

TCK-4 Thermocouple Amplifier Unit

Introduction

The TCK-4 is a low cost 4-channel type K thermocouple amplifier unit. The TCK-4 produces a high-level voltage output proportional to input temperature for use with data acquisition and control systems, which have no thermocouple support.

Features

- 4 differential type-k thermocouple input channels
- 10mV/°C output
- -200°C to 1250°C thermocouple range
- On-board cold junction compensation
- Single 5V or 7 to 28V supply
- Low current consumption
- All IO via screw terminals
- Desktop, panel or DIN Rail mounting



Description

To achieve a temperature proportional output of 10 mV/°C and accurately compensate for the cold junction over the rated operating range of the circuit, the TCK-4 is gain trimmed to match the transfer characteristic of a K type thermocouple at 25°C. For a type K output in this temperature range the TC is 40.44 $\mu\text{V}/^\circ\text{C}$ and the resulting gain is nominally 247.3.

Because a thermocouple output voltage is non-linear with respect to temperature, and the TCK-4 linearly amplifies the thermocouple signal, the TCK-4 output signal is non-linear with temperature. Most Data acquisition software will include a look-up table to correct for this non-linearity.

Typical output readings for an input temperature are shown below;

Thermo-couple	Output	Thermo-couple	Output	Thermo-couple	Output
-200°C	-1.45V	300°C	3.022V	800°C	8.23V
-100°C	-0.876V	400°C	4.057V	900°C	9.23V
0°C	0.027V	500°C	5.107V	1000°C	10.2V
100°C	1.015V	600°C	6.160V	1100°C	11.15V
200°C	2.015V	700°C	7.20V	1200°C	12.07V

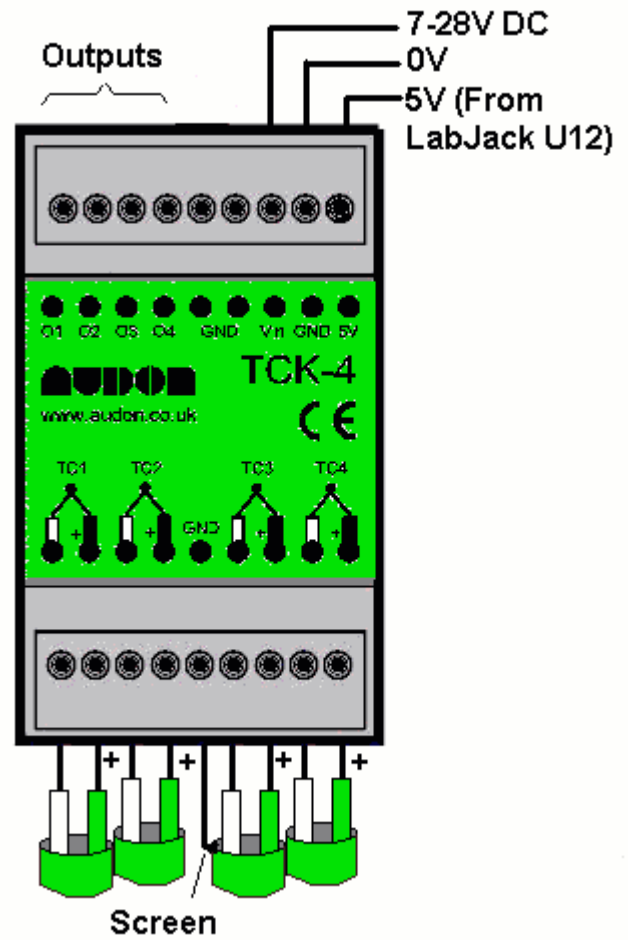
Connection

The type-K thermocouples are connected to the bottom row of screw terminals as shown. The Green cable is +ve and should be connected to the +ve input. If the thermocouple cable has an outer screen, this can be connected to the centre “GND” screw terminal.

The high-level voltage outputs are available from screw terminals O1 to O4, referenced to GND.

The TCK-4 can be powered from a 5V supply, commonly available from USB based DAQ units such as the LabJack U12. The 5V supply is connected between GND and 5V.

The TCK-4 can also be powered from any DC PSU with an output voltage of between 7 and 28VDC. The PSU output should be connected between the GND and Vin terminals.



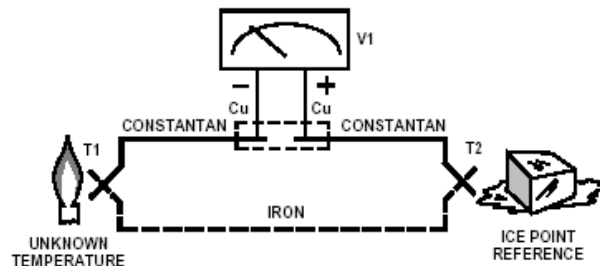
TCA-4 Specifications

- Power Supply +5V @ 30mA, 9-28V @ 40mA
- Operating Temperature 0-70°C
- CJC Temperature Range 0-70°C
- Calibration Error @ 25°C $\pm 1^\circ\text{C}$
- Gain error $\pm 0.75\%$
- Nominal Thermocouple Output 10mV/°C
- Bandwidth 15kHz
- Usable Output current 5mA
- Dimensions 90mm x 53mm x 57mm

Thermocouple Theory

The thermocouple is a very simple device that is simply the junction of two dissimilar metals. The principle is that two dissimilar metals always have a contact voltage between them, and this contact voltage changes as the temperature changes.

The contact voltage is not measurable for a single junction, but when two junctions are in a circuit with the junctions at different temperatures then a voltage of a few millivolts can be detected. In theory, one of the junctions should be held at a constant known temperature, usually 0°C but this often not possible in real applications.

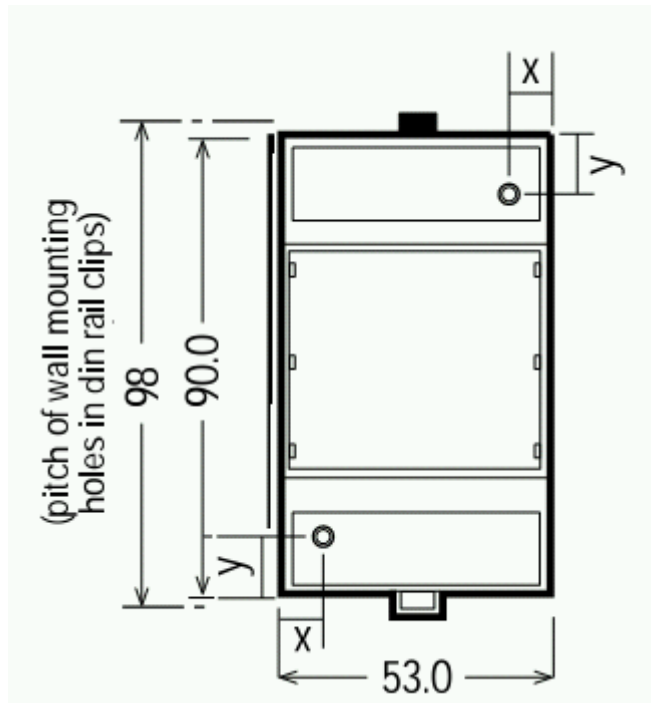
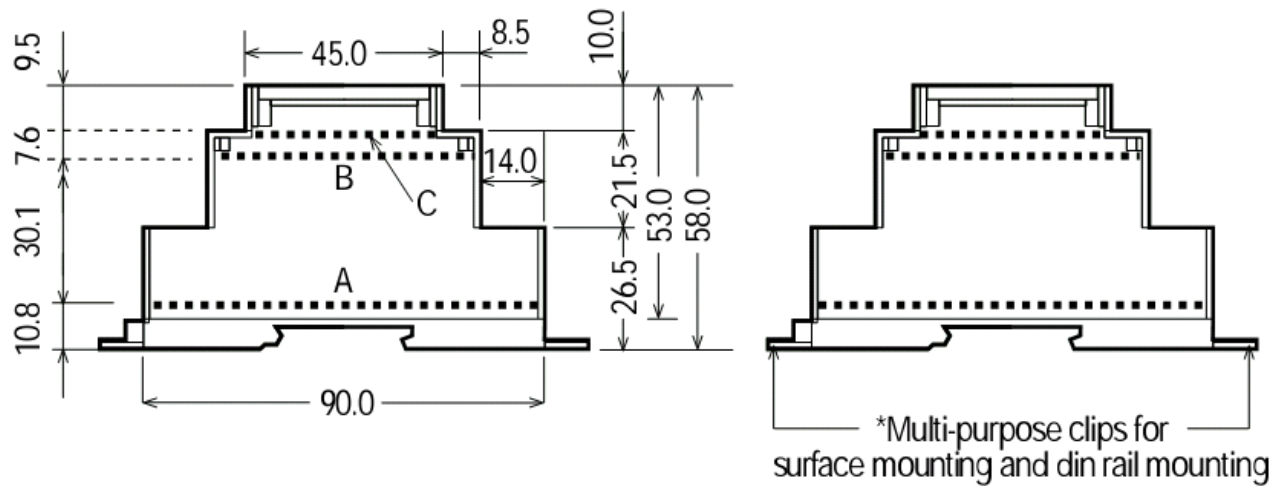


In practice, a single junction thermocouple is used and the thermocouple screw terminals are assumed to be the second “cold” junction. Instead of keeping the screw terminals at a constant temperature, the actual temperature of the screw terminals is measured and used to compensate the thermocouple output signal.

Any two dissimilar metal wires will produce a thermoelectric voltage, however, certain types of thermocouples are selected as standard thermocouples because of the characteristics of the voltage output. Type K is the most common.

Thermocouples are widely used in industry and academia because they are low cost, simple, versatile rugged and small. They can also be very sensitive, give fast response and have a very wide operating temperature range.

Dimensions



Mounting

The TCK-4 can be desktop, panel or DIN rail mount. The units will clip on to standard 35mm DIN rail. The DIN rail mounting clips may be extended to reveal 4mm screw holes for fixing to a panel or wall.