# 2559-TC QUICK START GUIDE

> ******** *NOTE:* ********
> **The 2559-TC uses a modified front panel connector (supplied) which has two temperature sensors directly set into the connector in order to provide the most accurate cold junction compensation and to avoid CJC calibration. A standard connector <u>will not</u> allow the module to function properly.**

*Summary*: The 2559-TC is designed to translate a J, K, T, E, R, S, or N thermocouple or millivolt input signal from the thermocouple element into an equivalent digital word which is then sent to the programmable logic controller (PLC). Configuration of the module, taken from the full-length 2559-TC Installation and Operation Guide's Chapter 2, is as follows:

## 2.3. Configuring the Module

The Model 2559-TC must be configured for the thermocouple type, scaling, digital filtering, and temperature units before wiring the input connectors and inserting the module into the I/O base. As shipped, all channels are configured for the type J thermocouple, scaling disabled, digital filtering enabled, and Fahrenheit ($^o$F) units (see Figure 2.1).

| CHANNEL NUMBER | THERMOCOUPLE TYPE JUMPER | JUMPER POSITION E or J,K,N,mV or R,S,T | DIP SWITCH SETTING |
|---|---|---|---|
| 1 | JP6/4/5 | JP4 (type J,K,N,mV) | CH 1 = 010 (type J) |
| 2 | JP14/12/13 | JP12 (type J,K,N,mV) | CH 2 = 010 (type J) |
| 3 | JP18/16/17 | JP16 (type J,K,N,mV) | CH 3 = 010 (type J) |
| 4 | JP22/20/21 | JP20 (type J,K,N,mV) | CH 4 = 010 (type J) |
| 5 | JP26/24/25 | JP24 (type J,K,N,mV) | CH 5 = 010 (type J) |
| 6 | JP30/28/29 | JP28 (type J,K,N,mV) | CH 6 = 010 (type J) |
| 7 | JP34/32/33 | JP32 (type J,K,N,mV) | CH 7 = 010 (type J) |
| 8 | JP38/36/37 | JP26 (type J,K,N,mV) | CH 8 = 010 (type J) |

| SCALING | JUMPER POSITION | DIGITAL FILTERING | JUMPER POSITION | TEMP UNITS JUMPER | JUMPER POSITION |
|---|---|---|---|---|---|
| JP1 | Dis | JP2 | En | JP3 | $^o$F |

**Figure 2.1 Shipping Jumper Configuration Locations**

Changing the configuration involves the following steps (notations in parenthesis are actual printed board titles) described in the following sections:
1.  Selecting thermocouple type (E or J, K, N, mV or R, S, or T) for each channel
2.  Selecting digital filtering (Enable (EN) or Disable (DIS)) for the module
3. ...Selecting scaling (Enable (EN) or Disable (DIS)) for the module

4. Selecting temperature units (Fahrenheit (F) or Celsius (C)) for the module

## 2.3.1. Selecting Thermocouple Type

This selection involves both changing the jumpers on a per channel basis as well as dip switch selection on a per channel basis.

The jumpers, per channel, can be set on one of three posts available used to determine thermocouple type. The three posts refer to groupings of thermocouple types: "E", "J, K, N, mV", and "R, S, T". Choose the post for the thermocouple type used. As shipped, each channel is set for thermocouple types J, K, N, mV.
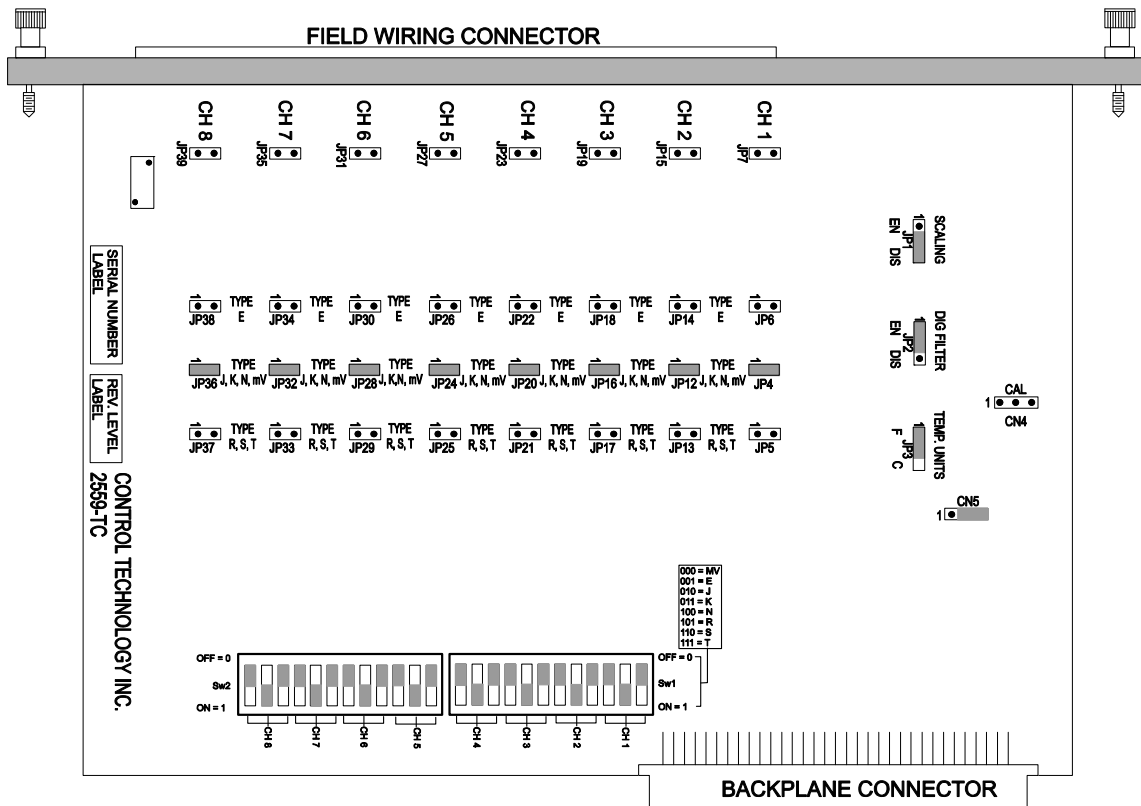


**Figure 2.2 Configuration Jumper Board Locations**
(shown as shipped from factory)

Once the hardware jumpers are selected this information needs to be reported to the microcomputer. The information is reported via DIP switches SW1 and SW2 (see Figure 2.2). Each output channel uses 3 switches with a BCD code to indicate the state of the hardware jumpers. The following chart illustrates the BCD which is needed to achieve the desired thermocouple type.

| Type | MV | E | J | K | N | R | S | T |
|------|-----|-----|-----|-----|-----|-----|-----|-----|
| BCD code | 000 | 001 | 010 | 011 | 100 | 101 | 110 | 111 |

| 3 (MSB) | 2 | 1 (LSB) | Type |
|---------|-----|---------|------|
| OFF | OFF | OFF | mV |
| OFF | OFF | ON | E |
| OFF | ON | OFF | J |
| OFF | ON | ON | K |
| ON | OFF | OFF | N |
| ON | OFF | ON | R |
| ON | ON | OFF | S |
| ON | ON | ON | T |
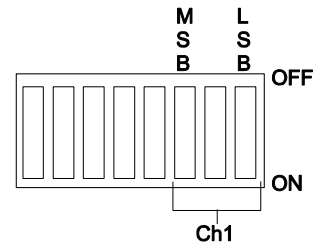


### 2.3.2. Selecting Digital Filtering

Locate the Digital Filtering Jumper "DIG FILTER" JP2 (see Figure 2.2). To enable digital filtering, set the jumper in the "EN" position; to disable, set to the "DIS" position. Since many analog input signals contain noise, CTI recommends using digital filtering unless maximum response time is required. As shipped, digital filtering is enabled for all 8 thermocouple inputs.

### 2.3.3. Selecting Offset Scaling

Locate the Offset Scaling "SCALING" jumper JP1 (see Figure 2.2). To enable offset scaling for all eight inputs set the jumper to the "EN" position. The module will provide the formatted data range as 0-32000 for thermocouples and -32,000 to +32,000 for mV. To disable scaling (and use Engineering units), set the jumper to the "DIS" position. The module will then format the data range as $^{o}$C x10 or $^{o}$F x10 for thermocouples and mV from –10,000 to +10,000. As shipped, the jumper is in the DIS (disable) position.

### 2.3.4. Selecting Temperature Units

Locate the Temperature Units "TEMP UNITS" jumper JP3 (see Figure 2.2). To enable Fahrenheit units, set the jumper to the "F" position; to enable Celsius units, set the jumper to the "C" position. As shipped, the jumper is in the "F" (Fahrenheit) position.

### 2.3.5. Jumper Settings for Future Reference

See Appendix B. Jumper Settings Log Sheet to record any changes to the module's jumper settings.

## 2.4. Inserting the Module into the I/O Base

Insert the module into the I/O base by carefully pushing the module into the slot. When the module is fully seated in the slot and backplane connector, tighten the captive screws at the top and bottom to hold the module in place. To remove the module from the I/O base, loosen the captive screws then remove the module from the I/O base. Be careful not to damage the edge card at the back of the module when inserting or removing the module.

## 2.5. Wiring the Input Connectors

Input signals are accepted through a connector assembly located on the front of the module. The connector assembly consists of a modified Siemens® front panel edge connector with built-in temperature sensors that mates with the printed circuit board. Wiring is connected to the front connector via recessed screw terminals. The screw terminals can accept wire sizes up to single stranded 14-gauge wire. The actual size used depends on the thermocouple wire providing the input signal.

To assign an input to a specific channel, locate the appropriate channel position on the screw terminal connector as shown in the following figure:
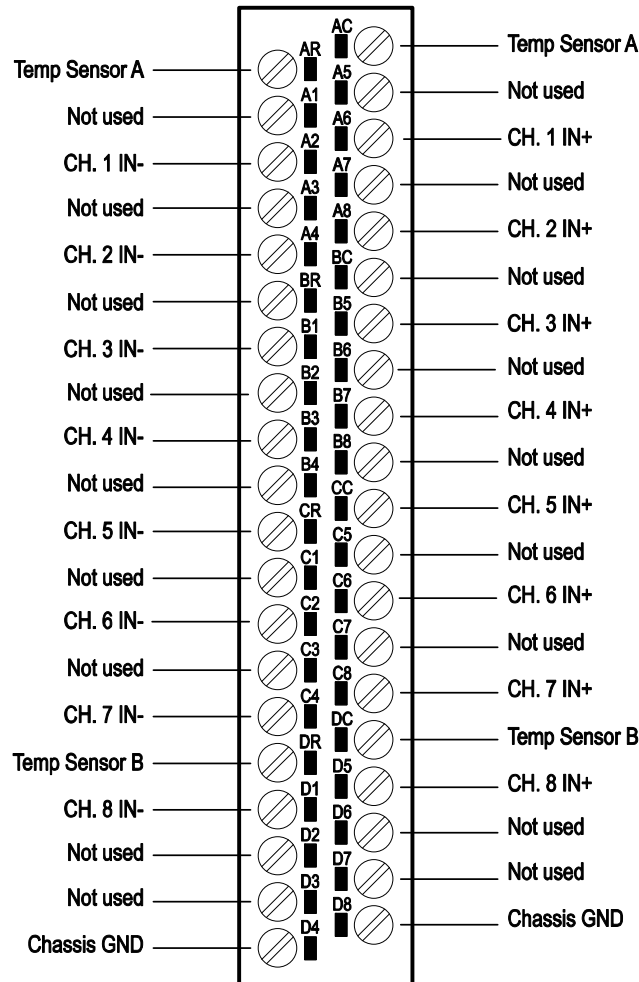


**Figure 2.3 Screw Terminal Connector Wiring**

### 2.5.1. Understanding the Modified Front Panel Connector

In order to provide the most accurate cold junction compensation and to avoid CJC calibration, the 2559-TC utilizes a modified front panel connector which has two temperature sensors directly set into the connector. These two temperature sensors are encapsulated in connector locations AR-AC and DR-DC, and are not user serviceable.

| NOTE: |
| --- |

*If either of the two temperature sensors fail, an error code of 32,761 will be reported to the PLC and the modified connector needs replacing. In the unlikely event this occurs, contact CTI for replacement connector part number '2559-FPC' for your replacement front panel connector.*

### 2.5.2. Connecting Thermocouple Input Wiring

For thermocouple input circuits, connect the thermocouple wires to the screw terminals, as indicated in Figure 2.3 Screw Terminal Connector Wiring. Insert the wires in the appropriate holes on the front of the connector (see Figure 2.4 and 2.5). When the wires are inserted, tighten the screws. Repeat this procedure for the remaining thermocouple input channels. Ensure that the proper wire polarity is followed for each of the seven supported thermocouple probe types, as shown in Figure 2.6.  See also Appendix C for more detailed information on different thermocouple types.
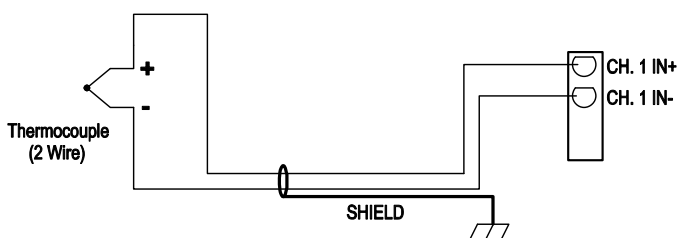


**Figure 2.4 Thermocouple wiring application**
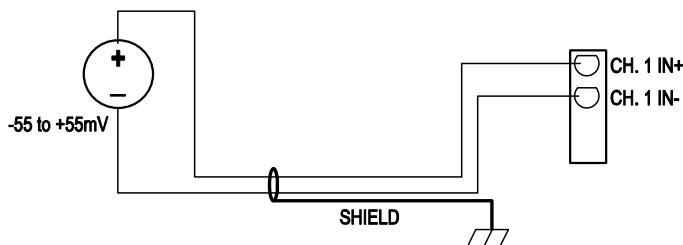


**Figure 2.5 Millivolt wiring application**

| Thermocouple Type | Negative (-) Lead | Positive (+) Lead |
|---|---|---|
| J | Copper-Nickel (Red) | Iron (White) |
| K | Nickel-Aluminum (Red) | Nickel-Chromium (Yellow) |
| T | Copper-Nickel (Red) | Copper (Blue) |
| E | Copper-Nickel (Red) | Nickel-Chromium (Purple) |
| R | Platinum (Red) | Platinum-13% Rhodium (Black) |
| S | Platinum (Red) | Platinum-10% Rhodium (Black) |
| N | Nisil (Red) | Nicrosil (Orange) |

**Figure 2.6 Thermocouple type and wire descriptions**

### 2.5.3. Connecting the Shield Wiring

Control Technology Inc. recommends that all wires be shielded twisted pair with a foil wrap shield and a separate drain wire and that they be installed in a metallic conduit. For millivolt applications, use Belden cable 8761 or equivalent which contains a foil wrap shield and a separate drain wire. The shield and the foil wrap should be twisted together and should be terminated at only one end. The other end should be left in an open circuit condition. CTI recommends that the shield be terminated at the PLC end of the signal wire. Special components are installed on the module to aid in the rejection of noise.

When entering the industrial cabinet the shield should be routed from the main terminal strip all the way to the PLC. Signal leads that do not maintain a shield from the terminal strip to the PLC act as antennas and are susceptible to radiated and conducted emissions in the cabinet. Unprotected cables may introduce measurement errors in the module.

The front connector on the module contains a CHASSIS terminal which may be used for the shield wire if the installation is in a noise free environment. If the installation is in an extremely noisy environment CTI strongly recommends that the shielded wires be terminated to the PLC chassis ground.

CTI has exhaustively tested this product to maximize its ability to reject noise from inductive sources as well as showering arcs, fast transients and other high frequency generators and has determined that the best performance results from connecting all shield wires together at the PLC module and terminating this single wire to the chassis ground with a large current capacity conductor. CTI recommends using a #8 gauge wire or larger from the PLC chassis to the earth ground connection.
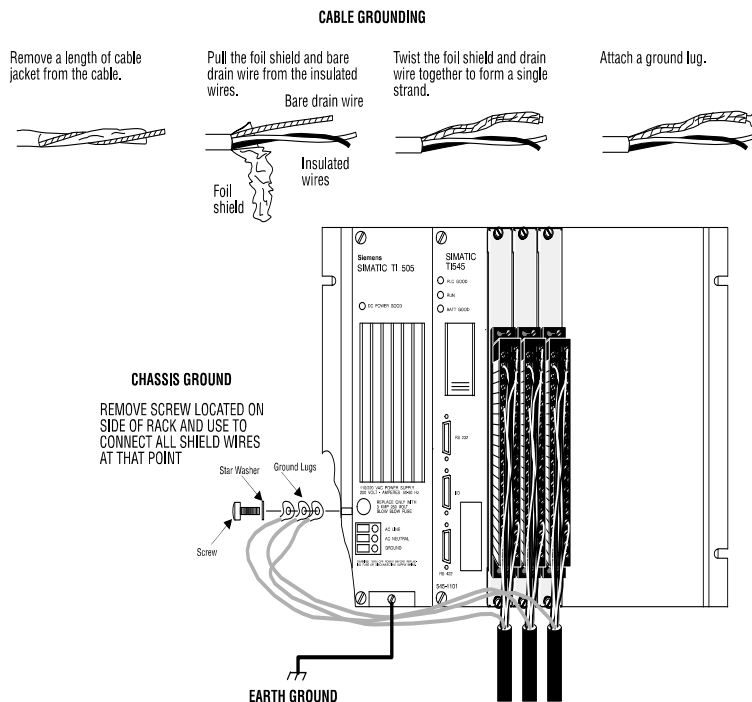


**Figure 2.7 Shield Wire Termination**

## 2.6. Installing the Screw Terminal Connector

When all the input signal wires are connected to the screw terminal connector, carefully install the connector on the front of the module.
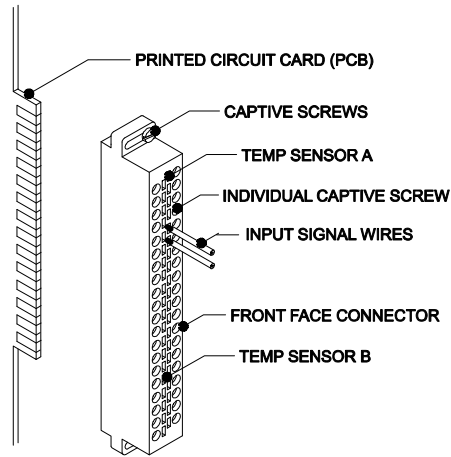


**Figure 2.8 Input Connector Assembly**

## 2.7. Calibration of the Module

Unlike its Siemens® counterpart, the CTI 2559-TC needs no calibration of inputs or cold junction compensation.

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*NOTE:*
*The 2559-TC Thermocouple Input Module is calibrated at the factory. No further calibration is required. All calibration parameters are stored in non-volatile memory. There are no user adjustments on this product. As shipped there is no jumper required on the CAL input.*

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## 2.8. Checking Module Operation

First turn on the base power. If the module diagnostics detect no problems, the status indicator on the front of the module will light. If the status indicator does not light, begins blinking (or goes out during operation), the module has detected a failure. For information on viewing failed module status, refer to your TISOFT user manual. To diagnose and correct a module failure, refer to the next section on troubleshooting.

You must also check that the module is configured in the memory of the PLC. This is important because the module will appear to be functioning regardless of whether it is communicating with the PLC. To view the PLC memory configuration chart listing all slots on the base and the inputs or outputs associated with each slot, refer to your TISOFT Programming Manual. An example chart is shown in the following figure.

**I/O Module Definition for Channel…….1   Base..…..00**

| | | Number of Bit and Word I/O | | | | |
|---|---|---|---|---|---|---|
| | **I/O Address** | | | | | **Special** |
| **Slot** | | **X** | **Y** | **WX** | **WY** | **Function** |
| 1 | 0001 | 00 | 00 | 08 | 00 | NO |
| 2 | 0000 | 00 | 00 | 00 | 00 | NO |
| . | . | . | . | . | . | . |
| . | . | . | . | . | . | . |
| 15 | 0000 | 00 | 00 | 00 | 00 | NO |
| 16 | 0000 | 00 | 00 | 00 | 00 | NO |

**Figure 2.9 Example I/O Configuration Chart**

In this example, the 2559-TC module is inserted in slot 1 in I/O base 0. Data for channel 1 appears in word location WX1, data for channel 2 appears in word location WX2, etc. For your particular module, look in the chart for the number corresponding to the slot occupied by the module. If word memory locations appear on this line, then the module is registered in the PLC memory and the module is ready for operation.

If the line is blank or erroneous, re-check the module to ensure that it is firmly seated in the slots. Generate the PLC memory configuration chart again. If the line is still incorrect, contact your local distributor or CTI at 1-800-537-8398 for further assistance.

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*NOTE:*
*Refer to Hewlett-Packard Applications Note 290 or Omega Temperature Handbook, Volume 26, Section T, for "practical thermocouple measurement" applications.*

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*CAUTION:*
*For proper operation, ensure that the 2559-TC and the thermocouple wires are not subjected to drafts or large temperature gradients during operation.*

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*NOTE:*
*In the event the 2559-TC detects an onboard module failure, the module will assert the module fail line and report the module failure in the I/O Status Word, which is reported to the PLC CPU. CTI strongly recommends the user application monitor the I/O Module Status Words which are Status Words 11-26 and apply to Controllers TI/545, TI/555, TI/560 & 565, and the TI/575. The I/O Module Status Word can be used to report a module failure for an I/O Module in any of the SIMATIC® 505 I/O slots. Please refer to the SIMATIC® 505 Programming Reference Manual for more information. If a module failure is reported by the status word, the module should be replaced with a working unit and the failed module sent in for repair.*

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*NOTE:*
*It may take 15-30 minutes after initial installation for temperature readings to stabilize.*

# *CHAPTER 3. TROUBLESHOOTING*

If the module provides improper readings or the status indicator is not on, use the following chart to determine the appropriate corrective action.

| Symptom | Probable Cause | Corrective Action |
|---|---|---|
| Indicator is not lit. | Base or PLC power is off. | Turn base or PLC on. |
| Indicator is blinking. | No calibration data. | Return to CTI for calibration. |
| Incorrect inputs. | Wrong addresses for word input. | Check program for correct work input addresses. |
| | Not logged in. | Read I/O configuration. |
| | Incorrectly calibrated. | Return the module to CTI for calibration. DO NOT ATTEMPT TO CALIBRATE. |
| | Blown fuse. | Measure F1 for continuity. Short all inputs and verify ambient temperature measurement. |
| Input does not work with PID loop or analog alarm block. | Value is not reported as integer 0-32,000. | Select SCALE format with jumper JP1 by placing in "EN" position. |
| Value is too large. | Temperature is reported to PLC as value x10. | Divide value by 10 in PLC. |
| Incorrect values to PLC. (values off by 10-15 degrees) | DIP switch not set in correct position. | Verify position of DIP switch. |
| | Wrong thermocouple type selected by jumpers. | Verify position(s) of jumpers. |
| | Temperature sensor(s) damaged. | Order special front panel connector from CTI, P/N '2559-FPC'. (see section 2.5.1.) |

**Figure 3.1 Troubleshooting Matrix**

> *CAUTION:*
> *The module fuse F1 is not user serviceable. If this fuse is blown, the module has a serious component failure and should be returned to CTI for repair.*

When it is inconvenient to visually check the status indicator, use the TISOFT "Display Failed I/O" or "Show PLC Diagnostics" support functions. If after consulting the chart above, you are unable to diagnose the problem, contact your local distributor or CTI at 1-800-537-8398 for further assistance.

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# *HARDWARE SPECIFICATIONS*

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| | |
|---|---|
| Input Channels: | 8 thermocouple inputs |
| Thermocouple Types: | J, K, T, E, R, S, N, and mV |
| Isolation: | 1500V channel-to-backplane |
| Input Overrange Protection: | 30 VDC or VAC continuous, 120VAC for 10 sec |
| Measurement Ranges: | J: -210$^o$C to 760$^o$C (-350$^o$F to 1400$^o$F) |
| | K: -270$^o$C to 1372$^o$C (-450$^o$F to 2500$^o$F) |
| | T: -270$^o$C to 400$^o$C (-454$^o$F to 752$^o$F) |
| | E: -270$^o$C to 1000$^o$C (-454$^o$F to 1832$^o$F) |
| | R: 0$^o$C to 1768$^o$C (32$^o$F to 3214$^o$F) |
| | S: 0$^o$C to 1768$^o$C (32$^o$F to 3214$^o$F) |
| | N: -260$^o$C to 1300$^o$C (-436$^o$F to 2372$^o$F) |
| | mV: -55 to +55mV |
| Millivolt Input Impedance: | 4.4M$\Omega$ DC, >10K$\Omega$ @60 Hz |
| Data Presentation: | Scaling Enabled: 0 to 32,000 (temperature) |
| | -32,000 to +32,000 (mV) |
| | Scaling Disabled: $^o$C x10 or $^o$F x10 (temperature) |
| | -10,000 to +10,000 (mV) |
| Measurement Units: | $^o$C or $^o$F (selectable by module) |
| Digital Filtering Time Constant: | 80 mSec |
| Update Time: | 9 mSec all channels |
| Repeatability: | +/- 1$^o$C, +/-2$^o$F for all thermocouple types |
| Accuracy: | J +/- 1$^o$C at 25$^o$C ambient |
| | K +/- 1$^o$C at 25$^o$C ambient |
| | T +/- 1$^o$C at 25$^o$C ambient |
| | E +/- 1$^o$C at 25$^o$C ambient |
| | R +/- 2$^o$C at 25$^o$C ambient* |
| | S +/- 2$^o$C at 25$^o$C ambient* |
| | N +/- 1$^o$C at 25$^o$C ambient |
| | mV +/- 0.5% full scale or +/- 500µV |
| | *reduced accuracy for measurements below 500$^o$C |
| ADC Resolution: | 16 bits |
| Common Mode Rejection: | >110 dB @ 60 Hz |
| Normal Mode Rejection: | >60 dB @ 60 Hz, >50 dB @ 50 Hz |
| Connector: | Removable |
| Wire Gauge: | 14-22 AWG |
| Backplane Power: | 1.0 Watt (maximum) |
| Module size: | Single-wide |
| Operating Temperature: | 0$^o$ to 60$^o$C (32$^o$ to 140$^o$ F) |

| Storage Temperature: | -40$^o$ to 85$^o$ C  (-40$^o$ to 185$^o$ F) |
| Relative Humidity: | 5% to 95% non-condensing |
| Agency Approvals Pending: | UL, ULC, Class 1-Div.2, CE |
| Shipping Weight: | 1.5 lbs. (0.68 Kg) |

- specifications subject to change without notice -

# APPENDIX A. COMPATIBILITY WITH SIEMENS® 505-7028-A

**Overview**

The CTI 2559-TC Thermocouple Module was designed to be a drop-in replacement for the Siemens® Model 505-7028-A. From set up of the module to wiring and PLC reporting, the user will find many similarities between the CTI and Siemens® models.

**Using the CTI 2559-TC in a 505-7028-A application**

The CTI 2559-TC should fulfill all the following requirements for the 505-7028-A replacement, as outlined below:

**Module setup**

The CTI 2559-TC sets up the same as its Siemen's counterpart, *without* any input *or* CJC calibration needed. See Chapter 2.3 Configuring the Module for Operation to determine the details in module setup.

**Wiring**

The wiring of the input connector is the same between the modules, although the 2559-TC utilizes a modified front panel connector. See Section 2.5. for details on the modified connector and a detailed explanation of how proper wiring is accomplished.

**PLC Reporting**

The word format is the same between the modules. See Chapter 1 for a more detailed explanation on PLC reporting.

# *APPENDIX B. JUMPER SETTINGS LOG SHEET*

| CHANNEL NUMBER | THERMO TYPE JUMPER | JUMPER POSITION E or J,K,N,mV or R,S,T | DIP SWITCH SETTING |
|---|---|---|---|
| 1 | JP6/4/5 | | |
| 2 | JP14/12/13 | | |
| 3 | JP18/16/17 | | |
| 4 | JP22/20/21 | | |
| 5 | JP26/24/25 | | |
| 6 | JP30/28/29 | | |
| 7 | JP34/32/33 | | |
| 8 | JP38/36/37 | | |

| SCALING | JUMPER POSITION | DIGITAL FILTERING | JUMPER POSITION | TEMP UNITS JUMPER | JUMPER POSITION |
|---|---|---|---|---|---|
| JP1 | | JP2 | | JP3 | |

Record the configuration jumper settings on this log for future reference. Make additional copies if necessary.

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*NOTE:*
*The 2559-TC Thermocouple Input Module is calibrated at the factory. No further calibration is required. All calibration parameters are stored in non-volatile memory. There are no user adjustments on this product. As shipped there is no jumper required on the CAL input.*