SIEMENS

SIMATIC 505

505–2556 Sixteen Channel Isolated Thermocouple Input Module

Installation and Operation Guide

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Original Edition

⚠ DANGER

DANGER indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury.

DANGER is limited to the most extreme situations.

⚠ WARNING

WARNING indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury, and/or property damage.

⚠ CAUTION

CAUTION indicates a potentially hazardous situation that, if not avoided, could result in minor or moderate injury, and/or damage to property.

CAUTION is also used for property-damage-only accidents.

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Preface

This *Installation and Operation Guide* provides installation and operation instructions for the SIMATIC® 505–2556 Sixteen Channel Isolated Thermocouple Input Module for SIMATIC 505 programmable controllers. We assume you are familiar with the operation of SIMATIC 505 programmable controllers. Refer to the appropriate SIMATIC 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 a description of the module.
- Chapter 2 covers installation and wiring.
- Chapter 3 is a guide to advanced function programming.
- Appendix A is a guide to troubleshooting
- Appendix B is a table of specifications.
- Appendix C is a log sheet for your configuration jumper settings.
- Appendix D is a Thermocouple Wire Guide

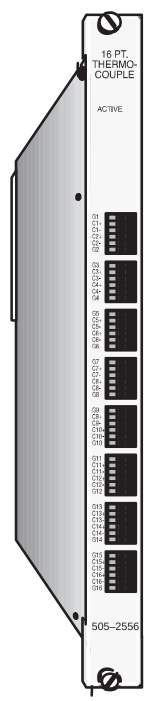

Figure 1 SIMATIC 505–2556 16-Channel Isolated Thermocouple Input Module

Related Manuals

Additional manuals that have relevant information include the following:

- *SIMATIC 545/555/575 System Manual* (PPX:505–8201–x).
- *SIMATIC 545/555/575 Programming Reference User Manual* (PPX:505–8204–x).
- *SIMATIC 505 TISOFT2™ User Manual* (PPX:TS505–8101–x).

Refer to material in these manuals as necessary for additional information about programming and operating your 545/555/575 system.

Agency Standards

Series 505 products have been developed with consideration of the draft standard of the International Electrotechnical Commission Committee proposed standard (IEC–65A/WG6) for programmable controllers (released as IEC 1131–2, Programmable Controllers, Part 2: Equipment Requirements and Tests, First Edition, 1992–09). Contact Siemens Energy & Automation, Inc., for information about regulatory agency approvals that have been obtained on Series 505 units.

Agency Approvals

Agency approvals are the following:

- UL-listed (industrial control equipment)
- CUL (Canadian UL)
- FM (Class I, Div. 2, Group A, B, C, D Hazardous Locations)

European Community (CE) Approval

Generally, products listed in this manual comply with the essential requirements of European Community EMC Directive, number 89/336/EEC, and carry the CE label. See the declaration of conformity included with each CPU for a listing of specific products and compliance details.

Technical Assistance

For additional technical assistance, call the Siemens Technical Services Group in Johnson City, Tennessee at 1-800-942-5697 or 423-461-2522, or contact them by e-mail at **simatic.hotline@sea.siemens.com**. For technical assistance outside the United States, call 49-911-895-7000.

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1.1 Front Panel Description

The Sixteen Channel Thermocouple Input Module is a member of Siemens Energy & Automation, Inc., family of I/O modules compatible with the SIMATIC 505 programmable controllers. The SIMATIC 505–2556 is designed to translate a J, K, R, S, T, E, and L (DIN J) thermocouple or millivolt input signal into an equivalent digital word which is then sent to the programmable controller (PLC).

The SIMATIC 505–2556 Thermocouple Input Module features built–in independent internal cold junction compensation and linearization for each thermocouple input for Types J, K, E, R, S, L, and T. No external cold junction compensation is required.

Active LED

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

Input Terminals for Channels 1–16

The SIMATIC 505–2556 uses a fixed wire press in connector to minimize the effects of the connector mettalurgy on the accuracy of the measurement. This connector provides wiring terminals for channels 1–16.

Figure 1-1 shows the front panel of the SIMATIC 505–2556.

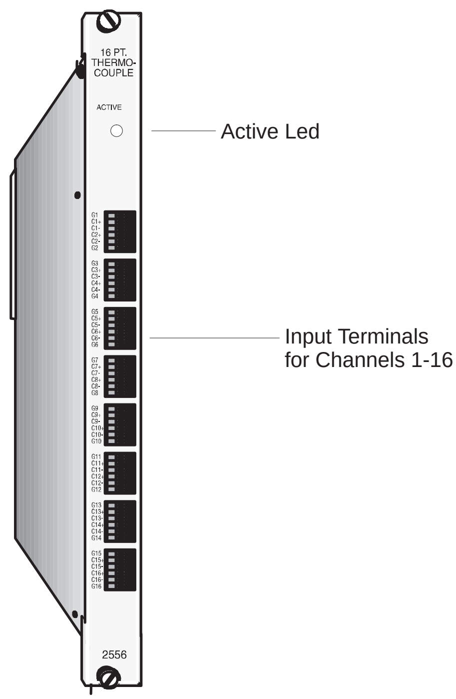

Figure 1-1 SIMATIC 505–2556 Front Panel Description

1.2 Operation and Configuration

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 inputs in one module update (24 milliseconds maximum) and store the translated words in a buffer memory. The PLC retrieves the stored words from the module buffer memory at the start of the I/O scan.

Immediate I/O Compatibility

The SIMATIC 505–2556 has been tested and is compatible with the Immediate Read function of the SIMATIC 545 and 555 PLC. The SIMATIC 505–2556 is compatible with 545 and 555 PLCs. It is compatible with the 525 PLCs in 16WX mode only.

J, K, R, S, T, E, or L Thermocouples

Each of the module's sixteen channels may be configured to receive either J, K, R, S, T, E, or L thermocouple input signals or a DC voltage signal ranging from –55 to +55 millivolts. Selection of thermocouple type or millivolts are made via internal DIP switch settings and hardware jumpers (see Sections 2.4.1 and 2.4.2).

Digital Word Map

Thermocouple and/or millivolt signals are translated into a 14–bit digital word. Since the PLC requires a 16–bit input word, the 14–bit value from the converter is placed into a 16–bit word for transmittal to the controller. As shown in Figure 1-2, of the two bits not used for the digital word, one is used to show the sign of the word, while the other is used to note values which are "overrange."

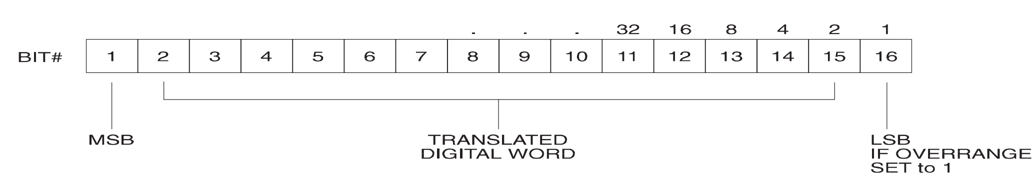

Figure 1-2 Word Input to the PLC from the Module

1.3 Thermocouple Input to Digital Conversion

Engineering Units

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

Thermocouple Mode, Digital Word (WX) = Degrees X10
Millivolt Mode, Digital Word (WX) = Millivolts X100

As an example, the following figure illustrates the effects of a change in input level going from 0° to 102.4° F in the Thermocouple Input Mode.

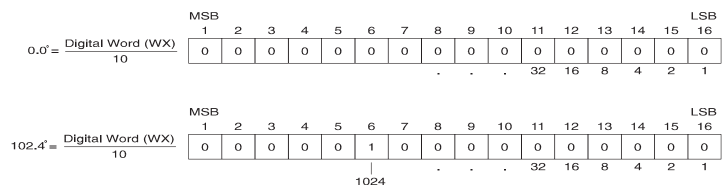

Figure 1-3 Example Change in Input Level

Scale Units

When data format is selected as SCALE the full temperature range of the thermocouple is scaled as an unsigned integer from 0–32000. The following formula may be used to calculate the scaled integer value.

Scaled Integer = (measured temp – min temp) ÷ (max temp – min temp) x 32000
For example the scaled integer offset at 0°C for a Type J thermocouple is:
Scaled integer = 0 – (–210) ÷ (760 – (–210)) x 32000 = 6928

Effect of Out-of-Range Input Signals

Thermocouple inputs exceeding the ANSI standard of 760 degrees C for Type J, or 1768 degrees C for Type R and S, and 1000 degrees C for Type E will cause the overrange bit to be set and the maximum temperature for that thermocouple type to be returned. Open thermocouples report temperatures that are out of the allowable range. This condition may occur due to failure of the thermocouple or due to the thermocouple wire being cut or disconnected. The SIMATIC 505–2556 will report an open thermocouple condition within 200 milliseconds.

NOTE: The SIMATIC 505–2556 uses the least significant bit (16) to indicate an open thermocouple. The value of this bit is set to 1 when this condition occurs. An open thermocouple condition will report within 200 milliseconds.

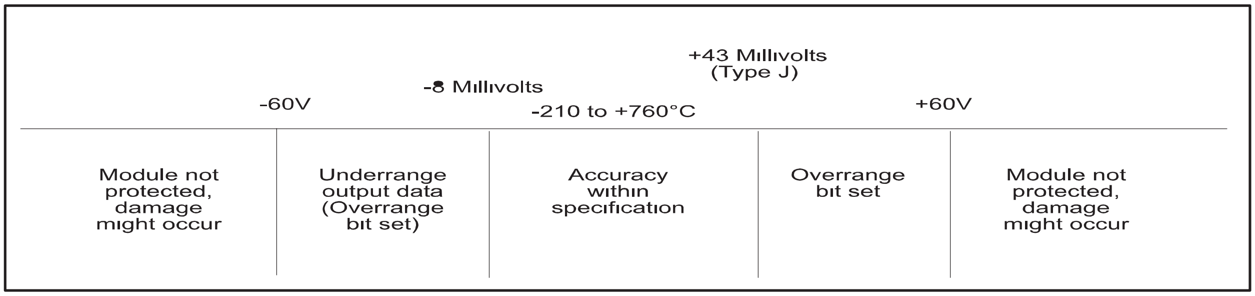

Figure 1-4 Effect of Voltage Input on Type J Thermocouple

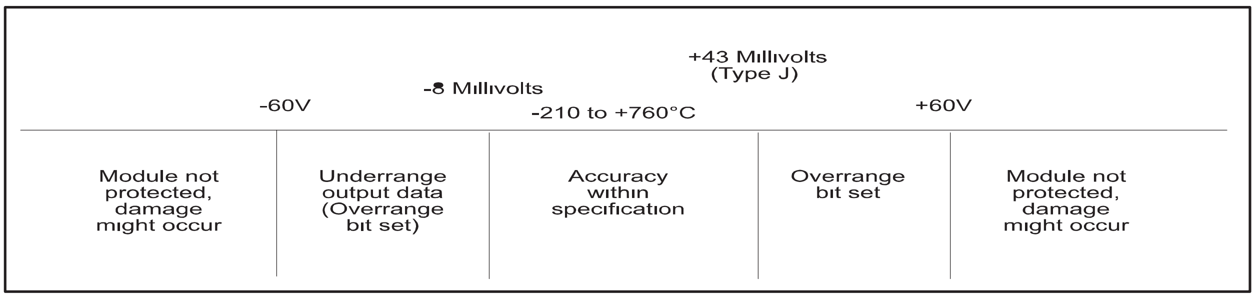

Figure 1-5 Effect of Voltage Input on Type K Thermocouple

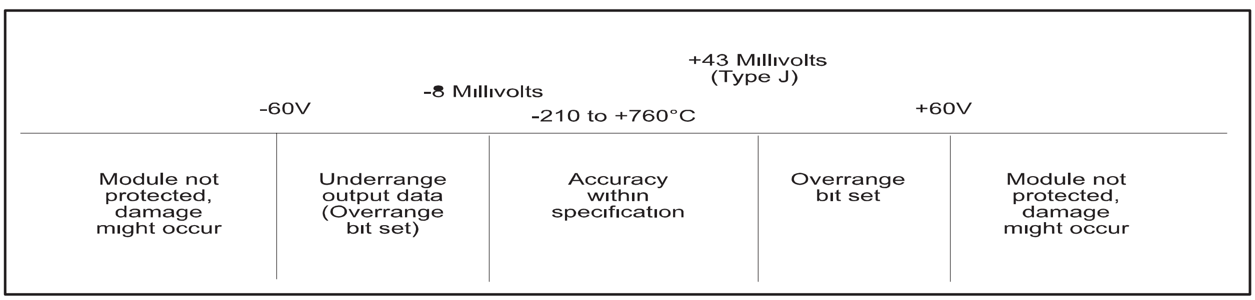

Figure 1-6 Effect of Voltage Input on Type R Thermocouple

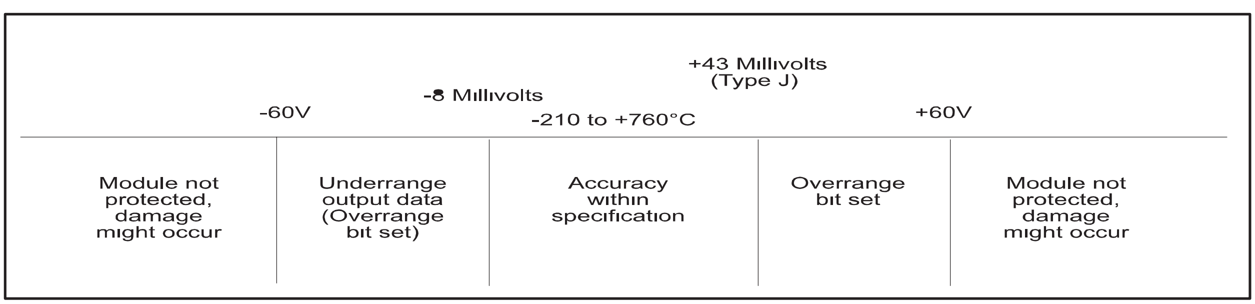

Figure 1-7 Effect of Voltage Input on Type S Thermocouple

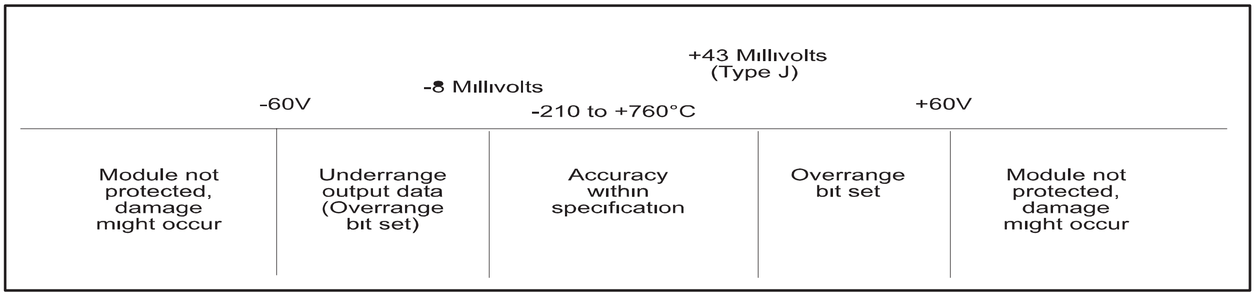

Figure 1-8 Effect of Voltage Input on Type T Thermocouple

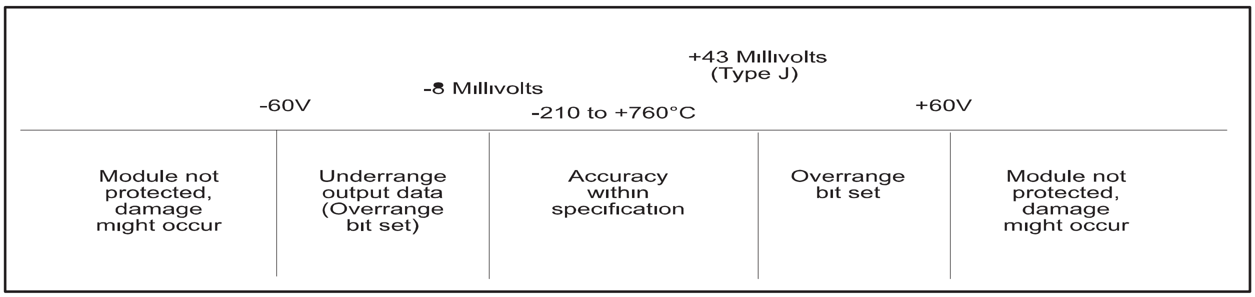

Figure 1-9 Effect of Voltage Input on Type E Thermocouple

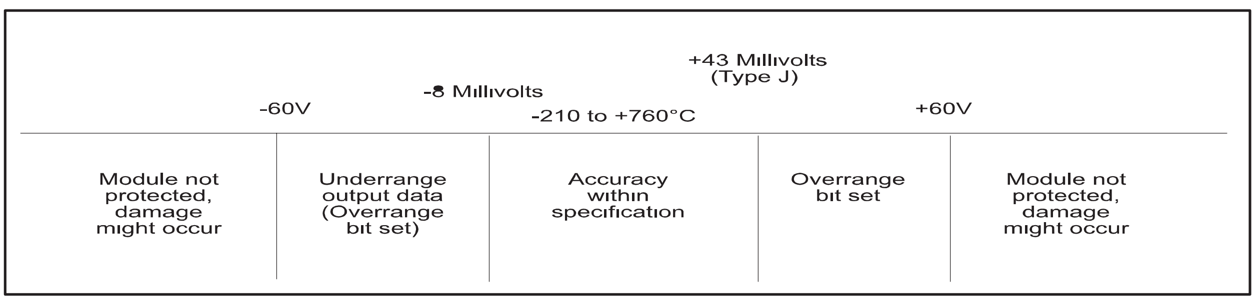

Figure 1-10 Effect of Voltage Input on Type L Thermocouple

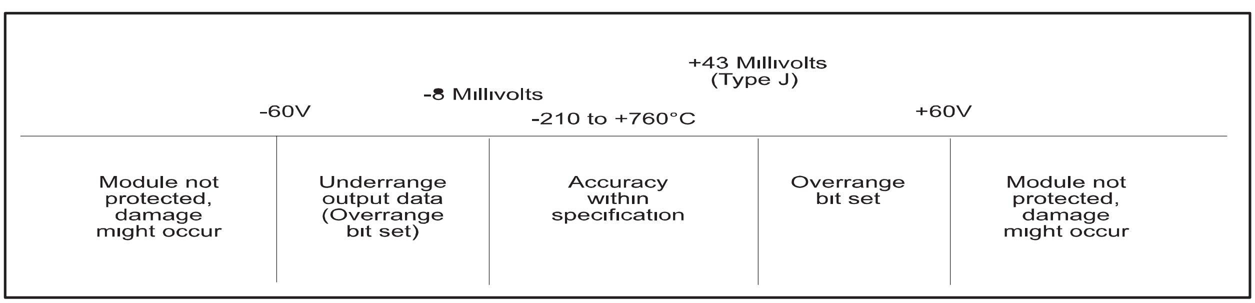

Figure 1-11 Effect of Voltage Input on Millivolt Range

Resolution

The module has a resolution of approximately 0.1°C, 0.2°F or exactly 0.01 millivolts.

Figure 1-12 shows the corresponding input resolution per step for each of the input configuration modes:

UNITS	DIGITAL COUNTS/STEP	INPUT RESOLUTION PER STEP
Temp Degrees C	2	~ 0.1°C
Temp Degrees F	2	~ 0.2°F
Millivolts	2	0.01 Millivolts

Figure 1-12 Input Resolution

Analog-to-Digital Converter Filter

The SIMATIC 505–2556 features a configurable notch filter on the analog–to–digital converters. This filter is very effective at removing power–line frequency input noise from the analog–to–digital conversion process. The filter frequency is configurable at jumper locatio CN10 on the printed circuit board. With no jumper at CN10, the filter frequency is 60 Hz. By placing the 3–pin jumper (included in an envelope packed with the SIMATIC 505–2556) at location CN10, the filter frequency is changed to 50 Hz.

Chapter 2

Installation

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2.1 Getting Started

The installation of the SIMATIC 505–2556 Sixteen Channel Thermocouple Input Module involves the following steps:

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

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

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.

Calculating the I/O Base Power Budget

The SIMATIC 505–2556 requires 5 watts of +5 VDC power from the I/O base. Use these values to verify that the base power supply capacity is not exceeded.

Unpacking the Module

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

CAUTION

The components on the SIMATIC 505–2556 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. You will need it for the following configuration procedure.

2.2 Configuring the Module

The SIMATIC 505–2556 must be configured for type J, K, R, S, T, E thermocouples or millivolt range and digital filtering/no filtering mode before wiring the input connectors and inserting the module into the I/O base.

NOTE: As shipped, all input channels are configured for Type J thermocouples (degrees Celsius) and digital filtering enabled, 16 WX mode and engineering units.

Changing the module input channel configuration involves the following steps:

1. Selecting thermocouple type or millivolt measurement via DIP switch
2. Selecting thermocouple type or millivolt input for each channel via hardware jumpers
3. Selecting digital filtering or no filtering for the module
4. Selecting standard login mode (16WX) or Advanced Operating Mode
5. Selecting degrees Celsius or Fahrenheit
6. Selecting Engr units or SCALE units for module
7. Logging the configuration jumper settings for future reference

Each of these steps is described in the following sections.

Selecting Thermocouple or Millivolt Measurement via DIP Switch

DIP switches 1–4 on the inside edge of the printed circuit board are used to inform the micro computer of changes in setup in the hardware selection jumpers (see Figure 13). Each channel has 3 switches to represent the thermocouple type or millivolt measurement that is performed.

NOTE: The ON position is selected by pushing the switch toward the center of the printed circuit board.

Switch Position	BCD Value	Measurement Selected
OFF OFF OFF	0	Millivolt
OFF OFF ON	1	E
OFF ON OFF	2	J
OFF ON ON	3	K
ON OFF OFF	4	L
ON OFF ON	5	R
ON ON OFF	6	S
ON ON ON	7	T

Selecting Thermocouple Type Input via Hardware Jumpers

Locate the hardware Thermocouple Compensation Jumpers corresponding to input channels 1 through 16. These jumpers are located adjacent tothe input terminal strip (see Figure 13). For each input channel, select either millivolt input or thermocouple type by placing the jumper in the correct position.

Selecting PLC Login Mode

Locate JP68 on the printed circuit board to select PLC Login Mode (see Figure 13). Standard login is 16WX registers in the PLC. Advanced Operating Mode logs in as 16X, 16Y, 32WX and 32WY registers. Consult the SIMATIC 255x Sixteen Channel Advanced Function Programming Reference Manual, part #62–177, if the advanced operating mode is to be selected.

Selecting Data Format

Locate SCALE jumper JP69 on the printed circuit board. (See Figure 13.) Select Engr to present data to the PLC as temperature X10 or Millivolt X100. Select SCALE to scale and present data as an unsigned integer from 0–32000.

Selecting Digital Filtering

Locate the Digital Filtering Jumper JP67. To enable digital filtering, set the jumper in the ”ENABLED” position. Since many analog input signals contain noise, Siemens recommends using digital filtering unless maximum response time is required. Digital filtering applies to both thermocouple or millivolt inputs.

The time step for digital filtering is .080 seconds. The filtering technique used provides that the full range of a voltage change reported to the PLC will be accomplished in 5 time steps or .40 seconds. The voltage change will be reported as a continuous exponential function over this time period with values at each time step as indicated

at .08 seconds, the value is 63% of full range
at .16 seconds, the value is 86% of full range
at .24 seconds, the value is 95% of full range, and
at .40 seconds, the value is 99% of full range.

Configuring the Module (continued)

Select Degrees Celsius or Fahrenheit

Locate the temperature scaling jumper JP66 on the right hand side of the module (see Figure 13) and select either degrees Celsius or Fahrenheit by positioning the jumper in the “DEG C” or “DEG F” position.

CHANNEL NUMBER	HARDWARE SELECTION	DIP SWITCH SELECTION
1	E, **J** / K, / mV / L / R, S, T	010 OFF / ON / OFF
2	E, **J** / K, / mV / L / R, S, T	010 OFF / ON / OFF
3	E, **J** / K, / mV / L / R, S, T	010 OFF / ON / OFF
4	E, **J** / K, / mV / L / R, S, T	010 OFF / ON / OFF
5	E, **J** / K, / mV / L / R, S, T	010 OFF / ON / OFF
6	E, **J** / K, / mV / L / R, S, T	010 OFF / ON / OFF
7	E, **J** / K, / mV / L / R, S, T	010 OFF / ON / OFF
8	E, **J** / K, / mV / L / R, S, T	010 OFF / ON / OFF
9	E, **J** / K, / mV / L / R, S, T	010 OFF / ON / OFF
10	E, **J** / K, / mV / L / R, S, T	010 OFF / ON / OFF
11	E, **J** / K, / mV / L / R, S, T	010 OFF / ON / OFF
12	E, **J** / K, / mV / L / R, S, T	010 OFF / ON / OFF
13	E, **J** / K, / mV / L / R, S, T	010 OFF / ON / OFF
14	E, **J** / K, / mV / L / R, S, T	010 OFF / ON / OFF
15	E, **J** / K, / mV / L / R, S, T	010 OFF / ON / OFF
16	E, **J** / K, / mV / L / R, S, T	010 OFF / ON / OFF

ALL CHANNELS 1-16	FAHRENHEIT / CENTIGRADE SELECT JP66	DIGITAL FILTERING JP67	LOGIN MODE JP68	DATA FORMAT JP69
	Left - Degrees C Right - Degrees F	Left - Disabled **Right - Enabled**	**Left - Standard 16WX** Right - Advanced	**Left - Engr (Temp X10)** Right - Scale (0-32,000)

Figure 2-1 Factory Configuration Jumper Settings

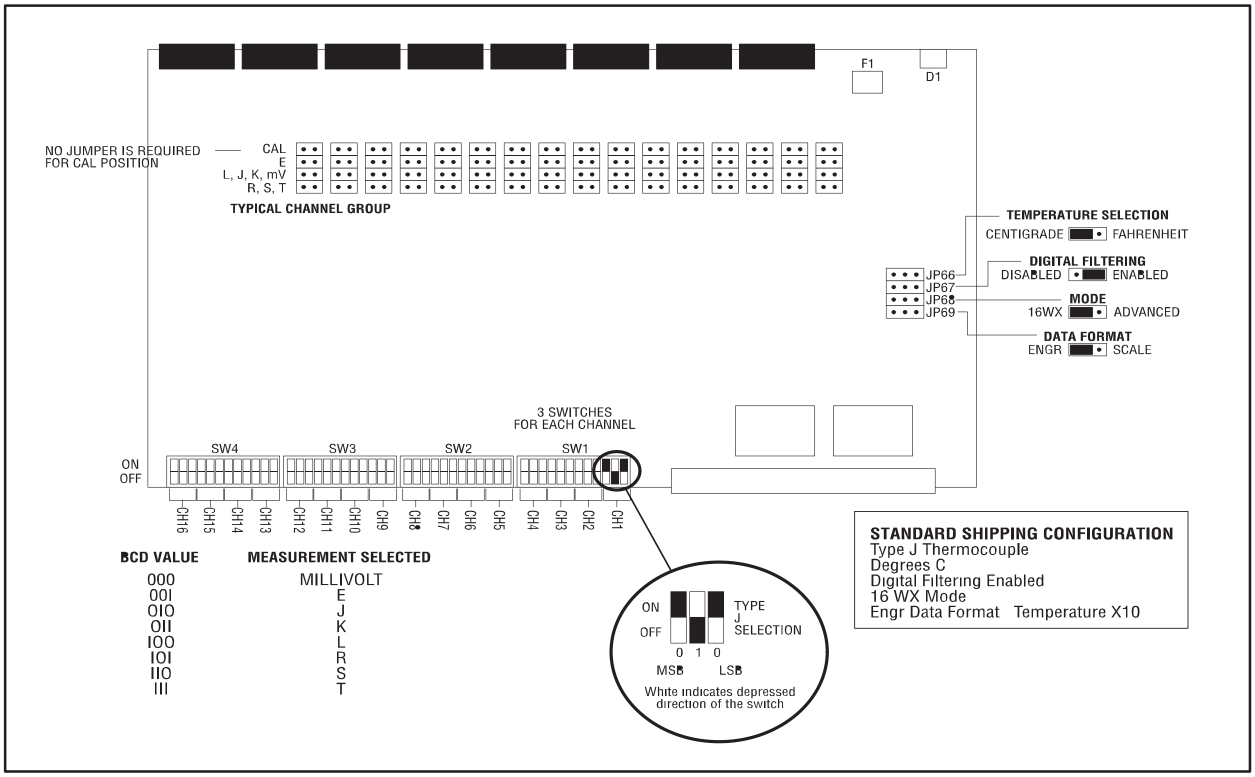

Figure 2-2 Configuration Jumper Location

⚠ WARNING

Inserting or removing a module while the system unit is connected to AC power could result in death or serious injury to personnel, and/or damage to equipment.

Ensure that the system unit is unplugged—that it is NOT connected to AC power—before attempting to insert or remove a module. Do not attempt these procedures unless you are thoroughly familiar with precautions required when working around high voltage equipment. Follow appropriate safety precautions.

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, 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 connector card at the back of the module when inserting or removing the module.

Wiring the Input Connectors

Thermocouple input signals are accepted through a fixed wire press in connector block located on the front of the module. Consult the thermocouple manufacturer's recommendations for selecting the input wire type and size. The front connector accepts wire from 18 to 30 AWG.

The SIMATIC 505–2556 uses a fixed connector to terminate field wiring. This is used because the chemistry of a removable connector may have an adverse effect on the accuracy of the measurement. Siemens has carefully selected a connector that minimizes this effect.

To assign an input to a specific channel, locate the appropriate channel position on the connector as shown in the following figure. Wires must be inserted by pressing the wire into the connector receptacle. To remove the wire use a small screwdriver to depress the connector lever. Then remove the thermocouple wire.

On each channel input the positive lead for the thermocouple is attached to the Cn+ terminal and the negative lead is attached to the Cn– terminal. If a shield is used it is attached at the Gn terminal. The "red" lead is always the negative lead for thermocouples.

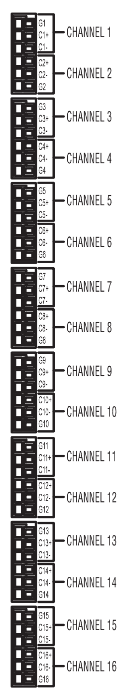

Figure 2-3 Input Connector Wiring

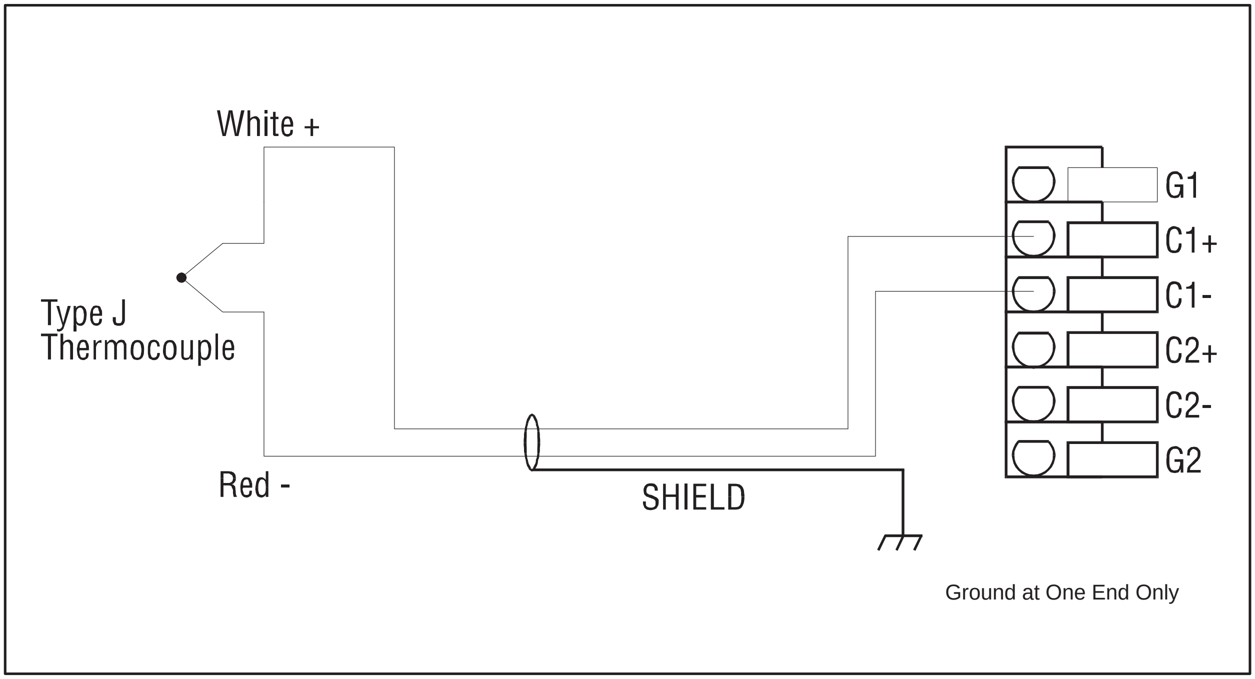

Figure 2-4 Thermocouple Wiring Application

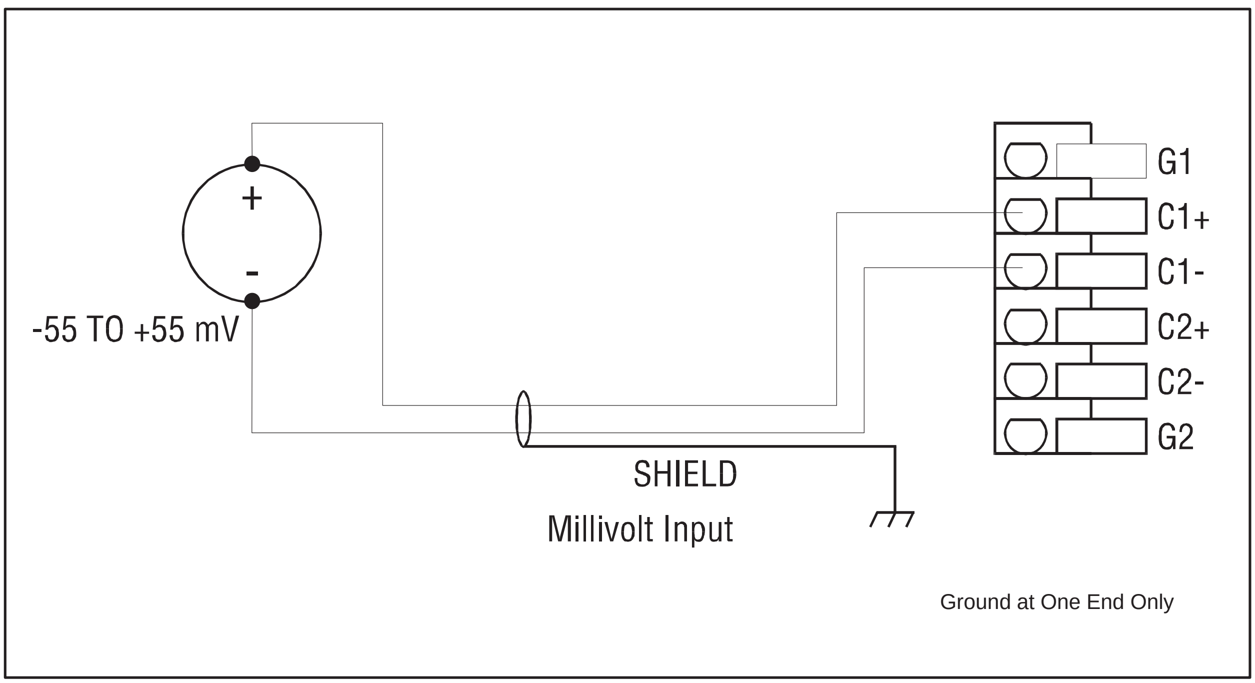

Figure 2-5 Millivolt Wiring Application

Connecting the Shield Wiring

Siemens recommends that all signal wires be shielded twisted–pair with foil wrap shield and a separate drain wire and that they be installed in a metallic conduit. Use Belden cable 8761 or equivalent whcih 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. Siemens recommends that the shield be terminated at the PLC end of signal wire. Special components are installed on the module to aid in the rejection of noise.

When entering the industrial cabinet the shield wires 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 G terminal whcih 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 Siemens strongly recommends that the shield wires be terminated tothe PLC chassis ground.

This product has been exhaustively tested 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. The PLC chassis should then be wired to earth ground with a large current capacity conductor. Siemens recommends using a #8 gauge wire from the PLC chassis to the earth ground connection.

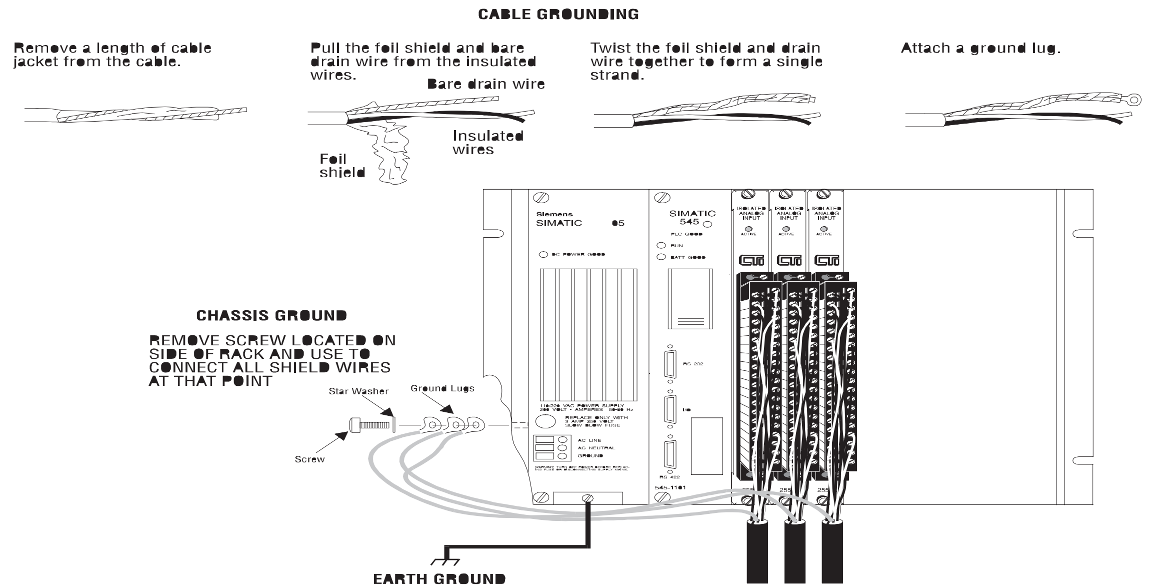

Figure 2-6 Cable Grounding

Configuring the Module (continued)

Checking Module Operation

First, turn on the base supply 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 (or goes out during operation), the module has detected a failure. For information on viewing failed module status, refer to your SIMATIC TISOFT or SoftShop 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 Figure 17.

NOTE: If thermocouples are not available for testing, the module will report ambient temperature by simply jumpering the (Cn+) and (Cn–) terminals with a short wire 26–18 gauge. This will verify that all channels are operating and that the module is logged into the PLC.

In this example, the SIMATIC 505–2556 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.

I/O MODULE DEFINITION FOR CHANNEL 1   BASE 00

I/O SLOT	ADDRESS	X	Y	WX	WY	SPECIAL FUNCTION
01	0001	00	00	**16**	00	NO
02	0000	00	00	00	00	NO
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
15	0000	00	00	00	00	NO
16	0000	00	00	00	00	NO

Figure 2-7   Example Configuration Chart

If the line is blank or erroneous, re–check the module to ensure that it is firmly seated in the slots. Generate the PLC I/O configuration chart again. If the line is still incorrect, contact your Siemens Energy & Automation, Inc., distributor or sales office.

NOTE: In Advanced Operating Mode the module logs in to the PLC as 16X, 16Y, 32WX, and 32WY.

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

NOTE: For proper operation, ensure that the SIMATIC 505–2556 and the thermocouple wires are not subjected to large temperature gradients during operation.

Chapter 3
Advanced Function Programming

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3.1 Advanced Software Functions

Introduction

As PLC control systems become more complex, the need for real-time processing of analog signals is needed at the I/O level. Current implementations using the 505 controllers utilize analog alarm blocks and/or special function programs within the controller. The SIMATIC 505–2556 analog input module from Siemens Energy & Automation, Inc., can reduce the program complexity and scan time by performing this signal processing in the module.

Scaling, alarming, peak/valley hold, digital filtering, and averaging are available on a per-channel basis and are selected through a simple PLC configuration routine. When these advanced functions are enabled, the module logs in as 16X / 16Y / 32WX / 32WY. A jumper on the module selects the standard 16WX login or the high-density advanced function interface.

Overview of the Advanced Functions

Each of these functions can be selected on a per-channel basis, and each channel can have any function in any combination, e.g. alarming on a scaled value which is digitally filtered and set for peak hold. (See Section 3.4 for timing considerations.)

Scaling Each channel can be configured with low and/or high scale value. A flowmeter that outputs 0 mA @ 5 cfm and 20 mA @ 50 cfm would have a low scale of 5 and a high scale of 50. An operator interface attached to the controller could then read the analog values directly in engineering units without having to run a Special Function program to scale the input.

Alarming Each channel can be assigned a low and/or high alarm value. No analog alarm blocks are needed in the controller. Alarming occurs real-time as the signal is processed by the module. Two WX words are used to indicate high and low alarm conditions (bit 1 = channel 16, etc.). A third WX word is the logical OR of the high and low alarms.

Peak/valley hold The peak or valley of a rapidly changing analog signal has been impossible to detect unless an external circuit was used. The SIMATIC 505–2556 makes possible the detection of a peak or valley and holds that value until reset by the controller. The peak/valley measurement is available to the controller at the same time as the currently measured analog value.

Averaging This option is used to “clean up” a signal that is at a steady state, e.g., a sensor riding on a liquid tank with riplets. The user specifies how many signal scans to average and this value is presented to the controller.

Digital filtering This has the effect of a moving average operation (actually it is an Infinite Impulse Response filter), and is useful to smooth out the high frequency noise on a changing analog signal. See Section 3.4.

All of these advanced function options are designed to be stored in the controller in a V-memory or K-memory table and downloaded to the module. The advantages of this method over a communications port on the module are greater flexibility, easier maintenance, and reduced documentation.

The controller can change any function "on the fly" if changing process conditions require (for example, a process needs tighter control, therefore narrower alarm limits). Any replacement module can be downloaded from the controller, which eliminates the need for a cable, a laptop computer and the most recent documentation.

Setting the Module Configuration Jumper

Before you begin to use the advanced mode of the SIMATIC 505–2556, all of the hardware functions, such as voltage range input levels, type of thermocouple, °C or °F, etc., should be set up in accordance with the instructions in Chapter 1 and Chapter 2.

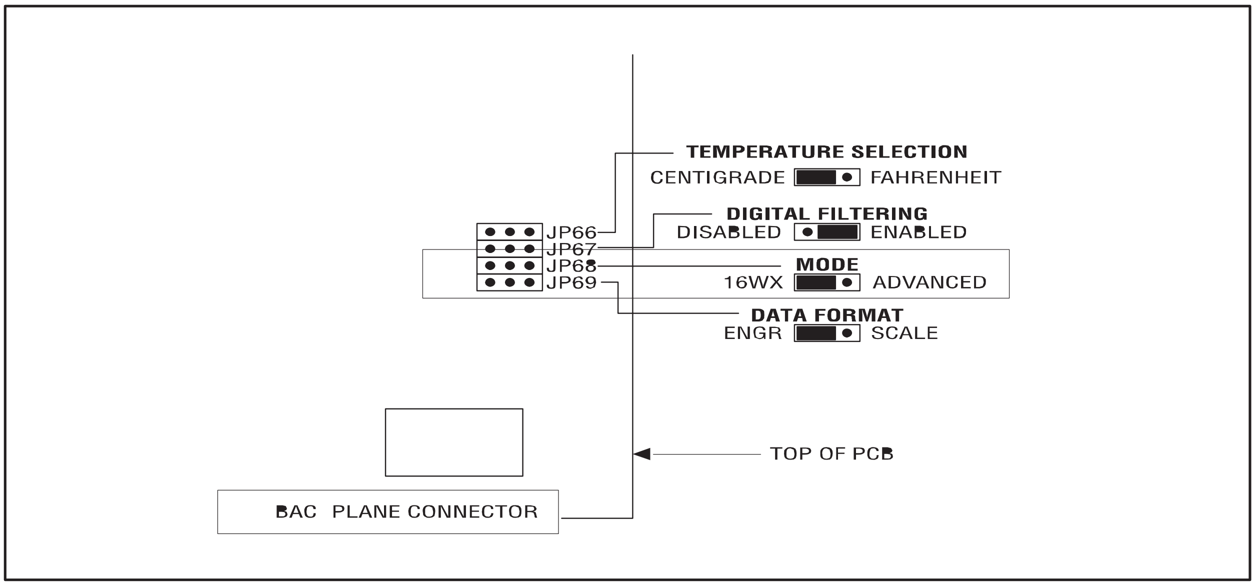

Figure 3-1 Configuring the SIMATIC 505–2556 Module for Advanced Features

Logging the Module in the Controller I/O Configuration Memory

First turn on the base power supply. 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, blinks (or goes out during operation), the module has detected a failure. For information on viewing failed module status, refer to your *SIMATIC 505 TISOFT2 User Manual* (PPX:TS505–8101–x). To diagnose and correct a module failure, refer to the section on troubleshooting.

You must also check that the module is configured in the controller memory. This is important because the module will appear to be functioning regardless of whether it is communicating with the controller. To view the controller memory configuration chart listing all slots on the base and the inputs or outputs associated with each slot, refer to your *SIMATIC 505 TISOFT2 User Manual*. An example chart is shown in Figure 3-2. When the module is properly logged in to the controller as a high-density discrete and analog module the configuration is 16X, 16Y, 32WX, and 32WY registers.

505 I/O MODULE DEFINITION FOR CHANNEL . . . 1 BASE 00

SLOT	I/O ADDRESS	NUMBER OF BIT AND WORD I/O X	Y	WX	WY	SPECIAL FUNCTION
01	0001	**16**	**16**	**32**	**32**	NO
02	0000	00	00	00	00	NO
.						
.						
.						
15	0000	00	00	00	00	NO
16	0000	00	00	00	00	NO

Figure 3-2 SIMATIC 505–2556 I/O Configuration Chart

In this example, the module is inserted in slot 1 in I/O base 0. The first X point is assigned the first I/O address. In this example, the I/O assignments are: X1 . . X16, Y17 . . Y32, WX33 . . WX64, WY65 . . WY96. For your particular module, look in the chart for the number corresponding to the slot occupied by the module. If word memory and discrete locations appear on this line, then the module is registered in the controller 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 controller memory configuration chart again. If the line is still incorrect, contact your local distributor or Siemens Energy & Automation, Inc., Technical Services Group.

3.2 Internal Register Structures

Description of the I/O Registers

The SIMATIC 505–2556 module in the high-density mode logs in to the controller as 32 WX input registers, 32 WY output registers and 16 X and 16 Y discrete inputs and outputs. This high-density configuration provides support for reading the raw data and the processed data, and for writing the configuration data to the module. Refer to section 3.7 for a one-page summary of I/O assignments.

Starting login addresses and the locations of their corresponding registers are shown in Table 3-1.

Table 3-1 Input and Output Register Offsets

Starting Controller Address	1	105
X registers begin	1	105
Y registers offset 16	17	121
WX registers offset 32	33	137
WY registers offset 64	65	169

Input Registers

The word input content of the module consists of 32 WX input registers. These registers present the raw measured data and the processed data to the controller.

WX33 – WX48 contain the converted data in engineering units for the sixteen input channels, as shown in Table 3-2.

Table 3-2 Input Channel Data

WX33	Channel 1	Conversion data
.	.	.
.	.	.
WX48	Channel 16	Conversion data

Input registers WX49 – WX54 consist of special flag bits that may be interrogated in the controller ladder program to detect alarm conditions, overrange or underrange conditions, or arithmetic overflow conditions due to scaling operations. See Figure 3-3.

WX49	Channel 1–16	Alarm flag bits
WX50	Channel 1–16	High alarm flag bits
WX51	Channel 1–16	Low alarm flag bits
WX52	Channel 1–16	Overrange flag bits
WX53	Channel 1–16	Underrange flag bits
WX54	Channel 1–16	Arithmetic overflow flag bits
WX55	Channel 1–16	Open Thermocouple flag bits
WX56	Channel 1–16	Front panel temperature
.WX64	Reserved for future use	

For each word, the bits are correlated to the channels according to the following:

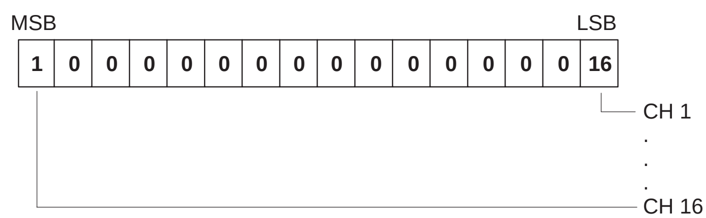

Figure 3-3 Input Flag Bits

If the peak or valley hold functions are enabled and Y31=1, then the data returned in WX49 – WX64 is the peak (Y30=1) or valley (Y30=0) value measured. See Table 3-3.

Table 3-3 Peak/Valley Hold Input Words

WX 49	Channel 1	Peak/Valley value
.	.	.
.	.	.
WX 64	Channel 16	Peak/Valley value

Output Registers

The SIMATIC 505–2556 module also utilizes 32 WY registers. These registers are used to transfer the scaling values, the alarm setpoints, the filtering time constants, and the averaging count values to each of the sixteen channels.

After the data is loaded into the module, these registers then enable each of the functions on a channel-by-channel basis. These WY registers become control words for enabling each channel for special operations (Table 3-4).

Table 3-4 Output Data Registers

Alarms	WY65 . . WY80 WY81 . . WY96	Channel 1 Channel 16 Channel 1 Channel 16	Low alarm setpoint Low alarm setpoint High alarm setpoint High alarm setpoint
Scaling	WY65 . . WY80 WY81 . . WY96	Channel 1 Channel 16 Channel 1 Channel 16	Scaling low setpoint Scaling low setpoint Scaling high setpoint Scaling high setpoint
Digital Filtering	WY65 . . WY80	Channel 1 Channel 16	Settling time Settling time
Averaging	WY81 . . WY96	Channel 1 Channel 16	Average sample counts Average sample counts

Internal Register Structures (continued)

After the values are loaded to the module, WY registers are used like those shown in Table 3-5.

Table 3-5 Function Enable Bits

WY65	Channel 1–16	Low alarm enable bits
WY66	Channel 1–16	High alarm enable bits
WY67	Channel 1–16	Scaling enable bits
WY68	Channel 1–16	Digital filtering enable bits
WY69	Channel 1–16	Averaging enable bits
WY70	Channel 1–16	Peak hold enable bits
WY71	Channel 1–16	Valley hold enable bits
WY72	Channel 1–16	Fahrenheit/Centigrade select bits
WY73	Channel 1–16	Peak hold reset bits
WY74	Channel 1–16	Valley hold reset bits
WY75	Channel 1–16	Averaging reset with new value bits
WY76–96		(Not used)

Control Registers

The control registers (X and Y discrete I/O points) are the handshake bits and steering logic used to load the data into the SIMATIC 505–2556 module and to request special operations from the module. These registers consist of the discrete inputs and outputs of the module.

Inputs

The SIMATIC 505–2556 input module uses a total of 5 discrete inputs in advanced mode. Four of the inputs are used as handshake bits from the module to the PLC to indicate that alarm levels, scaling data, filter and averaging values and function enable bits have been transferred successfully to the module. (See Figure 3-4).

The remaining input bit, X16, is used by the module to inform the controller that the module is ready to accept data.

Before any transfers are made to the module, the relay ladder program should examine the state of this input. (Only when the input is true), can the loading operation begin.

Input#		
X	1	**Alarm_Acknowledge**
0		no alarm levels loaded
1		alarm levels loaded
X	2	**Scaling_Acknowledge**
0		no scaling values loaded
1		scaling values loaded
X	3	**Filter/Sample_Acknowledge**
0		no filter or sample values loaded
1		filter/sample values loaded
X	4	**Function Bits_Acknowledge**
0		no functions enabled
1		functions enabled
X	16	**Module_Ready Flag**
0		busy
1		ready for transfer

Figure 3-4 Discrete Handshake Inputs

Outputs

The discrete output points consist of Y17 – Y32.

Y17 – Y19 are used to identify the data being transferred. As data is loaded to the module, the state of these bits identifies the type of data being transferred (see Table 3-6). The SIMATIC 505–2556 module decodes these bits and processes the data accordingly.

Table 3-6 Data Identification Bits

Y19	Y18	Y17	Data Transfer Type
0	0	0	No operation
0	0	1	Function enable bits
0	1	0	Low/High alarm setpoint values
0	1	1	Scaling low/high values
1	0	0	Filtering time constant/Number of averages

In addition, Y27 – Y32 are used to reset averaging, reset valley hold values, reset peak hold values, read peak or valley values, read flags, and to write data to the module. See Figure 3-5.

Y27	Averaging reset
1	Resets averaging on all channels to new values loaded
Y28	Valley hold reset
1	Reset valley hold
Y29	Peak hold reset
1	Reset peak hold
Y30	Read peak hold/valley hold
0	Read valley hold values
1	Read peak hold values
Y31	Read peak hold/valley hold or Read flags
0	Read flags
1	Read peak hold/valley hold values

NOTE: In operation, the state of Y31 determines whether WX49 — WX64 return peak/valley data or the flag bits defined in Figure 3-3. If Y31 is on, then the type of data (valley hold or peak hold) is selected with Y30.

Y32	**Data_Ready**, controller to module data ready flag
0	no data
1	data ready to transfer

Figure 3-5 Data Transfer Control Bits

Loading Data into the SIMATIC 505–2556 Module

The process by which data is loaded into the SIMATIC 505–2556 module is shown in Figure 3-6.

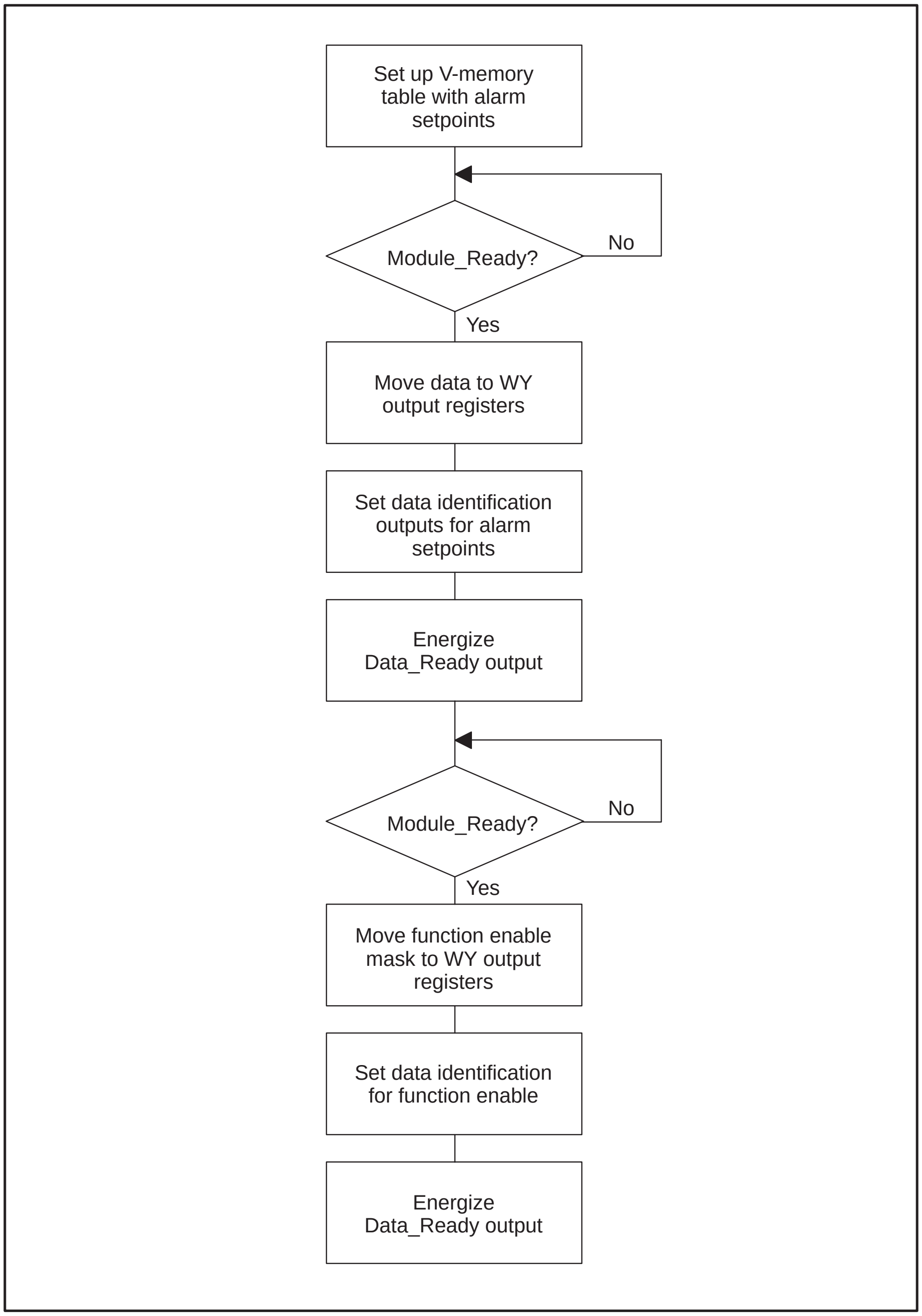

Figure 3-6 Data Loading Process

The following steps explain how data is loaded into the SIMATIC 505–2556 module.

1. V- or K-memory tables are constructed with the scaling, alarm setpoints, filtering and averaging units. In the example below, low alarm and high alarm setpoints are loaded for each channel from V1 through V32. V1 – V16 contain the low alarm setpoints for channels 1–16, and V17 – V32 contain the high alarm setpoints for channels 1–16. See Figure 3-7.

V1	100	V17	20,100
V2	200	V18	20,200
V3	300	V19	20,300
V4	400	V20	20,400
V5	500	V21	20,500
V6	600	V22	20,600
V7	700	V23	20,700
V8	800	V24	20,800
V9	900	V25	20,900
V10	1000	V26	21,000
V11	1100	V27	22,000
V12	1200	V28	23,000
V13	1300	V29	24,000
V14	1400	V30	25,000
V15	1500	V31	26,000
V16	1600	V32	27,000

Figure 3-7 Sample Low and High Alarm Setpoints

2. By monitoring the state of the Module_Ready flag, data is moved to the WY output registers. See Figure 3-8.

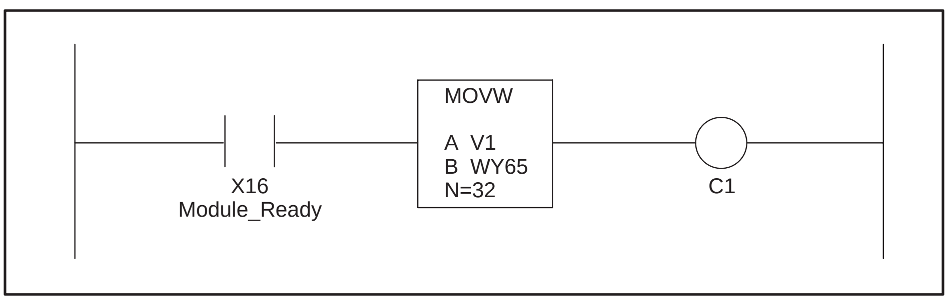

Figure 3-8 The Module_Ready Bit

3. The data identification outputs Y19 – Y17 are set according to the data being transferred. These are decoded by the module in order to distinguish the type of data being loaded (see Figure 3-9).

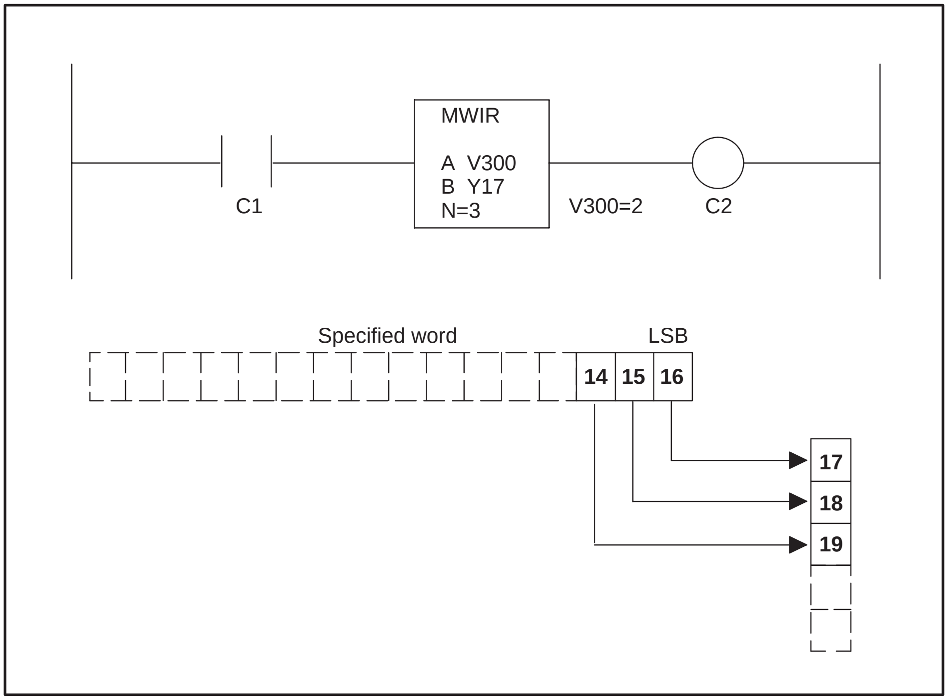

Figure 3-9 Identifying the Data Being Transferred

4. Y32 Data_Ready is energized to transfer the word data into the module (see Figure 3-10).

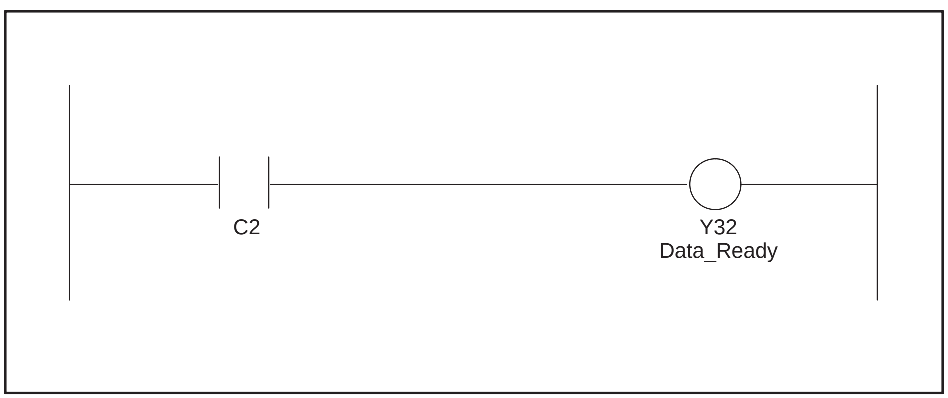

Figure 3-10 The Data_Ready Bit

5. The functions are enabled with the enable bits. WY65 and WY66 are set to all 1's with a MOVW instruction (see Figure 3-11).

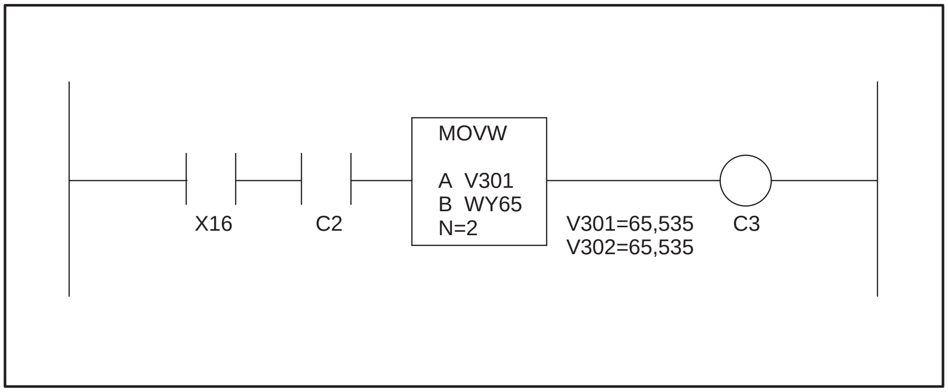

Figure 3-11 Enabling the Functions Loaded

6. With the Data_Ready bit, data is transferred with Y32 (see Figure 3-12).

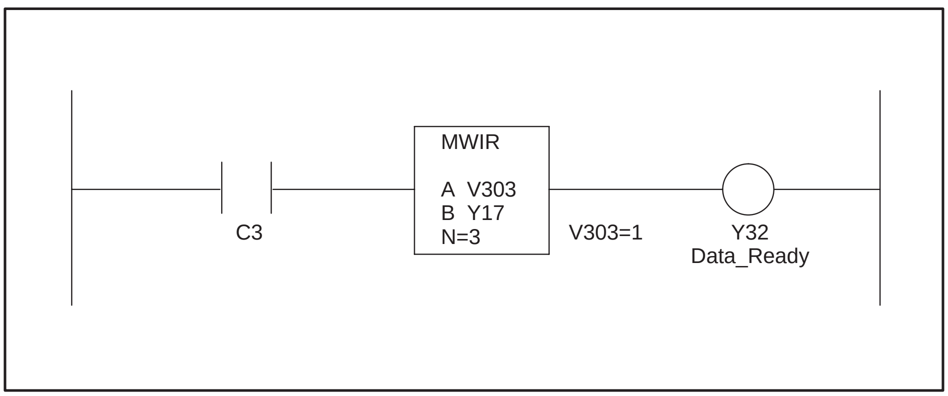

Figure 3-12 Loading the Enable Bits

3.3 Loading Programs into the I/O Module

Before entering relay ladder logic in the controller, utilize the worksheets in sections 3.8 and 3.9 to ensure a successful installation and start-up.

The following sample ladder program is provided to demonstrate how the data is loaded into the SIMATIC 505–2556 module. Each channel is enabled for all functions supported.

This sample RLL loads the module with alarm, scaling, filtering, averaging, and function enable bits. V200 manipulation is left to the programmer.
See

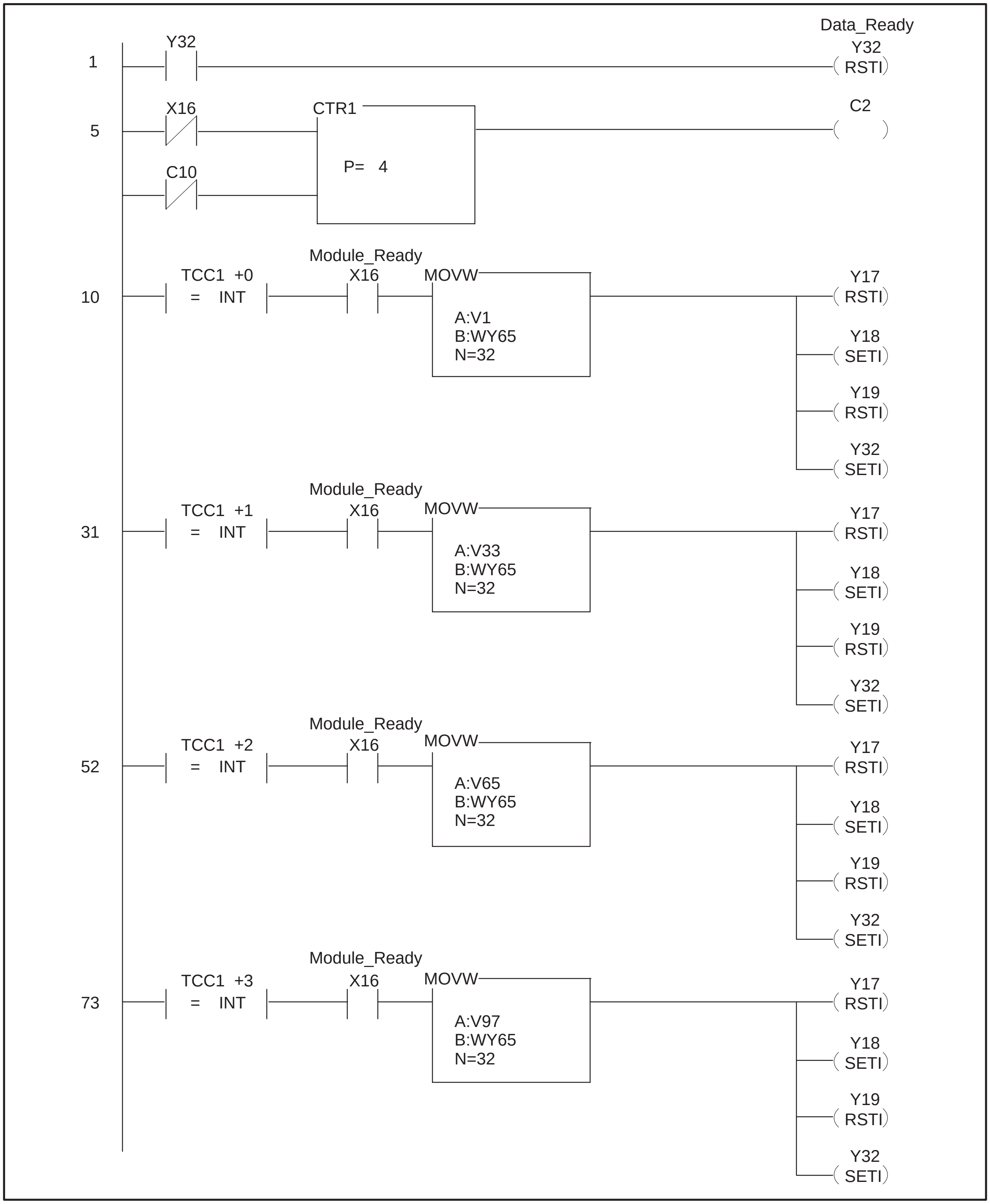

Figure 3-13 Startup Relay Ladder Logic

The configuration example ladder program sequences through the transfer of all configuration data to the module.

The first rung in the example resets Y32 if Y32 was turned ON on the previous scan. This should be done at the beginning of the ladder scan.

The second rung is a counter that controls loading of the WY registers with configuration data.

When the counter is reset, the current count is equal to zero. If X16 is ON, the WY registers are loaded with Low and High Alarm data from V1 through V32. Y12, Y18, and Y19 are set to the appropriate bit pattern to identify Low/High Alarms Values and Y32 is set ON.

After the WY registers have been read by the module, X16 is turned OFF which bumps the counter current value to 1. When the module has finished processing the Low/High Alarm data, X16 is turned ON and the next MOVW instruction is executed. This rung moves Low/High Scaling values from V33 through V64.

After this data is processed by the module, the next MOVW instruction is executed which loads the WY registers with Filtering Time Constants and Average Sample Counts from V65 through V96.

After this data is processed by the module, the last MOVW instruction is executed which loads the Function Enable Bits into the WY registers from V Memory beginning at V97.

When this transfer is complete, the counter current value is now equal to 4 which is the preset value and the configuration sequence is complete. Another configuration sequence can be initiated by toggling the counter reset bit to reset the counter.

3.4 Timing Considerations

Without any of the advanced features enabled, the SIMATIC 505–2556 module will update all 16 points in less than 6 msec. With all functions enabled for all 16 points, the module will update all 16 channels in less than 56 msec. Each function has a specific overhead associated with it and your application should consider the time delays to ensure that there is adequate time allowed for the processing of data.

Timing Constraints When Using Advanced Functions

Table 3-7 shows a chart of the overhead required for all 16 channels when each of the advanced functions is enabled. Operations such as scaling and offset mode require the greatest amount of time due to the multiplication and division in the microcomputer.

Table 3-7 Timing Overhead for Functions Enabled

Functions Enabled in Enhanced Mode (32 WX and 32 WY, 16 X and 16 Y)	Time for All 16 Channels
None	6.5 msec
Low alarm	7.73 msec
High alarm	7.73 msec
Scaling	27.1 msec
Offset mode	27.1 msec
Filtering	8.97 msec
Averaging	7.85 msec
Averaging reset (16 channels)	41.8 msec
Peak hold	7.65 msec
Valley hold	7.65 msec
16 WX MODE	
No digital filtering	5.80 msec
Filtering enabled	8.20 msec

3.5 Additional Information about Each Function

Default Values

There are default values for every function that is supported. If no data is transferred to the module and the enable bits for a function are set and written to the module, then the default values will be used. See Table 3-8.

NOTE: No matter what functions are enabled, the actual hardware data from the I/O channel is always present in WX33 – WX48.

Table 3-8 Default Function Values

Functions Enabled	Low Default Value	High Default Value
Alarm setpoints	1000	31,000
Scaling engineering units	0	32,000
Offset mode 4–20 mA	6400	32,000
Filtering time constants	250 msec	
Averaging	20 averages	
Peak hold	0	0
Valley hold	0	0

Table 3-9 Default Function Values for SIMATIC 505–2556

Functions Enabled	Low Default Value	High Default Value
Alarm setpoints	50	200
Scaling engineering units	0	100
Filtering time constants	250 msec	
Averaging	20 averages	
Peak hold	0	0
Valley hold	0	0

Degrees Centigrade or Degrees Fahrenheit

In advanced mode the selection of degrees C or F is controlled by the information stored and transferred to the module at WY72. The default parameters are all zeroes which will cause the 505–2556 module to return the value in degrees Centigrade x10. To select degrees F for the module write a value of FFFF Hex to WY72 and use the documented transfer procedure setting the data identification bits Y17, Y18 and Y19 to 1, 0, 0, (See section 3.7).

To verify the Fahrenheit/Centigrade settings, the module reports back its F/C status in WX57. The least significant bit (LSB) of WX57, corresponds to channel one, while the most significant bit (MSB) corresponds to channel 16. A status bit of “1” indicates the channel is reporting in degrees F.
A status bit of “0” indicates the channel is reporting in degrees C.

Scaling

Numerical Range All numbers used for scaling are expressed as signed integers.

The numerical range for scaling is ± 32767. If a value of –32768 is loaded into the module, then the value will be adjusted in the module to –32767.

Arithmetic Overflow Scaling operations may result in arithmetic overflow. Errors of this kind for each channel may be detected with the WX54 arithmetic overflow bits.

Overflow conditions can occur during normalization of the input value. If the input word reaches + 32767 or –32767 before the ADC (analog-to-digital converter) saturates, then an overrange condition occurs and the overrange bit for that channel is set.

In a scaling operation, if the result of scaling forces the value to the PLC to exceed 32767, the overrange bit for that channel is set.

During an overflow condition, the value to the controller defaults to ± 32767 and there is no rollover of data. That is, the data does not return to zero and beyond.

Alarm Setpoints

Numerical Range All numbers used for alarm setpoints are expressed as signed integers. The numerical range for scaling is ±32767. If a value of –32768 is loaded into the module, then the value in the module is adjusted to –32767.

Digital Filtering

Digital filtering time is the settling time to within 1 LSB of the analog-to-digital converter on the module. (Often digital filtering is specified as a time constant in milliseconds. With a time constant specification, it will take the input 4 to 5 time constants to reach 99% of the final value.) The value entered is the actual settling time.

NOTE: In the SIMATIC 505–2556 module, the value used in digital filtering is not a time constant but is the settling time for the system to reach the full resolution of the analog-to-digital converter (ADC).

When filtering is enabled, the actual resolution of the module is a full 16 bits. The filtering function performs a dithering operation for the least significant bits.

Default Filter Settling Time If the digital filtering bits are enabled via the WY register and the Y32 output and no settling time values are written to the module, then the default digital filter settling time of 250 msec is automatically used.

Filtering and Alarms If filtering is enabled, then the filtered data will be used for alarm comparisons; that is, the data will first pass through the digital filter and its associated settling time and then be compared to any low or high alarm setpoint. This prevents alarm conditions that are attributable to noise.

Changing the Settling Time When new filter data is written to the module, the microcomputer must recompute the filter time constants. This operation takes 25 msec and no new data is written to the controller during this time.

Numerical Range Values loaded into the module for digital filtering are expressed as 16-bit unsigned integers 0 to 65535 in units of milliseconds.

NOTE: Signed integers will be interpreted as unsigned values.

Averaging

Exclusivity If averaging and filtering are both enabled, alarming is exclusive of averaging. This means that after the data is filtered it is compared against alarm setpoints and then averaged.

Numerical Range Values loaded into the module for averaging are expressed as 16-bit unsigned integers 1 to 65535 in units of number of samples. Signed integers will be interpreted as unsigned values.

NOTE: A value of zero is ignored and the default value of 20 is used if zero is loaded and enabled.

Averaging Reset Y27 is used to reset all 16 channels to begin the averaging process again. The previously loaded averaging sample number is used (or the default value of 20 if no data is loaded) and the averaging function is enabled.

Averaging Reset with New Value In the event a very large number for averaging is inadvertently loaded into the module and enabled, the input channel will appear to not be working correctly. The input channel requires a reset with a smaller number of samples. To initate a reset with a new averaging value, the number of samples is loaded as previously described and then each channel may be individually reset and enabled for the new value with WY75.

Peak and Valley Hold

Peak or valley hold data is returned in locations WX49 – WX64, provided that Y30 and Y31 are set accordingly. See Figure 3-14.

Data Read	Y30	Y31
Peak	1	1
Valley	0	1
Flags	X	0

Figure 3-14 Peak/Valley Truth Table

NOTE: Upon power up and the enabling of peak and valley hold, peak values returned will be the actual value at input. Valley values must go below zero, which is the default value before data is returned. This is not the case if a reset is issued to the valley function. On reset the valley threshold is the current value.

Peak and Valley Hold Reset

Outputs Y28 and Y29 are used to reset the valley or peak hold functions. The operation during reset is dependent on whether the hold function is enabled for each individual channel.

Figure 3-15 shows how the peak value and the valley value react during reset.

Peak or Valley Hold Function	
Enabled	Reset to current input value
Disabled	Reset to zero

Figure 3-15 Peak/Valley Reset Truth Table

Flag Bits

When not using peak or valley hold, WX49 – WX54 return flag bits for each of the functions, and each of the channels may be interrogated with ladder logic instructions.

The flag bits correspond to the 16 channels in the module. The LSB or bit 16 corresponds to channel 1, and the MSB or bit 1 corresponds to channel 16. See Figure 3-16.

	MSB															LSB
Bit #	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Channel #	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

Figure 3-16 Mapping Bit Position to Channel Number

Alarm flags (WX49) The alarm flag bit is the logical OR of the low alarm bit (WX5) and the high alarm bit (WX50) for each channel. This allows one simple check to determine if an alarm exists on a channel. These alarm bits reset automatically when the alarm condition is no longer true. In the event that an alarm exists on a channel, the ladder logic may determine whether the alarm has reached the low alarm or the high alarm.

Overrange/Underrange flags The overrange (WX52) and underrange (WX53) flag bits are set any time the analog-to-digital converter (ADC) saturates and cannot produce any higher value for positive inputs or lower value for negative inputs.

NOTE: A zero input value is a reasonable input level of signal. It is not uncommon for the input to go below zero and the sign bit to change. The ADC will function below a value of zero until saturation.

Advanced Function Precedence

When using more than one of the advanced functions, it is necessary to understand the order in which these functions are performed in the SIMATIC 505–2556 hardware. The order of precedence for these functions is as follows:

1. Scaling for low and high engineering units
2. Filtering
3. Alarm processing
4. Peak and Valley hold measurements
5. Averaging

3.6 Troubleshooting

Troubleshooting the System

Use the following procedures and Table 3-10 to troubleshoot your system.

- First examine your V- or K-memory tables to ensure that the data to be loaded into the module makes sense.
- Utilize the worksheets located at the end of this chapter to calculate key address locations.
- Examine the relay ladder program to verify that the V-memory tables are being loaded into the correct WY65 – WY96 output registers.
- Examine the starting address of the module and ensure that the offsets for the X16 input Module_Ready = (starting address + 15) and that the Y outputs = (starting address + 16), that the WX registers = (starting address + 32) and the WY registers = (starting address + 64).
- Examine the relay ladder program to verify that the addresses used match the offsets as described above and those from the worksheets.
- Verify that the data identification outputs Y19 – Y17 properly reference the data that is being loaded.
- Use the TISOFT status and chart functions to debug the program and to verify that the X16 Module_Ready input does indeed turn on. If this input does not turn on, there is a problem with the module. Contact the Siemens Energy & Automation, Inc., Technical Services Group.
- Verify that the Y32 Data_Ready output does indeed turn on to load the data into the SIMATIC 505–2556 module.
- Place a known input value on the module channel and verify that the channel is producing the correct results.

Table 3-10 Troubleshooting Flow Diagram

Symptom	Probable Cause	Corrective Action
Wrong values	Not logged in	Login to controller
No functions working	Not logged in correctly	Verify log-in
	Ladder program did not execute	Debug ladder program. Verify V-memory tables.
	Offsets incorrect	Calculate offsets starting address
	Functions never enabled	Edit ladder program to enable function after loading data

3.7 I/O Register Quick Reference

X1 thru X15	reserved
X16	Module Ready (2556/2557 to PLC)

X17	0	1	0	1	0
X18	0	0	1	1	0
X19	0	0	0	0	1
	no operation	function enable	low/high alarm values	low/high scaling values	filtering time constants/number of averages

Y20 thru Y26	not used
Y27	Averaging reset (all channels)
Y28	Valley hold reset (all channels)
Y29	Peak hold reset (all channels)
Y30	0 – read valley hold values, 1 – read peak hold values
Y31	0 – read flags, 1 – read peak/valley hold values
Y32	Data ready (PLC to 2556/2557)

Y32 thru WX48	Channel 1 conversion data (in engineering units) thru Channel 16
WX49	Alarm flag bits
WX50	High alarm flags
WX51	Low alarm flags
WX52	Overrange flags
WX53	Underrange flags
WX54	Overflow flags
WX55	Open thermocouple/RTD flag
WX56 thru WX64	reserved

WX49–WX54 <--OR--> (ref Y31) WX49 Channel 1 peak/valley hold thru WX64 Channel 16

WY65 thru WY80	Channel 1 low alarm setpoint (in engineering units) thru Channel 16	if Y17–0 Y18–1 Y19–0
WY81 thru WY96	Channel 1 high alarm setpoint (in engineering units) thru Channel 16	

WY65 thru WY80	Channel 1 scaling low setpoint (in engineering units) thru Channel 16	if Y17–1 Y18–1 Y19–0
WY81 thru WY96	Channel 1 scaling high setpoint (in engineering units) thru Channel 16	

WY65 thru WY80	Channel 1 filtering time constant (in milliseconds) thru Channel 16	if Y17–0 Y18–0 Y19–1
WY81 thru WY96	Channel 1 averaging (number of samples) thru Channel 16	

WY65	Low alarm enable	(LSB – Ch 1, MSB – Ch 16)	if Y17–1 Y18–0 Y19–0
WY66	High alarm enable	‘	
WY67	Scaling enable	‘	
WY68	Digital filtering enable	‘	
WY69	Averaging enable	‘	
WY70	Peak hold enable	‘	
WY71	Valley hold enable	‘	
WY72	Degrees F or C select 1 –°F	‘	
WY73	Peak hold reset	‘	
WY74	Valley hold reset	‘	
WY75	Averaging reset with new sample counts	‘	
WY76 thru WY96	reserved		

Figure 3-17 I/O Register Quick Reference

3.8 V or K Memory Configuration Tables

Alarm Setpoints

Table address ____________________

Channel #		Setpoint
1	Low	
	High	
2	Low	
	High	
3	Low	
	High	
4	Low	
	High	
5	Low	
	High	
6	Low	
	High	
7	Low	
	High	
8	Low	
	High	
9	Low	
	High	
10	Low	
	High	
11	Low	
	High	
12	Low	
	High	
13	Low	
	High	
14	Low	
	High	
15	Low	
	High	
16	Low	
	High	

Scaling Units

Table address ____________________

Channel #		Units
1	Low	
	High	
2	Low	
	High	
3	Low	
	High	
4	Low	
	High	
5	Low	
	High	
6	Low	
	High	
7	Low	
	High	
8	Low	
	High	
9	Low	
	High	
10	Low	
	High	
11	Low	
	High	
12	Low	
	High	
13	Low	
	High	
14	Low	
	High	
15	Low	
	High	
16	Low	
	High	

Number of Averages

Table address ______________

Channel #		Number of Averages
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		

Filtering Settling Time

Table address ______________

Channel #		Settling Time (milliseconds)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		

Function Enable Bits

Start of Enable block WY ______________

	Value
Low alarm	
High alarm	
Scaling	
Digital Filtering	
Averaging	
Peak Hold	
Valley Hold	
Fahrenheit/Centigrade	

3.9 Addressing Worksheet

PLC start login address (Start)	X	____________
Module_Ready (Start +15)	X	____________
Data Identification Bits (Y 17- Y 19)(Start +16)	Y	____________
Data_Ready (Start +31)	Y	____________
Averaging Reset (Start +26)	Y	____________
Peak Hold Reset (Start + 27)	Y	____________
Valley Hold Reset (Start +28)	Y	____________
Start of WX registers (Start +32)	WX	____________
Start of WY registers (Start +64)	WY	____________
Peak/Valley Select Bit (Start +29)	Y	____________
Flag Bits or Peak/Valley Select (Start +30)	Y	____________

3.10 Items Unique to the SIMATIC 505–2556 Module

Items unique to the SIMATIC 505–2556 Thermocouple Input Module.

Open Thermocouple Status Bits: WX55

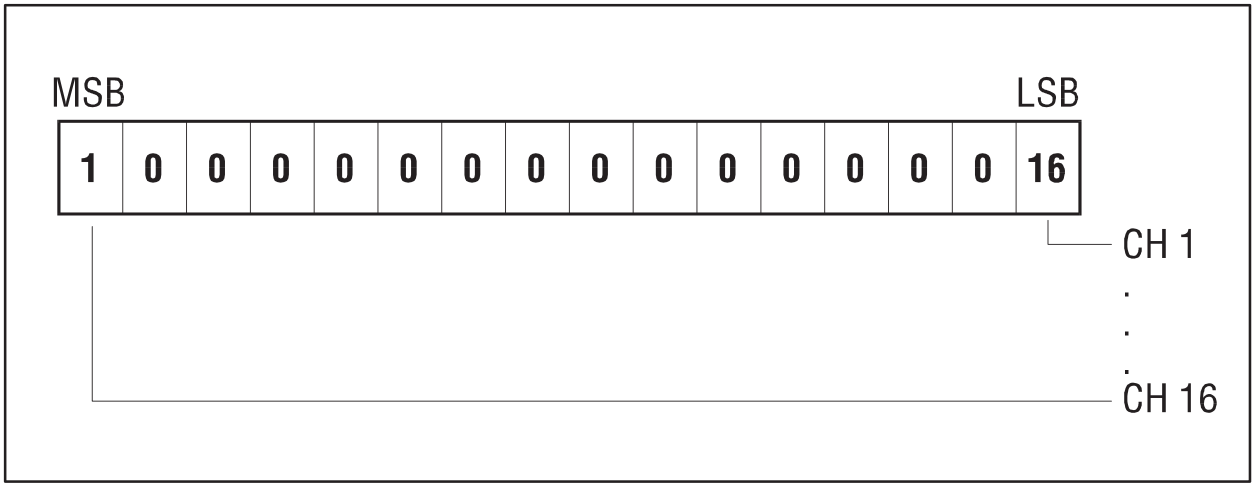

Figure 3-18 Open Thermocouple Bits

The bits returned in WX 55 indicate if there is an open thermocouple.

Front Panel Temperature: WX56
The measured temperature value of the front connector is reported in WX 56. The value is returned in tenths of degrees C.

Example
The front panel temperature is 25°C. The value returned in WX 56 is 250. (Temperature X10).

Appendix A
Troubleshooting

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

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 below, you are unable to diagnose or solve the problem, contact the Siemens Energy & Automation, Inc., Technical Services Group.

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
Indicator is not lit	Base or PLC power is off	Turn base or PLC on
	Wrong connections	Trace wiring to check connections
	Blown fuse	Measure F1 for continuity Short all inputs and verify ambient temperature measurement
Indicator is blinking	No calibration data	Return to CTI for calibration
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. DO NOT 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 0-32000	Select SCALE format with JP69
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	Compensation jumpers in wrong position or DIP switch not set	Verify position of cold junction compensation jumpers for each channel and corresponding DIP switch for microcomputer

Figure A-1 Troubleshooting Matrix

Appendix B
Specifications

Table B-1 Physical and Environmental Specifications

Input Channels	16 isolated thermocouple or millivolt inputs
Thermocouple Types	J, K, R, S, T, E, and L (DIN J) (C and N by Special Product Quotation)
Millivolt Input Range	–55 to +55 mV
Millivolt Input Impedance	>10KΩ @ 50/60 Hz >100MΩ @ DC
Absolute Millivolt Accuracy	±0.5% full scale or ±500 µV
Input Overrange Protection	30 VDC or VAC continous
Measurement Ranges	J –210°C to +760°C (–350°F to + 1400°F) K –270°C to +1372°C (–450°F to + 2500°F) R,S 0°C to +1768°C (0°F to + 3214°F) T –270°C to +400°C (–450°F to + 752°F) E –270°C to +1000°C (–450°F to + 1832°F) L –210°C to +900°C (–350°F to + 1652°F)
ADC Resolution	16 bits
Data Presentation	Measurement returned in 0.2 degree resolution as temperature X10 or as a scaled integer (0–32000). (16WX mode.) Data word includes sign bit and overrange/underrange bit. Millivolts returned as millivolts X100. (16WX mode.) 0.1 degree in Advanced Mode.
Measurement Units	Selectable for the entire module in 16WX mode Degrees C or F Scaled signed integer (0–32000) Selectable by channel in Advanced Mode
Digital Filtering Time Constant	80mSec (16WX mode), 80–32000 mSec (Advanced Mode)
Update Time (all 16 channels)	18 mSec no filtering 20 mSec digital filtering enabled 48 mSec advanced functions enabled
Repeatability	±0.2°C or °F all thermocouple types (16WX mode) ±0.1°C or °F all thermocouple types (advanced mode) ±50 µV (millivolt inputs)

Table B–1 Physical and Environmental Specifications (continued)

Accuracy Types J, K, E, T, L Types R,S Millivolt	At a fixed ambient temperature between 0°C to 60°C and a reported temperature above 0°C for types J, K, T, L, E or above 500°C for types R and S ±0.5°C at 25° ±1°C from 0°C to 60°C 0°C to full scale ±1°F at 25°C ±2°F from 0°C to 60°C 32°F to full scale Reduced accuracy for measurements below 0°C to 32°F ±1°C at 25°C for measurement range 500-1768°C ±2°C from 0°C to 60°C ±2°F at 25°C ±4°F from 0°C to 60°C Reduced accuracy for measurements below 500°C ±50 µV from 0°C to 60°C
Common Rejection Mode	>130 db @ 50/60 Hz
Normal Rejection Mode	>180 db @ 60 Hz >80 db @ 50 Hz
Connector	48 position fixed, wire press in
Wire Gauge	18 to 30 AWG
Module Size	Single Wide
Backplane Power Consumption	5 Watts
Isolation	1500 VDC channel-to-channel 1500 VDC channel-to-backplane
Operaing Temperature	0°C to 60°C (32°F to 140°F)
Storage Temperature	–40°C to 85°C (–40°F to 185°F)
Humidity, Relative	5% to 95% (non-condensing)
Agency Approvals	UL, UL for Canada FM (Class I, Div 2), CE
Shipping Weight	1.5 lbs. (0.68 kg)
Specifications subject to change without notice.	

Appendix C
Jumper Settings Log Sheet

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

CHANNEL NUMBER	HARDWARE SELECTION	DIP SWITCH SELECTION
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		

ALL CHANNELS 1-16	FAHRENHEIT / CENTIGRADE SELECT JP66	DIGITAL FILTERING JP67	LOGIN MODE JP68	DATA FORMAT JP69
	Left - Degrees C Right - Degrees F	Left - Disabled Right - Enabled	Left - Standard 16WX Right - Advanced	Left - Engr (Temp X10) Right - Scale (0 to 32,000)

Figure C-1 Factory Configuration Jumper Settings

NOTE: The SIMATIC 505–2556 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.

Appendix D
Thermocouple Wire Guide

ANSI Code	Color Code: Thermocouple Grade	Color Code: Extension Grade	Lead Material: + Lead	Lead Material: - Lead	Magnetic Lead	Maximum Useful Temperature Range	EMF (mV) Over Useful Temperature Range
J	WHITE + / - RED / BROWN	WHITE + / - RED / BLACK	IRON Fe	CONSTANTAN COPPER-NICKEL Cu-Ni	IRON (+)	32 to 1382°F 0 to 750°C Thermocouple Grade 32 to 392°F 0 to 200°C Extension Grade	0 to 42.283
K	YELLOW + / - RED / BROWN	YELLOW + / - RED / YELLOW	CHROMEL NICKEL-CHROMIUM Ni-Cr	ALUMEL NICKEL-ALUMEL Ni-Al	ALUMEL (-)	-328 to 2282°F -200 to 1250°C Thermocouple Grade 32 to 392°F 0 to 200°C Extension Grade	-5.973 TO 50.633
T	BLUE + / - RED / BROWN	BLUE + / - RED / BLUE	COPPER Cu	CONSTANTAN COPPER-NICKEL Cu-Ni	NONE	-328 to 662°F -200 to 350°C Thermocouple Grade -76 to 212°F -60 to 100°C Extension Grade	-5.602 to 17.816
E	PURPLE + / - RED / BROWN	PURPLE + / - RED / PURPLE	CHROMEL NICKEL-CHROMIUM Ni-Cr	CONSTANTAN COPPER-NICKEL Cu-Ni	NONE	-328 to 1652°F -200 to 900°C Thermocouple Grade 32 to 392°F 0 to 200°C Extension Grade	-8.824 to 68.783
N	ORANGE + / - RED / BROWN	ORANGE + / - RED / ORANGE	OMEGA-P™ NICROSIL Ni-Cr-Si	OMEGA-N™ NISIL Ni-Si-Mg	NONE	-450 to 2372°F -270 to 1300°C Thermocouple Grade 32 to 392°F 0 to 200°C Extension Grade	-4.345 to 47.502
R	NONE ESTABLISHED	BLACK + / - RED / GREEN	PLATINUM-13% RHODUIM Pt-13% Rh	PLATINUM Pt	NONE	-32 to 2642°F 0 to 1450°C Thermocouple Grade 32 to 300°F 0 to 150°C Extension Grade	0 to 16.741
S	NONE ESTABLISHED	BLACK + / - RED / GREEN	PLATINUM-10% RHODIUM Pt-10% Rh	PLATINUM Pt	NONE	-32 to 2642°F 0 to 1450°C Thermocouple Grade 32 to 300°F 0 to 150°C Extension Grade	0 to 14.973
B	NONE ESTABLISHED	GREY + / - RED / GREY	PLATINUM-30% RHODIUM Pt-30% Rh	PLATINUM-6% RHODIUM Pt-6% Rh	NONE	32 to 3092°F 0 to 1700°C Thermocouple Grade 32 to 212°F 0 to 100°C Extension Grade	0 to 12.426
G	NONE ESTABLISHED	WHITE + / - RED / WHITE - BLUE TRACE	TUNGSTEN W	TUNGSTEN-26% RHENIUM W-26% Re	NONE	-32 to 4208°F 0 to 2320°C Thermocouple Grade 32 to 500°F 0 to 260°C Extension Grade	0 to 38.564
C	NONE ESTABLISHED	WHITE + / - RED / WHITE - RED TRACE	TUNGSTEN-5% RHENIUM W-5% Re	TUNGSTEN-26% RHENIUM W-26% Re	NONE	32 to 4208°F 0 to 2320°C Thermocouple Grade 32 to 1600°F 0 to 870°C Extension Grade	0 to 37.066
D	NONE ESTABLISHED	WHITE + / - RED / WHITE - YELLOW TRACE	TUNGSTEN-3% RHENIUM W-3% Re	TUNGSTEN-25% RHENIUM W-25% Re	NONE	32 to 4208°F 0 to 2320°C Thermocouple Grade 32 to 500°F 0 to 260°C Extension Grade	0 to 39.506

Figure D-1 Thermocouple Wire Guide

Customer Response

We would like to know what you think about our user manuals so that we can serve you better. How would you rate the quality of our manuals?

	Excellent	Good	Fair	Poor
Accuracy	_______	_______	_______	_______
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