CTI 2559-RTD
EIGHT-POINT RTD MODULE
INSTALLATION AND OPERATION GUIDE
Version 1.2

CTI Part # 062-00337-012

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REVISION HISTORY

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PREFACE

This *Installation and Operation Guide* provides installation and operation instructions for the CTI 2559-RTD Eight-Point Resistance Temperature Detector (RTD) Input Model for SIMATIC® 505 programmable controllers. We assume you are familiar with the operation of SIMATIC® 505 series programmable controllers. Refer to the appropriate SIMATIC® 505 user documentation for specific information on the SIMATIC® 505 programmable controllers and I/O modules.

This *Installation and Operation Guide* is organized as follows:

Chapter 1 provides an overview of the module.
Chapter 2 covers installation and wiring.
Chapter 3 is a guide to troubleshooting.

The Model 2559-RTD 8-Pt RTD Module

USAGE CONVENTIONS

NOTE:
Notes alert the user to special features or procedures.

CAUTION:
Cautions alert the user to procedures that could damage equipment.

WARNING:
Warnings alert the user to procedures that could damage equipment and endanger the user.

TABLE OF CONTENTS

TABLE OF FIGURES

LIST OF TABLES

CHAPTER 1. OVERVIEW

1.0. Product Summary

The CTI 2559-RTD Eight-Channel RTD Module is a member of Control Technology's family of I/O modules compatible with the SIMATIC® 505 programmable controllers. It is a single-wide module that is compatible with two-, three-, and four-wire RTDs, with automatic lead wire resistance compensation for three-wire and four-wire RTDs.

The 2559-RTD pulses a small amount of current through the RTD. The module measures the voltage generated by the current through the RTD and determines the resistance. Lookup tables relating temperature to resistance for different RTD probes are used to determine the temperature.

1.1. Front Panel Description

Figure 1.1 CTI 2559-RTD Front Panel

The Active LED will be illuminated when the module is functioning normally. If the Active LED is not lit, or if it is blinking the module is not working properly. Refer to Chapter 3 for troubleshooting.

1.2. Asynchronous Operation

The module operates asynchronously with respect to the PLC (a scan of the PLC and input sampling of the module do not occur at the same time). Instead, the module will translate all RTD inputs in one module update (25 milliseconds maximum) and store the translated words in buffer memory. The PLC retrieves the stored words from the module buffer memory at the start of the I/O scan.

1.3. Immediate I/O

The 2559-RTD has been tested and is fully compatible with the immediate input instruction for the SIMATIC® 545 and 555 PLCs.

1.4. Supported RTD Probes

1.4.1. RTD Probe Types

Seven RTD probe types from standard RTD materials are supported as inputs to the 2559-RTD. The types supported are listed in Table 1.1. RTD types are selectable with dipswitches 4, 5, and 6 on switch block 1.

1.4.2. RTD Ohm Values

RTD types are supported in the following ohm values listed in Table 1.2. These values are selectable with dipswitches 1, 2, and 3 on switch block 1.

RTD Type
Platinum 0.003850
Platinum 0.003916
Platinum 0.003902
Platinum 0.003920
Copper   0.004274
Nickel   0.006720
Nickel   0.006178

Ohms (Ω) 0.0 Cº
100 Ω
120 Ω
130 Ω
200 Ω
500 Ω
1000 Ω
10 Ω
9.03 Ω

Table 1.1 RTD Types   **Table 1.2   Supported RTD Ohm Values**

1.4.3. 2-Wire, 3-Wire, and 4-Wire RTDs

The 2559-RTD supports 2-wire, 3-wire, and 4-wire RTD probes that are selectable on dipswitch 1 on switch block 2. Position 0 is for 4-wire RTDs and position 1 selects 2- and 3-wire RTDs.

1.5. Direct Resistive Device Input

Direct ohm inputs to the module are supported for measuring resistive loads or with resistive sensors. Resistance measurements are made by setting dipswitches 7 and 8 on switch block 1 to **Ohms** (Ω). Dipswitches 1, 2, and 3 on switch block 1 are used to select the order of magnitude of the resistance to be measured (10 Ω or 1k Ω). By selecting 10 Ω Ohm, values are reported as ohms x 100 to the PLC and selecting 1k Ω reports ohms x 10.

1.6. Digital Word Map

RTD inputs are translated into 16-bit digital words. Figure 1.2 illustrates the WX word format represented in the PLC.

	MSB														LSB	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0

Sign   15 Bits Reporting Data
Bit

Figure 1.2 Word Input to the PLC

1.7. RTD Input to Digital Conversion

1.7.1. Engineering Units

Temperature can be reported in Fahrenheit or Celsius degrees times 10 as a word input.
As an example, the following Figure 1.2 illustrates the effects of a change in input level going from 0 to 102.4^{o}F in the RTD Input Mode.

Example 1:

0.0^{o}F = (Digital Word (WX))/10

	MSB														LSB	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

+ 32 16 8 4 2 1

Example 2:

102.4^{o}F = (Digital Word (WX))/10

	MSB														LSB	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0

+   .   .   .   1024   .   .   .   32 16 8 4 2 1

Figure 1.3 Digital Representation of Input Temperature Change

1.7.2. Scaled Integer Data

When the data format is selected as Integer, the full temperature range of the RTD is scaled as an unsigned integer from 0 to 32000. The following formulas may be used to calculate the scaled integer value for temperature.

Temperature: Scaled Integer = (measured temp - min temp) / (max temp - min temp) x 32000
                    ex: the scaled integer offset at 0°C for a 100Ω Pt RTD is:
                    Scaled integer = (0 - (-199.8)) / (849 - (-199.8)) x 32000 = 6091

1.8. Module Addressing

The 2559-RTD module can be configured as an 8 WX or 16 WX word module. This is selectable using dipswitch 2 on switch block 2. Table 1.3 lists the WX configurations for the 2559-RTD module. In 16 WX mode, errors are reported in Words 9-16 for inputs 1-8.

Format	Inputs	I/O	Values
WX16	8	WX 1-8	Input Points 1-8
		WX 9-16	Separate Error Words
WX8	8	WX 1-8	Input Points 1-8, upscale errors

Table 1.3 Module Addressing Configurations

1.9. Error Reporting

If the module is set for 8WX and an error occurs, the input data are replaced by an error word and that input ceases updating. You must correct the error condition before the input resumes updating. If the module is set for 16WX word inputs and an error occurs, the last valid data are frozen. An error word is reported in one of the last eight inputs as shown in Table 3.2 This allows the error to be detected in your application program without immediately affecting controller operation. Errors are reported as values greater than or equal to 32752. Refer to Table 3.2 for error code descriptions.

CHAPTER 2. INSTALLATION

The installation of the Eight-Point RTD Module involves the following steps:

1. Planning the installation,
2. Unpacking and configuring the module.
3. Wiring the input connector.
4. Inserting the module into the I/O base.
5. Checking module operation.

The steps listed above are explained in detail in the following pages.

2.1. Planning the Installation

Planning is the first step in the installation of the module. This involves calculating the I/O base power budget and routing the input signal wiring to minimize noise and selecting RTDs. The following sections discuss these important considerations.

2.1.1. Calculating the I/O Base Power Budget

The Model 2559-RTD requires 2.8 watt (maximum) of +5 VDC power from the I/O base. Use this value to verify that the base power supply is not exceeded.

2.1.2. Input Signal Wiring

Input signal wiring can be 2, 3 or 4-wire twisted shielded cable. The cable can be stranded or solid 14-24 AWG wire. Standard practices usually require that all shields be tied together and grounded at a single point. These guidelines will minimize noise problems when installing the module.

- Always use the shortest possible cables
- Avoid placing low voltage wire parallel to high-energy wire (if the two wires must meet, cross them at a right angle)
- Avoid bending the wire into sharp angles
- Use wire raceways or conduit for wire routing
- Avoid placing wires on any vibrating surface
- Use a 4-wire conductor with shielding and tie shield to ground.
- Terminating the shield to earth ground at the PLC is preferred.
- Never terminate the shield at both the RTD and PLC.

2.1.3 Selecting RTDs

RTDs should be selected to optimize the accuracy of temperature measurements over the range of temperatures to be measured, survive in the environmental conditions where it will operate, and be appropriately packaged to meet the mounting requirements. Platinum RTD probes are the most stable material that is commonly used and provide long-term accuracy. Refer to manufacturer's recommendation to determine the best RTD for a particular application.

2.1.3.1 Four-wire RTDs

Four-wire RTDs give the best accuracy and are not affected by changes in terminal, wire, or contact impedance. Wire type and temperature coefficients do not affect accuracy, and wire impedance is relatively unimportant for the Sense+ and Sense- wires.

2.1.3.2 Three-wire RTDs

Three-wire RTDs are less accurate than the 4-wire RTDs. The contact resistances cannot be compensated for and could become significant. The following guidelines will minimize errors.
  o Minimize the difference in resistance between the Source and Return
  o Resistive differences cause offsets.
  o Wire the Sensor as illustrated in Figure 2.3
  o Restrict the lead resistance to less than 50Ω.
  o Source and Return wires should have same temperature coefficient.

2.1.3.3 Two-wire RTDs

Two-wire RTDs can be used if accuracy is non-critical. Lead resistance and lead-wire temperature drift cause temperature offsets .

2.2. Unpacking the Module

Open the shipping carton and remove the special anti-static bag which contains the module. After discharging any static build-up, remove the module from the static bag. Do not discard the static bag. Always use this bag for protection against static damage when the module is not inserted into the I/O backplane.

CAUTION:
HANDLING STATIC SENSITIVE DEVICES
The components on the Model 2559-RTD module printed circuit card can be damaged by static
electricity discharge. To prevent this damage, the module is shipped in a special anti-static bag.
Static control precautions should be followed when removing the module from the bag, when
opening the module, and when handling the printed circuit card during configuration.

2.3 Configuring the Module

The 2559-RTD is configured using two switch blocks located at the top front of the module. **Table 2.1** lists the features and options associated with the dipswitches and the default configuration of the module.

NOTE:
Configuration applies to ALL CHANNELS.

NOTE: Shipping Configuration
100Ω   Pt 0.003850   °F × 10   3-Wire   16WX   60Hz   Digital Filtering

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Table 2.1 Dipswitch Assignments

Feature	Options	Assembly	Switches	Default
Input resistance at 0°C	One of eight values for input resistance at 0°C. Also selects the reporting scale for direct Ω input.	S1	1, 2, and 3	100 Ω
Probe type	One of 7 RTD curves.	S1	4, 5, and 6	Pt 0.003850 DIN
WX input Format	°F × 10 °C × 10 ohms x 10 ohms x 100 scaled integer.	S1	7 and 8	°F × 10
Lead resistance Compensation	2-, 3-, or 4-wire.	S2	1	3-wire
Error format	16WX/separate error words or 8WX/upscale errors (32752 and above).	S2	2	16WX
Input filtering	50 or 60 Hz.	S2	3	60 Hz
Digital filtering	Enable/Disable	S2	4	Enabled
Calibration	Run or calibration mode.	S2	8	Run

Figure 2.1 shows the location of the two switch-blocks on the module with a detailed diagram illustrating the location and function of the dipswitches used to configure the module.
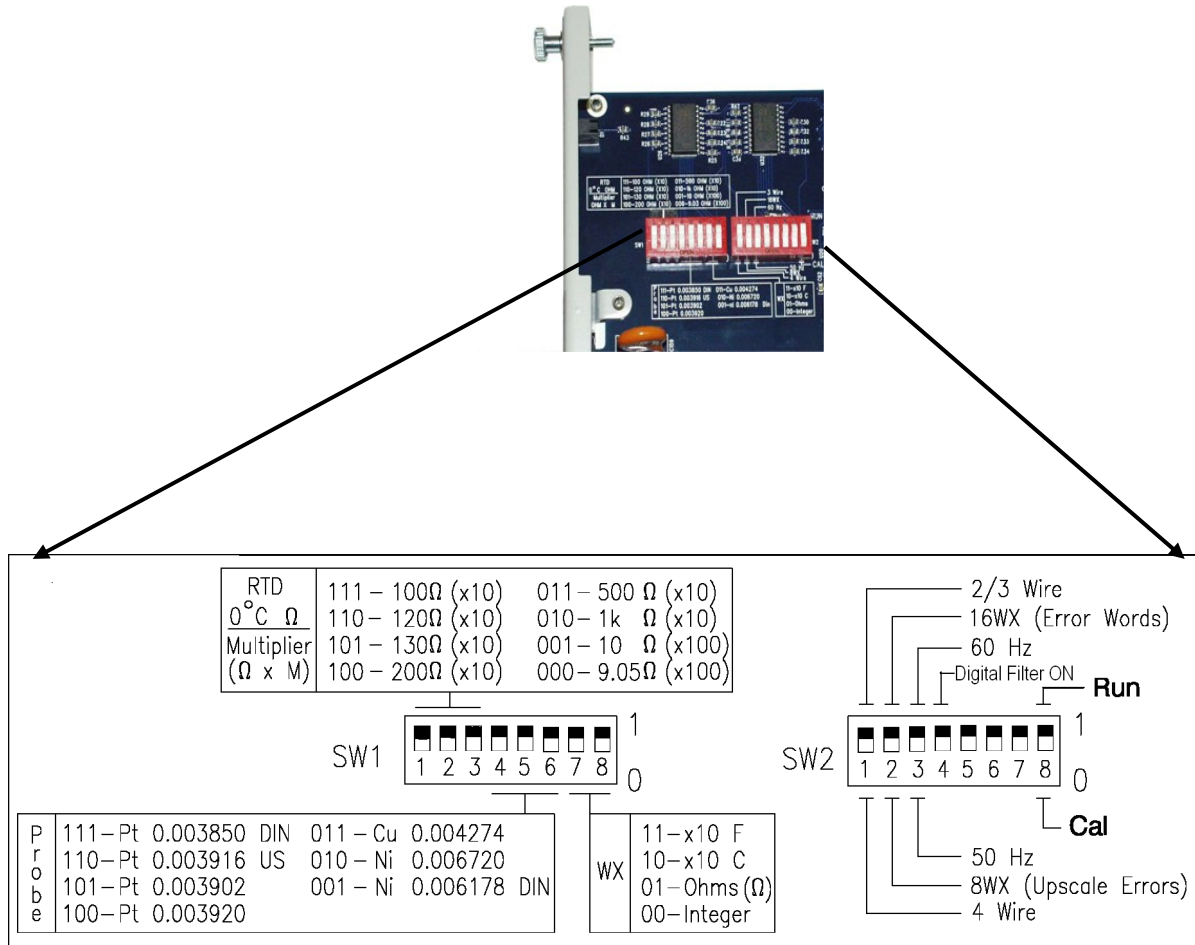
Figure content

```
RTD        111 – 100Ω (x10)    011 – 500 Ω (x10)
0°C  Ω     110 – 120Ω (x10)    010 – 1k  Ω (x10)
Multiplier 101 – 130Ω (x10)    001 – 10  Ω (x100)
(Ω x M)    100 – 200Ω (x10)    000 – 9.05Ω (x100)
```

```
                                               2/3 Wire
                                               16WX (Error Words)
                                               60 Hz
                                               Digital Filter ON    Run
SW1  [1 2 3 4 5 6 7 8] 1/0        SW2  [1 2 3 4 5 6 7 8] 1/0
                                                          Cal
                                               50 Hz
                                               8WX (Upscale Errors)
                                               4 Wire
```

```
P  111 – Pt 0.003850 DIN   011 – Cu 0.004274        11 – x10 F
r  110 – Pt 0.003916 US    010 – Ni 0.006720        10 – x10 C
o  101 – Pt 0.003902       001 – Ni 0.006178 DIN  WX 01 – Ohms (Ω)
b  100 – Pt 0.003920                                00 – Integer
e
```

Figure 2.1 Dipswitch Locations and Function

2.3.1 Selecting the Input Resistance.

Dipswitches 1, 2, and 3 are used to select RTD resistance for the probe types. When measuring ohm (Ω) values, select *1k Ω*, which reports ohms x 10, or *10 Ω,* when measuring resistive values less than 100 Ω. These values are reported as ohms x 100. Refer to **Figure 2.1.**

2.3.2. Selecting RTD Probe Type.

Seven RTD material types are selectable using dipswitches 4, 5, and 6 on switch block 1. Refer to **Figure 2.1.**

2.3.3. Selecting WX Word Input Format.

Dipswitches 7 and 8 on switch block 1 are used to select the format that data is presented in the WX input word for the 8 channels. Refer to Section 1.7.1 for engineering format and Section 1.7.2 for scaled integer format. Reporting ohm Ω resistive values is also selected using dipswitches 7 and 8 on switch block 1. Data is presented as ohms x 10 or 100, °F x 10, °C x 10, or as a scaled integer.

2.3.4. Selecting Lead Resistance Compensation.

Dipswitch 1 on switch block 2 is used to select the type of lead compensation. Two- and three-wire compensation is selected with a 1 and 4-wire with a 0.

2.3.5. Selecting the Error Formatting.

Dipswitch 2 on switch block 2 is used to select how errors are reported. With the dipswitch in the 1 position the module logs into the base as a WX16 module. Errors are reported in words WX 9-16. In the zero position the module logs into the base as a WX8 module. When errors occur, error words are written to the corresponding data word and the error condition must be cleared before data is again reported.

2.3.6. Selecting Digital Filtering.

Digital Filtering is selected by positioning dipswitch 4 on switch block 2 in the 1 position. Selecting digital filtering will limit data fluctuations due to signal noise.

2.3.7. Selecting Run or Calibration Mode.

Dipswitch 8 on switch-block two is in the 1 position for normal operation. To calibrate the module, put dipswitch 8 in the 0 position.

2.4. Inserting the Module into the I/O Base

Avoid installing the 2559-RTD in a slot adjacent to a high-energy switching module.

WARNING:
Turn power off to base before installing or removing the module.

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 standard 40 terminal connector located on the front of the module. Figure 2.2 illustrates how the 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 RTD 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 Figure 2.4 and connect wiring.
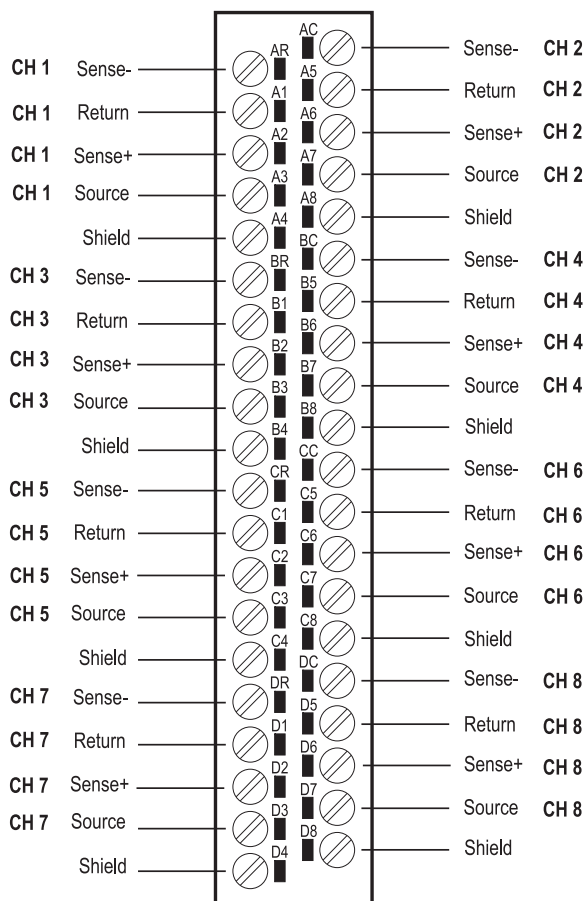
Figure 2.2 Screw Terminal Connector Wiring

2.5.1. Connecting RTD Input Wiring

For RTD input circuits, connect the RTD wires to the screw terminals on the front connector. Refer to Figure 2.2 and Figure 2.3 to determine the correct channel and proper wiring connections for 2-wire, 3-wire, and 4-wire RTDs. After the wires are inserted in the correct terminals, tighten the screws using CARE not to over-tighten and strip the connector terminal. Repeat this procedure for the remaining RTD input channels.
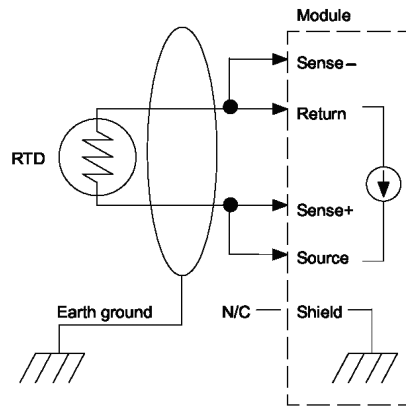
Two-wire, no lead compensation
Set module to 2/3 wire mode
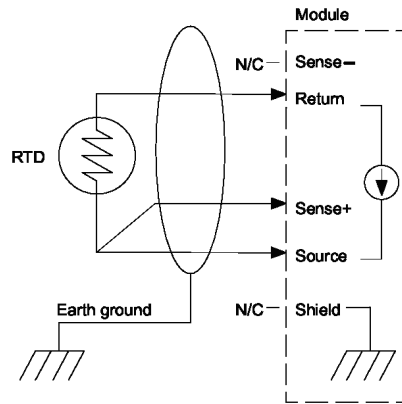
Three-wire, lead compensation
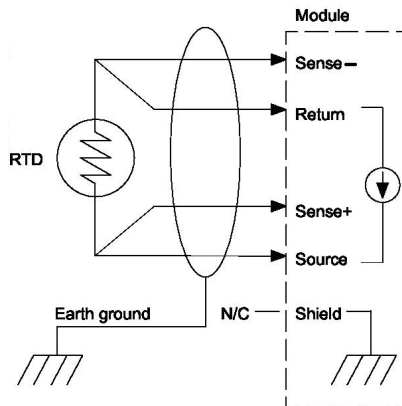
Four-wire, lead compensation

Figure 2.3 RTD Sensor Wiring

2.5.2. Terminating the Wire Shielding

Conductor shielding must be connected to earth ground. Terminating the shield to earth ground at the PLC is preferred. If terminating the shield at the PLC, follow procedures illustrated in Figure 2.4. **NEVER terminate the shield at both the RTD and PLC.**
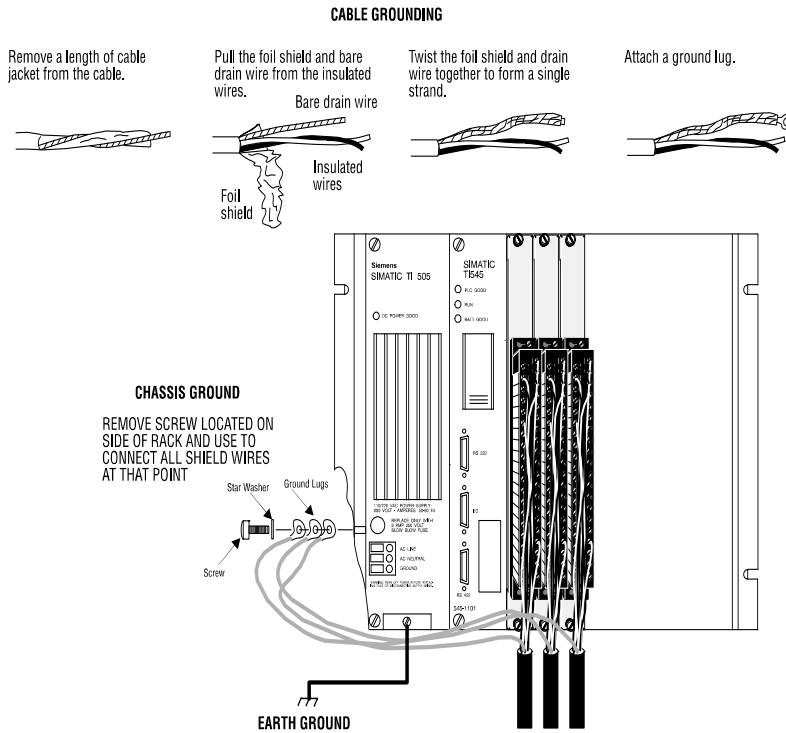
Figure 2.4 Terminating the Wire Shielding

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 (see Figure 2.5).
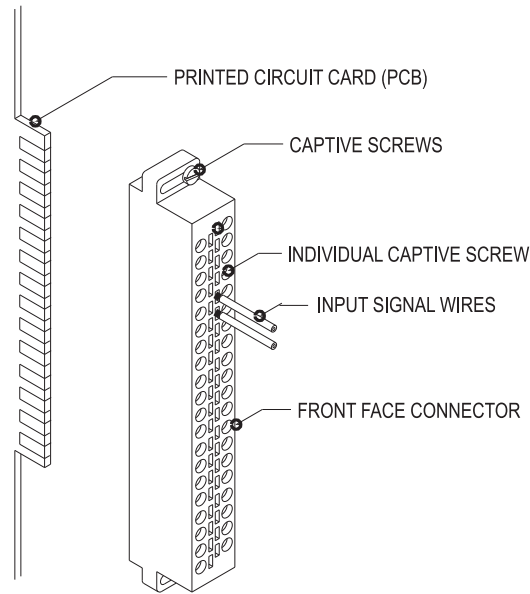
Figure 2.5 Input Connector Assembly

2.7. Calibrating the Module

The 2559-RTD is calibrated at the factory and needs no calibration when installed. The module should be calibrated yearly for best accuracy. If the module operates in an environment where the ambient temperature cycles outside the range of $20\,^{o}C$ to $30\,^{o}C$, more frequent calibration may be required. Also, if the ambient temperature is constantly outside the range of $20\,^{o}C$ to $30\,^{o}C$, calibration at the ambient temperature may improve accuracy.

> ***NOTE:***
> *The 2559-RTD Input Module is calibrated at the factory for initial installation. Further calibration may be required depending on the environment in which the module and/or the RTD operates..*

2.7.1 Calibration Requirements

Calibration of the 2559-RTD is accomplished by the use of a standard 505 connector (CTI P/N 4-565) and four precision resistors. Make sure the resistors meet or exceed the specifications in Table 2.2.

Table 2.2 Precision Resistor Values for Calibration

Ohms	Tolerance	Temperature Coefficient
20.00	0.001%	25 ppm/^{o}C
402.0	0.001%	10 ppm/^{o}C
2000.0	0.001%	10 ppm/^{o}C
4020.0	0.001%	10 ppm/^{o}C

2.7.2 Calibration Connector Wiring Instructions

Precision resistor values for calibration are installed on a specially wired 40-Pin connector which **MUST** be in place prior to initiating the calibration.

The connector is wired as follows:
- o   Channel 1   Four Wire 2000.0 Ohm Resistor   (500 Ohm Range)
- o   Channel 2   Short all four terminals
- o   Channel 3   Four Wire 402.0 Ohm Resistor   (100 Ohm Range)
- o   Channel 4   Short all four terminals
- o   Channel 5   Four Wire 20.00 Ohm Resistor   (10 Ohm Range)
- o   Channel 6   Short all four terminals
- o   Channel 7   Four Wire 4020.0 Ohm Resistor   (1K Ohm Range)
- o   Channel 8   Short all four terminals.

The calibration connector wiring for channels 1-4 is illustrated in Figure 2.6. Channels 5-8 are wired similarly, just substitute resistor values from the preceding list.
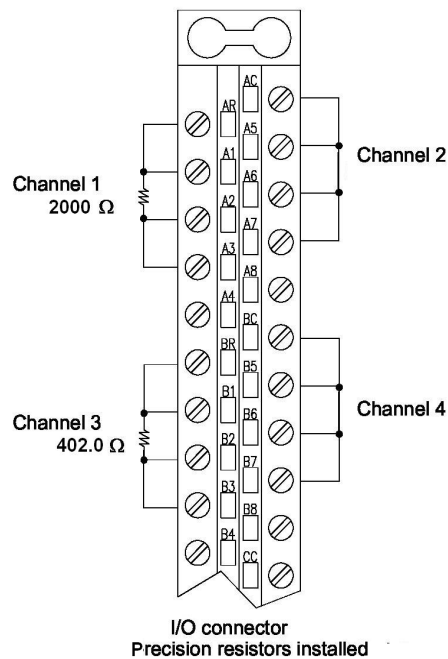
Figure 2.6 Calibration Connector Wiring Diagram

2.7.3 Calibration Procedure

The following steps are needed to ensure proper calibration of the module:
1. Remove power from the 505 rack that contains the RTD module.
2. Remove the field wiring connector from the RTD module.
3. Remove the module from the rack.
4. Set dipswitch 8 SW2 to the Cal (0) position.
5. Install the precision resistors per Figure 2.6.
6. Reinsert the module into the rack.
7. Apply power to the rack. The module LED will begin to blink slowly and, after around 3 minutes, the LED will begin to blink rapidly to indicate completion of the calibration.
8. Work through the above steps in a backward progression to return the module to operation.

2.7.4 Calibration Process

During the calibration process, the front panel LED will blink at a rate indicating the Calibration Phase.

1. 0.25 Hz - Phase 1 Acquiring 2000 Ohm data
2. 0.5 Hz - Phase 2 Acquiring   0 Ohm data (for 200/500 Ohm Range)
3. 1 Hz - Phase 3 Acquiring 402 Ohm data
4. 2 Hz - Phase 4 Acquiring   20 Ohm data
5. 4 Hz - Phase 5 Acquiring 4020 Ohm data
6. Solid - Calibration complete - set Run/Calibrate switch to Run and restart module.

The calibration process is terminated in one of three ways.

1. A successful completion leaves the Active LED SOLID ON. Power off the base, remove the module. Return dipswitch 8 on SW 2 to the Run position, reinstall the module and power up the base.

2. An EEPROM write failure leaves the Active LED SOLID OFF.

3. Any out of range condition detected during the acquisition phase causes the Active LED to blink out Morse Code S - O - S, i.e. three short flashes, three long flashes, and three short flashes. A pause occurs, then the pattern repeats. The calibration failed but the existing calibration in the module is UNAFFECTED.

2.7.5. Calibration Troubleshooting

If the LED does not follow the slow-fast blinking that describes a successful calibration, one or more of the calibration resistors may be out of range. Call CTI if module does not properly calibrate after re-checking the procedure and calibration connector.

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 be solid red. 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 SIMATIC® 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 SIMATIC® 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 2.7 Example I/O Configuration Chart

In this example, the 2559-RTD module is inserted in slot 1 in I/O base 0 and configured as a WX8 word module. 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.

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

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

NOTE:
In the event the 2559-RTD 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. CTI strongly recommends the user application monitor the I/O Module Status Words which are Status Words 11-26 and apply to SIMATIC® 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 505 I/O slots. Please refer to Siemens® 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.

CHAPTER 3. TROUBLESHOOTING

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

Symptom	Probable Cause	Corrective Action
Active LED is not lit.	Base or PLC power is off.	Turn base or PLC on.
	Module has failed.	Return to CTI for repair.
	Blown fuse.	Measure F1 for continuity. Return to CTI if Blown
Active LED is blinking.	No calibration data.	Return to CTI for calibration or recalibrate per manual.
Incorrect inputs.	Wrong addresses for word input.	Check program for correct word input addresses.
	Not logged in.	Read I/O configuration.
	Incorrectly calibrated.	Return the module to CTI for calibration or recalibrate according to instructions.
Input does not work with PID loop or analog alarm block.	Value is not reported as integer 0-32,000.	Select INTEGER format with dipswitches 7 and 8 on SW1.
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 dipswitches.
	Wrong RTD type selected by dipswitches.	Verify position of dipswitches.
	Unbalanced lead wires	Check lead resistance.
	Signal wire noise	Refer to Section 2.1.2

Figure 3.1 Troubleshooting Matrix

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.

Table 3.1 Problem Codes and Messages Reported in Three Wire Mode

Signed Integer	Hex Code	Problem	Description	Corrective Action
32767	7FFF	Not used		
32766	7FFE	Input underrange	RTD input is below expected range	Check dipswitches. Check wiring, sensor.
32765	7FFD	Input overrange	RTD input is above expected range	Check dipswitches. Check wiring, sensor.
32764	7FFC	Not Used		
32763	7FFB	Sense short	Short from Sense+ to Return (3-wire)	Check wiring, sensor.
32762	7FFA	Input not wired	All three inputs are open or improperly wired: Source, Sense+, and Sense-	Wire module channel.
32761	7FF9	Source open	Source to Return ≥ 20K Ω	Check Source wire.
32760	7FF8	Not used		
32759	7FF7	Not used		
32758	7FF6	Source-to-Return overrange	>20K Ω from Source to Return	Check wiring, sensor.
32757	7FF5	Not used		
32756	7FF4	Not used		
32755	7FF3	Not used		
32754	7FF2	Not used		
32753	7FF1	Invalid RTD Type selected	Invalid selection of RTD material, TCR, and Ω combination	Select Valid RTD Type
32752	7FF0	Not used		
3	0003	Three/Two-wire mode	Module is correctly performing 3/2-wire conversions for this input (separate error words only)	Module channel functioning properly

Table 3.2 Problem Codes and Messages Reported in Four Wire Mode

Signed Integer	Hex Code	Problem	Description	Corrective Action
32767	7FFF	Not used		
32766	7FFE	Input underrange	RTD input is below expected range	Check dipswitches. Check wiring, sensor.
32765	7FFD	Input overrange	RTD input is above expected range	Check dipswitches. Check wiring, sensor.
32764	7FFC	Not used		
32763	7FFB	Sense short	Short from Sense+ to Return (3-wire) or from Sense+ to Sense- (4-wire)	Check wiring, sensor.
32762	7FFA	Input not wired	All three inputs are open or improperly wired: Source, Sense+, and Sense-	Wire module channel.
32761	7FF9	Source open	Source to Return ≥ 20K Ω	Check Source wire.
32760	7FF8	Not used		
32759	7FF7	Sense - open		Check Sense - wire.
32758	7FF6	Source-to-Return overrange	>20K Ω from Source to Return	Check wiring, sensor.
32757	7FF5	Not used		
32756	7FF4	Not used		
32755	7FF3	Not used		
32754	7FF2	Not used		
32753	7FF1	Invalid RTD Type selected	Invalid selection of RTD material, TCR, and Ω combination	Select Valid RTD Type
32752	7FF0	Not used		
4	0004	Four-wire mode	Module is correctly performing 4-wire conversions for this input (separate error words only)	Module channel functioning properly

HARDWARE SPECIFICATIONS

Input Channels: 8 RTD inputs

RTD Types:

Platinum 0.003850	European DIN Standard
Platinum 0.003916	American Curve
Platinum 0.003902	
Platinum 0.003920	
Copper 0.004274	
Nickel 0.006720	
Nickel 0.006178	European DIN Standard

Supported Ohm values:

Ohms (Ω) 0.0 C°
    100 Ω
    120 Ω
    130 Ω
    200 Ω
    500 Ω
  1000 Ω
      10 Ω
   9.03 Ω

Supported Probes Types: 2, 3, & 4 wires

RTD Excitation Current: 250 micro Amp

Lead Compensation: 1000Ω per lead wire (max)

Input Overrange Protection: 30 VDC or VAC continuous

Measurement Ranges: 10Ω Cu: -100°C to 260°C (-148°F to 500°F)
                               100Ω Pt: -200°C to 850°C (-328°F to 1562°F)
                               120Ω Pt: -80°C to 260°C (-112°F to 500°F)

ADC Resolution: 16 bits

Data Presentation: Measurement returned in 0.1 degree resolution as temperature x10 or as an integer (0-32000). Data word includes sign bit and 15-Bit data

Measurement Units: ^{o}C, ^{o}F, or Ohm (selectable by module)

Digital Filtering Time Constant: 1000 ms with digital filtering enabled

Update Time: 25 ms no filtering (all channels)

Repeatability: +/- 0.1^{o}C, +/-0.2^{o}F for all RTD types

Accuracy: 100Ω Pt: 0.9^{o}C (1.6^{o}F) from 0-60°C
                                            Ω x 100   0.36 Ω from 0-60°C

Common Mode Rejection: >130 dB @ 60 Hz

Normal Mode Rejection
        at line frequency +/- 0.01 Hz: >80 dB
        at line frequency +/- 3 Hz: >25 dB

Step response time: 100 Ω Pt   25 ms

Step response time: Inputs to 2 kΩ   25 ms

Connector: Removable

Wire Gauge: 14-22 AWG

Backplane Power: +5 VDC 2.8 Watt (maximum)
                                            -5 VDC 0.0 Watt

Module size: Single-wide

Isolation: 1500V channel-to-backplane

Operating Temperature: 0° to 60 ^{o} C (32° to 140° F)

Storage Temperature: -40° to 85° C (-40° to 185° F)

Relative Humidity: 5% to 95% non-condensing

Agency Approvals Pending: UL, ULC, FM Class 1-Div.2

Shipping Weight: 1.5 lbs. (0.68 Kg)

- Specifications subject to change without notice -

APPENDIX A. COMPATIBILITY WITH SIEMENS® 505-7038

Overview

The CTI 2559-RTD RTD Module was designed to be a drop-in replacement for the Siemens® Model 505-7038. Set up of the module, wiring and PLC reporting are compatible with the 505-7038. Digital filtering has been added as a user selectable option with dipswitch 4 on switch-block 2.

Using the CTI 2559-RTD in a 505-7038 application

The CTI 2559-RTD should fulfill all the following requirements for the 505-7038 replacement, as outlined below:

Module setup

The CTI 2559-RTD sets up the same as its Siemen's® counterpart. Refer to **Chapter 2** for details.

Wiring

The wiring of the input connector is the same for both modules.

PLC Reporting

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

APPENDIX B. RTD TEMP VS. RESISTANCE

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Table C-1 Platinum 0.003850 DIN

°F	°C	100 Ω	200 Ω	500 Ω
-328	-200	18.49	36.99	92.47
-148	-100	60.25	120.51	301.27
32	0	100.00	200.00	500.00
212	100	138.50	277.00	692.50
392	200	175.84	351.68	879.20
572	300	212.02	424.04	1060.09
752	400	247.04	494.08	1235.19
932	500	280.90	561.79	1404.48
1112	600	313.59	627.19	1567.97
1292	700	345.13	690.26	1725.66
1472	800	375.51	751.02	1877.55
1562	850	390.26	780.53	1951.31

Table C-2 120-ohm Nickel

°F	°C	0.00672	DIN 0.006178
-112	-80	66.60	72.59
-58	-50	86.16	89.11
32	0	120.00	120.00
122	50	157.75	154.93
212	100	200.64	194.14
302	150	248.95	238.39
392	200	303.45	288.95
482	250	366.53	347.57
527	275	401.69	380.60

Table C-3 10-ohm Copper 0.004274

°F	°C	Ohms
-328	-200	1.17
-238	-150	3.44
-148	-100	5.68
-58	-50	7.86
32	0	10.00
122	50	12.14
212	100	14.27
302	150	16.41
392	200	18.57
482	250	20.73

LIMITED PRODUCT WARRANTY

CTI warrants that this CTI Industrial Product shall be free from defects in material and workmanship for a period of one (1) year after purchase from CTI or from an authorized CTI Industrial Distributor. This CTI Industrial Product will be newly manufactured from new and/or serviceable used parts which are equal to new in the Product.

Should this CTI Industrial Product fail to be free from defects in material and workmanship at any time during this (1) year warranty period, CTI will repair or replace (at its option) parts or Products found to be defective and shipped prepaid by the customer to a designated CTI service location along with proof of purchase date and associated serial number. Repair parts and replacement Product furnished under this warranty will be on an exchange basis and will be either reconditioned or new. All exchanged parts or Products become the property of CTI. Should any Product or part returned to CTI hereunder be found by CTI to be without defect, CTI will return such Product or part to the customer.

This warranty does not include repair of damage to a part or Product resulting from: failure to provide a suitable environment as specified in applicable Product specifications, or damage caused by an accident, disaster, acts of God, neglect, abuse, misuse, transportation, alterations, attachments, accessories, supplies, non-CTI parts, non-CTI repairs or activities, or to any damage whose proximate cause was utilities or utility like services, or faulty installation or maintenance done by someone other than CTI.

Control Technology Inc. reserves the right to make changes to the Product in order to improve reliability, function, or design in the pursuit of providing the best possible Product. CTI assumes no responsibility for indirect or consequential damages resulting from the use or application of this equipment.

THE WARRANTY SET FORTH ABOVE IN THIS ARTICLE IS THE ONLY WARRANTY CTI GRANTS AND IT IS IN LIEU OF ANY OTHER IMPLIED OR EXPRESSED GUARANTY OR WARRANTY ON CTI PRODUCTS, INCLUDING WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE AND IS IN LIEU OF ALL OBLIGATIONS OR LIABILITY OF CTI FOR DAMAGES IN CONNECTION WITH LOSS, DELIVERY, USE OR PERFORMANCE OF CTI PRODUCTS OR INTERRUPTION OF BUSINESS, LOSS OF USE, REVENUE OR PROFIT. IN NO EVENT WILL CTI BE LIABLE FOR SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES FOR CONSUMER PRODUCTS, SO THE ABOVE LIMITATIONS OR EXCLUSIONS MAY NOT APPLY TO YOU.

THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH MAY VARY FROM STATE TO STATE.

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REPAIR POLICY

In the event that the Product should fail during or after the warranty period, a Return Material Authorization (RMA) number can be requested orally or in writing from CTI main offices. Whether this equipment is in or out of warranty, a Purchase Order number provided to CTI when requesting the RMA number will aid in expediting the repair process. The RMA number that is issued and your Purchase Order number should be referenced on the returning equipment's shipping documentation. Additionally, if the product is under warranty, proof of purchase date and serial number must accompany the returned equipment. The current repair and/or exchange rates can be obtained by contacting CTI's main office at 1-800-537-8398.

When returning any module to CTI, follow proper static control precautions. Keep the module away from polyethylene products, polystyrene products and all other static producing materials. Packing the module in its original conductive bag is the preferred way to control static problems during shipment. Failure to observe static control precautions may void the warranty. For additional information on static control precautions, contact CTI's office at 1-800-537-8398.