

March 20, 2006

Hardware Manual

Precision 4 Channel Thermocouple System
Model No: S4TC

GEC Instruments
5530 N. W. 97th Street
Gainesville, FL 32653

Table of Contents

SYSTEM DESCRIPTION.....	1
HARDWARE.....	1
TEMPERATURE MEASUREMENT SYSTEM	2
THERMOCOUPLE CALIBRATION	3
WARRANTY.....	5
SPECIFICATIONS	6

SYSTEM DESCRIPTION

The GEC Instruments model S4TC precision thermocouple temperature measurement system consists of specialized hardware and associated Windows software which together result in a very accurate and flexible display, logging and realtime graphing system for temperature measurements. The standard system has 4 thermocouple inputs. Custom units with more thermocouple channels or with added RTD or thermistor probes are available on special order.

Software operation is detailed in a separate manual.

HARDWARE

The hardware provided with the GEC Instruments system includes a metal enclosure containing the electronics and 4 miniature Type T female thermocouple jacks. The unit connects to a computer via a standard 9 pin serial cable. The default port is COM1. Other COM ports may be selected via the PinPoint Settings (PPS) program.

A 6' serial cable is provided with the unit. The RS232 Standard allows cables up to 20' in length. Cables up to 50' between this instrument and the computer should work in most circumstances. If communication difficulties are encountered, the baud can be lowered in software, allowing communication distances of 100' or more.

Should you need to connect this unit to a USB port, a USB to serial converter is needed. Manhattan Model No. 205146 is recommended.

Note that the unit comes with shorting plugs in each of the 4 thermocouple input connectors. Unless actual working thermocouples are plugged into all 4 channels, it is best to leave a shorting plug in each unused channel. The system will work correctly with open channels, but will be more accurate overall if all channels have thermocouples plugged in or if unused channels have shorting plugs installed. A shorted channel will read the temperature of the input connector that is shorted.

The unit is powered by 12 volts DC. A DC adaptor is provided with the unit. If portability is desired, the unit can be powered from a 12 volt battery. The unit will require 20 ma of current. Be sure to observe correct polarity when connecting a battery. However, reverse polarity on a battery input will not damage the unit. To

connect a battery, use a 5.5mm barrel plug with 2.1 mm center. The +12 volts is on the center pin.

The GEC Instruments S4TC unit has two small LED indicators on the front panel. The red LED indicates power on, and the green LED indicates that the software is communicating with the unit.

A special multiconductor ground wire is provided with the unit. Use of this ground wire is not mandatory but will help to reduce interference from other electrical sources if necessary. Connect one end of the ground wire to the connector on the back of the unit and the other end to a good earth ground or copper water pipe.

It is good practice to plug the computer and the GEC Instruments unit into an Uninterruptible Power Supply to avoid loss of data logging during power interruptions.

TEMPERATURE MEASUREMENT SYSTEM

The GEC Instruments S4TC system is capable of measuring, displaying and recording temperatures from thermocouples to a resolution of 0.01°C and with an accuracy better than $\pm 0.1^\circ\text{C}$. Software calibration procedures are provided which enable the user to maintain this accuracy by periodically calibrating the system at two points against a precision thermometer provided by the user. Very careful calibration can yield accuracies in the order of 0.05°C over certain ranges if necessary.

The GEC Instruments system is designed to use Type T (Copper-Constantan) thermocouples. For best system accuracy and interchangeability, these thermocouples should all be made from the same roll of thermocouple wire. Unless the thermocouple measuring junctions are electrically insulated, they must not touch each other and they must not touch a grounded metal object. Touching each other or touching ground will not cause any damage, but this will disturb the temperature readings. Even placing two or more uninsulated thermocouples in water in close proximity to each other can cause disturbance in the readings due to electrically conductive ions that naturally occur in water. If you experience any such problems, the thermocouple junctions may be electrically insulated by dipping them in a fast drying lacquer such as automotive touch up paint or by covering the junctions with thin wall heat shrink tubing.

Do not connect high voltage signals to the thermocouple inputs, else the circuitry will be damaged.

THERMOCOUPLE CALIBRATION

The GEC Instruments system uses unique hardware and software procedures to enable very stable and highly accurate temperature measurements with thermocouples. The unit has been carefully calibrated prior to delivery. However, the user may wish to calibrate the entire system, including user installed thermocouples, to provide the utmost accuracy available from the equipment. If the user wishes extreme accuracy in a particular range, the system can be calibrated against a precision thermometer at two temperatures near the ends of the range of interest.

Because thermocouple wires can vary significantly from the standard tables, the user of the GEC Instruments system might wish to check the accuracy of the thermocouple readings from the system against a known temperature standard before performing important measurements. This can be done by placing all of the thermocouples in a thermos of water along with a precision thermometer. The thermocouples should be arranged so that their junctions do not touch each other electrically, and they should be taped together near the bulb of the standard thermometer. The PinPoint Monitor software can be used to compare the thermocouple readings against those of the standard thermometer. This can be done at more than one temperature in the range of interest if desired.

If the temperature readings are not accurate enough, then the thermocouple measurement system, together with the installed thermocouples can be recalibrated.

The thermocouple calibration procedure involves generating a set of correction factors for each thermocouple channel and storing these in a calibration file, *.cal. If a one point calibration is performed, this file will contain a list of temperature offsets which will be applied to those channels which were calibrated. If a two point calibration is performed, the *.cal file will contain a list of slopes and offsets which will automatically be applied to those channels that were calibrated.

A new calibration file is created and loaded into PinPoint Monitor whenever you calibrate thermocouples. If a mistake is made, you can always go back and recover a previous calibration.

Before calibrating thermocouples, the reference junction sensor within the GEC Instruments unit should be stabilized. Place the thermocouple box in a stable temperature environment with the female thermocouple jacks facing upward. Avoid drafts and sunlight falling on the unit. The reference junction temperature can be viewed in PinPoint Monitor. Wait until this temperature becomes stable before performing a calibration. It is a good idea to start the program with the unit connected an hour or more before you do a calibration in order that the temperatures of the internal electronics may become stabilized. Refer to the Calibration Procedure in the PinPoint Monitor software manual for further instructions.

Note also that the thermocouple calibration procedure enables using one of the existing thermocouples (or a precision RTD probe or thermistor probe if your unit has either of these) to calibrate other thermocouples against. In this instance, choose "Use Reference" in step one of the Calibration Wizard and click on the box below to select which input to use as a reference.

The two point thermocouple calibration procedure involves placing the thermocouples and a standard thermometer together in two thermos bottles of water at two different temperatures, one near the low end and one near the high end of the range of interest. Simply run the Calibration Wizard in PinPoint Monitor and follow the directions on the screen. It makes no difference if the hotter or colder temperature is used first. Be sure to wait long enough for the thermocouples to stabilize at each temperature. Shake the thermos to promote mixing of the water. It is very important that all of the thermocouples become uniform with the water temperature and that the water temperature is read accurately by the user and entered correctly into the program.

If desired, the low temperature can be a well prepared ice bath using finely chopped ice surrounded by water in a thermos. For best results, use distilled water ice, although most ice from regular tap water will be at the freezing point within $\pm 0.01^{\circ}\text{C}$. Place the thermocouple junctions so that they are close to each other. Make sure that they are not touching each other electrically. Attach the thermocouples to a glass or plastic rod with tape and submerge them so that the junctions are in the spaces of the floating mass of chopped ice and not in the water below the ice.

If all of the thermocouples were made from the same roll of thermocouple wire, they will be matched very closely with each other. Following a thermocouple calibration, they can be exchanged between different channels with little or no loss

in accuracy of the readings. On the other hand, if the thermocouples come from different sources, then they must be plugged into the same channel in which they were calibrated in order to obtain high accuracy in temperature readings.

WARRANTY

The GEC Instruments unit is guaranteed against defects in material or workmanship under normal use and service for a period of two years from the date of delivery. This warranty shall not extend to any malfunction or other problem caused by unreasonable use or alteration, abuse, misuse, or damage caused by fire, flood, or acts of God.

This warranty is in lieu of all warranties express or implied. GEC Instruments will not be liable for indirect or consequential damages caused by any defects in this product.

SPECIFICATIONS: GEC S4TC – 4 Channel Thermocouple System

4 each type T female miniature thermocouple input connectors.

Temperature measurement range: -200 to +400 °C (-328 to 752 °F)

Operating Temperature: -10 to 50 °C (avoid condensation)

Resolution of temperature measurement: 0.01 °C (0.018 °F).

Accuracy of temperature measurement: If the instrument is operated in an ambient of 15 to 35 °C, instrument accuracies better than ± 0.1 °C (0.18 °F) can be attained over the measurement range of -10 to 70 °C. Very high accuracies can be attained at higher and lower measurement temperatures as well. This specification includes all instrument errors including reference junction error.

Total system accuracies (including thermocouple wire error) better than ± 0.1 °C (0.18 °F) can be attained through software calibration of thermocouples by comparison with a known standard. Measurement accuracies considerably better than ± 0.1 °C have been attained over certain temperature ranges.

Uniformity between thermocouples of 0.02 °C (0.036 °F) enables accurate measurements of small temperature differences. Built in auto zero eliminates system offset errors. Both 50 and 60 Hz. noise rejection are available.

Scan rate: 2 to 10 channels/second, depending on desired resolution.

Size: 3" high x 9" wide x 5.5" deep (7.62 cm. high x 22.9 cm wide x 14.0 cm deep).

Weight: 3.3 pounds (1.50 kg) Shipping Weight: 5 pounds (2.3 kg)

Communication protocol: 9 pin female RS-232 connector, optional USB adapter.

Options: Additional thermocouple channels, precision high accuracy (0.005 °C) high resolution (0.001 °C) thermistor probes, 4 to 20 ma inputs, relative humidity inputs, custom thermocouple calibrations.