

# X-TC1W-K

*Thermocouple to 1-Wire Adapter*

**USERS MANUAL** Revision 1.0



*Compatible with Type K Thermocouples*

## Features

- ▶ Works with Type-K thermocouples (-200°C to 1250°C)  $\pm 0.5^{\circ}\text{C}$  Accuracy
- ▶ Built-in miniature polarized thermocouple connector
- ▶ Internal cold junction temperature compensation
- ▶ Fully calibrated and linearized (uses NIST Type-K thermocouple polynomial)
- ▶ Digital "1-Wire" interface
- ▶ Easy to use

**DIREKTRONIK**

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## Section 1: Introduction

The X-TC1W-K is a thermocouple to 1-Wire® signal adapter for use in a broad range of industrial applications. It works directly with many ControlByWeb™ products (see [www.controlbyweb.com](http://www.controlbyweb.com) for a list of compatible products.) No power supply or additional software is required. Simply connect and configure using the built-in configuration and setup web pages of the host device.

Use thermocouple sensors to monitor temperature in freezers, ovens, incubators, generators – Anywhere precision and rugged temperature sensors are required.



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### 1.1 Features

- Works with Type-K thermocouples (-200°C to 1250°C)
- ±0.5°C Accuracy
- Built-in miniature polarized thermocouple connector
- Internal cold junction temperature compensation
- Fully calibrated and linearized (uses NIST Type-K thermocouple polynomial)
- Digital “1-Wire®” interface
- Easy to use

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### 1.2 Advantages of Thermocouples

Thermocouples are used extensively in the scientific and automation industries. They are available in a wide variety of industrial housings, including thermowells, threaded wells, PFA coated thermowells for corrosive applications, and high temperature lead wires. Thermocouples have a much wider range than with the “1-Wire” digital sensors (-55°C to 125°C) supported by the ControlByWeb products.

Thermocouples are workable in high temperature applications such as in a fermenter where steam is injected to sterilize the vessel.

**Temperature Range:** Type-K thermocouples have a measurement range of -200°C to +1250°C

**Robust:** Thermocouples are inexpensive, extremely simple, and rugged devices which are suitable for use in hazardous environments.

**Rapid response:** Because they are small and have low thermal mass, thermocouples respond rapidly to temperature fluctuations.

**No self heating:** Thermocouples require no excitation power; therefore, they are not prone to self heating.

## 1.3 Installation Instructions

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Install the X-TC1W-K in a protected location away from rain or direct sunlight. The internal cold junction compensation will be more accurate if the X-TC1W-K is protected from rapid temperature changes.

### Thermocouple Input

The X-TC1W-K works with Type-K thermocouples. It has a built-in miniature thermocouple connector together with a precision cold-junction temperature compensation circuit. The cold junction compensation is accurate to  $\pm 0.5^{\circ}\text{C}$  from  $-40^{\circ}\text{C}$  to  $80^{\circ}\text{C}$ . The X-TC1W-K only works with ungrounded or isolated thermocouples.

### 1-Wire connections

The sensor has 3-wires which are connected to a compatible ControlByWeb device. The cable can then be extended with additional wire, if needed.

3-Wire Cable	
Terminal	Description
<b>+5V</b>	+5V power
<b>Data</b>	1-Wire Data
<b>Gnd</b>	Ground

ControlByWeb devices can support multiple "1-Wire" sensors. The sensors share the same three connections for communications and power (+5V, Ground, Data). Every sensor on the bus is assigned a unique serial number when it is manufactured. That number is used to address the sensor during communication.

Multiple sensors can be connected in two ways: directly connected (star topology) or "daisy chained" (linear topology). Many factors can determine the maximum length of the cable, including the sensor network topology, the type of cable used, the number of sensors, and ambient electromagnetic noise.

Combined cable lengths to all sensors of 600 ft using Cat 5e cable have been successful. However, due to the uniqueness of installation environments, results may vary. Please test in the desired environment before making a permanent installation. Cable capacitance generally limits the length. A linear (daisy chain) topology will minimize signal reflections, providing a more reliable connection and will allow longer cable length than a star topology.

The 1-Wire bus is "single-ended" and has no intrinsic noise protection. It is susceptible to interference if the cable is routed near power lines, fluorescent fixtures, motors or other noise sources. Keep the cable wiring short and avoid routing it near other electrical equipment.

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## 1.4 Setup Instructions

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Once the sensor is connected to a compatible device, the device must associate a sensor name with the sensor address. You must define a sensor name and associate an address for each 1-Wire sensor.


For example, up to 16 1-Wire sensors can be connected to a ControlByWeb X-410 module. From the X-410 setup page, select the *I/O Setup>1-Wire Sensors* tab. A list of associated 1-Wire sensors is shown:



Name	1-Wire Sensor #	Edit
Temperature (X-DTHS-P)	29-05A02300000003	Edit X
Humidity (X-DTHS-P)	29-05A02300000003	Edit X
Oven Temperature (X-TC1W-K)	29-AE7B15000000C8	Edit X
Outdoor Temp (DS18B20)	28-FF0D86A416043B	Edit X

[Add 1-Wire Sensor +](#)

To add a new 1-Wire sensor click *Add 1-Wire Sensor*.

Enter a descriptive name for the sensor in the *Sensor Name* box such as “Freezer Temperature”. Click ▼ to see a list of the connected 1-Wire sensors. The addresses of the non associated sensors on the bus are shown in the drop-down list together with the sensor type of each sensor. Click  button to make a fresh scan of the bus for sensors. For each sensor being added, select the appropriate address from the sensor address drop-down list. As 1-Wire sensors are associated, the addresses are automatically removed from the pull down ▼ list of available addresses. Select the sensor address that matches the sensor address printed on the housing of the X-TC1W-K.

Alternatively, connect the sensors to the bus one at a time. The procedure is to start with one sensor and associate it with the appropriate sensor name by selecting the sensor address within the drop-down list. Submit the page, connect a second sensor, and press the Refresh List button. Associate the second sensor to the appropriate sensor name. Continue this procedure until all sensors are set up.

For more information about how to configure these options, consult the user manual for the specific host device. Normally the *General Settings* page has a setting to select the display for Fahrenheit or Centigrade units.

## Appendix A: Specifications

### Input

Thermocouple:	Type-K
Number of channels:	1
Linear Range:	-200°C to 1250°C
Operating Ambient:	-40° C to 80°C (internal cold junction compensation)
Resolution:	0.027°C
Accuracy:	±0.5°C
Drift:	4ppm/°C typical, 15ppm/°C max
Type:	Input is not isolated, only use <u>ungrounded</u> thermocouples
Input Current:	Differential, +-165nA max
Error Detection:	Detects sensor breakage or disconnection of lead wire

### Thermocouple Connector

Type:	Miniature size, Omega PCC-SMP Series, Type-K
Mating Connector:	Miniature size, SMP

### Power Requirements

Input Voltage:	+5.0 VDC ±0.25V
Input Current:	1mA max (idle) 5mA, 50mS typ during measurement and communication

### Communication

Protocol:	Maxim (Dallas) "1-Wire®"
Sensor Address:	Factory-lasered 64-bit registration number
Conversion Time:	30mS max
Sensor fault:	If the thermocouple or lead wire is broken, the X-TC1W-K reports a floating point NAN (not a number) value.

### Environmental

Indoor use or NEMA-4 protected location	
Altitude:	up to 2000m
Operating Temperature:	-40°C to 80°C (-40°F to 180°F)
Storage Temperature:	-40°C to 85°C (-40°F to 185°F)
Humidity:	5-95%, non-condensing

### Mechanical

Size:	1.57in (40mm) x 2.21in (56.3mm) x 0.59in (15mm) high
Weight:	0.7oz (20 grams)
Enclosure Material:	Grey ABS

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## Appendix B: 1-Wire Format

The X-TC1W-K is designed for direct connection to ControlByWeb host devices; however, as a “1-Wire” sensor it can also be used with other host devices with appropriate custom programming. The information below is provided to facilitate using the X-TC1W-K with other devices.

The first byte indicates the sensor type, for the X-TC1W-K the device code is 0x02. The X-TC1W-K sensor transmits temperature in four, IEEE-574 floating point bytes (°C). Following the temperature data is a CRC of bytes 0-4. This CRC uses the standard 1-Wire CRC polynomial:

$$CRC = X^8 + X^5 + X^4 + X^0$$

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
0x02	IEEE-574 (LSB)	IEEE-574	IEEE-574	IEEE-574 (MSB )	Checksum

The X-TC1W-K employs a Maxim DS2408 interface chip. With this chip the 1-Wire measurements are “pipe-lined” such that the data returned from a data collection sequence is from the previous measurement sequence. If the sensor is polled every few seconds this delay will not be a problem. If longer polling options are desired, make a measurement, wait at least 30ms for a new conversion, then read the data again for a fresh measurement.

## Appendix C: Trademark and Copyright Information

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## Appendix D: Warranty

This Xytronix Research & Design, Inc. product is warrantied against defects in material and workmanship for a period of five years from the date of shipment. During the warranty period, Xytronix Research & Design, Inc. will, at its option, either repair or replace products that prove to be defective. This warranty is extended to the original purchaser of the equipment only.

For warranty service or repair, customer must contact Xytronix Research & Design, Inc. technical support ([support@ControlByWeb.com](mailto:support@ControlByWeb.com)) and obtain a Return Authorization number (RA#). Before issuing an RA#, a support technician will work with customer to try to resolve the issue without returning the product. If technician determines that product must be returned for service an RA# will be issued. Next, the product must be properly packaged and returned to Xytronix Research & Design, Inc. with the RA# clearly marked on the package. The purchaser shall prepay all charges for shipping to Xytronix Research & Design, Inc. For warranty repairs of products less than one year old, Xytronix Research & Design, Inc. will pay the shipping charges to return the product to the purchaser as long as the product is shipped within the continental United States. If the product is shipped outside of the continental United States or the product was shipped more than one year earlier, the purchaser shall pay all shipping charges both ways.

### **Limitation**

The foregoing warranty shall not apply to defects or damage resulting from improper use or misuse, unauthorized repair, tampering, modification, improper connection, or operation outside the electrical/environmental specifications for the product. Further, the warranty does not cover damage from Acts of God, such as lightning, fire, flood, hurricanes and tornadoes. This warranty does not cover damage to property, equipment, direct, indirect, consequential, or incidental damage (including damage for loss of business profit, business interruption, loss of data, and the like) arising out of the use or misuse of this product.

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## Appendix E: FCC Statement

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.

### Warning

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not in-stalled and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into a relay on a circuit different from where the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

### Notice

Changes or modification not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.