



# **USB TC-08**

## **Temperature Logger**

User's Guide



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# 1 Introduction

## 1.1 Overview

The USB TC-08 is a temperature and voltage logger designed to support multiple thermocouples. With the accompanying PicoLog software, the unit can be used with any laptop or PC running Windows XP SP2, Vista or Windows 7.

The driver provides cold junction compensation for thermocouples. PicoLog supports up to 20 USB TC-08 devices and the driver can support more (as many as 64, if you have a high-specification PC).

This manual describes the physical and electrical properties of the USB TC-08. For an explanation of how to use the software drivers please refer to the "USB TC-08 Programmer's Guide", and "PicoLog User's Guide".

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## 1.3 Safety warning

We strongly recommend that you read the general safety information below before using your product for the first time. If the equipment is not used in the manner specified, then the protection provided may be impaired. This could result in damage to your computer and/or injury to yourself or others.

### Maximum input range

The USB TC-08 is designed to measure voltages in the range of  $\pm 70$  mV. Any voltages in excess of  $\pm 30$  V may cause permanent damage to the unit.

### Mains voltages

Pico products are not designed for use with mains voltages.

### Safety grounding

The ground of every product is connected directly to the ground of your computer through the interconnecting cable provided. This is done in order to minimise interference. If the PC (especially laptop) is not grounded, reading stability cannot be guaranteed and it may be necessary to manually ground the equipment.

Take care to avoid connecting the inputs of the product to anything which may be at a hazardous voltage. If in doubt, use a meter to check that there is no hazardous AC or DC voltage. Failure to check may cause damage to the product and/or computer and could cause injury to yourself or others.

Take great care when measuring temperatures near mains equipment. If a sensor is accidentally connected to mains voltages, you risk damage to the converter or your computer and your computer chassis may become live.

You should assume that the product does not have a protective safety earth. Incorrect configuration or use of the device to measure voltages outside the maximum input range can be hazardous.

### Repairs

The unit contains no user-serviceable parts: repair or calibration of the unit requires specialised test equipment and must be performed by Pico Technology Limited or their authorised distributors.

## 1.4 Company details

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## 2 Getting Started

### 2.1 Installing the driver

The driver is installed automatically when you install the PicoLog software. Alternatively, you can download the driver from our website at <http://www.picotech.com>.

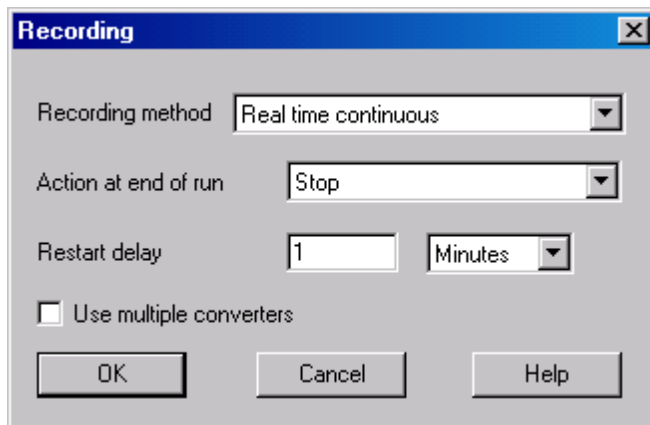
### 2.2 Connecting the USB TC-08

**Please note: do not connect the USB TC-08 until you have installed the software and restarted your PC.**

To begin using the USB TC-08, connect it to the USB port on your computer using the cable provided. Next, connect a thermocouple to one of the thermocouple input connectors. To complete the installation, select the USB TC-08 unit and thermocouple type in PicoLog as follows:

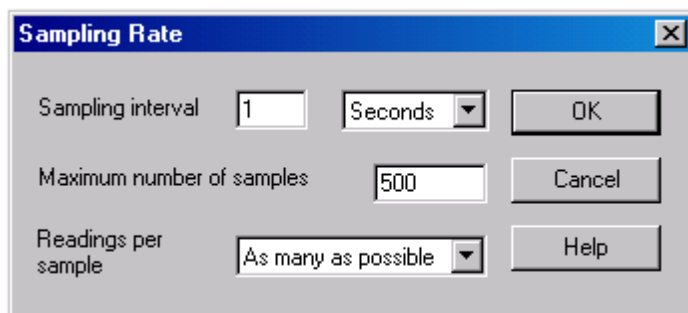
1. Start up PicoLog Recorder
2. Select **New Settings** from the **File** menu.

The **Recording** dialog box appears:



3. Click the **OK** button.

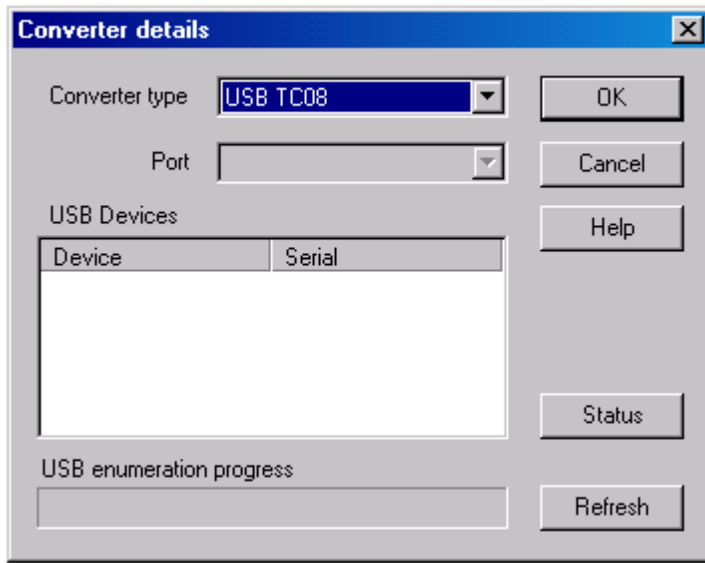
The **Sampling Rate** dialog box appears



4. Click the **OK** button.

The **Converter details** dialog box appears



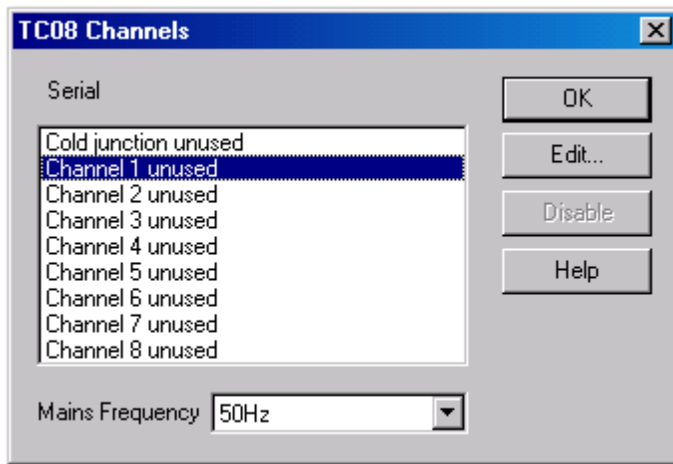


5. Select **USB TC-08** from the drop-down list of converters.

The device name and serial number should appear in the **USB Devices** pane and the USB enumeration progress bar gradually expand to 100%. If the progress bar does not start moving, disconnect and reconnect the USB TC-08, then click **Refresh**.

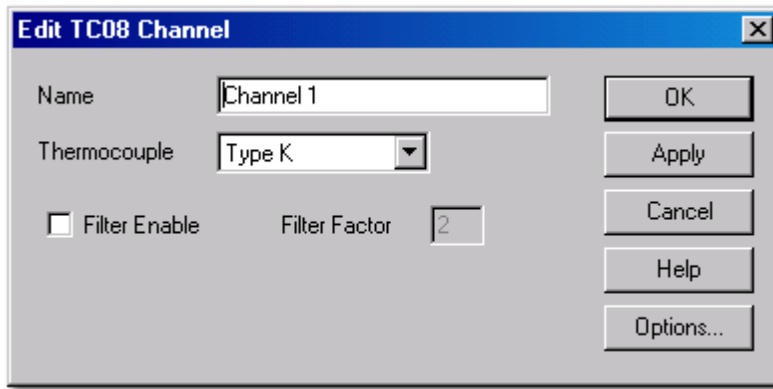
6. In the **USB Devices** pane, select the **USB TC-08**. If you are using more than one USB TC-08, check the serial number on the bottom of the device so that you know which one to select from the list
7. Click the **OK** button.

The following dialog box appears



8. In the **TC-08 Channels** window, double-click on **Channel 1 unused**.

The **Edit TC-08 Channel** dialog box appears

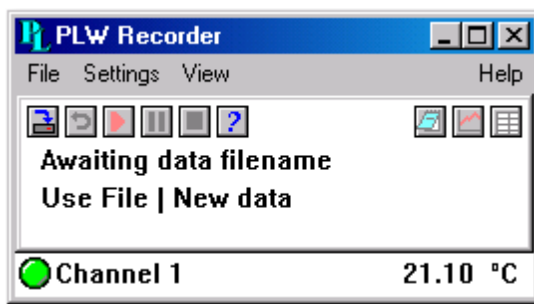


9. From the **Thermocouple** drop-down list, select the type of thermocouple you are using and click **OK**.

The **TC-08 Channels** dialog box reappears.

10. Click **OK**.

Channel 1 should now appear in the monitor window with the current temperature reading.



#### **TIP: Front panel LED**

- When a connection to the device has been established, the LED will be green.
- When readings are being captured, the LED will change to alternating red and green.

## 3 Product information

Note: Do not expose the USB TC-08 to a direct heat source (e.g. sunlight) as heating/cooling of the device may cause inaccurate readings.

### 3.1 Specifications

<b>Resolution</b>	20 bits (16.25 NFR)
<b>Thermocouple types</b>	B,E,J,K,N,R,S,T
<b>Number of input channels</b>	8
<b>Conversion time - per active channel</b>	100 ms
<b>Conversion time - CJC</b>	100 ms
<b>Uncalibrated accuracy</b>	The sum of $\pm 0.2\%$ and $\pm 0.5^\circ\text{C}$
<b>Full scale input</b>	$\pm 70$ mV
<b>Common mode range</b>	$\pm 7.5$ V
<b>Overvoltage protection</b>	$\pm 30$ V
<b>Input impedance</b>	2 M $\Omega$
<b>Input connectors</b>	8 x miniature thermocouple
<b>Output connector</b>	USB upstream connector
<b>Power requirements</b>	No power supply required
<b>Environmental conditions</b>	
<b>Operating temperature:</b>	0 to $50^\circ\text{C}$ (for stated accuracy 20 to $30^\circ\text{C}$ )
<b>Humidity (operating):</b>	5% to 80% RH non-condensing,
<b>Humidity (storage):</b>	5% to 95%
	NOT water-resistant

Note: The resolution and accuracy depend upon the thermocouple type and the temperature range. Below is a list of the thermocouples and temperature ranges supported by the USB TC-08.

	<b>Actual measurable range</b>	<b>Theoretical ranges</b>
CJC	$-5^\circ\text{C}$ to $70^\circ\text{C}$	N/A
Type B	$20^\circ\text{C}$ to $1820^\circ\text{C}$ (CJC must be $>20^\circ\text{C}$ )	$0^\circ\text{C}$ to $1820^\circ\text{C}$
Type E	$-270^\circ\text{C}$ to $910^\circ\text{C}$	$-270^\circ\text{C}$ to $1000^\circ\text{C}$
Type J	$-210^\circ\text{C}$ to $1200^\circ\text{C}$	$-210^\circ\text{C}$ to $1200^\circ\text{C}$
Type K	$-270^\circ\text{C}$ to $1370^\circ\text{C}$	$-270^\circ\text{C}$ to $1370^\circ\text{C}$
Type N	$-270^\circ\text{C}$ to $1300^\circ\text{C}$	$-270^\circ\text{C}$ to $1300^\circ\text{C}$
Type R	$-50^\circ\text{C}$ to $1760^\circ\text{C}$	$-50^\circ\text{C}$ to $1760^\circ\text{C}$
Type S	$-50^\circ\text{C}$ to $1760^\circ\text{C}$	$-50^\circ\text{C}$ to $1760^\circ\text{C}$
Type T	$-270^\circ\text{C}$ to $400^\circ\text{C}$	$-270^\circ\text{C}$ to $400^\circ\text{C}$

## 3.2 How a thermocouple works

In a closed circuit of two dissimilar metals (a thermocouple), an electric current flows when one of the two junctions is heated with respect to the other. The current continues to flow as long as the two junctions are at different temperatures. The magnitude and direction of the current is a function of the temperature difference between the junctions and of the thermal properties of the metals used in the circuit. This phenomenon is known as the Seebeck Effect.

The conductors can be made of any two dissimilar metals, and when the hot junction is heated the current flow can be observed. If the positions of the hot and cold junctions are reversed, current flows in the opposite direction.

A thermocouple circuit actually generates a measurable, low-voltage output that is almost directly proportional to the temperature difference between the hot junction and the cold junction. A change in this temperature difference produces some net change in the voltage.

Note: More information on choosing and using thermocouples can be found [at this page on our website](#).

## 4 Glossary

**Cold junction compensation (CJC).** A method of compensating for ambient temperature variations in thermocouple circuits.

**Common mode range.** The voltage range, relative to the ground of the data logger, within which both inputs of a differential measurement must lie in order to achieve an accurate measurement.

**DLL.** Dynamic Link Library. Files with this file extension contain a collection of Windows functions designed to perform a specific class of operations.

**Input impedance.** The resistance measured between the input terminals of a circuit.

**NFR.** Noise-Free Resolution. The effective number of bits of resolution that can be considered noise-free.

**Overvoltage protection.** The maximum input voltage that can be applied without damaging the unit.

**Resolution.** A value in bits, related to the number of increments of an analog input signal that can be detected by a digital measurement system. A high-resolution measurement system detects smaller signal increments than a low-resolution measurement system.

**Thermocouple.** A device consisting of two dissimilar metals joined together. The thermoelectric voltage developed between the two junctions is proportional to the temperature difference between the junctions.

**Type B thermocouple.** Type B thermocouples are made from platinum and rhodium and are suitable for high temperature measurements of up to 1820°C. Unusually, due to the shape of their temperature / voltage curve, type B thermocouples give the same output at 0°C as at 42°C.

**Type E thermocouple.** Type E thermocouples are made from chromel and constantan. They have a high output (68  $\mu\text{V}/^\circ\text{C}$ ), making them well suited to low-temperature (cryogenic) use. They are non-magnetic.

**Type J thermocouple.** Type J thermocouples are made from iron and constantan. They measure temperatures in the range -210 to +1200°C. The main application is with old equipment that can not accept the more modern thermocouple. J types should not be used above 760°C, as an abrupt magnetic transformation will cause permanent decalibration.

**Type K thermocouple.** Type K thermocouples are low-cost, general-purpose thermocouples, made from chromel and alumel, operating in the -270°C to +1370°C temperature range. Sensitivity is approx 41  $\mu\text{V}/^\circ\text{C}$ .

**Type N thermocouple.** Type N thermocouples are made from nicrosil and nisil. The high stability and resistance to high-temperature oxidation of these thermocouples make them suitable for measuring high temperatures. They are less expensive than platinum types B,R, and S and were designed to be an improved type K.

**Type R thermocouple.** Type R thermocouples are made from platinum and rhodium, and are suitable for high-temperature measurements of up to 1760°C. Low sensitivity (10  $\mu\text{V}/^\circ\text{C}$ ) and high cost make them unsuitable for general purpose use.

**Type S thermocouple.** Type S thermocouples are made from platinum and rhodium, and are suitable for high-temperature measurements of up to 1760°C. Low sensitivity (10  $\mu\text{V}/^\circ\text{C}$ ) and high cost make these thermocouples unsuitable for general purpose use. Due to their high stability, type S thermocouples are used as the standard of calibration for the melting point of gold.

**Type T thermocouple.** Type T thermocouples are made from copper and constantan, are highly accurate, and operate in the  $-270^\circ\text{C}$  to  $+400^\circ\text{C}$  temperature range.

**USB.** Universal Serial Bus. This is a standard port that enables you to connect external devices to PCs. A typical USB 1.1 port supports a data transfer rate of 12 Mbps (12 megabits per second), and is much faster than a COM port.

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