CTI 2452 EIGHT CHANNEL
RTD INPUT MODULE
INSTALLATION AND OPERATION GUIDE

Version 1.4
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PREFACE

This ***Installation and Operation Guide*** provides installation and operation instructions for the CTI 2452 Eight Channel RTD Input Module for SIMATIC® 405 Series programmable controllers. We assume you are familiar with the operation of SIMATIC® 405 Series programmable controllers. Refer to the appropriate SIMATIC® user documentation for specific information on the SIMATIC® 405 Series programmable controllers and I/O modules.

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

Chapter 1 provides a description of the module.

Chapter 2 covers installation and wiring.

Chapter 3 is a guide to troubleshooting.

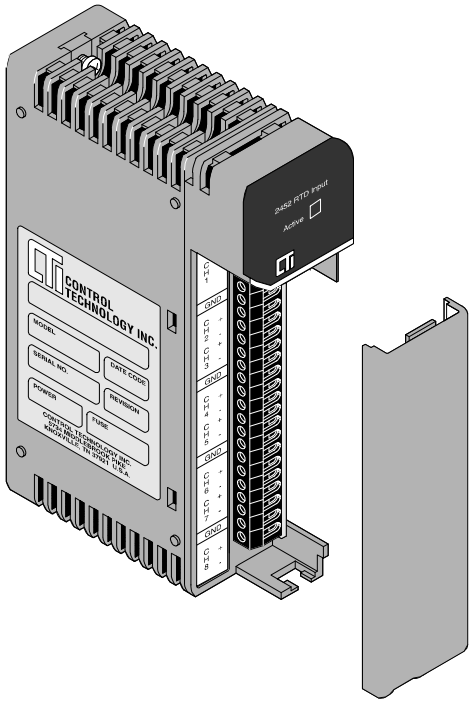

Figure 1 *The Model 2452 RTD Input Module*

USAGE CONVENTIONS

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

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

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

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CHAPTER 1. DESCRIPTION

The 2452 Eight Channel RTD Input Module is a member of Control Technology's family of I/O modules compatible with the SIMATIC® 405 Series programmable controllers. The Model 2452 is designed to translate 100 ohm platinum RTD input signals or 120 ohm nickel RTD input signals into equivalent digital words which are then sent to the programmable controller (PLC).

Support for other RTD types and millivolt inputs is available through special request from the factory. Call CTI at 1-800-537-8398 to determine if support is available for your special RTD.

1.1 Front Panel Description

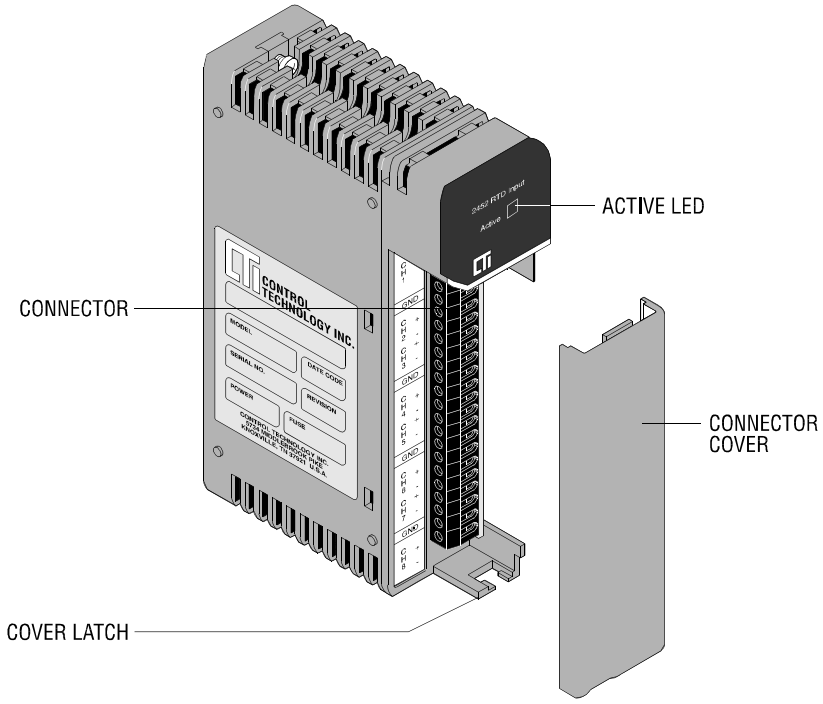

Figure 2 *2452 Front Panel*

1.1.1 Active LED

The Active LED will be illuminated when the module is functioning normally. If the Active LED is not lit, refer to Chapter 3 for troubleshooting type.

1.1.2 Connector Cover

The connector cover is a plastic plate on the front of the 2452. The connector cover conceals the connector and cabling. The connector cover also protects the temperature sensing components from external drafts.

To remove the cover, press up on the latch at the bottom of the cover and pull the cover forward.

To reinstall the cover, place the tab at the top of the cover into the slot on the module case. Push forward until the latch seats into place.

1.1.3 Connector

The connector provides screw terminals for attaching RTD wires to the 2452. See Section 2.6 for wiring details.

1.2 Asynchronous Operation

The module operates asynchronously with the CPU. That is, the update times of the CPU and module do not occur simultaneously. The module converts all selected RTD inputs in one module update (which is less than 3.0 milliseconds per selected channel), and stores digital information in a buffer.

1.2.1 Active Channels

One of the channels is considered to be active during each CPU scan. On any given CPU scan, both a control bit describing which channel is active and the information for the active channel is transferred from the module to the CPU. Following the transfer, the channel is deactivated and the next selected channel automatically becomes active. The next CPU scan triggers the active channel indicator and data for this channel and sends it to the CPU; this process repeats. Eight CPU scans are required to obtain data from all eight channels. Thus, although the module itself performs conversions asynchronously with the CPU, the transmission of data from the module to the CPU is synchronous with the CPU scan. This process is illustrated in the following figure.

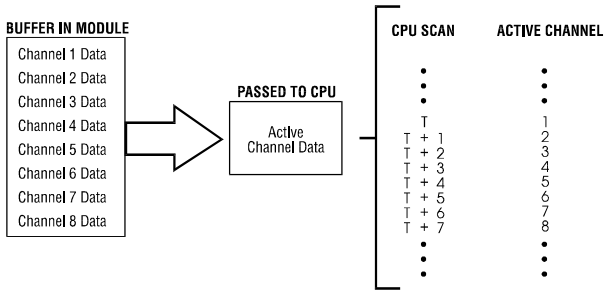

Figure 3 *Active Channels*

The module appears to the controller as 32 X inputs. The module can be installed in any slot of any 405 Series base. Since the 405 Series CPU supports 320 total X inputs, a maximum of 10 RTD input modules (80 channels) can be installed in a single 405 Series system.

1.3 100 Ohm Platinum or 120 Ohm Nickel RTD

Each of the module's eight channels may be configured to receive either a 100 ohm platinum RTD or a 120 ohm nickel RTD input signal. Selection of 100 ohm platinum or 120 ohm nickel RTDs is made via internal switch and jumper settings (see Sections 2.4.1 and 2.4.3).

1.4 Digital Word Map

Since the module requires a 32-bit input word, the temperature data value is placed into the lower 16-bits (bits 0-17 octal) for transmittal to the PLC (as a V memory location). As shown in the following figure, bit 17 is used as a sign bit. The LSB (bit 0) is used to note values which are "overrange".

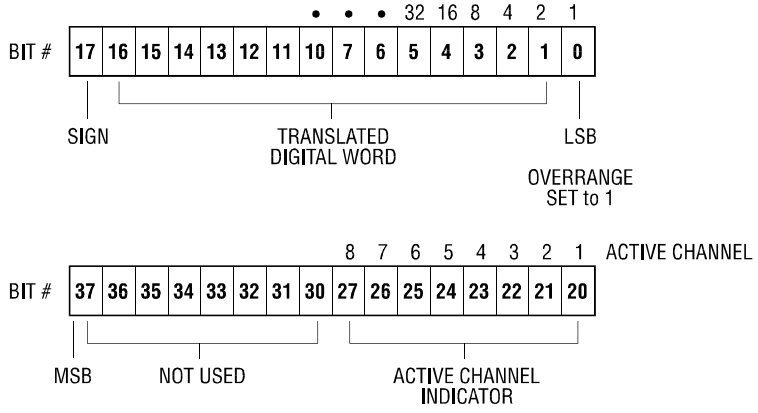

Figure 4 *Word Map*

The first 8 bits (20-27 octal) of the upper 16 bits are used for channel status and are read as X values. Bits 30-37 (octal) are not used.

Sections 2.7 and 2.8 describe the digital word in more detail.

1.5 RTD Input to Digital Conversion

The following equations may be used to calculate the digital word in decimal format which will result from a particular RTD input:

RTD Mode, Digital Word (bits 0-17) = Degrees X 10

As an example, the following figure illustrates the effects of a change in input level going from 3.2 degrees to 102.4 degrees in the RTD Input Mode.

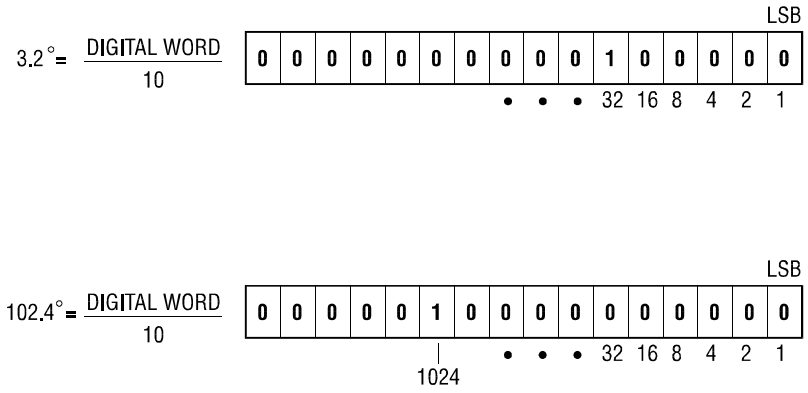

Figure 5 *Example Change in Input Level*

1.6 Effect of Out-of-Range Input Signals

RTD inputs exceeding the ANSI standard of 849.8 degrees C for 100 ohm platinum or 260.0 degrees C for 120 ohm nickel will cause the overrange bit to be set. A maximum temperature of 849.8 degrees C for 100 ohm platinum or 260.1 degrees C for 120 ohm nickel will be returned to the PLC for any positive overrange input.

Similarly an input below -199.8 degrees C (see Section 2.7.2 for negative numbers) for 100 ohm platinum or -79.8 degrees C for 120 ohm nickel will cause the overrange bit to be set. A temperature of -199.8 degrees C (63535) will be returned to the PLC for 100 ohm platinum and -79.9 degrees C (64737) for 120 ohm nickel RTDs for any negative underrange input.

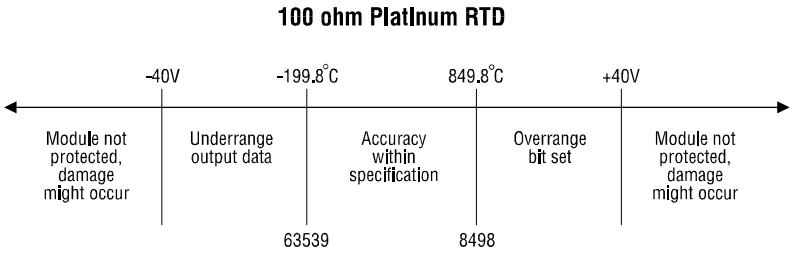

Figure 6 *Effect of Temperature Input on Module Performance*

1.7 Resolution

The module has a resolution of 0.025% of full scale.

For a 100 ohm platinum RTD with a maximum temperature of 849.8 degrees C, the resolution will be:

Resolution = 849.8° x 0.00025 = 0.212°

or approximately 0.2 degrees C.

CHAPTER 2. INSTALLATION

The installation of the Eight Channel RTD Input Module involves the following steps:

1. Planning the installation
2. Configuring the module
3. Inserting the module into the base
4. Wiring the module input connector
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. The following sections discuss these important considerations.

2.2 Calculating the I/O Base Power Budget

The 2452 requires 2.8 watts of +5V power from the I/O base. Use this figure to verify that the base power supply capacity is not exceeded.

2.3 Unpacking the Module

Open the shipping carton and remove the special anti-static bag which contains the module.

> ***CAUTION:***
> *HANDLING STATIC SENSITIVE DEVICES*
> *The components on the Model 2452 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.*

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.**

2.4 Configuring the Module

The Model 2452 must be configured for 100 ohm platinum or 120 ohm nickel RTDs and digital filtering in/digital filtering out mode before wiring the input connectors and inserting the module into the I/O base. As shipped, all input channels are configured 100 ohm platinum RTDs, degrees Celsius and digital filtering in (see Figure 8). The jumpers and switches are available at the rear of the module (see Figure

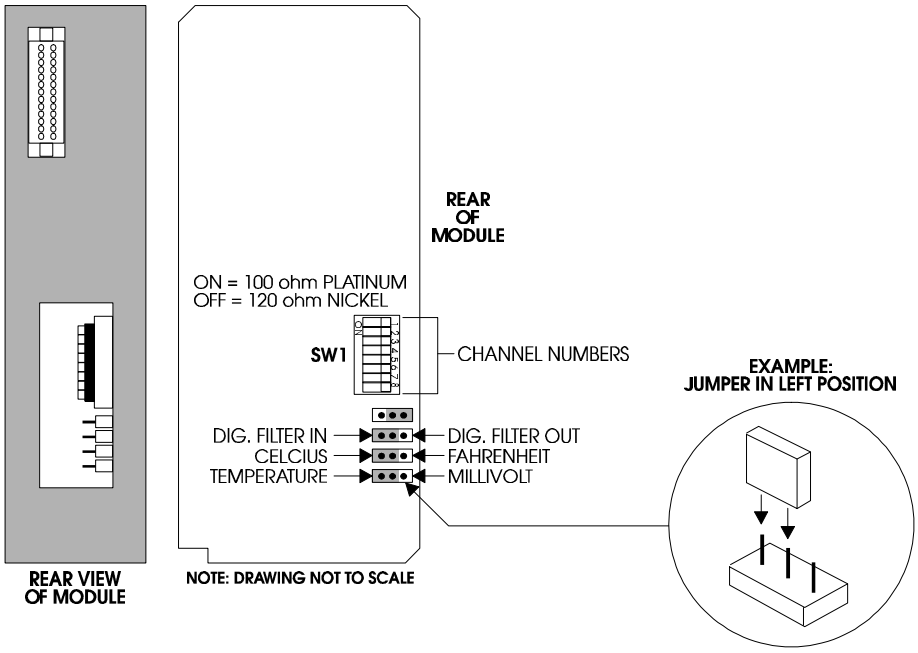

Figure 7 *Jumper Locations*

7).

Changing the module input channel configuration involves the following steps:

1. Selecting 100 ohm platinum or 120 ohm nickel RTD input mode for each channel.
2. Selecting digital filtering in or digital filtering out for the module.
3. Logging the configuration jumper settings for future reference.

Each of these steps is described in the following sections.

2.4.1 Selecting 100 Ohm Platinum or 120 Ohm Nickel RTD Inputs

Select the correct linearization table by locating DIP switch 1 (SW1 in Figure 7) on the 2452 circuit card and select either 100 ohm platinum or 120 ohm nickel RTD for each of the eight inputs by turning each switch to the proper position. The "ON" position corresponds to 100 ohm platinum RTD input.

CHANNEL NUMBER	SWITCH POSITION VS CHANNEL# SW1	RTD TYPE SWITCHES (SW1)	
		OFF	ON
1	1	120 ohm NICKEL	100 ohm PLATINUM
2	2	120 ohm NICKEL	100 ohm PLATINUM
3	3	120 ohm NICKEL	100 ohm PLATINUM
4	4	120 ohm NICKEL	100 ohm PLATINUM
5	5	120 ohm NICKEL	100 ohm PLATINUM
6	6	120 ohm NICKEL	100 ohm PLATINUM
7	7	120 ohm NICKEL	100 ohm PLATINUM
8	8	120 ohm NICKEL	100 ohm PLATINUM

ALL CHANNELS	DIGITAL FILTERING JUMPER	FAHRENHEIT/ CELCIUS SELECT	TEMP/MILLIVOLT SWITCHES
1-8	JP 10 LEFT - Filtering Enabled RIGHT - Filtering Disabled	JP 11 LEFT - Degrees C RIGHT - Degrees F	JP 12 LEFT - Temp RIGHT - Millivolts

Figure 8 *Factory Configuration Jumper Settings*

2.4.2 Selecting Digital Filtering

Locate the Digital Filtering Jumper (see Figure 7). To enable digital filtering, set the jumper in the "Dig Filter In" position. Since many analog input signal contain noise, CTI recommends using digital filtering unless maximum response time is required.

2.4.3 Select Degrees Fahrenheit or Celsius

Locate the temperature scaling jumper (see Figure 7) and select either degrees Fahrenheit or Celsius by positioning the jumper in the "FAHRENHEIT" or "CELSIUS" position.

2.5 Inserting the Module Into the I/O Base

Insert the module into the I/O base by tilting the top front of the module forward. Hook the tab at the bottom rear of the case into the slot at the bottom of the base frame. Push the module toward the base until it is securely seated. Tighten the securing screw. Refer to the SIMATIC® 405 Series User's Manual for additional installation information.

2.6 Wiring the Input Connectors

RTD input signals are accepted through a screw terminal connector block located under the wiring plate on the front of the module. Consult the RTD manufacturer's recommendations for selecting the input wire type and size.

All GND terminals on the 2452 terminal block (see Figure 9) are common to each other. They are provided as a convenient termination point for cable shields. All input terminals are isolated from the PLC up to 1500 VDC.

2.6.1 Wiring Guidelines

To avoid noise problems, follow these guidelines when installing the module.

- Use the shortest possible wires.
- Avoid placing signal wires parallel to high-energy wires. If the two must meet, cross them at right angles.
- Avoid bending the wire into sharp angles.
- Use wireways for wire routing.
- When using shielded wires, ground them only at the module end for better noise immunity.
- Place wires so that they do not interfere with existing wiring.

> ***CAUTION:***
> *Tighten the screw terminals snugly.*
> *Do not over tighten as damage to the connector may occur.*

NOTE:

All unused channels should be shorted from the I1 to the GND terminals to prevent saturation of the input amplifier. Failure to do so will result in erroneous readings on adjacent channels.

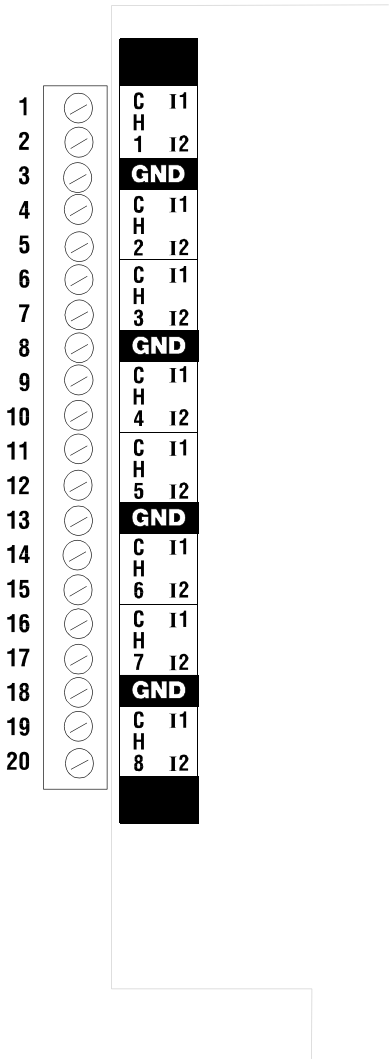

Figure 9 *Screw Terminal Block Wiring*

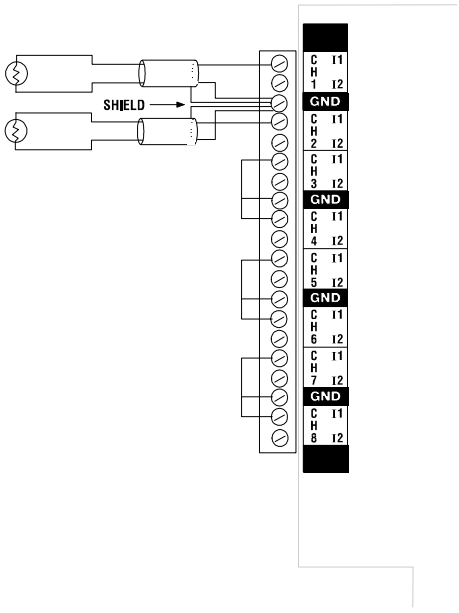

Figure 10 *Required Jumpering - 2452*

2.6.2 Wiring Examples

The following example demonstrates hooking up two 3-wire RTDs to channels 1 and 2 of the 2452. The

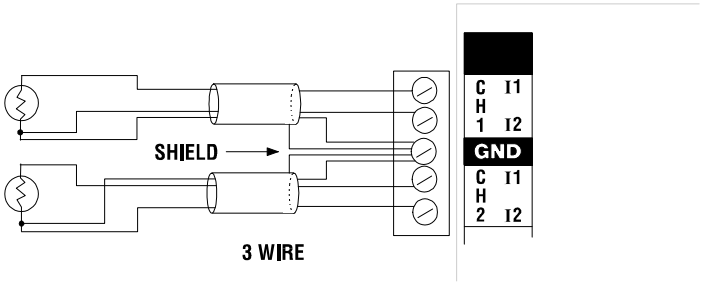

Figure 11 *Wiring Example 3-Wire RTD*

shields of both RTDs are connected to terminal 3 GND terminal.

The 2452 is designed to accommodate 3-wire RTDs. However, using the following wiring diagrams, 2

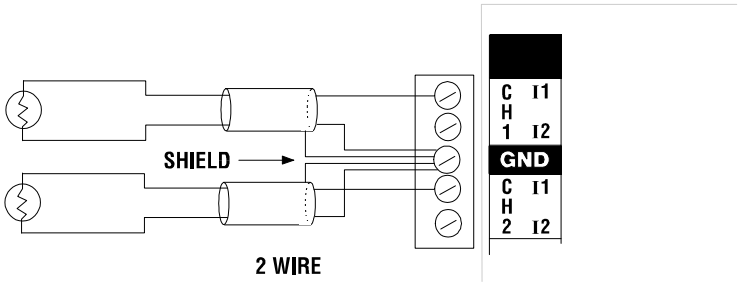

Figure 12 *Wiring Example 2-Wire RTD*

and 4-wire RTDs may also be used.

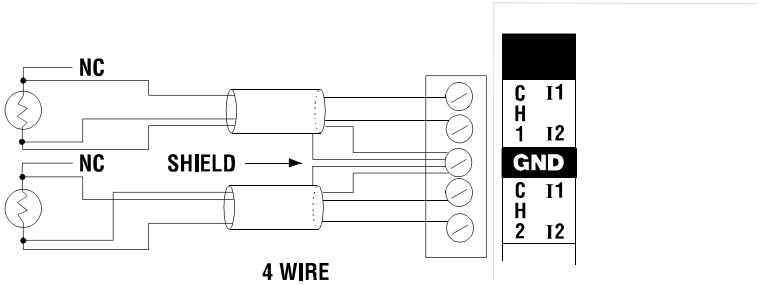

Figure 13 *Wiring Example 4-Wire RTD*

2.7 I/O Configuration and Input Format

2.7.1 Octal Numbering

405 Series I/O references are numbered in octal (also known as base 8). In octal, the digits 8 and 9 are not used. I/O points are counted as usual from 0 up to 7. Since 8 and 9 are not used, the next point after 7 is 10. When the count reaches 17, the next point is 20. The point following 77 is 100.

2.7.2 Negative Numbers

The 405 Series PLC is an unsigned integer machine and does not handle negative numbers. If the 405 reads a number larger than 8499 (see Section 1.5 for maximum temperatures) from the 2452, it can be assumed that the 2452 is reporting a negative number.

Two's complement arithmetic can be used to determine the actual minus temperature (assume that the measured temperature is located at V2000):

Negative Temperature = (65535 - V2000) + 1

As an example, Figure 14 shows a data value from channel 1 of 65496. Using the above formula:

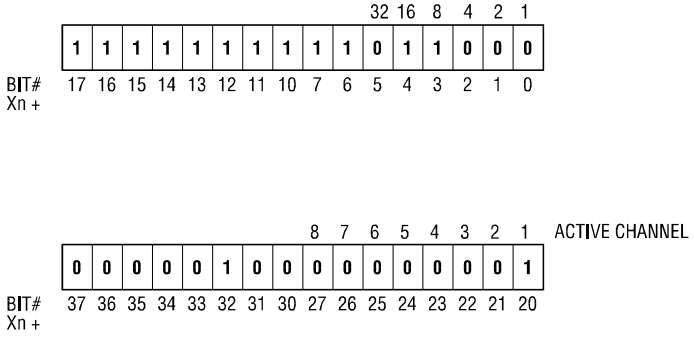

Figure 14 *Example Negative Measurement*

Negative Temperature = (65535 -65496) + 1 = -40 Degrees

To assist in displaying negative numbers, it can be noted that the CTI 5250-TI4 Access Module can be configured to display the 405 registers as signed integer values.

2.7.3 Input Format

The module appears to the controller as 32 X inputs.

The module reserves points Xn through Xn + 37 (octal), where n is the starting point number. These 32 X inputs or bits are defined as shown in Figures 15, 16 and 17 which also shows the most significant bit (MSB) and the least significant bit (LSB).

As shown in Figure 15, the eight highest X locations (Xn + 30 through Xn + 37) are not used by this module.

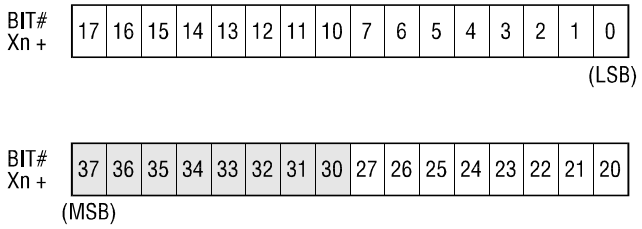

Figure 15 *Unused Bits*

The next highest eight bits (Xn + 20 through Xn + 27) are used by the module to indicate the active channel (as shown in Figure 16). The data bits from one channel and only one channel are transferred to the CPU with each CPU scan. The active channel indicators identify which channel corresponds to those data bits.

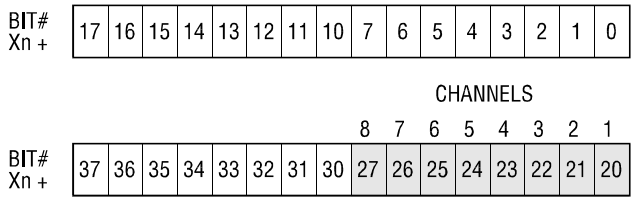

Figure 16 *Active Channel Bits*

Data bits Xn + 1 through Xn + 16 contain the temperature data of the active channel. Data bit Xn + 0 is the out of range bit. Data bit Xn + 17 is the sign bit. (See Figure 17.)

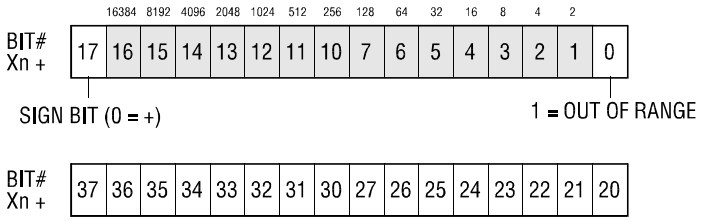

Figure 17 *Data Word*

2.7.4 Operating the Module

For example, the 32 bits given in Figure 18 might be read by the CPU during a scan. Since Xn + 23 contains a 1, channel 4 is active. Thus, the data given in bits Xn + 0 through Xn + 16 belongs to channel 4. Data bits 7, 4 and 3 contain a 1, so the data value would be (128 + 16 + 8) 152 and the temperature would be 15.2 degrees.

The active channel is automatically incremented to the next selected channel with each CPU scan. The conversion of the analog signals to digital data is asynchronous with the CPU. However, the transfer of data from the module to the CPU is synchronous with the CPU scan. (One channel's data is transferred on each CPU scan.)

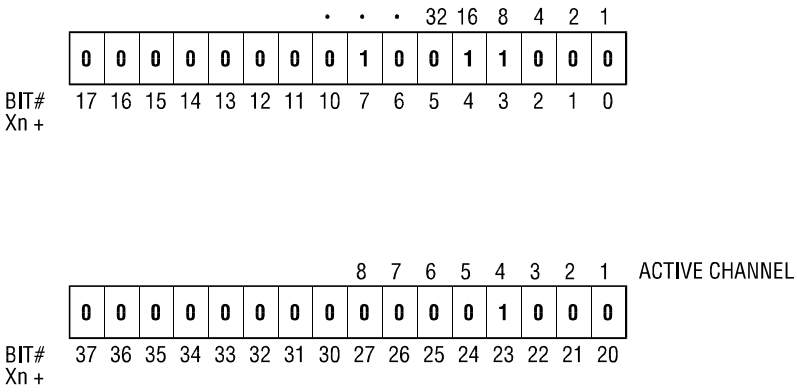

Figure 18 *Example Measurement*

2.8 Decoding Channels

Since data from all channels are multiplexed into a single word, you might wish to write a program to decode the information for each channel, as shown in the following figure. This program decodes information from the eight channels and stores it in V memory. Channel 1 is stored in V2000, channel 2 in V2001, etc. This program assumes the module is configured as X0 - X37.

X0 - X17 can be read as V memory location 40400. Refer to the memory map in the *405 Series User Manual* for details.

> ***NOTE:***
> *Only one channel is accessed per CPU scan. The active channel is incremented to the next selected channel following each CPU scan.*

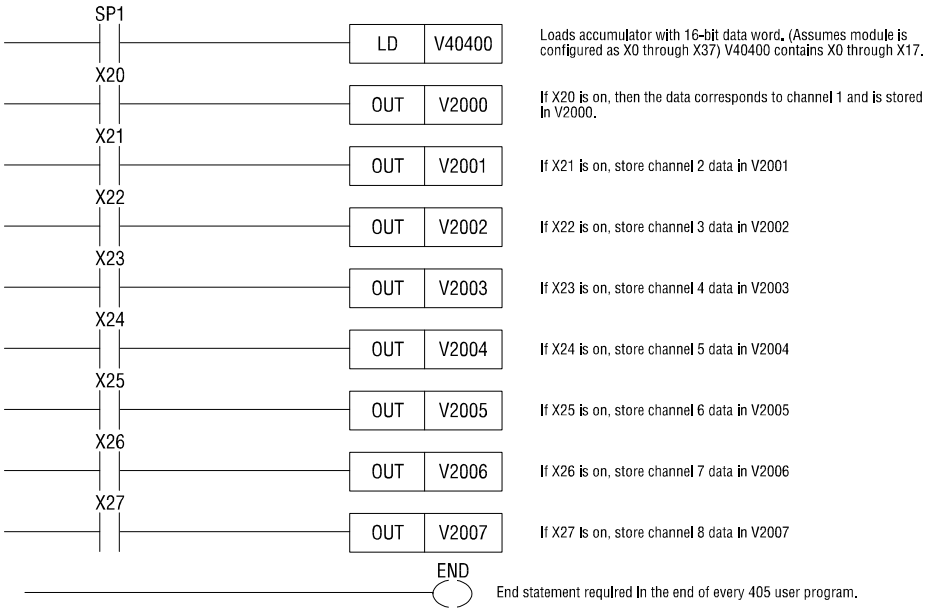

Figure 19 *Ladder Diagram Example*

2.9 Checking Module Operation

First turn on the base supply power. If the module diagnostics detect no problems, the Active LED on the front of the module will light. If the Active LED does not light (or goes out during operation), the module has detected a failure. For information on viewing failed module status, refer to your SIMATIC® MIU or 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 and outputs associated with each slot, refer to your SIMATIC® MIU or TISOFT Programming Manual. An example chart is shown in the following figure.

In this example, the 2452 Module is inserted in slot 0 in I/O base 0. Data for all channels appears in V memory location V40400. See Section 2.8 for a sample program to decode the data for individual channels. If 32 point input module appears on this line, then the module is registered in the PLC memory and the module is ready for operation.

```
                I/O MODULE DEFINITION FOR BASE .... 0

                ADDRESS          POINTS                    MODULE
SLOT       IN        OUT       IN   OUT      ID              NAME
  0 .... 0000 A .. 0000 A .... 32 .. 00 .... 3F .. (435) : 32 PT INPUT MOD
  1 .... 0000 A .. 0000 A .... 00 .. 00 .... FF .. (435) : EMPTY I/O SLOT
  2 .... 0000 A .. 0000 A .... 00 .. 00 .... FF .. (435) : EMPTY I/O SLOT
                                   .
                                   .
                                   .
  6 .... 0000 A .. 0000 A .... 00 .. 00 .... FF .. (435) : EMPTY I/O SLOT
  7 .... 0000 A .. 0000 A .... 00 .. 00 .... FF .. (435) : EMPTY I/O SLOT
```

Figure 20 *Example I/O Configuration Chart*

If the line is listed as an empty slot or shows erroneous data, 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 futher assistance.

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 PC power is off	Turn base or PC on
	Defective module	Return the module to CTI for service
Incorrect inputs	Wrong addresses for word input	Check program for correct word input addresses
	Wrong connections	Trace wiring to check connections
	Not logged-in	Read I/O configuration
	Incorrectly calibrated	Return the module to CTI for calibration
	Blown fuse	Return the module to CTI for calibration

Figure 21 *Troubleshooting Matrix*

When it is inconvenient to visually check the status indicator, use the MIU or TISOFT "Display Failed I/O" or "Show PLC Diagnostics" support functions.

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

If after consulting the chart above, you are unable to diagnose or solve the problem, contact your local distributor or CTI at 1-800-537-8398 for further assistance.

SPECIFICATIONS

Channels Per Module:	8 (eight) RTD Input Channels
Standard RTD Types:	
100 Ohm Platinum	TCR=0.003850 Ω/Ω/°C (European DIN 43760) -199.89°C to 849.8°C (-327.6°F to 1561.6°F)
120 Ohm Nickel	TCR=0.00672 Ω/Ω/°C -79.8°C to 260.0°C (-111.6°F to 500.0°F)
Absolute Temp Accuracy:	±0.4°C (±0.8°F)
Temperature Resolution:	0.025% Full Scale
Isolation:	1500 VDC channel-to-backplane
Input Protection:	4,000 Volts ESD
Input Bandwidth (@ -3 dB point)	5.5 Hz (digital filtering disabled) 0.16 Hz (single pole filter) (digital filtering enabled)
Normal Mode Rejection:	>45 dB @ 60 Hz (digital filtering enabled)
Filtering Time Constant:	50 mV step input, 28 mSec (digital filtering disabled) 1.0 Sec (digital filtering enabled)
Update Time:	1.2 mSec per channel
Field Wiring Connector:	Accepts 14-26 AWG
Module Power from Base:	2.8 Watts @ 5 V
Operating Temperature:	0°C to 60°C (32°F to 140°F)
Storage Temperature:	-40°C to 85°C (-40°F to 185°F)
Humidity:	5% to 95% (non-condensing)
Shipping Weight:	1 lb. (0.45 Kg)

Specifications subject to change without notice.

JUMPER SETTINGS LOG SHEET

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

CHANNEL NUMBER	SWITCH POSITION VS CHANNEL# SW1	RTD TYPE SWITCHES (SW1)	
		OFF	ON
1	1	120 ohm NICKEL	100 ohm PLATINUM
2	2	120 ohm NICKEL	100 ohm PLATINUM
3	3	120 ohm NICKEL	100 ohm PLATINUM
4	4	120 ohm NICKEL	100 ohm PLATINUM
5	5	120 ohm NICKEL	100 ohm PLATINUM
6	6	120 ohm NICKEL	100 ohm PLATINUM
7	7	120 ohm NICKEL	100 ohm PLATINUM
8	8	120 ohm NICKEL	100 ohm PLATINUM

ALL CHANNELS	DIGITAL FILTERING JUMPER	FAHRENHEIT/ CELCIUS SELECT	TEMP/MILLIVOLT SWITCHES
1-8	JP 10 LEFT - Filtering Enabled RIGHT - Filtering Disabled	JP 11 LEFT - Degrees C RIGHT - Degrees F	JP 12 LEFT - Temp RIGHT - Millivolts

Figure 22 *Jumper Setting Log Sheet*

USER NOTES

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 one (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 the 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.

REPAIR POLICY

In the event that the Product should fail during or after the warranty period, a Return Material Authorization number (RMA) can be requested verbally 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 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 main office at 1-800-537-8398.