User's Guide

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OM-WLS-TC and OM-WLS-TEMP

Wireless Temperature Measurement Modules

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ISO 9001 Certified

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Table of Contents

About this User's Guide

What you will learn from this user's guide

This user's guide describes the Omega Engineering OM-WLS Series data acquisition devices and lists device specifications.

Conventions in this user's guide

For more information about …
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.

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 OM-WLS Series hardware is available on our website at 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

Introducing the OM-WLS Series

The OM-WLS Series includes the following devices:

- OM-WLS-TC
- OM-WLS-TEMP
- OM-WLS-IFC

OM-WLS Series hardware are USB 2.0 full-speed devices temperature measurement devices supported under popular Microsoft® Windows® operating systems. The OM-WLS Series is compatible with both USB 1.1 and USB 2.0 ports, although the speed of the module maybe limited when using USB 1.1 ports.

The OM-WLS-TC and OM-WLS-TEMP can be operated as local devices connected to a computer, or as remote devices. Remote operation requires the OM-WLS-IFC USB-to-wireless interface device and an external power supply (included).

OM-WLS-TC and OM-WLS-TEMP features

The OM-WLS-TC and OM-WLS-TEMP hardware provide the following features:

- Eight differential temperature input channels

  A 24-bit analog-to-digital (A/D) converter is provided for each pair of analog inputs. Each pair of inputs constitutes a channel pair.
- Eight digital I/O channels

  The DIO channels are independently configurable for input or output, and can monitor TTL-level inputs, communicate with external devices, and generate alarms
- Two integrated cold junction compensation (CJC) sensors

  Each CJC sensor is dedicated to two channel pairs.
- Open thermocouple detection (OTD)
- Temperature alarms
- Onboard microprocessor automatically linearizes the measurement data according to the sensor category

Sensor support

The OM-WLS-TC supports thermocouple sensors. The OM-WLS-TEMP supports thermocouples, resistance temperature detectors (RTD), thermistors, and semiconductor sensors.

The sensor category is software-selectable for each channel pair. With the OM-WLS-TEMP, each channel pair can connect to a different category of sensor. The sensor category between the channels that constitute a channel pair cannot be mixed. However, thermocouple types within a channel pair can be mixed.

Remote wireless operation

Before operating remotely, you first connect the device to the computer's USB port and configure the network parameters required to establish a wireless link with the OM-WLS-IFC interface device. All configurable options are programmable with InstaCal.

During remote operation, the OM-WLS-TC and OM-WLS-TEMP communicate with the computer through the OM-WLS-IFC device connected to the computer's USB port. External power is required for remote operation.

For more information on setting up network parameters, refer to "Network parameters (remote operation)" on page 11.

OM-WLS-IFC features

The OM-WLS-IFC device operates as the interface between a computer and one or more remote OM-WLS Series devices. Remote devices can be located up to 150 feet (50 meters) indoors, or up to ½ mile (750 m) outdoors from the OM-WLS-IFC.

You configure the network parameters required for communication with remote devices. All configurable options are programmable with InstaCal. Only devices with the same parameter settings can communicate with each other. Once you configure the OM-WLS-IFC to communicate with remote devices, you can connect it to different computers without having to configure the network parameters.

Device LEDs indicate the status of communication over the wireless link. An LED bar graph shows the fade margin of signals received by the OM-WLS-IFC.

The OM-WLS-IFC draws power through the USB cable, and no external power is required.

For more information on setting up network parameters, refer to "Network parameters (remote operation)" on page 11.

Functional block diagrams

OM-WLS-TC and OM-WLS-TEMP device functions are illustrated in the block diagram shown here.

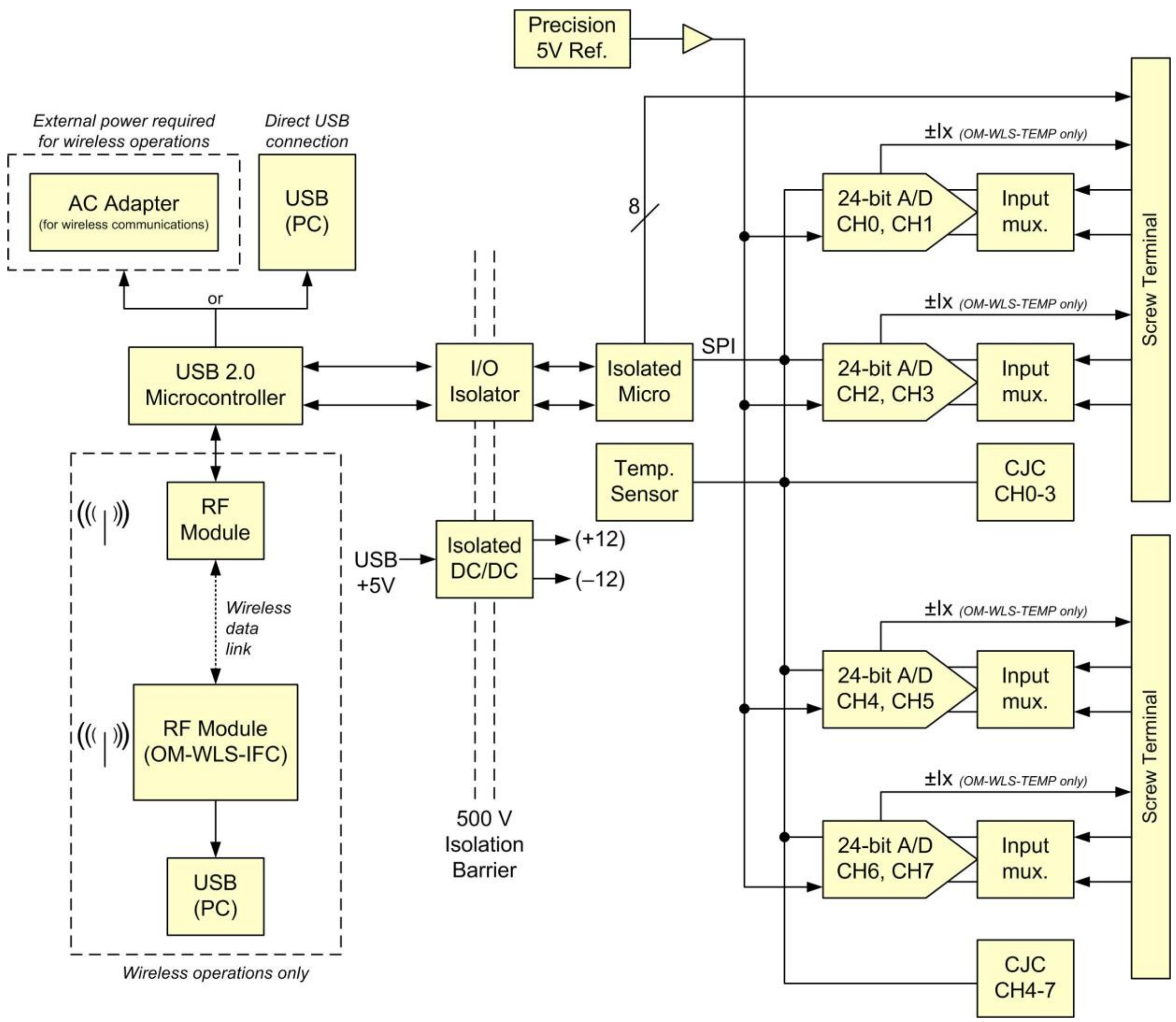


Figure 1. OM-WLS-TC and OM-WLS-TEMP functional block diagram

OM-WLS-IFC device functions are illustrated in the block diagram shown here.

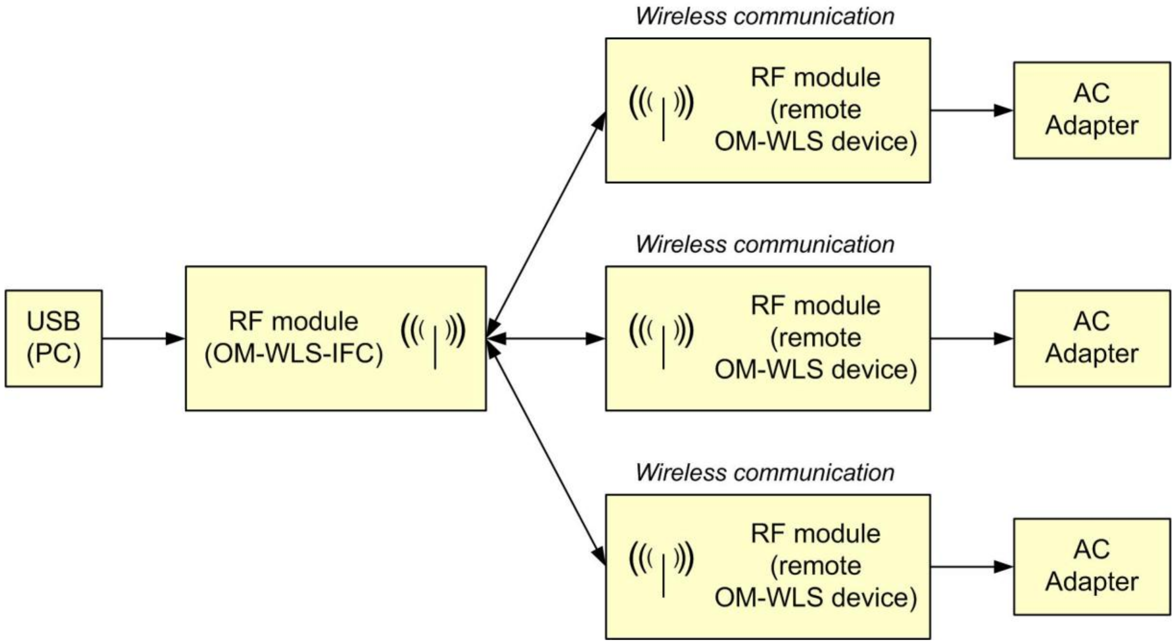


Figure 2. OM-WLS-IFC functional block diagram

Software features

For information on the features of InstaCal and the other software included with your OM-WLS Series hardware, refer to the *OMB-DAQ-2400, OM-USB, OM-WEB, and OM-WLS Series Data Acquisition Software User's Guide* that shipped with the device.

Installing an OM-WLS Series Device

What comes with your shipment?

The following items are shipped with OM-WLS Series hardware:

OM-WLS-TC/ OM-WLS-TEMP Hardware

- OM-WLS-TC or OM-WLS-TEMP
- USB cable
- AC-to-USB power adapter (required for wireless operation)

OM-WLS-IFC Hardware

- OM-WLS-IFC
- USB cable

Documentation

The following documentation ships with the OM-WLS Series hardware:

- *OMB-DAQ-2400, OM-USB, OM-WEB, and OM-WLS Series Data Acquisition Software User's Guide*

  This booklet provides an overview of the software you received with the device.
- *OM-WLS Series Wireless Setup Quick Start*

  This document provides a procedure to perform wireless temperature measurement out-of-the-box. Detailed information is provided in this user's guide.

Unpacking

As with any electronic device, you should take care while handling to avoid damage from static electricity. Before removing the device from its packaging, ground yourself using a wrist strap or by simply touching the computer chassis or other grounded object to eliminate any stored static charge.

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-2400, OM-USB, OM-WEB, and OM-WLS Series Data Acquisition Software User's Guide* for instructions on installing the software on the *Software for OMB-DAQ-2400, OM-USB, OM-WEB, and OM-WLS Series Data Acquisition Modules* CD. This booklet is available in PDF at http://www.omega.com/manuals/manualpdf/M4803.pdf.

Installing the hardware

Install the software before you install your hardware

The driver needed to run your board is installed with the software. Therefore, you need to install the software before you install your hardware.

To connect OM-WLS Series hardware to your system, perform the following steps:

1. Turn your computer on and connect the USB cable to a USB port on your computer or to an external USB hub connected to your computer. The USB cable provides power and communication to the OM-WLS Series hardware.

Always connect an external hub to its power supply

If you are using a hybrid hub (one that can operate in either self-powered or bus-powered mode), always connect it to its external power supply.

If you use a hub of this type without connecting to external power, communication errors may occur that could result in corrupt configuration information on your wireless device. You can restore the factory default configuration settings with *Insta*Cal.

When you connect OM-WLS Series hardware for the first time, a **Found New Hardware** dialog opens when the operating system detects the device. The dialog closes after the device is installed

After your system detects new hardware, the **Found New Hardware Wizard** opens and prompts you for the location of the software required to run the new hardware.

2. Keep the default selection "*Install the software automatically*" and then click **Next**.

The wizard locates and installs the software on your computer for the OM-WLS Series hardware. A dialog appears when the wizard completes the installation.

3. Click **Finish** to exit the **Found New Hardware Wizard**.

After installing the OM-WLS-TC or OM-WLS-TEMP, the **Command** LED blinks on the device, and then turns on to indicate that communication is established between the device and the computer. Refer to Figure 13 on page 21 for the locations of this LED.

If the Command LED turns off (OM-WLS-TC and OM-WLS-TEMP)

If the Command LED is on but then turns off, the computer has lost communication with the OM-WLS-TC or OM-WLS-TEMP device. If the device is connected to the computer's USB port, disconnect the USB cable from the computer and then reconnect it. This should restore communication, and the LED should turn on.

If the Command LED turns off when you are operating the OM-WLS-TC or OM-WLS-TEMP remotely through the wireless interface, disconnect the USB cable from the USB power adapter, and then reconnect it. This should restore communication, and the Command and Wireless Power LEDs should turn on.

After installing the OM-WLS-IFC, the **Power** and **USB Activity** LEDs blink, and then the **Power** LED turns on to indicate that communication is established between the device and the computer, and that the device is receiving power. Refer to Figure 14 on page 23 for the locations of these LEDs.

Configuring OM-WLS Series hardware

Before using OM-WLS Series devices, configure the temperature sensors and network parameters for remote wireless communication. All hardware configuration options are programmable with InstaCal. Configuration options are stored on the device in non-volatile memory in EEPROM, and are loaded on power up.

Temperature sensors

Use InstaCal to set the sensor type for each channel pair of an OM-WLS-TEMP or OM-WLS-TC. The configurable options of the OM-WLS-TEMP dynamically update according to the selected sensor category.

You can configure sensor settings when the device is connected locally to the computer through the USB port, or when the device is operated remotely through the wireless interface.

The factory default sensor configuration is *Disabled*. The Disabled mode disconnects the analog inputs from the terminal blocks and internally grounds all of the A/D inputs. This mode also disables each of the current excitation sources.

Network parameters (remote operation)

The following network parameter options are programmable with InstaCal.

- **Identifier**: Text that identifies the device (optional).
- **PAN (hex)**: The personal area network (PAN) ID assigned to the device.

  The PAN value is a number used to identify the interface device with which you want to communicate. The OM-WLS Series devices can only communicate with a device whose PAN is set to the same value.

  Most users do not need to change the default value assigned to the device. However, you may want to assign a different PAN ID in the following situations:

  - You have multiple OM-WLS Series devices, and do not want to allow communication between all of them. Set the PAN ID to the same value on each device that you want to communicate.
  - If other OM-WLS Series devices are operating in the vicinity, you can avoid accidental changes to your device settings by changing the default PAN value.
- **CH**: The radio frequency (RF) channel number assigned to the device.

  The channel number is used to transmit and receive data over the wireless link. You may want to change the channel number in InstaCal when another OM-WLS Series device is already transmitting on that channel, or when noise is present on the channel.

  The table below lists each available channel and its corresponding transmission frequency.

RF Channel	Transmission Frequency (GHz)	RF Channel	Transmission Frequency (GHz)
12	2.410	18	2.440
13	2.415	19	2.445
14	2.420	20	2.450
15	2.425	21	2.455
16	2.430	22	2.460
17	2.435	23	2.465

- **AES Key**: Value used to encrypt data (optional).

  AES encryption is disabled by default. Unless you suspect that there are other users of OM-WLS Series devices in the area, there should be no need to enable encryption. However, if you suspect that there are other OM-WLS Series devices in the area and you need to secure the devices from being accessed by other users, enable AES encryption.

  Enabling encryption does NOT secure the device from access through a local USB connection. A remote device configured for encryption can be connected locally through the USB port to access other remote OM-WLS Series devices with the same settings; you may need to physically secure the remote devices to prevent tampering of the of device's network settings.

Set the PAN ID, RF channel, and AES key to the same value for each device that you want to communicate

Only devices with matching parameter settings for PAN, CH, and AES Key (if set) can communicate with each other.
For information on setting up the network parameters for your OM-WLS Series device, refer to the "OM-WLS Series" section of the "Temperature Input Boards" chapter in the *Universal Library User's Guide*.

After configuring the network parameters, disconnect the OM-WLS Series device from the computer, and move the device to its remote location. The OM-WLS-TC and OM-WLS-TEMP can be located up to 150 feet (50 meters) indoors, or up to ½ mile (750 m) outdoors from the OM-WLS-IFC.

Restoring factory default settings

You can restore the factory default configuration settings with InstaCal.

Connecting the external power supply for remote operation

Connect the USB cable to the AC-to-USB power adapter when you are operating an OM-WLS-TC or OM-WLS-TEMP device remotely through the OM-WLS-IFC interface. The **Command** and **Wireless Power** LEDs turn on approximately five seconds after you connect the AC power adapter.

Caution! To satisfy FCC RF exposure requirements for mobile transmitting devices, maintain a separation distance of 20 cm (0.66 feet) or more between the antenna of this device and personnel during device operation. To ensure compliance, operation at closer than this distance is not recommended. The antenna used for this transmitter must not be co-located in conjunction with any other antenna or transmitter.

Calibrating OM-WLS Series hardware

The OM-WLS-TC and OM-WLS-TEMP support field calibration with InstaCal. Allow a 30-minute warm up before calibrating. InstaCal prompts you to run its calibration utility when you change the sensor category configured for the device. If you don't change the sensor category, the normal calibration interval is once per year. You can calibrate the OM-WLS-TC and OM-WLS-TEMP whether connected locally or remotely.

You can restore the factory default configuration settings with InstaCal.

Warm up time

Allow OM-WLS Series hardware to warm up for 30 minutes before taking measurements. This warm up time minimizes thermal drift and achieves the specified rated accuracy of measurements.

For RTD or thermistor measurements, this warm-up time is also required to stabilize the internal current reference.

Sensor Connections

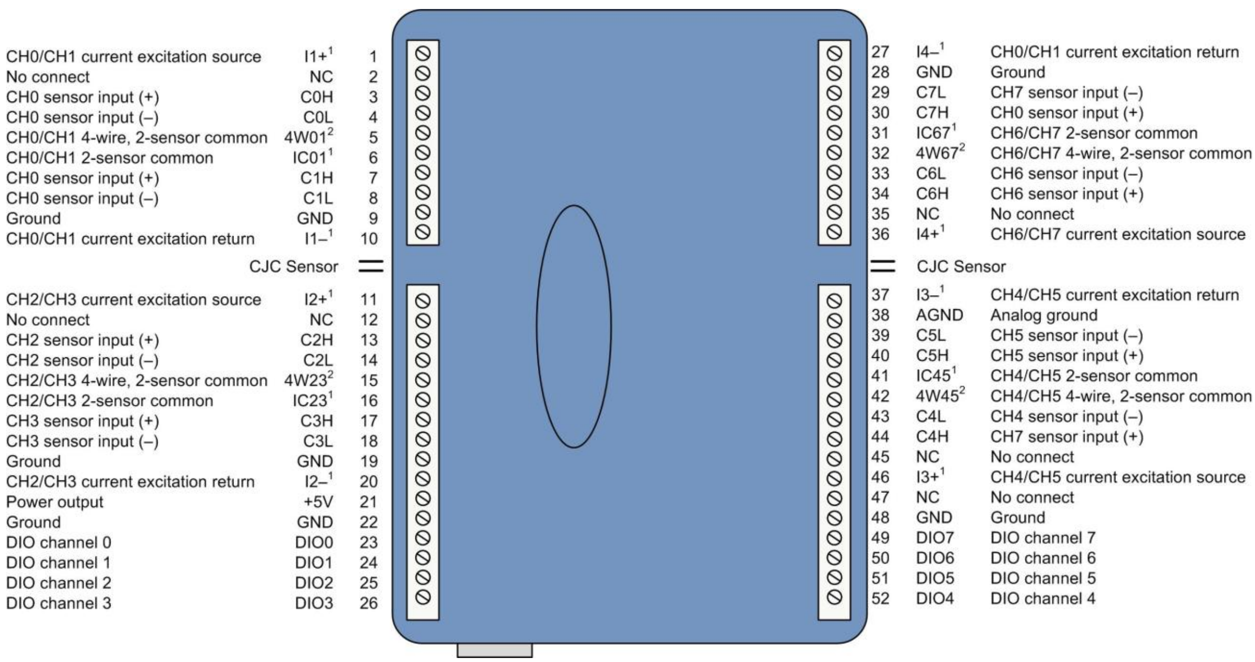
The temperature sensor types supported by the OM-WLS-TEMP and OM-WLS-TC are shown here:

Sensor type	OM-WLS-TC	OM-WLS-TEMP
Thermocouple – types J, K, R, S, T, N, E, and B	4	4
Resistance temperature detectors (RTDs) – two-, three-, or four-wire measurement modes of 100 Ω platinum RTDs.		4
Thermistors – two-, three-, or four-wire measurement modes		4
Semiconductor temperature sensors – LM36 or equivalent		4

The type of sensor you select depends on your application needs. Review the temperature ranges and accuracies of each sensor type to determine which is best suited for your application.

Screw terminal pinout (OM-WLS-TEMP and OM-WLS-TC)

The OM-WLS-TEMP and OM-WLS-TC have four banks of screw terminals. Between each bank of screw terminals are two integrated CJC sensors used for thermocouple measurements. Signal locations are identified in Figure 3.



[1] OM-WLS-TEMP only. These pins are labeled **RSVD** (reserved for future use) on the OM-WLS-TC.

[2] OM-WLS-TEMP only. "NC" (no connection) on the OM-WLS-TC.

Do not connect anything to pins labeled "NC".

Figure 3. OM-WLS-TEMP and OM-WLS-TC pinout

Tighten screw terminal connections
When making connections to the screw terminals, be sure to tighten the screw until tight. Simply touching the top of the screw terminal is not sufficient to make a proper connection.

Sensor input terminals

You can connect up to eight temperature sensors to the differential sensor inputs (**C0H**/**C0L** to **C7H**/**C7L**). Supported sensor categories include thermocouples, RTDs, thermistors, or semiconductor sensors.

The sensor category is software-selectable for each channel pair. With the OM-WLS-TEMP, each channel pair can connect to a different category of sensor. Do not mix sensor categories within channel pairs. However, thermocouple types within a channel pair can be mixed.

Do not connect two different sensor categories to the same channel pair
Each channel pair has a dedicated 24-bit A/D converter. Each channel pair can monitor one sensor category. To monitor a sensor from a different category, connect the sensor to a different channel pair of input terminals.

Current excitation output terminals (OM-WLS-TEMP)

The OM-WLS-TEMP has four dedicated pairs of current excitation output terminals (±**I1** to ±**I4**). These terminals have a built-in precision current source to provide excitation for the resistive sensors used for RTD and thermistor measurements.

Current excitation terminals are dedicated to one pair of sensor input channels:

- I1+ and I1– are the current excitation source for channel 0 and channel 1
- I2+ and I2– are the current excitation source for channel 2 and channel 3
- I3+ and I3– are the current excitation source for channel 4 and channel 5
- I4+ and I4– are the current excitation source for channel 6 and channel 7

Four-wire, two sensor common (OM-WLS-TEMP)

Terminals **4W01** to **4W67** are used as the common connection for four-wire configurations with two RTD or thermistor sensors.

Two sensor common (OM-WLS-TEMP)

Terminals **IC01** to **IC67** are used as the common connection for two-wire configurations with two RTD or thermistor sensors.

CJC sensors

The OM-WLS-TEMP and OM-WLS-TC have two built in high-resolution temperature sensors for thermocouple measurements. These sensors measure the ambient temperature at the terminal block so that the cold junction voltage can be calculated.

Digital I/O (DIO0 to DIO7)

You can connect up to eight digital I/O lines to the screw terminals labeled **DIO0** to **DIO7**. Each terminal is software configurable for input or output.

Ground

The six ground terminals (**GND**) provide a common ground for the input channels and DIO bits, and are isolated (500 VDC) from the USB GND.

Power output (+5V)

The two **+5V** output terminals are isolated (500 VDC) from the USB +5V.

Thermocouple connections (OM-WLS-TC and OM-WLS-TEMP)

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.

The OM-WLS-TC and OM-WLS-TEMP make fully-differential thermocouple measurements without the need of ground-referencing resistors. A 32-bit floating point value in either a voltage or temperature format is returned by software. An open thermocouple detection feature is available for each analog input which automatically detects an open or broken thermocouple.

Use InstaCal to select the thermocouple type (J, K, R, S, T, N, E, and B) and one or more sensor input channels to connect the thermocouple.

Wiring configuration

Connect thermocouples using a differential configuration, as shown in Figure 4.

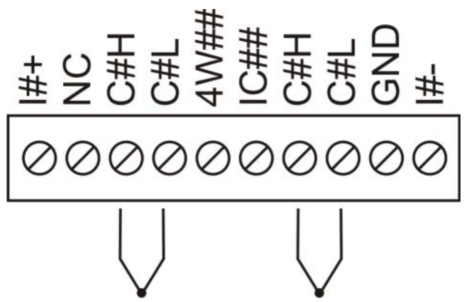


Figure 4. Typical thermocouple connection

Connect thermocouples so that they float with respect to GND (pins 9, 19, 28, 38). The **GND** pins are isolated from earth ground, so you can connect thermocouple sensors to voltages referenced to earth ground as long as you maintain the isolation between the GND pins (9, 19, 28, 38) and earth ground.

When you attach thermocouples to conductive surfaces, the voltage differential between multiple thermocouples must remain within ±1.4 V. For best results, we recommend the use of insulated or ungrounded thermocouples when possible.

Maximum input voltage between analog input and ground

The absolute maximum input voltage between an analog input and the isolated GND pins is ±25 VDC when the OM-WLS-TEMP or OM-WLS-TC is powered on, and ±40 VDC when the OM-WLS-TEMP or OM-WLS-TC is powered off.

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

RTD and thermistor connections (OM-WLS-TEMP)

A resistance temperature detector (RTD) measures temperature by correlating the resistance of the RTD element with temperature. A thermistor is a thermally-sensitive resistor that is similar to an RTD in that its resistance changes with temperature. Thermistors show a large change in resistance that is proportional to a small change in temperature. The main difference between RTD and thermistor measurements is the method used to linearize the sensor data.

RTDs and thermistors are resistive devices that need an excitation current to produce a voltage drop that can be measured differentially across the sensor. The OM-WLS-TEMP has four built-in current excitation sources (±**I1** to ±**I4**) for measuring resistive type sensors. Each current excitation source is dedicated to one channel pair.

The OM-WLS-TEMP can make two, three, and four-wire measurements of RTDs (100 Ω platinum type) and thermistors.

Use InstaCal to select the sensor type and the wiring configuration. Once the resistance value is calculated, the value is linearized in order to convert it to a temperature value. A 32-bit floating point value in either temperature or resistance is returned by software.

- In RTD mode, the OM-WLS-TEMP cannot measure resistance values greater than 660 Ω. This 660 Ω resistance limit includes the total resistance across the current excitation (±Ix) pins, which is the sum of the RTD resistance and the lead resistances.
- In thermistor mode, the OM-WLS-TEMP cannot measure resistance values greater than 180 kΩ. This 180 kΩ resistance limit includes the total resistance across the current excitation (±Ix) pins, which is the sum of the thermistor resistance and the lead resistance.

Two-wire configuration

The easiest way to connect an RTD sensor or thermistor to the OM-WLS-TEMP is with a two-wire configuration, since it requires the fewest connections to the sensor. With this method, the two wires that provide the RTD sensor with its excitation current also measure the voltage across the sensor.

Since RTDs exhibit a low nominal resistance, the lead wire resistance can affect measurement accuracy. For example, connecting lead wires that have a resistance of 1 Ω (0.5 Ω each lead) to a 100 Ω platinum RTD results in a 1% measurement error.

With a two-wire configuration, you can connect either one sensor per channel pair, or two sensors per channel pair.

Two-wire, single-sensor

A two-wire, single-sensor measurement configuration is shown in Figure 5.

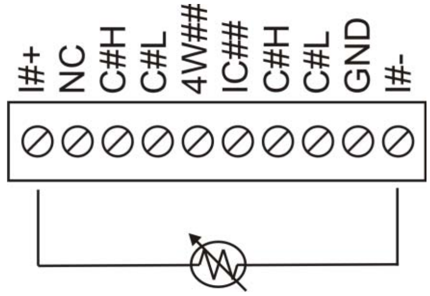


Figure 5. Two-wire, single RTD or thermistor sensor measurement configuration

When you select a two-wire, single-sensor configuration with InstaCal, connections to C#H and C#L are made internally.

Two-wire, two sensor

A two-wire, two-sensor measurement configuration is shown in Figure 6.

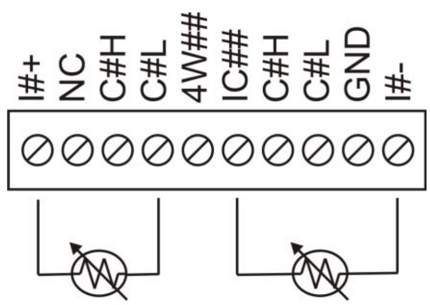


Figure 6. Two-wire, two RTD or thermistor sensors measurement configuration

When you select a two-wire, two-sensor configuration with InstaCal, connections to C#H (first sensor) and C#H/C#L (second sensor) are made internally.

When configured for two-wire mode, connect both sensors to obtain proper measurements.

Three-wire configuration

A three-wire configuration compensates for lead-wire resistance by using a single-voltage sense connection. With a three-wire configuration, you can connect only one sensor per channel pair. A three-wire measurement configuration is shown in Figure 7.

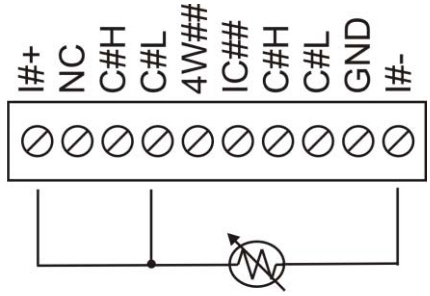


Figure 7. Three-wire RTD or thermistor sensor measurement configuration

When you select a three-wire sensor configuration with InstaCal, the OM-WLS-TEMP measures the lead resistance on the first channel (C#H/C#L) and measures the sensor itself using the second channel (C#H/C#L). This configuration compensates for any lead-wire resistance and temperature change in lead-wire resistance. Connections to C#H for the first channel and C#H/C#L of the second channel are made internally.

For accurate three wire compensation, the individual lead resistances connected to the ±I# pins must be of equal resistance value.

Four-wire configuration

With a four-wire configuration, connect two sets of sense/excitation wires at each end of the RTD or thermistor sensor. This configuration completely compensates for any lead-wire resistance and temperature change in lead-wire resistance.

Connect your sensor with a four-wire configuration when your application requires very high accuracy measurements. Examples of a four-wire single-sensor measurement configuration are shown in Figure 8 and Figure 9.

You can configure the OM-WLS-TEMP with either a single sensor per channel or two sensors per channel pair.

Four-wire, single-sensor

A four-wire, single-sensor connected to the first channel of a channel pair is shown in Figure 8.

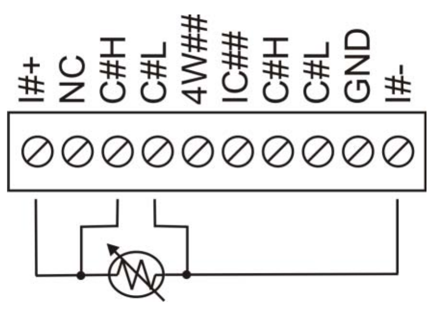


Figure 8. Four-wire, single RTD or thermistor sensor measurement configuration

A four-wire, single-sensor connected to the second channel of a channel pair is shown in Figure 9.

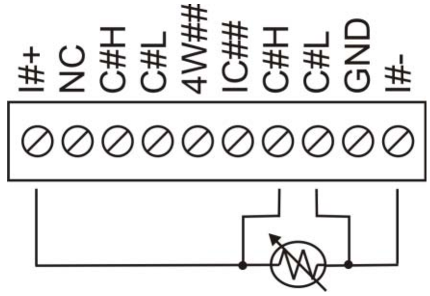


Figure 9. Four-wire, single RTD or thermistor sensor measurement configuration

Four-wire, two-sensor

A four-wire, two-sensor measurement configuration is shown in Figure 10.

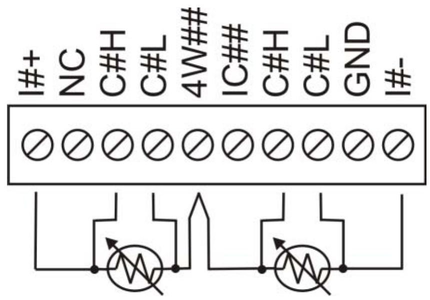


Figure 10. Four-wire, two RTD or thermistor sensors measurement configuration

When configured for four-wire, two sensor mode, both sensors must be connected to obtain proper measurements.

Semiconductor sensor measurements (OM-WLS-TEMP)

Semiconductor sensors are suitable over a range of approximately –40 °C to 125 °C, where an accuracy of ±2 °C is adequate. The temperature measurement range of a semiconductor sensor is small when compared to thermocouples and RTDs. However, semiconductor sensors are accurate, inexpensive, and easily interface with other electronics for display and control.

The OM-WLS-TEMP makes high-resolution measurements of semiconductor sensors, such as the LM36 or equivalent, and returns a 32-bit floating point value in either a voltage or temperature format. Use InstaCal to select the sensor type (TMP36 or equivalent), and the sensor input channel that connects to the sensor.

Wiring configuration

You can connect a TMP36 (or equivalent) semiconductor sensor to the OM-WLS-TEMP using a single-ended configuration, as shown in Figure 11. The device also provides **+5V** and **GND** pins for powering the sensor.

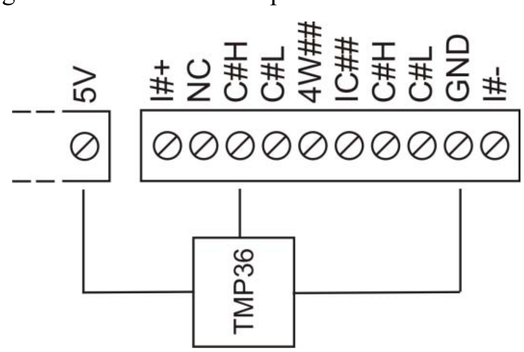


Figure 11. Semiconductor sensor measurement configuration

The Universal Library outputs the measurement data as a 32-bit floating point value in either voltage or temperature.

Digital I/O connections (OM-WLS-TC and OM-WLS-TEMP)

You can connect up to eight digital I/O lines to the screw terminals labeled **DIO0** to **DIO7**. You can configure each digital bit for either input or output. All digital I/O lines are pulled up to +5V with a 47 kΩ resistor (default). You can request the factory to configure the resistor for pull-down to ground if desired.

When you configure the digital bits for input, you can use the digital I/O terminals to detect the state of any TTL-level input. Refer to the schematic shown in Figure 12. If you set the switch to the +5V input, DIO0 reads *TRUE* (1). If you move the switch to GND, DIO0 reads *FALSE* (0).

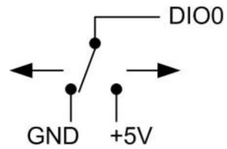


Figure 12. Schematic showing switch detection by digital channel DIO0

Caution! All ground pins are common and are isolated from earth ground. If a connection is made to earth ground when using digital I/O and conductive thermocouples, the thermocouples are no longer isolated. In this case, thermocouples must not be connected to any conductive surfaces that may be referenced to earth ground.

For general information regarding digital signal connections and digital I/O techniques, refer to the *OMB-DAQ-2400, OM-USB, OM-WEB, and OM-WLS Series General Guide to Signal Connections* (available on our web site at www.omega.com/manuals/manualpdf/M4830.pdf).

Configuring the DIO channels to generate alarms

The OM-WLS-TC and OM-WLS-TEMP feature eight independent temperature alarms. All alarm options are software configurable. Remote alarm configuration is supported.

When a digital bit is configured as an alarm, that bit is configured as an output on the next power cycle and assumes the state defined by the alarm configuration.

Each alarm controls an associated digital I/O channel as an alarm output. The input to each alarm is one of the temperature input channels. You set up the temperature conditions to activate an alarm, and also the output state of the channel (active high or low) when activated. When an alarm is activated, its associated DIO channel is driven to the output state specified.

The alarm configurations are stored in non-volatile memory and are loaded on power up. The temperature alarms function in wireless operations and while attached to the USB port on a computer.

You can configure alarm settings when you connect the device locally to the computer through the USB port, or when operating remotely through the wireless interface. All configurable options are selectable with software.

Functional Details

Thermocouple measurements

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.

The OM-WLS-TC and OM-WLS-TEMP hardware level-shifts the thermocouple's output voltage into the ADC common mode input range by applying +2.5 V to the thermocouple's low side at the C#L input. Always connect thermocouple sensors in a floating fashion. Do not attempt to connect the thermocouple low side C#L to GND or to a ground referencing resistor.

Cold junction compensation (CJC)

When you connect the thermocouple sensor leads to the sensor input channel, the dissimilar metals at the device terminal blocks produce an additional thermocouple junction. This junction creates a small voltage error term which must be removed from the overall sensor measurement using a cold junction compensation technique. The measured voltage includes both the thermocouple voltage and the cold junction voltage. To compensate for the additional cold junction voltage, the device subtracts the *cold junction* voltage from the thermocouple voltage.

The OM-WLS-TC and OM-WLS-TEMP have two high-resolution CJC temperature sensors. The CJC sensors measure the average temperature at the terminal blocks so that the cold junction voltage can be calculated. A software algorithm automatically corrects for the additional thermocouples created at the terminal blocks by subtracting the calculated cold junction voltage from the analog input's thermocouple voltage measurement.

Increasing the thermocouple length

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

Data linearization

After the CJC correction is performed on the measurement data, an onboard 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

Open-thermocouple detection (OTD) is automatically enabled for each analog input channel when a channel pair is configured for thermocouple sensor. The maximum open detection time is 3 seconds.

With OTD, any open-circuit or short-circuit condition at the thermocouple sensor is detected by the software. An open channel is detected by driving the input voltage to a negative value outside the range of any thermocouple output. 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 open-thermocouple detection enabled, a maximum of 105 nA of input leakage current is injected into the thermocouple. This current can cause an error voltage to develop across the lead resistance of the thermocouple that is indistinguishable from the thermocouple voltage you are measuring. You can estimate this error voltage with the following formula:

error voltage = resistance of the thermocouple x 105 nA

To reduce the error, reduce the length of the thermocouple to lower its resistance, or lower the AWG of the wire by using a wire with a larger diameter. With OTD disabled, a maximum of 30 nA of input leakage current is injected into the thermocouple.

RTD and thermistor measurements

RTDs and thermistors are resistive devices that require an excitation current to produce a voltage drop that can be measured differentially across the sensor. The device measures the sensor resistance by forcing a known excitation current through the sensor and then measuring (differentially) the voltage across the sensor to determine its resistance.

After the voltage measurement is made, the resistance of the RTD is calculated using Ohms law – the sensor resistance is calculated by dividing the measured voltage by the current excitation level (±**Ix**) source. The value of the ±**Ix** source is stored in local memory.

Once the resistance value is calculated, the value is linearized in order to convert it to a temperature value. The measurement is returned by software as a 32-bit floating point value in a voltage, resistance or temperature format.

Data linearization

An onboard microcontroller automatically performs linearization on RTD and thermistor measurements.

- RTD measurements are linearized using a Callendar-Van Dusen coefficients algorithm (you select DIN, SAMA, or ITS-90).
- Thermistor measurements are linearized using a Steinhart-Hart linearization algorithm (you supply the coefficients from the sensor manufacturer's data sheet).

AC power supply

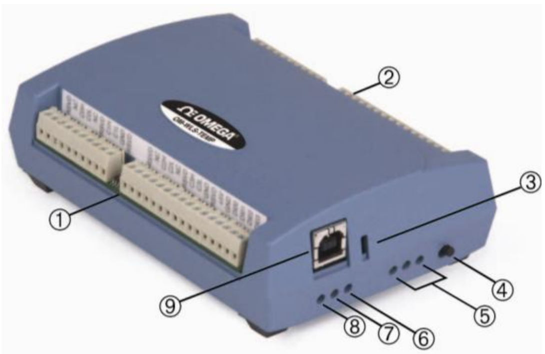
- The external power supply is an AC-to-USB 2.5 W supply that is used to power the OM-WLS-TC and OM-WLS-TEMP during remote wireless operations (Omega part number *OM-USB-5200-ADAPTOR*.)

External components

OM-WLS-TC and OM-WLS-TEMP

The OM-WLS-TC and OM-WLS-TEMP have the following external components, as shown in Figure 13.

- Screw terminals
- USB connector
- Status LEDs (Command, Wireless Power, Transmit, Receive, Received Signal Strength indicators)
- LED Test button



1	Screw terminal pins 1 to 26	4	LED Test button	7	Transmit LED
2	Screw terminal pins 27 to 52	5	Received Signal Strength (RSS) LEDs	8	Wireless Power LED
3	Command LED	6	Receive LED	9	USB connector

Figure 13. OM-WLS-TC and OM-WLS-TEMP component locations

Screw terminals

Use the screw terminals to connect connecting temperature sensors and digital I/O lines. These terminals also provide ground and power output connections. Refer to the Screw terminal pinout section on page 13 for screw terminal descriptions.

Caution! The two **+5V** terminals (pin 21 and pin 47) are isolated (500 VDC) from the USB +5V. Each +5V terminal is an output. Do not connect to an external power supply or you may damage the OM-WLS-TC or OM-WLS-TEMP and possibly the computer.

USB connector

The USB connector provides +5V power and communication. External power is required to operate the OM-WLS-TC and OM-WLS-TEMP remotely through the wireless interface.

For local operation, connect to the USB port or hub on your computer. For remote wireless operation, connect to the external AC adapter shipped with the device.

Status LEDs

The LEDs indicate the communication status of USB and wireless operations. In addition, three LEDs indicate the signal strength of data received over the wireless link. Refer to the table below for the function of each LED.

LED functions

LED	Function
Command	Steady green – the OM-WLS Series device is connected to a computer or AC adapter
	Blinking green – the OM-WLS-TEMP, OM-WLS-TC and OM-WLS-IFC is receiving a command over the USB or wireless link.
Wireless Power (green)	The internal RF module is receiving power (USB or AC adapter).
Transmit (yellow)	Data is being transmitted over an active wireless link.
Receive (red)	Data is being received over an active wireless link.
Received Signal Strength (RSS) indicator LEDs	3 green LED bar graph. The LEDs will turn on when receiving a wireless message and stay on for approximately 1 second after the end of the message. They indicate the amount of fade margin present in an active wireless link. Fade margin is defined as the difference between the incoming signal strength and the device's receiver sensitivity. ▪ Three LEDs on: Very strong signal (> 30 dB fade margin) ▪ Two LEDs on: Strong signal (> 20 dB fade margin) ▪ One LED on: Moderate signal (> 10 dB fade margin) ▪ No LEDs on: Weak signal (< 10 dB fade margin)

LED Test button

The LED Test button tests the functionality of the LEDs. When pressed, each LED lights in sequence (first the Command LED then left to right from the Wireless Power LED to the RSS indicator LEDs).

OM-WLS-IFC

The OM-WLS-TEMP, OM-WLS-TC and OM-WLS-IFC has the following external components, as shown in Figure 14.

- Status LEDs (USB Activity, Transmit, Receive, Received Signal Strength indicator)
- Power LED
- USB connector

1	Power LED	4	USB Activity LED
2	Received Signal Strength (RSS) indicator	5	Transmit LED
3	USB connector	6	Receive LED

Figure 14. OM-WLS-IFC component locations

Status LEDs

The LEDs indicate the communication status of USB and wireless operations. An LED bar graph indicates the strength of the signal received by the remote device. Refer to the table below for the function of each LED.

LED functions

LED	Function
Power	Steady green – the OM-WLS-IFC is connected to a computer or external USB hub.
	Blinking green – indicates activity over the USB connection.
Received Signal Strength (RSS) indicator	3 green LED bar graph. The LEDs turn on when receiving a wireless message, and stay on for approximately 1 second after the end of the message. The LEDs indicate the amount of fade margin present in an active wireless link. Fade margin is defined as the difference between the incoming signal strength and the device's receiver sensitivity. ▪ Three LEDs on : Very strong signal (> 30 dB fade margin) ▪ Two LEDs on : Strong signal (> 20 dB fade margin) ▪ One LED on : Moderate signal (> 10 dB fade margin) ▪ No LEDs on: Weak signal (< 10 dB fade margin)
USB Activity (green)	Activity over the USB connection is detected.
Transmit (yellow)	Data is being transmitted over the wireless link
Receive (red)	Data is being received over the wireless link.

Power LED

The **Power** LED is on when the OM-WLS-IFC is connected to a computer or external USB hub.

USB connector

The USB connector provides +5V power and communication to the OM-WLS-IFC.

Specifications

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

Analog input (OM-WLS-TEMP and OM-WLS-TC only)

Table 1. Generic analog input specifications

Parameter	Conditions	Specification
A/D converters		Four dual 24-bit, Sigma-Delta type
Number of channels		8 differential
Input isolation		*500 VDC minimum between field wiring and USB interface*
Channel configuration		▪ OM-WLS-TEMP: Software-selectable to match sensor type ▪ OM-WLS-TC: Thermocouple sensor type
Differential input voltage range for the various sensor categories	Thermocouple	±0.080 V
	RTD (OM-WLS-TEMP only)	0 to 0.5 V
	Thermistor (OM-WLS-TEMP only)	0 to 2 V
	Semiconductor sensor (OM-WLS-TEMP only)	0 to 2.5 V
Absolute maximum input voltage	*±C0x through ±C7x relative to GND (pins 9, 19, 28, 38)*	±25 V power on, ±40 V power off.
Input impedance		5 GΩ, min
Input leakage current	Open thermocouple detect disabled (OM-WLS-TEMP only)	30 nA max
	Open thermocouple detect enabled	105 nA max
Normal mode rejection ratio	f_{IN} *=60 Hz*	*90 dB min*
Common mode rejection ratio	f_{IN} *=50 Hz/60 Hz*	*100 dB min*
Resolution		24 bits
No missing codes		*24 bits*
Input coupling		DC
Warm-up time		30 minutes min
Open thermocouple detect		Automatically enabled when the channel pair is configured for thermocouple sensor. The maximum open detection time is 3 seconds.
CJC sensor accuracy	*15 °C to 35 °C*	*±0.25 °C typ,±0.5 °C max*
	0 °C to 70 °C	*–1.0 °C to +0.5 °C max*

Channel configurations (OM-WLS-TEMP and OM-WLS-TC only)

Table 2. Channel configuration specifications

Sensor Category	Conditions	Max number of sensors (all channels configured alike)
Disabled (OM-WLS-TEMP only)		
Thermocouple	J, K, S, R, B, E, T, or N	8 differential channels
Semiconductor sensor		8 differential channels
RTD and thermistor (OM-WLS-TEMP only)	2-wire input configuration with a single sensor per channel pair	4 differential channels
	2-wire input configuration with two sensors per channel pair	8 differential channels
	3-wire configuration with a single sensor per channel pair	4 differential channels
	4-wire input configuration with a single sensor per channel pair	4 differential channels
	4-wire input configuration with two sensors per channel pair	8 differential channels

Note 1: Internally, the device has four dual-channel, fully differential A/Ds providing a total of eight differential channels. The analog input channels are therefore configured in four channel pairs with CH0/CH1 sensor inputs, CH2/CH3 sensor inputs, CH4/CH5 sensor inputs, and CH6/CH7 sensor inputs paired together. This "channel-pairing" requires the analog input channel pairs be configured to monitor the same category of temperature sensor. Mixing different sensor types of the same category (such as a type J thermocouple on channel 0 and a type T thermocouple on channel 1) is valid.

Note 2: Channel configuration information is stored in the EEPROM of the isolated microcontroller by the firmware whenever any item is modified. Modification is performed by commands issued over USB or wireless from an external application, and the configuration is made non-volatile through the use of the EEPROM.

Note 3: The OM-WLS-TC factory default configuration is *Type J*.

The OM-WLS-TEMP factory default configuration is *Disabled*. The Disabled mode will disconnect the analog inputs from the terminal blocks and internally ground all of the A/D inputs. This mode also disables each of the current excitation sources.

Compatible sensors (OM-WLS-TEMP and OM-WLS-TC only)

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
RTD (OM-WLS-TEMP only)	100 Ω PT (DIN 43760: 0.00385 ohms/ohm/°C)
	100 Ω PT (SAMA: 0.003911 ohms/ohm/°C)
	100 Ω PT (ITS-90/IEC751:0.0038505 ohms/ohm/°C)
Thermistor (OM-WLS-TEMP only)	Standard 2,252 Ω through 30,000 Ω
Semiconductor/IC (OM-WLS-TEMP only)	TMP36 or equivalent

Accuracy (OM-WLS-TEMP and OM-WLS-TC only)

Thermocouple measurement accuracy

Table 4. Thermocouple accuracy specifications, including CJC measurement error

Sensor Type	Maximum error	Typical error	Temperature range
J	±1.499 °C	±0.507 °C	–210 °C to 0 °C
	±0.643 °C	±0.312 °C	0 °C to 1200 °C
K	±1.761 °C	±0.538 °C	–210 °C to 0 °C
	±0.691 °C	±0.345 °C	0 °C to 1372 °C
S	±2.491 °C	±0.648 °C	–50 °C to 250 °C
	±1.841 °C	±0.399 °C	250 °C to 1768.1 °C
R	±2.653 °C	±0.650 °C	–50 °C to 250 °C
	±1.070 °C	±0.358 °C	250 °C to 1768.1 °C
B	±1.779 °C	±0.581 °C	250 °C to 700 °C
	±0.912 °C	±0.369 °C	700 °C to 1820 °C
E	±1.471 °C	±0.462 °C	–200 °C to 0 °C
	±0.639 °C	±0.245 °C	0 °C to 1000 °C
T	±1.717 °C	±0.514 °C	–200 °C to 0 °C
	±0.713 °C	±0.256 °C	0 °C to 600 °C
N	±1.969 °C	±0.502 °C	–200 °C to 0 °C
	±0.769 °C	±0.272 °C	0 °C to 1300 °C

Note 4: Thermocouple measurement accuracy specifications include linearization, cold-junction compensation and system noise. These specs are for one year, or 3000 operating hours, whichever comes first, and for operation of the device between 15 °C and 35 °C. For measurements outside this range, add ±0.5 degree to the maximum error shown. There are CJC sensors on each side of the module. The accuracy listed above assumes the screw terminals are at the same temperature as the CJC sensor. Errors shown do not include inherent thermocouple error. Please contact your thermocouple supplier for details on the actual thermocouple error.

Note 5: Thermocouples must be connected to the device such that they are floating with respect to GND (pins 9, 19, 28, 38). The device GND pins are isolated from earth ground, so connecting thermocouple sensors to voltages referenced to earth ground is permissible as long as the isolation between the GND pins and earth ground is maintained.

Note 6: When thermocouples are attached to conductive surfaces, the voltage differential between multiple thermocouples must remain within ±1.4 V. For best results we recommend the use of insulated or ungrounded thermocouples when possible.

Semiconductor sensor measurement accuracy (OM-WLS-TEMP only)

Table 5. Semiconductor sensor accuracy specifications

Sensor Type	Temperature Range (°C)	Maximum Accuracy Error
TMP36 or equivalent	–40 °C to 150 °C	±0.50 °C

Note 7: Error shown does not include errors of the sensor itself. These specs are for one year while operation of the device is between 15 °C and 35 °C. Please contact your sensor supplier for details on the actual sensor error limitations.

RTD measurement accuracy (OM-WLS-TEMP only)

Table 6. RTD measurement accuracy specifications

RTD	Sensor Temperature	Maximum Accuracy Error (°C) I_{x+} = 210 µA	Typical Accuracy Error (°C) I_{x+} = 210 µA
PT100, DIN, US or ITS-90	–200 °C to –150 °C	±2.85	±2.59
	–150 °C to –100 °C	±1.24	±0.97
	–100 °C to 0 °C	±0.58	±0.31
	0 °C to 100 °C	±0.38	±0.11
	100 °C to 300 °C	±0.39	±0.12
	300 °C to 600 °C	±0.40	±0.12

Note 8: Error shown does not include errors of the sensor itself. The sensor linearization is performed using a Callendar-Van Dusen linearization algorithm. These specs are for one year while operation of the device is between 15 °C and 35 °C. The specification does not include lead resistance errors for 2-wire RTD connections. Please contact your sensor supplier for details on the actual sensor error limitations.

Note 9: Resistance values greater than 660 Ω cannot be measured by the device in the RTD mode. The 660 Ω resistance limit includes the total resistance across the current excitation (±Ix) pins, which is the sum of the RTD resistance and the lead resistances.

Note 10: For accurate three wire compensation, the individual lead resistances connected to the ±Ix pins must be of equal value.

Thermistor measurement accuracy (OM-WLS-TEMP only)

Table 7. Thermistor measurement accuracy specifications

Thermistor	Temperature Range	Maximum Accuracy Error (°C) I_{x+} = 10 µA
2252 Ω	–40 °C to120 °C	±0.05
3000 Ω	–40 °C to120 °C	±0.05
5000 Ω	–35 °C to120 °C	±0.05
10000 Ω	–25 °C to120 °C	±0.05
30000 Ω	–10 °C to120 °C	±0.05

Note 11: Error shown does not include errors of the sensor itself. The sensor linearization is performed using a Steinhart-Hart linearization algorithm. These specs are for one year while operation of the device is between 15 °C and 35 °C. The specification does not include lead resistance errors for 2-wire thermistor connections. Please contact your sensor supplier for details on the actual sensor error limitations. Total thermistor resistance on any given channel pair must not exceed 180 k Ω. Typical resistance values at various temperatures for supported thermistors are shown in Table 8.

Table 8. Typical thermistor resistance specifications

Temp	**2252 Ω thermistor**	**3000 Ω thermistor**	**5 kΩ thermistor**	**10 kΩ thermistor**	**30 kΩ thermistor**
–40 °C	76 kΩ	101 kΩ	168 kΩ	240 kΩ (Note 12)	885 kΩ (Note 12)
–35 °C	55 kΩ	73 kΩ	121 kΩ	179 kΩ	649 kΩ (Note 12)
–30 °C	40 kΩ	53 kΩ	88 kΩ	135 kΩ	481 kΩ (Note 12)
–25 °C	29 kΩ	39 kΩ	65 kΩ	103 kΩ	360 kΩ (Note 12)
–20 °C	22 kΩ	29 kΩ	49 kΩ	79 kΩ	271 kΩ (Note 12)
–15 °C	16 kΩ	22 kΩ	36 kΩ	61 kΩ	206 kΩ (Note 12)
–10 °C	12 kΩ	17 kΩ	28 kΩ	48 kΩ	158 kΩ
–5 °C	9.5 kΩ	13 kΩ	21 kΩ	37 kΩ	122 kΩ
0 °C	7.4 kΩ	9.8 kΩ	16 kΩ	29 kΩ	95 kΩ

Note 12: Resistance values greater than 180 kΩ cannot be measured by the device in the thermistor mode. The 180 kΩ resistance limit includes the total resistance across the current excitation (±Ix) pins, which is the sum of the thermistor resistance and the lead resistances.

Note 13: For accurate three wire compensation, the individual lead resistances connected to the ±Ix pins must be of equal value.

Throughput rate to PC (USB or wireless) (OM-WLS-TEMP and OM-WLS-TC only)

Table 9. Throughput rate specifications

Number of Input Channels	**Maximum Throughput**
1	2 Samples/second
2	2 S/s on each channel, 4 S/s total
3	2 S/s on each channel, 6 S/s total
4	2 S/s on each channel, 8 S/s total
5	2 S/s on each channel, 10 S/s total
6	2 S/s on each channel, 12 S/s total
7	2 S/s on each channel, 14 S/s total
8	2 S/s on each channel, 16 S/s total

Note 14: The analog inputs are configured to run continuously. Each channel is sampled twice per second. The maximum latency between when a sample is acquired and the temperature data is provided by the device is approximately 0.5 seconds

Digital input/output (OM-WLS-TEMP and OM-WLS-TC only)

Table 10. Digital input/output specifications

Parameter	Conditions
Digital type	CMOS
Number of I/O	8 (DIO0 through DIO7)
Configuration	Independently configured for input or output. Power on reset is input mode unless bit is configured for alarm.
Pull up/pull-down configuration	All pins pulled up to +5 V via 47 K kΩ resistors (default). Pull down to ground (GND) also available.
Digital I/O transfer rate (software paced)	▪ Digital input – 50 port reads or single bit reads per second typ ▪ Digital output – 100 port writes or single bit writes per second typ
Input high voltage	2.0 V min, 5.5 V absolute max
Input low voltage	0.8 V max, –0.5 V absolute min
Output low voltage (IOL = 2.5 mA)	0.7 V max
Output high voltage (IOH = –2.5 mA)	3.8 V min

Note 15: All ground pins on the device (pins 9, 19, 28, 38) are common and are isolated from earth ground. If a connection is made to earth ground when using digital I/O and conductive thermocouples, the thermocouples are no longer isolated. In this case, thermocouples must not be connected to any conductive surfaces that may be referenced to earth ground.

Temperature alarms (OM-WLS-TEMP and OM-WLS-TC only)

Table 11. Temperature alarm specifications

Parameter	Conditions
Number of alarms	8 (one per digital I/O line)
Alarm functionality	Each alarm controls its associated digital I/O line as an alarm output. The input to each alarm may be any of the analog temperature input channels. When an alarm is enabled, its associated I/O line is set to output (after the device is reset) and driven to the appropriate state determined by the alarm options and input temperature. The alarm configurations are stored in non-volatile memory and are loaded at power on. Alarms will function both in wireless mode and while attached to USB.
Alarm input modes	▪ Alarm when input temperature > T1 ▪ Alarm when input temperature > T1, reset alarm when input temperature goes below T2 ▪ Alarm when input temperature < T1 ▪ Alarm when input temperature < T1, reset alarm when input temperature goes above T2 ▪ Alarm when input temperature is < T1 or > T2 **Note**: T1 and T2 may be independently set for each alarm.
Alarm output modes	▪ Disabled, digital I/O line may be used for normal operation ▪ Enabled, active high output (digital I/O line goes high when alarm conditions met) ▪ Enabled, active low output (digital I/O line goes low when alarm conditions met)
Alarm update rate	1 s

Memory

Table 12. Memory specifications

Parameter	**Conditions**
EEPROM	▪ OM-WLS-TEMP and OM-WLS-TC 1,024 bytes isolated micro reserved for sensor configuration 256 bytes USB micro for external application use ▪ OM-WLS-IFC 256 bytes USB micro for external application use

Microcontroller

Table 13. Microcontroller specifications

Parameter	**Conditions**
Type	▪ OM-WLS-TEMP and OM-WLS-TC Three high performance 8-bit RISC microcontrollers ▪ OM-WLS-IFC One high performance 8-bit RISC microcontroller

Wireless communications

Table 14. Wireless Communications specifications

Parameter	**Conditions**
Communication standard	*IEEE 802.15.4, ISM 2.4GHz frequency band, non-beacon, point-to-point*
Range	Indoor/urban: Up to 150 ft (50 m) Outdoor RF line-of-sight: Up to ½ mile (750 m)
Transmit power output	10 mW (10 dBm)
Receiver sensitivity	*–100 dBm (1% packet error rate)*
RF channels	*12 direct sequence channels available, channels 12 to 23 (2.410 GHz to 2.465 GHz); software selectable*
Addressing	16-bit PAN (personal area network) IDs per channel (software selectable) 64-bit device address
Encryption	*128-bit AES (software selectable)*

Contains FCC ID: OUR-XBEEPRO. The enclosed device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (*i.*) this device may not cause harmful interference and (*ii.*) this device must accept any interference received, including interference that may cause undesired operation.

Note 16: Canada: Contains Model XBee Radio, IC: 4214A-XBEEPRO

Caution! To satisfy FCC RF exposure requirements for mobile transmitting devices, a separation distance of 20 cm or more should be maintained between the antenna of this device and persons during device operation. To ensure compliance, operations at closer than this distance is not recommended. The antenna used for this transmitter must not be co-located in conjunction with any other antenna or transmitter.

USB +5V voltage

Table 15. USB +5V voltage specifications

Parameter	**Specification**
USB +5V (VBUS) input voltage range	4.75 V to 5.25 V

Power

Table 16. Power specifications

Parameter	Conditions	Specification
Connected to USB (OM-WLS-TEMP and OM-WLS-TC only)		
Supply current		500 mA max
User +5V output voltage range (terminal block pin 21 and 47)	Connected to a self-powered hub. (Note 17)	4.75 V min to 5.25 V max
User +5V output current (terminal block pin 21 and pin 47)	Connected to a self-powered hub. (Note 17)	10 mA max
Isolation	*Measurement system to PC*	*500 VDC min*
Connected to USB (OM-WLS-IFC only)		
Supply current		300 mA max
Wireless Communications operation		
Supply current		500 mA max
AC Adapter Power Supply (used for remote wireless communications operation) (OM-WLS-TEMP and OM-WLS-TC only)		
Standalone power supply		USB power adapter 2.5 Watt USB adapter with interchangeable plugs (Includes plug for USA)
Output voltage		5 V ±5%
Output wattage		2.5 W
Input voltage		100 VAC to 240 VAC 50 Hz to 60 Hz
Input current		0.2 A

Note 17: Self-Powered Hub refers to a USB hub with an external power supply. Self-powered hubs allow a connected USB device to draw up to 500 mA. This device may not be used with bus-powered hubs due to the power supply requirements.

Root Port Hubs reside in the PC's USB Host Controller. The USB port(s) on your PC are root port hubs. All externally powered root port hubs (desktop PC's) provide up to 500 mA of current for a USB device. Battery-powered root port hubs provide 100 mA or 500 mA, depending upon the manufacturer. A laptop PC that is not connected to an external power adapter is an example of a battery-powered root port hub.

USB specifications

Table 17. USB specifications

Parameter	Conditions
USB device type	USB 2.0 (full-speed)
Device compatibility	USB 1.1, USB 2.0
	Bus powered. OM-WLS-TEMP and OM-WLS-TC: 500 mA consumption max OM-WLS-IFC: 300 mA consumption max
USB cable type	*A-B cable, UL type AWM 2725 or equivalent. (min 24 AWG VBUS/GND, min 28 AWG D+/D-)*
USB cable length	3 meters max

Current excitation outputs (Ix+) (OM-WLS-TEMP only)

Table 18. Current excitation output specifications

Parameter	Conditions	Specification
Configuration		4 dedicated pairs: ±I1: CH0/CH1 ±I2: CH2/CH3 ±I3: CH4/CH5 ±I4: CH6/CH7
Current excitation output ranges	Thermistor	10 µA typ
	RTD	210 µA typ
Tolerance		±5% typ
Drift		200 ppm/°C
Line regulation		*2.1 ppm/V max*
Load regulation		*0.3 ppm/V typ*
Output compliance voltage (relative to GND pins 9, 19, 28, 38)		3.90 V max –0.03 V min

Note 18: The device has four current excitation outputs, with ±I1 dedicated to the CH0/CH1 analog inputs, ±I2 dedicated to CH2/CH3, ±I3 dedicated to CH4/CH5, and ±I4 dedicated to CH6/CH7. The excitation output currents should always be used in this dedicated configuration.

Note 19: The current excitation outputs are automatically configured based on the sensor (thermistor or RTD) selected.

Environmental

Table 19. Environmental specifications

Parameter	Conditions
Operating temperature range	0 °C to 70 °C
Storage temperature range	–40 °C to 85 °C
Humidity	0% to 90% non-condensing

Mechanical

Table 20. Mechanical specifications

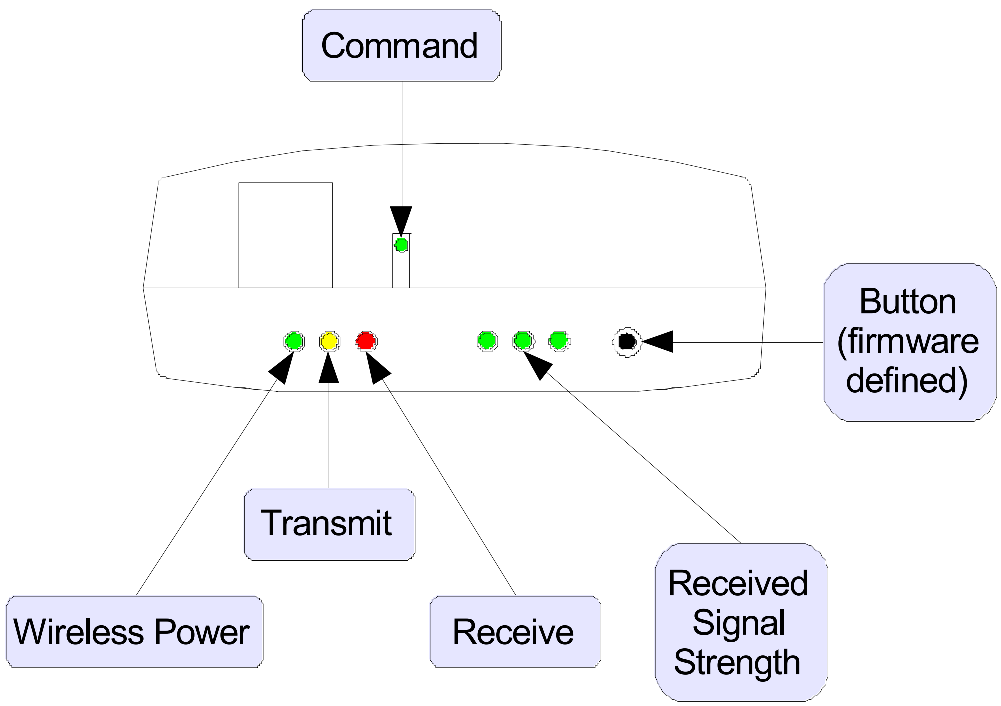
Parameter	Conditions
Dimensions (L × W × H)	▪ OM-WLS-TEMP and OM-WLS-TC 127.0 × 88.9 × 35.6 mm (5.0 × 3.5 × 1.4 in.) ▪ OM-WLS-IFC 79.0 × 75.0 × 26.5 mm (3.1 × 3.0 × 1.0 in.)
User connection length	3 meters max

LED/button configuration

OM-WLS-TEMP and OM-WLS-TC

Table 21. OM-WLS-TEMP and OM-WLS-TC LED configuration

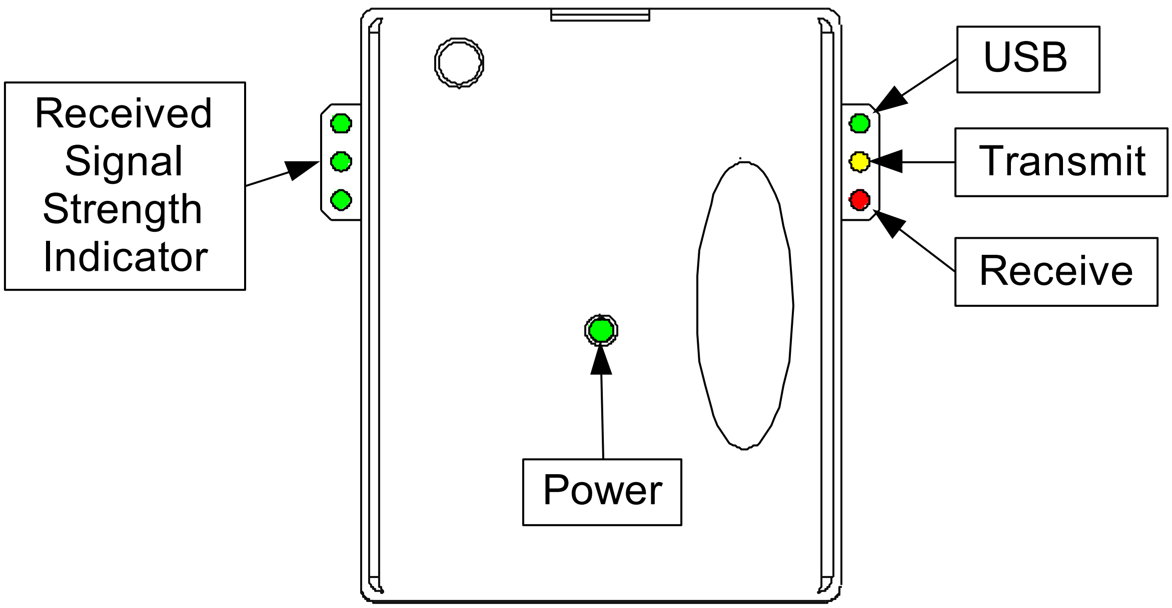
Parameter	Conditions
Command LED	Green LED – indicates a command was received by the device (either USB or wireless)
Received Signal Strength Indicator (RSSI) LEDs	Three green LED bar graph. LEDs will turn on when receiving a wireless message and stay on for approximately 1 second after the end of the message. They indicate the amount of fade margin present in an active wireless link. Fade margin is defined as the difference between the incoming signal strength and the device's receiver sensitivity. ▪ 3 LEDs on: Very strong signal (> 30 dB fade margin) ▪ 2 LEDs on: Strong signal (> 20 dB fade margin) ▪ 1 LED on: Moderate signal (> 10 dB fade margin) ▪ 0 LED on: Weak signal (< 10 dB fade margin)
Wireless Power LED	Green LED – indicates that the internal RF module is powered.
Transmit LED	Yellow LED – indicates transmitting data over the wireless link.
Receive LED	Red LED – indicates receiving data over the wireless link.
Button	Firmware defined; this revision executes an LED test.



OM-WLS-IFC

Table 22. OM-WLS-IFC LED configuration

Parameter	**Conditions**
Power	The OM-WLS-IFC is connected to a computer or external USB hub
Received Signal Strength Indicator (RSSI)	3 green LED bar graph. The LEDs will turn on when receiving a wireless message and stay on for approximately 1 second after the end of the message. They indicate the amount of fade margin present in an active wireless link. Fade margin is defined as the difference between the incoming signal strength and the device's receiver sensitivity. ▪ 3 LEDs on: Very strong signal (> 30 dB fade margin) ▪ 2 LEDs on: Strong signal (> 20 dB fade margin) ▪ 1 LED on: Moderate signal (> 10 dB fade margin) ▪ 0 LEDs on: Weak signal (< 10 dB fade margin)
USB activity	Green LED – indicates activity over the USB connection
Transmit	Yellow LED – indicates transmitting data over the wireless link
Receive	Red LED – indicates receiving data over the wireless link



Screw terminal connector type and pinout (OM-WLS-TEMP and OM-WLS-TC only)

Table 22. Screw terminal connector specifications

Parameter	**Conditions**
Connector type	Screw terminal
Wire gauge range	16 AWG to 30 AWG

Table 23. Screw terminal pinout

Pin	Signal Name	Pin Description	Pin	Signal Name	Pin Description
1	I1+ [1]	CH0/CH1 current excitation source	27	I4– [1]	CH6/CH7 current excitation return
2	NC	No connect	28	GND	Ground
3	C0H	CH0 sensor input (+)	29	C7L	CH7 sensor input (–)
4	C0L	CH0 sensor input (–)	30	C7H	CH7 sensor input (+)
5	4W01 [2]	CH0/CH1 4-wire, 2 sensor common	31	IC67 [1]	CH6/CH7 2 sensor common
6	IC01 [1]	CH0/CH1 2-sensor common	32	4W67 [2]	CH6/CH7 4-wire, 2 sensor common
7	C1H	CH1 sensor input (+)	33	C6L	CH6 sensor input (–)
8	C1L	CH1 sensor input (–)	34	C6H	CH6 sensor input (+)
9	GND	Ground	35	NC	No connect
10	I1– [1]	CH0/CH1 current excitation return	36	I4+ [1]	CH6/CH7 current excitation source
	CJC sensor			CJC sensor	
11	I2+ [1]	CH2/CH3 current excitation source	37	I3– [1]	CH4/CH5 current excitation return
12	NC	No connect	38	GND	Ground
13	C2H	CH2 sensor input (+)	39	C5L	CH5 sensor input (–)
14	C2L	CH2 sensor input (–)	40	C5H	CH5 sensor input (+)
15	4W23 [2]	CH2/CH3 4-wire, 2 sensor common	41	IC45 [1]	CH4/CH5 2 sensor common
16	IC23 [1]	CH2/CH3 2 sensor common	42	4W45 [2]	CH4/CH5 4-wire, 2 sensor common
17	C3H	CH3 sensor input (+)	43	C4L	CH4 sensor input (–)
18	C3L	CH3 sensor input (–)	44	C4H	CH4 sensor input (+)
19	GND	Ground	45	NC	No connect
20	I2– [1]	CH2/CH3 current excitation return	46	I3+ [1]	CH4/CH5 current excitation source
21	+5V	+5V output	47	+5V	+5V output
22	GND	Ground	48	GND	Ground
23	DIO0	Digital Input/Output	49	DIO7	Digital Input/Output
24	DIO1	Digital Input/Output	50	DIO6	Digital Input/Output
25	DIO2	Digital Input/Output	51	DIO5	Digital Input/Output
26	DIO3	Digital Input/Output	52	DIO4	Digital Input/Output

[1] OM-WLS-TEMP only. These pins are labeled **RSVD** (reserved for future use) on the OM-WLS-TC.

[2] OM-WLS-TEMP only. "NC" (no connection) on the OM-WLS-TC.

Do not connect anything to pins labeled "NC".

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FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. Purchase Order number under which the product was PURCHASED,
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3. Repair instructions and/or specific problems relative to the product.

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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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