

Connecting a Thermocouple to the Model 400

Introduction

Thermocouples are temperature sensors whose operation is based on the principle that when two dissimilar metals are joined a predictable voltage will be generated that relates to the difference in temperature between the measuring junction and the reference junction (connection to the measuring device). This tech-note details the wiring and input configuration necessary to connect a thermocouple to a precision input of the Model 400.

An ANSI code (in the form of a letter) exists for each type of thermocouple. Currently, two types of thermocouples are supported by the Model 400's companion software, the Data Dolphin software; a type T thermocouple accurate from -200° C to 350° C (-330° F to 660° F), and a type K thermocouple accurate from -270° C to 1372° C (-454° F to 2501° F). Specifications for each of these thermocouple types are shown in the table below.







ANSI Code	Alloy Combination		Color Coding		Maximum Useful Temperature Range	Maximum Thermocouple Grade Temperature Range	EMF (mV) Over Max. Temperature Range	Standard Limits of Error (Above 0°C)
	+ Lead	- Lead	Thermocouple Grade	Extension Grade				
J	Iron Fe (magnetic)	Constantan Copper- Nickel Cu-Ni			Thermocouple Grade: 32 to 1382°F 0 to 750°C Extension Grade: 32 to 392°F 0 to 200°C	-346 to 2193°F -210 to 1200°C	-8.095 to 69.553	greater of 2.2°C or 0.75%
K	NICKEL- CHROMIUM Ni-Cr	NICKEL- ALUMINIUM Ni-Al (magnetic)			Thermocouple Grade: -328 to 2282°F -200 to 1250°C Extension Grade: 32 to 392°F 0 to 200°C	-454 to 2501°F -270 to 1372°C	-6.458 to 54.886	greater of 2.2°C or 0.75%
T	Copper Cu	Constantan Copper- Nickel Cu-Ni			Thermocouple Grade: -328 to 662°F -250 to 350°C Extension Grade: -76 to 212°F -60 to 100°C	-454 to 752°F -270 to 400°C	-6.258 to 20.872	greater of 1.0°C or 0.75%

Table 1: ANSI thermocouple specifications

Wiring

Connect the cold junction compensation kit and thermocouple to the Model 400's screw terminals as shown in Figure 1 below. The cold junction compensation kit internally consists of a 5kΩ semiconductor thermistor with a 10 kΩ precision resistor, connected as shown in Figure 2 to precision input 11. Once this compensation kit is installed, the other seven precision inputs (inputs 12 – 18) can be used as thermocouple inputs.

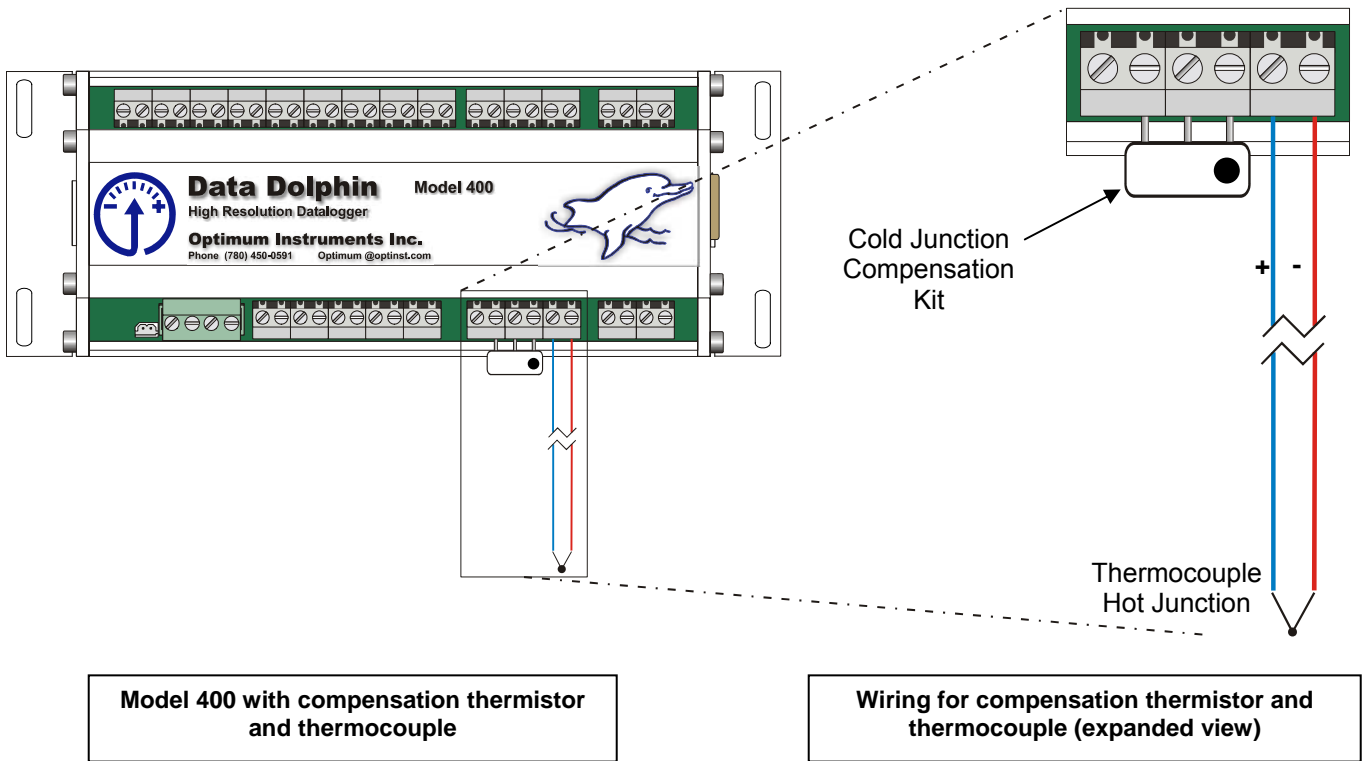


Figure 1: Cold junction compensation thermistor and thermocouple wiring connections to the Model 400

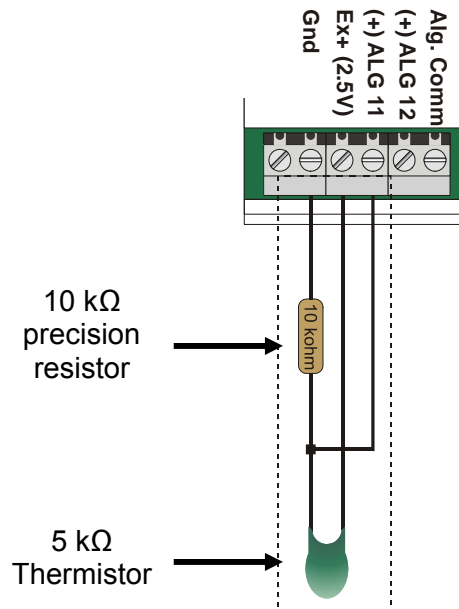


Figure 2: Internal schematic for compensation kit

Configuring a Model 400 Precision Input for a Thermocouple

Once you have correctly connected the cold junction compensation thermistor and thermocouple to the Model 400's screw terminals, you will want to configure the precision inputs of the Model 400 for these devices. Complete the following steps to configure the precision inputs of the Model 400 with the Data Dolphin software:

1. Load the Data Dolphin software on your desktop or laptop PC and connect to the Model 400 with a direct, on-site or wireless connection (see Data Dolphin software manual).
2. Click on the Setup button on the Data Dolphin toolbar to load the Dolphin Setup window.
3. Click on the Precision Inputs tab.
4. Now load the controls of the Precision Inputs tab with the Model 400's current input settings. To do this, click on the Load From Dolphin button in the lower left hand corner of the Setup window.
5. Enable precision input 11 if it has not already been done so by clicking the "Input 11 On" checkbox.
6. Configure precision input 11 for the cold junction compensation thermistor by choosing the 5K thermistor selection in the scaling selection box. Note that there is a separate selection for measurement in Celsius or Fahrenheit with the 5k Ω thermistor. Enter a rate of 3 Hz and a terminating resistance of 10000 ohms. Figure 3 shows Input 11 correctly configured for the cold junction compensation thermistor.
7. Next, configure the input to which the thermocouple is attached. Enable the input first by clicking on the "Input ## On" checkbox.
8. Select the type of thermocouple and units of measurement from the Scaling drop-down list. As an example, precision input 12 has been configured for reading from a type T thermocouple. In Figure 3, "Thermocouple T - °C, CJ on Inp11" has been selected from the Scaling drop down list to configure the input to correctly read the temperature, in degrees Celsius, on the type T thermocouple. Separate selections are available under Scaling for thermocouple temperature measurement in degrees Fahrenheit and for measurement using the type K thermocouple.
9. Appropriately name the input (eg. Thermo 1). Figure 3 shows Input 12 correctly configured for the type T thermocouple.
10. Repeat step 6 for each of the precision inputs to which a thermocouple is attached.
11. Click the apply button to program the new settings into the Model 400.
12. To verify that the Model 400 is indeed reading from the thermocouples correctly, apply a known temperature to the thermocouple(s), and click on the Status button on the Data Dolphin toolbar to open the Status window. The temperature displayed for the thermocouple(s) should equal the applied temperature.

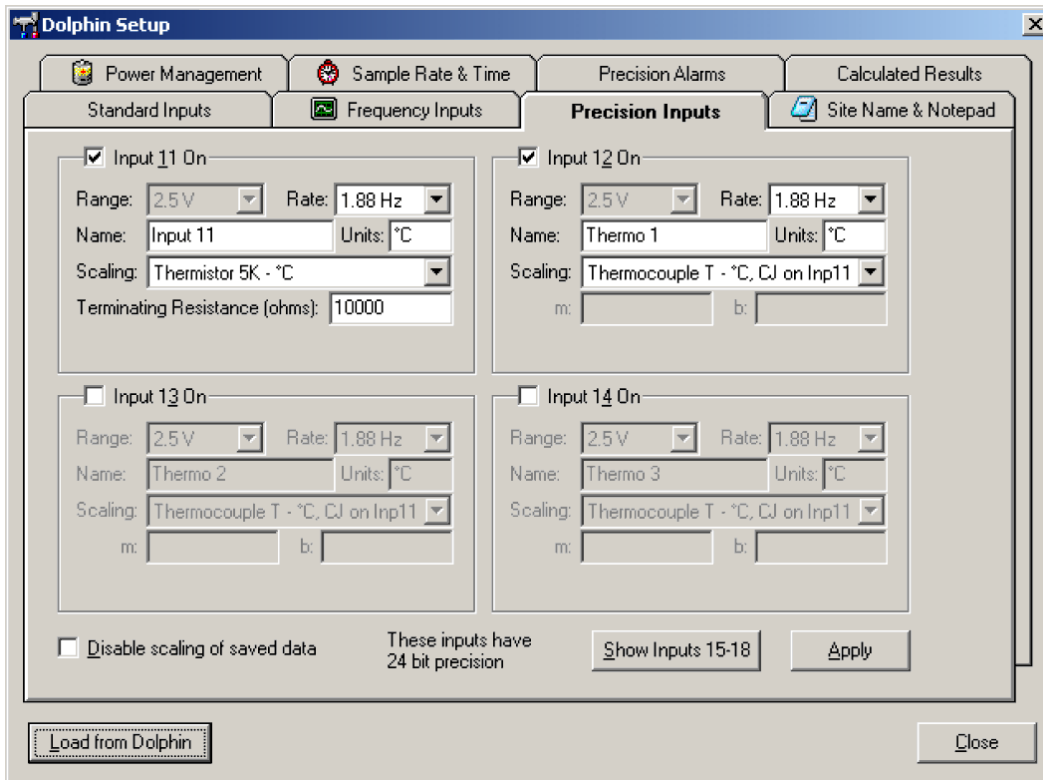


Figure 3: Precision input configuration settings in the Data Dolphin software