by Connected OMB-DAQ-TC-RACK

The OMB-DAQ-TC-RACK and OMB-DAQ-TC-RACK-EXP32 offer exceptional performance and accuracy for thermocouple measurement applications at a low cost per channel. Offering both Ethernet and USB ports, the OMB-DAQ-TC-RACK provides 32 channels of 24-bit resolution for medium channel installations. The OMB-DAQ-TC-RACK-EXP32 adds 32 high-precision channels to support larger installations. Accuracy is designed into the product with sigma-delta 24-bit ADCs, differential inputs, thermocouple-to-host isolation and cold-junction compensation (CJC) for each channel to reduce the effects of thermal gradients. With digital alarming notifications when a temperature exceeds programmed limits, the OMB-DAQ-TC-RACK and OMB-DAQ-TC-RACK-EXP32 offer the perfect solution for temperature monitoring applications including server rooms, refrigerated storage, and long-run test cells.

Channel Expansion with the OMB-DAQ-TC-RACK-EXP32

Connect an OMB-DAQ-TC-RACK-EXP32 expansion module to double the number of thermocouple inputs (64), digital inputs (16), and digital outputs/ alarms (64). The OMB-DAQ-TC-RACK-EXP32 connects to the host OMB-DAQ-TC-RACK through a 40-pin expansion connector. The host OMB-DAQ-TC-RACK provides all power to the OMB-DAQ-TC-RACK-EXP32. The OMB-DAQ-TC-RACK-EXP32 supports all of the thermocouple input and digital I/O features of the host OMB-DAQ-TC-RACK, including built-in cold-junction compensation and open thermocouple detection.

USB or Ethernet Interface

The OMB-DAQ-TC-RACK can communicate with a host device through either USB or 10/100 Ethernet. By offering both USB and Ethernet ports, the OMB-DAQ-TC-RACK is the perfect solution for local or remote monitoring.

Thermocouple Input

Connect up to 32 differential thermocouple input channels using the four groups of eight mini-jack connectors on the front panel of each device. Both the OMB-DAQ-TC-RACK and OMB-DAQ-TC-RACK-EXP32 support a maximum sample rate of 3 S/s per channel, and thermocouple types J, K, T, E, R, S, B, and N. Thermocouple types are software-selectable per channel.

Cold-Junction Compensation (CJC)

Each thermocouple input on OMB-DAQ-TC-RACK devices has a high-resolution CJC sensor that provides a local cold-junction temperature reference point. This feature ensures the highest level of temperature measurement accuracy.

Data Linearization

After the device performs CJC correction, an onboard microcontroller automatically linearizes the thermocouple data using National Institute of Standards and Technology (NIST) linearization coefficients for the selected thermocouple type. The data is then output as a 32-bit floating point value in the configured format (voltage or temperature).

Open-Thermocouple Detection (OTD)

OMB-DAQ-TC-RACK devices are equipped with OTD for all thermocouple input channels. When enabled, OTD allows users to monitor their thermocouples and determine if they are broken or disconnected.

Connecting Thermocouples to Common-Mode Voltage Sources

Thermocouple inputs are isolated and thermocouple common-mode voltage may deviate up to 48 Vdc or 3.5 Vac (at 60 Hz) from chassis ground without any negative impact to measurement accuracy. Common-mode voltages between channels, however, should not vary more than ±1.4 Vdc (refer to common mode voltage range specifications for more information).

Digital I/O and Alarms

The OMB-DAQ-TC-RACK provides up to 8 digital inputs and 32 digital outputs that are electrically isolated from the host device and from the OMB-DAQ-TC-RACK analog circuits. This configuration allows users to enable a digital output/alarm for each thermocouple channel. 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 up. OMB-DAQ-TC-RACK input channels are constantly converted on enabled channels and processed for alarm conditions regardless of communications connectivity ensuring proper alarming even if communication to the device is lost. Alarm outputs can be used to indicate when a temperature threshold has been exceeded. This output can be connected to another device, such as a physical alarm or control system. Each digital output is open-drain, which can sink up to 100 mA for direct drive applications.

The OMB-DAQ-TC-RACK-EXP32 provides an additional 8 digital inputs and 32 digital outputs. Digital I/O signals and alarms are accessible through a 50-pin connector on both the OMB-DAQ-TC-RACK and OMB-DAQ-TC-RACK-EXP32.

Power

The OMB-DAQ-TC-RACK requires external power. A 5V, 10 W power adaptor (OMB-DAQ-TC-RACK-PS) is included with the OMB-DAQ-TC-RACK. The OMB-DAQ-TC-RACK provides power to the OMB-DAQ-TC-RACK-EXP32 when they are connected.

Calibration

Both the OMB-DAQ-TC-RACK and OMB-DAQ-TC-RACK-EXP32 are factory-calibrated using a NIST-traceable calibration process. Specifications are guaranteed for one year. For calibration beyond one year, return the device to the factory for recalibration. The OMB-DAQ-TC-RACK and OMB-DAQ-TC-RACK-EXP32 devices also support field calibration so that users can calibrate a device locally.

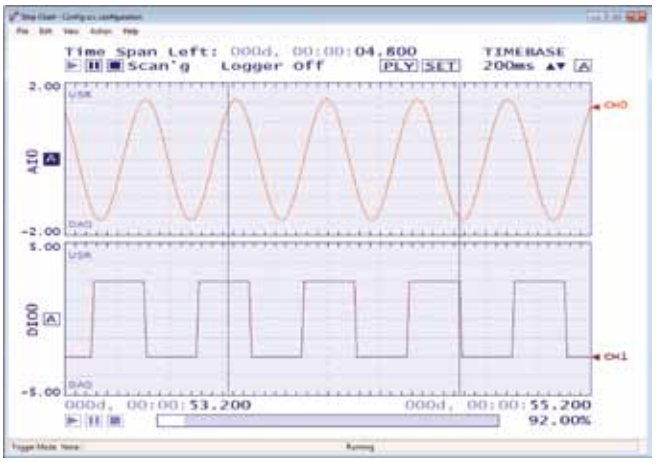
Software

The OMB-DAQ-TC-RACK module ships with an impressive array of software, including TracerDAQ®, a full-featured, out-of-the-box data logging, viewing, and analysis application. Driver support and detailed example programs are included for Universal Library programming libraries for Microsoft® Visual Studio® programming languages, and other languages, including DASYLab®, and ULx for NI LabVIEW® (comprehensive library of VIs and example programs compatible with 32-bit and 64-bit LabVIEW 2010 or later) and InstaCal™ installation, calibration and test utility-powerful solutions for programmers and nonprogrammers alike. These modules operate under Microsoft Windows® VISTA/7/8/10 (32-bit and 64-bit) operating systems.

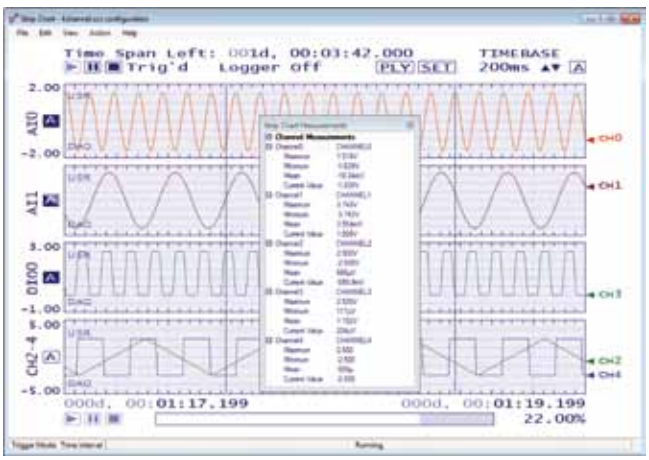
The OMB-DAQ-TC-RACK data acquisition module is supplied with TracerDAQ software which is a collection of four virtual instrument applications used to graphically display and store input data and generate output signals:

- Strip Chart—Log and graph values acquire from analog inputs, digital inputs, temperature inputs and counter inputs
- Oscilloscope—Display values acquired from analog inputs
- Function Generator—Generate waveforms for analog outputs
- Rate Generator—Generate waveforms for counter outputs

TracerDAQ PRO is an enhanced version of TracerDAQ and is available as a purchased upgrade (SWD-TRACERDAQ-PRO). A comparison of some of the features included in TracerDAQ vs TracerDAQ PRO is shown below.



TracerDAQ Strip Chart.



TracerDAQ Pro Strip Chart with Measurements.

Features Comparison

Strip Chart

Feature	TracerDAQ	TracerDAQ Pro
Channel Types	Analog input, temperature input, digital input, event counter	
Number of Channels	8	48
Number of Lanes	2	8
Maximum Samples per Channel	32,000	1 million
Alarm Conditions	No	Yes
Measurements Window	No	Yes
Enter Annotations	No	Yes
Software Triggering	No	Yes
Hardware Triggering	No	Yes
Time-of-Day Triggering	No	Yes
Linear Scaling	No	Yes

Oscilloscope

Feature	TracerDAQ	TracerDAQ Pro
Channel Type	Analog input	
Number of Channels	2	4
Measurements Window	No	Yes
Reference Channel	No	Yes
Math Channel	No	Yes

Rate Generator

Feature	TracerDAQ	TracerDAQ Pro
Channel Type	Counter output	
Number of Channels	1	20

Function Generator

Feature	TracerDAQ	TracerDAQ Pro
Channel Type	Analog output	
Number of Channels	1	16
Waveform Types	Sine	Sine, square, triangle, flat, pulse, ramp, random, arbitrary
Duty Cycle	No	Yes
Phase	No	Yes
Gate Ratio	No	Yes
Rate Multiplier	No	Yes
Sweep (Linear and Exponential)	No	Yes

Specifications

(TYPICAL FOR 25°C (77°F) UNLESS OTHERWISE SPECIFIED)

These specifications apply to both the OMB-DAQ-TC-RACK and OMB-DAQ-TC-RACK-EXP32 unless noted otherwise.

THERMOCOUPLE INPUT

A/D Converter Type: Delta-Sigma

A/D Resolution: 24-bit

Number of Channels: 32 (64 when OMB-DAQ-TC-RACK is connected to OMB-DAQ-TC-RACK-EXP32)

Filtering Options: 50 Hz or 60 Hz noise filtering, software-selectable

Isolation Between Any Thermocouple Input Channel and Chassis Ground: 500 Vdc absolute max

Channel Configuration: Software-selectable to match thermocouple sensor type

Differential Input Voltage Range: ±78.125 mV

Absolute Maximum Input Voltage (Between any Two TCx Inputs): ±25V (power on), ±25V (power off)

Differential Input Impedance:

- **50 Hz Filtering, Power On:** 26 MΩ
- **60 Hz Filtering, Power On:** 20 MΩ

Input Current:

- **Open Thermocouple Detect Disabled:** 2 nA
- **Open Thermocouple Detect Enabled:** 75 nA

Common Mode Rejection:

- **50 Hz Filtering at DC and f_{IN}=50 Hz:** 110 dB
- **60 Hz Filtering at DC and f_{IN}=60 Hz:** 110 dB

Noise Rejection:

- **50 Hz Filtering at f_{IN}=50 Hz:** 80 dB typ
- **60 Hz Filtering at f_{IN}=60 Hz:** 80 dB typ

Input Bandwidth:

- **50 Hz Filtering:** 22 Hz
- **60 Hz Filtering:** 26 Hz

Crosstalk Between Any Two Thermocouple Inputs: -90 dB

Sample Rate: 3 Hz max (per channel); the enabled thermocouple inputs are continuously converted at the maximum A/D converter rate

Common Mode Voltage Range:

- **TCx Channel to TCx Channel:** ±1.40V
- **TCx Channel Relative to Chassis Ground, f_{IN} = 60 Hz:** ±3.5 Vac p-p
- **TCx Channel Relative to Chassis Ground:** ±48 Vdc

When thermocouple sensors are connected to different common mode voltages, the channels with floating thermocouples sensors are 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 [$CMV_{applied} \leq (CMV_{average} \pm 1.4\ V)$].

Input Noise (50 or 60 Hz Filtering): 510 nV rms

Gain Error (50 or 60 Hz Filtering): 0.004% FSR

Offset Error (50 or 60 Hz Filtering): 3 µV

Measurement Sensitivity (Smallest Change in Temperature That Can Be Detected):

- **Thermocouple Type J, K, T, E, N:** 0.05°C
- **Thermocouple Type R, S:** 0.10°C
- **Thermocouple Type B:** 0.15°C

Warm-Up Time: 20 minutes min

Open Thermocouple Detect Response Time: 1 s

CJC Sensor Accuracy (0 to 45°C): ±0.20°C typ, ±0.40°C max

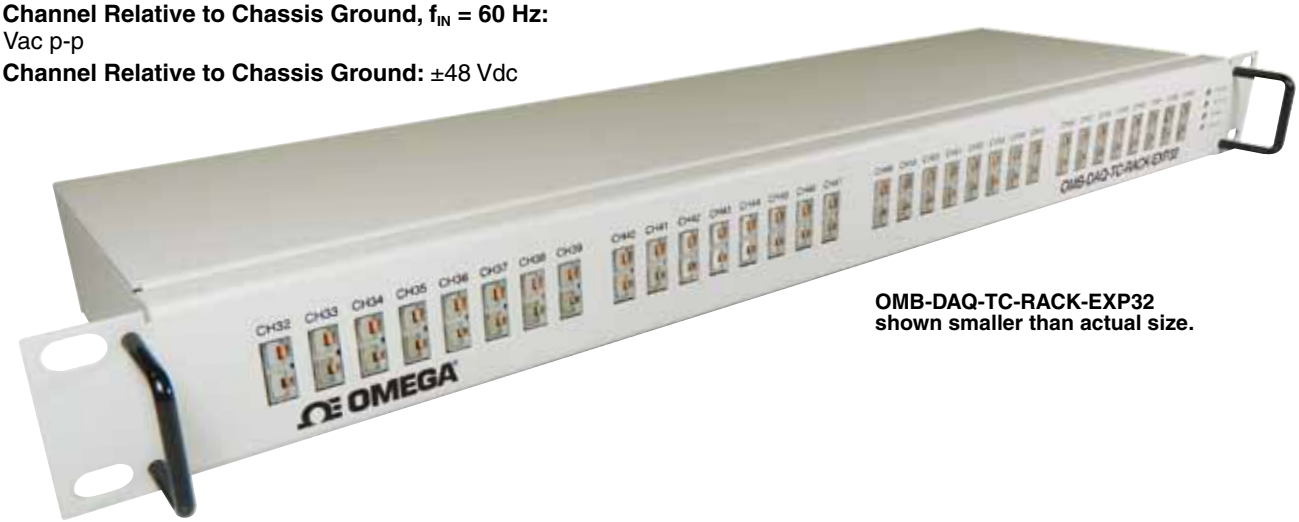
CHANNEL CONFIGURATION

Thermocouple (J, K, T, E, R, S, B, N): 32 differential channels

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.

Thermocouple Input Types and Ranges

Type	Range
J	-210 to 1200°C (-346 to 2192°F)
K	-270 to 1372°C (-454 to 2502°F)
T	-270 to 400°C (-454 to 752°F)
E	-270 to 1000°C (-454 to 1832°F)
R	-50 to 1768°C (-58 to 3214°F)
S	-50 to 1768°C (-58 to 3214°F)
B	0 to 1820°C (32 to 3308°F)
N	-270 to 1300°C (-454 to 2372°F)



OMB-DAQ-TC-RACK-EXP32 shown smaller than actual size.

Thermocouple Measurement Accuracy, Including CJC Measurement Error. All Specifications are (±).

Sensor Type	Sensor Temperature		Accuracy Error Maximum (°C), 15 to 35°C	Accuracy Error Typical (°C), 15 to 35°C	Accuracy Error Maximum (°C), 0 to 45°C	Accuracy Error Typical (°C), 0 to 45°C
	°C	°F				
J	-210	-346	1.965	0.910	2.167	0.989
	0	32	0.787	0.361	0.816	0.375
	1200	2192	0.752	0.371	1.148	0.508
K	-210	-346	2.295	1.061	2.520	1.152
	0	32	0.821	0.376	0.852	0.392
	1372	2502	1.029	0.504	1.560	0.688
T	-200	-328	2.005	0.923	2.207	1.005
	0	32	0.836	0.382	0.874	0.400
	400	752	0.544	0.255	0.659	0.297
E	-200	-328	1.754	0.811	1.933	0.880
	0	32	0.775	0.355	0.806	0.369
	1000	1832	0.657	0.323	0.989	0.437
R	-50	-58	2.609	1.174	2.810	1.293
	250	482	1.862	0.837	1.992	0.918
	1768	3214	0.754	0.305	1.346	0.520
S	-50	-58	2.467	1.111	2.655	1.223
	250	482	1.835	0.825	1.961	0.904
	1768	3214	0.893	0.361	1.519	0.590
B	250	482	2.450	1.090	2.707	1.254
	700	1292	0.937	0.424	1.136	0.520
	1820	3308	0.610	0.300	1.056	0.467
N	-200	-328	2.255	1.038	2.481	1.134
	0	32	0.908	0.415	0.949	0.437
	1300	2372	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 (0.54°F) to the typical and maximum accuracy specifications listed above. Errors shown do not include inherent thermocouple error.

DIGITAL INPUT

Number of Inputs: 8 channels (16 when OMB-DAQ-TC-RACK connected to OMB-DAQ-TC-RACK-EXP32)

Configuration: Fixed input

Input Voltage Range: 0 to 15V

Input Type: CMOS (Schmitt trigger)

Input Characteristics: 100 kΩ pull-up resistor, 28.7 kΩ series resistor

Maximum Input Voltage Range: 0 to 20V max (power on/off, relative to IGND pins)

Pull-Up Configuration: All pins pulled up to 5V via individual 100 kΩ resistors using slide switch SW5; SW5 default position are on (pulled up)

Transfer Rate (Software Paced): 500 port reads per second typ

Input High Voltage: 1.3V min, 2.2V max

Input Low Voltage: 1.5V max, 0.6V min

Schmitt Trigger Hysteresis: 0.4V min, 1.2V max

DIGITAL OUTPUT

Number of Outputs: 32 channels, shared with alarms (64 when OMB-DAQ-TC-RACK connected to OMB-DAQ-TC-RACK-EXP32)

Configuration: Open drain output

Output Characteristics: 100 kΩ pull-up, open drain (DMOS transistor)

Pull-Up Configuration: All pins pulled up to 5V through individual 100 kΩ resistors using slide switches SW1-SW4; the default positions for SW1-SW4 are on (pulled up)

Transfer Rate (Software Paced): Digital output–500 port writes per second typ

Output Voltage Range:

0 to 5V: Internal 100 kΩ pull-up resistors connected to 5V by default

0 to 15V: Max (using external pull-up resistor)

Ground: Pins labeled IGND are isolated from AGND and chassis ground

Off State Leakage Current: 0.1 µA

Sink Current Capability: 100 mA max (continuous) per output pin

DMOS Transistor On-Resistance (Drain to Source): 4 Ω

TEMPERATURE ALARMS

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.

Alarm Input Modes (T1 and T2 Can Be Independently Set for Each Alarm):

- Alarm when input temperature ≥ T1, reset alarm when input temperature < T2
- Alarm when input temperature ≤ T1, reset alarm when input temperature > T2
- Alarm when input temperature is < T1 or > T2

Alarm Error Modes:

- Alarm on temperature reading only
- Alarm on temperature reading, open thermocouple, or common-mode voltage error
- Alarm on open thermocouple or common-mode voltage error only

Alarm Output Modes:

- Disabled, digital output line may be used for normal operation
- Enabled, active high output (output line goes high when alarm condition is met)
- Enabled, active low output (output line goes low when alarm condition is met)
- Alarm output may be latched and will not clear unless explicitly cleared by the user

Alarm Latency: 1 second, max

- 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

EEPROM: 4096 bytes

MICRO CONTROLLER

Type: One high-performance 32-bit RISC microcontroller

USB (OMB-DAQ-TC-RACK ONLY)

Device Type: USB 2.0 full speed

Device Compatibility: USB 1.1, USB 2.0, USB 3.0

Connector: Standard B

Cable Length: 5 m (16.4') max

Power: Self-powered (no USB current consumed)

NETWORK (OMB-DAQ-TC-RACK ONLY)

Ethernet Connection

Ethernet Type: 100 Base-TX, 0 Base-T

Communication Rates: 10/100 Mbps, auto-negotiated

Connector: RJ-45, 8 position

Cable Length: 100 m (328') max

Additional Parameters: HP Auto-MDIX support

Network Interface

Protocols Used: TCP/IP (IPv4 only), UDP

Network Ports Used: UDP: 54211 (discovery)

TCP: 54211 (commands)

Network IP Configuration: DHCP + link-local, DHCP, static, link-local

Network Name: TC-32-xxxxxx, where xxxxxx are the lower 6 digits of the device MAC address

Network Name Publication: By NBNS (responds to b-node broadcasts, therefore only available on the local subnet)

Network Factory Default Settings

Factory Default IP Address: 192.168.0.101

Factory Default Subnet Mask: 255.255.255.0

Factory Default Gateway: 192.168.0.1

Factory Default DHCP Setting: DHCP + link-local enabled

Network Security

Security Implementation: TCP sockets are not opened unless application sends the correct PIN code (stored in non-volatile memory, may be changed by user, default value 0000)

Number of Concurrent Sessions: 1

Vulnerabilities: TCP Sequence number approximation vulnerability

POWER (OMB-DAQ-TC-RACK ONLY)

Supply Current: 330 mA typ, 610 mA max; 550 mA typ, 1000 mA max (with OMB-DAQ-TC-RACK-EXP32 connected)

External Power Input: 5 Vdc ±5% (5 Vdc power supply provided)

Voltage specification applies at barrel plug power input. The power supply provided with the device meets this specification at the rated total power supply current. If a different power supply is used, small line resistances could cause significant voltage drop between the power supply and the barrel plug input.

Power Switch: Rocker type

External Power Supply (Included): 5 Vdc, 10 W, 5% regulation (model number OMB-DAQ-TC-RACK-PS)

External Power Input Voltage Supervisor Limits:

4.0V > Vext > 5.75V: PWR LED = Off (power fault)

4.0V < Vext < 5.75V: PWR LED = On

Chassis Ground Connection: 6-32 screw on rear of enclosure

OMB-DAQ-TC-RACK shown smaller than actual size.

LED DISPLAYS AND THE FACTORY RESET BUTTON

POWER LED (top): Indicates power on. Blinks when blink command is sent. Both the POWER and ACTIVITY LEDs blink in firmware upgrade mode

ACTIVITY LED: On when there is a valid connection and blinks when a command is sent to the OMB-DAQ-TC-RACK-EXP32. Both the POWER and ACTIVITY LEDs blink in firmware upgrade mode

ALARM LED: Indicates that an alarm condition is met

OPEN TC LED (Bottom): Indicates that there is an open thermocouple condition

Factory Reset Button: When held for 3 seconds, the LEDs turn off for a short time, indicating a reset is in process. When the LEDs turn back on, reset is complete and the factory-default network settings are restored

ENVIRONMENTAL

Operating Temperature Range: 0 to 45°C (32 to 113°F)

Storage Temperature Range: -40 to 85°C (-40 to 185°F)

Humidity: 0 to 90% RH non-condensing

MECHANICAL

Dimensions: 482.6 L x 128.6 W x 43.18 mm H (19 x 6.15 x 1.74")

Weight:

OMB-DAQ-TC-RACK: 3.8 lb (1.73 kg)

OMB-DAQ-TC-RACK-EXP32: 3.2 lb (1.45 kg)

SIGNAL I/O CONNECTORS

User Accessible I/O Connectors (Excluding USB and Ethernet): Thermocouple inputs, digital I/O connector, expansion connector, chassis ground

Thermocouple Connector Type: Female subminiature thermocouple jack

Digital I/O Connector Type: 50-pin IDC header

Compatible Cable for the 50-Pin DIO Connector: C50FF-x

Compatible Accessory Board With the C50FF-x Cable: CIO-MINI50

Expansion Connector Type: 40-pin IDC header

Compatible Cables for the 40-Pin Expansion Connector: C40FF-x

Chassis Ground Connector: 6-32 screw

OMEGACARE℠ Extended Warranty Program

OMEGACARE℠ extended warranty program is available for models shown on this page. Ask your sales representative for full details when placing an order. OMEGACARE℠ covers parts, labor and equivalent loaners.

To Order

Model No.	Description
OMB-DAQ-TC-RACK	32-channel USB/ethernet based thermocouple input data acquisition system
OMB-DAQ-TC-RACK-EXP32	32-channel expansion module for OMB-DAQ-TC-RACK
C40FF-2	Expansion connector 40-pin cable, 0.6 m (2')
C50FF-2	Digital I/O 50-pin cable, 0.6 m (2')
C50FF-10	Digital I/O 50-pin cable, 3 m (10')
CIO-MINI50	50-pin universal screw terminal board for digital I/O
SWD-TRACERDAQ-PRO	TracerDAQ PRO software
OMB-DAQ-TC-RACK-PS	Replacement 100/240 Vac 50/60 Hz universal power supply for OMB-DAQ-TC-RACK

Comes complete with 1 m (3.2') CAT-6 Ethernet cable, 1.8 m (6') USB cable, TracerDAQ software and operator's manual on CD.

***Ordering Example: OMB-DAQ-TC-RACK** 32-channel USB/ethernet based thermocouple input data acquisition system, **OCW-1** OMEGACARE℠ 1-year extended warranty for OMB-DAQ-TC-RACK (adds 1 year to standard 1-year warranty), **OMB-DAQ-TC-RACK-EXP32** 32-channel expansion module, **OCW-1** OMEGACARE℠ 1-year extended warranty for OMB-DAQ-TC-RACK-EXP32 (adds 1 year to standard 1-year warranty) and **C40FF-2** expansion connector 40-pin cable, 0.6 m (2').*