2501 QUICK START GUIDE

Summary: The 2501 is designed to translate a digital word from the programmable logic controller (PLC) into an equivalent analog voltage and/or current output signal, and to translate an analog input signal into an equivalent digital word which is then sent to the PLC.

Configuring the Module

Using dip switches and jumpers, the 2501 must be configured for certain operating parameters, both on a module and per-channel basis. The configuration parameters are the density mode, outputs at power up, simulation mode, input/output scaling, digital filtering, voltage or current inputs, input voltage range, unipolar/bipolar input mode, and output voltage range. As shipped, the jumpers are set in the positions outlined in Figure 2.4 Shipping Jumper Configuration Locations.

Configuring the 2501 for operation consists of the following steps (notations in parenthesis are actual printed board titles; see Figure 2.3 Jumper and Switch Locations for actual board layout):

1. Selecting Hi (HI) or Lo (LO) Density mode for the module.
2. Selecting Last Value (LAST) or Zero (ZERO) output at power up for the module.
3. Selecting the 7012 (7012) or 7016 (7016) simulation mode for the module.
4. Selecting input/output scaling (EN) or no input/output scaling (DIS) for the module.
5. Selecting digital filtering (EN) or no filtering (DIS) for the module.
6. Selecting voltage (VOLTAGE) or current (20MA) mode for each input channel.
7. Selecting 0 to 5V (5V) or 0 to 10V (10V) input voltage range for each channel.
8. Selecting unipolar (UNI) or bipolar (BI) mode for each input channel.
9. Selecting 0 to 5V (5V) or 0 to 10V (10V) output voltage range for each channel.
10. Selecting unipolar (UNI) or bipolar (BI) mode for each output channel.
11. Configuring DIP switches to report the hardware selections to the microcomputer.
12. Logging the configuration jumper settings for future reference.

Selecting Hi or Lo Density Mode

The 2501 is shipped to log in as a 12WX and 4WY module, which simulates the Siemens® 7012 mode (see Figure 2.7). This represents one of two HI density modes the 2501 is capable of handling. The second HI mode simulates the 7016 in which there are 20WX and 4WY (see Figure 2.8). Error codes are defined in Figure 2.5. The Low density mode exists to provide yet another alternative input/output combination, namely an 8WX input module (see Figure 2.6). The analog outputs are not driven and remain at zero volts/amps out.
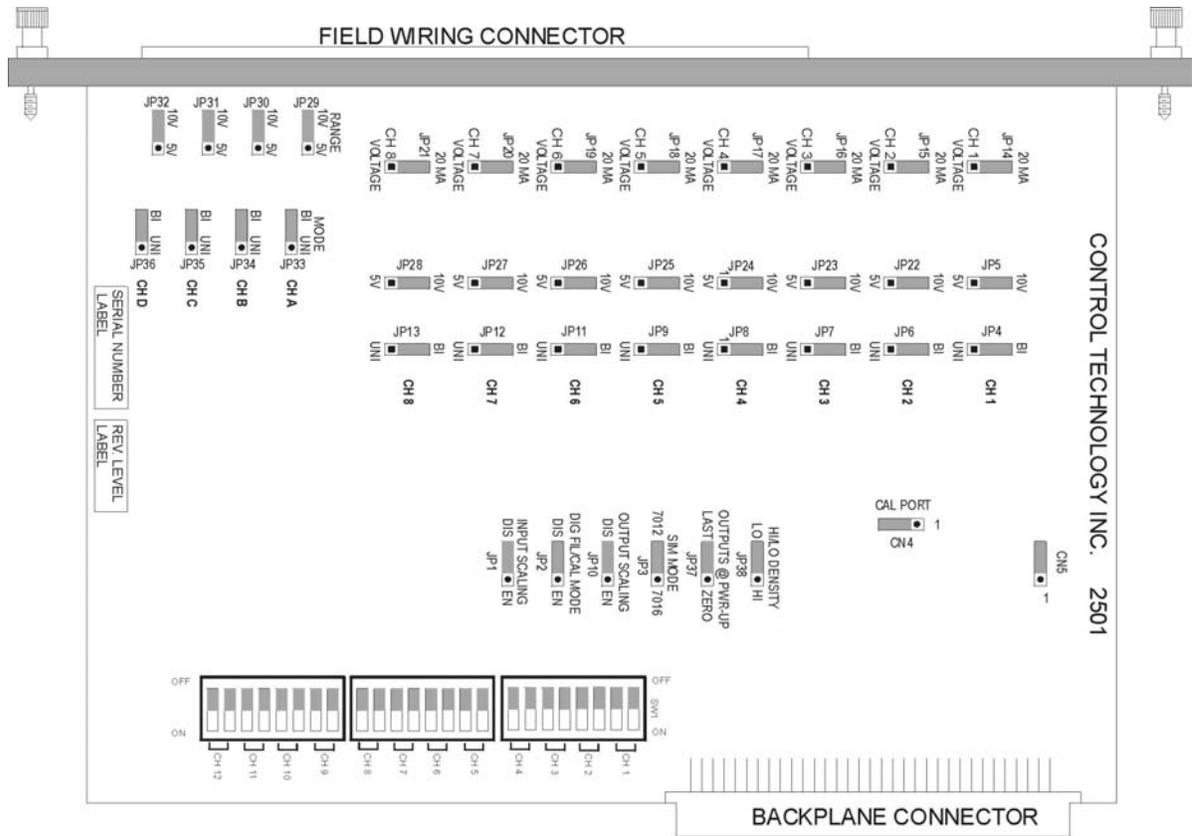
Figure 2.3 Jumper and Switch Locations

Channel Number	Voltage Current Jumper	Jumper Position *V or 20mA*	Voltage Range Jumper	Jumper Position *5V or 10V*	Unipolar/ Bipolar Jumper	Jumper Position *Uni or Bi*
1	JP14	20mA	JP5	5V	JP4	UNI
2	JP15	20mA	JP22	5V	JP6	UNI
3	JP16	20mA	JP23	5V	JP7	UNI
4	JP17	20mA	JP24	5V	JP8	UNI
5	JP18	20mA	JP25	5V	JP9	UNI
6	JP19	20mA	JP26	5V	JP11	UNI
7	JP20	20mA	JP27	5V	JP12	UNI
8	JP21	20mA	JP28	5V	JP13	UNI
A	-	-	JP29	5V	JP33	UNI
B	-	-	JP30	5V	JP34	UNI
C	-	-	JP31	5V	JP35	UNI
D	-	-	JP32	5V	JP36	UNI

All Channels 1-8 IN, A-D OUT	Hi/Lo Density *Hi or Lo*	Outputs at Power Up *Last or Zero*	SIM Mode *7012 or 7016*	Output Scaling *Dis or En*	Dig Fil/ Cal Mode *Dis or En*	Input Scaling *Dis or En*
Jumper	JP38	JP37	JP3	JP10	JP2	JP1
Jumper Position	HI	LAST	7012	DIS	EN	DIS

Figure 2.4 Shipping Jumper Configuration Locations

Error Code	Error Code Definition
32,759	Input Overrange
32,758	Input Underrange
32,757	Input Failure (Not Used on the 2501)
32,756	Input Conversion or Arithmetic Overflow
32,755	Output Overrange
32,754	Output Underrange
32,753	Output 24V Power Supply Failure

Figure 2.5 CTI/ Siemens® Error Code Definitions

Density Mode	Channel	Inputs	Item	Simulation Mode
Lo	1	WX1	Input data or error code	none
Lo	2	WX2	Input data or error code	none
Lo	3	WX3	Input data or error code	none
Lo	4	WX4	Input data or error code	none
Lo	5	WX5	Input data or error code	none
Lo	6	WX6	Input data or error code	none
Lo	7	WX7	Input data or error code	none
Lo	8	WX8	Input data or error code	none

Figure 2.6 Word Mapping for Lo Density, No Simulation

Density Mode	Channel	Inputs	Item	Simulation Mode
Hi	1	WX1	Input data or error code	7012
Hi	2	WX2	Input data or error code	7012
Hi	3	WX3	Input data or error code	7012
Hi	4	WX4	Input data or error code	7012
Hi	5	WX5	Input data or error code	7012
Hi	6	WX6	Input data or error code	7012
Hi	7	WX7	Input data or error code	7012
Hi	8	WX8	Input data or error code	7012
Hi	9	WX9	Output data echo or error code	7012
Hi	10	WX10	Output data echo or error code	7012
Hi	11	WX11	Output data echo or error code	7012
Hi	12	WX12	Output data echo or error code	7012

Figure 2.7 Word Mapping for Hi Density, 7012 Simulation

Density Mode	Channel	Inputs	Item	Simulation Mode
Hi	1	WX1	Input data	7016
Hi	2	WX2	Input data	7016
Hi	3	WX3	Input data	7016
Hi	4	WX4	Input data	7016
Hi	5	WX5	Input data	7016
Hi	6	WX6	Input data	7016
Hi	7	WX7	Input data	7016
Hi	8	WX8	Input data	7016
Hi	1	WX9	Error code	7016
Hi	2	WX10	Error code	7016
Hi	3	WX11	Error code	7016
Hi	4	WX12	Error code	7016
Hi	5	WX13	Error code	7016
Hi	6	WX14	Error code	7016
Hi	7	WX15	Error code	7016
Hi	8	WX16	Error code	7016
Hi	9	WX17	Output data echo or error code	7016
Hi	10	WX18	Output data echo or error code	7016
Hi	11	WX19	Output data echo or error code	7016
Hi	12	WX20	Output data echo or error code	7016

Figure 2.8 Word Mapping for Hi Density, 7016 Simulation

Selecting Either Zero or Last Value Output at Power Up

Upon power up of the base power, the 2501 allows the user to choose between either a zero output value or last output value when transitioning to the next update. A hardware JP37 jumper setting (see Figure 2.3) sets the entire module for the mode chosen. The normal shipping configuration is in the LAST VALUE mode.

Selecting Simulation Mode

Locate the Simulation Mode "SIM MODE" jumper JP3 (see Figure 2.3). To enable 7012 simulation mode for the module set the jumper to the "7012" position. To enable the 7016 simulation mode for the module set the jumper to the "7016" position. As shipped, the 7012 mode is enabled.

Selecting Automatic Input/Output Scaling Mode

Some applications require an Offset Input/Output Scaling Mode for 4-20mA or 1-5VDC. The PLC can adjust a loop calculation to provide an offset scaling input/output. If the application does not use the PID control block then the processing must be done in relay ladder logic. The 2501 can perform this offset calculation and input or output an offset signal independent of the PLC. Selecting this function with JP1 (input) or JP10 (output) causes all inputs and outputs to be scaled. Move the

jumper to the ENABLED position to select this function. The normal shipping configuration is DISABLED for both inputs and outputs.

Selecting Digital Filtering

Locate the Digital Filtering Jumper "DIG FIL/CAL MODE" JP2 (see Figure 2.3). To enable digital filtering, set the jumper in the "EN" position; to disable, set to the "DIS" position. Since many analog input signals contain noise, CTI recommends using digital filtering unless maximum response time is required. As shipped, digital filtering is ENABLED for all 8 analog inputs.

Selecting Voltage or Current Input Mode

Locate the 8 Voltage/Current Jumpers corresponding to input channels 1 through 8 (see Figure 2.3 for the location of these jumpers). For each input channel, select current mode by placing the jumper in the "20MA" position or voltage mode by placing the jumper in the "VOLTAGE" position. For each input channel set to current mode, you must set the corresponding Voltage Range Jumper to the 5V.

Selecting Voltage Input Range

Locate the Voltage Range Jumpers corresponding to input channels 1 through 8 (see Figure 2.3). For each input channel operating in current mode, set the corresponding Voltage Range Jumper to 5V.

CAUTION:
For each input channel configured for current mode, the corresponding Voltage Range Jumper must be set to 5V.

For each input channel operating in voltage mode, set the corresponding Voltage Range Jumper to "5V" for 0 to +5V or –5 to +5V input range or "10V" for 0 to +10V or –10 to +10V input range.

Selecting Unipolar or Bipolar Input Mode

Locate the Unipolar/Bipolar Jumpers for each channel (see Figure 2.3). Set each jumper to "UNI" for unipolar operation or "BI" for bipolar operation for each input channel with input ranges of 0 to +5VDC, 0 to +10VDC, -5 to +5VDC or -10 to +10VDC. Select 5VDC range for all current applications.

NOTE:
The 5V input signal range configuration is used for both 0 to 5VDC and 1 to 5VDC or 0 to 20mA and 4 to 20mA input signal ranges.

Selecting Output Voltage Range

The 2501 is capable of supporting Unipolar or Bipolar applications with an output range of 0 to +5VDC, 0 to +10VDC, -5 to +5VDC or -10 to +10VDC. For each channel a hardware jumper selects the range for that output circuit (see Figure 2.3). Select 5VDC range for all current applications.

Selecting Unipolar or Bipolar Output

Each output channel on the 2501 supports Unipolar or Bipolar output operation. Hardware jumpers select operation of the output (see Figure 2.3). Select Bipolar for applications that drive the outputs from -5 to +5VDC, -10 to +10VDC, or -20 to +20mA.

Setting DIP Switches to Match the Hardware Selections

Once the hardware jumpers are selected this information needs to be reported to the microcomputer. The information is reported via DIP switches SW1, SW2, and SW3. Each input and output channel uses 2 switches with a BCD code to indicate the state of the hardware jumpers.

2 (MSB)	1 (LSB)	Range
OFF	OFF	Unipolar 5VDC
OFF	ON	Unipolar 10VDC
ON	OFF	Bipolar 5VDC
ON	ON	Bipolar 10VDC
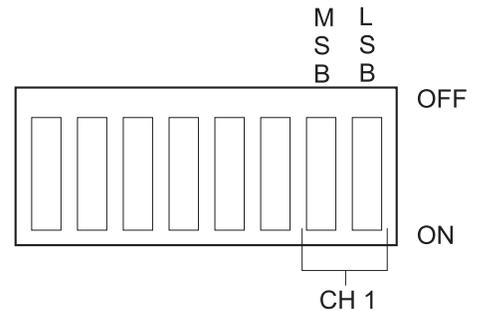
> *NOTE:*
> *The OFF position is selected by actuating the switch in the direction of the center of the printed circuit board.*

> *NOTE:*
> *Standard shipping configuration is all switches in the OFF position which denotes the Unipolar 5VDC range.*

Jumper Settings for Future Reference

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

Inserting the Module into the I/O Base

When the module is fully seated in the slot, captive screws at the top and bottom will hold the module in place. To remove the module from the I/O base, loosen these captive screws, and then remove the module from the I/O base. Do not damage the edge connector at the back of the module when inserting or removing the module.

WARNING: Always remove power from the I/O base before inserting a module to minimize the risk of injury of damage to equipment. Never insert a module into a powered I/O base.

Wiring the Output Connector

Output signals are provided through a connector assembly located on the front of the module. The connector assembly consists of a header attached to the printed circuit card and a mating removable screw terminal connector (see Figure 2.9). Wiring is connected through the removable screw terminal connector.
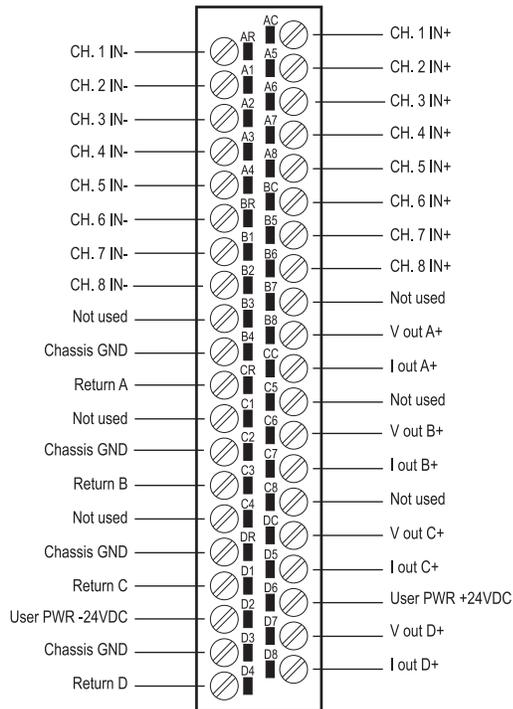
Figure 2.9 Output Screw Terminal Connector Wiring

Connecting Voltage Output Wiring

First, loosen the wire locking screws on the output screw terminal plug. For voltage output circuits, connect the signal wire to the V_{OUT} screw terminal, and the return wire to the Return (channel ground) screw terminal. Insert the wires in the appropriate holes next to the screws. When the wires are inserted, tighten the screws. Repeat this procedure for the remaining voltage output channels.

Connecting Current Output Wiring

For current output circuits, connect the signal wire to the I_{OUT} screw terminal, and the return wire to the Return (channel ground) screw terminal. Insert the wires in the appropriate holes next to the

screws. When the wires are inserted, tighten the screws. Repeat this procedure for the remaining current output channels.

Connecting the Shield Wiring

See Figure 2.10 below for a description of cable grounding and chassis ground.
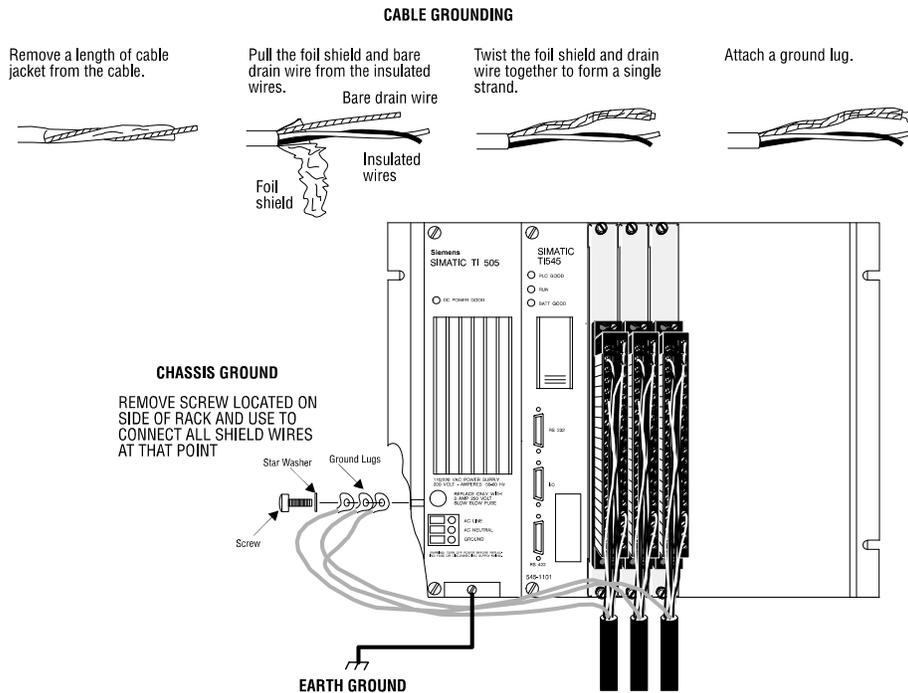
Figure 2.10 Connecting the Shield Wiring

> *NOTE:*
> *Five static drains are recommended on the 2501 to prevent static charges from building up. The eight analog inputs, which share the same isolated common, may be protected by a single 10K to Meg resistor from ANY analog negative (-) terminal to chassis ground. If ANY of the circuits being monitored provide a static drain, then the resistor is not only not required, but not recommended - a ground loop would result. Each of the four analog outputs require a separate static drain if the circuits being driven does not provide a static discharge path. A 10K to 1 Meg resistor to chassis ground should be sufficient. (Note also that chassis ground is available on front panel connector pins B4, C2, DR, and D3.)*

Connecting the Shield Wiring

First, loosen the wire locking screws on the output screw terminal plug. For voltage output circuits, connect the signal wire to the V_{OUT} screw terminal, and the return wire to the Return (channel ground) screw terminal. Insert the wires in the appropriate holes next to the screws. When the wires are inserted, tighten the screws. Repeat this procedure for the remaining voltage output channels.

Inserting the Screw Terminal Connector

When all the output signal wires are connected to the screw terminal connector, carefully insert the connector into its header. Both the plug and header are keyed to prevent reverse wiring. When the screw terminal is fully inserted onto the header, use the captive screws to secure the connector to the front panel.

Connecting the 24VDC User Power Supply

The power supply is connected to the "D2" and "D6" positions for the connector on the front of the module (as shown in Figure 2.9). Be sure to check that the fuse is present and intact. The fuse will blow if the +24VDC power falls below ~21VDC or goes above ~31VDC, and will report a power supply error code (+32753) to the PLC (see Figure 2.5 CTI/ Siemens® Error Code Definitions). See the Troubleshooting section for replacement fuse recommendations.

Checking Module Operation

First, turn on the base supply power. If diagnostics detects no problems, the front panel status indicator will light. If the 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 TISOFT Programming Manual. To diagnose and correct a module failure, refer to the next section on troubleshooting.

NOTE:
If 24VDC power fails or is removed and then later restored, the module will automatically resume normal operation. No external reset is required after power is restored.

You must also check that the module is configured in the memory of the PLC. This is important because the module will appear to be functioning regardless of whether it is communicating with the PLC. To view the PLC memory configuration chart listing all slots on the base and the inputs or outputs associated with each slot, refer to your TISOFT Programming Manual. Example charts are shown in the following figures, one for each login mode. Also, note the Wxs and Wys mix in Figure 2.12 below.

Module Configuration		Analog		I/O Words	Values
		Inputs	Outputs		
Lo:	8WX	8	0	WX1-8	Input data 1-8 / error words
Hi, 7012:	12WX 4WY	8	4	WX1-8 WX9-12 WY13-16	Input data / error words Output echo / error words Output points A-D
Hi, 7016:	20WX 4WY	8	4	WX1-8 WX9-16 WX17-20 WY21-24	Input data Input error words Output echo / error words Output points A-D

Figure 2.12 WXs and WYs mix

In this first example, the 2501 Module is inserted in slot 1 in I/O base 0, logging in as a Lo Density module (see Figure 2.13). Input data for channel 1 appears in word location WX1, data for channel 2 appears in word location WX2, etc. through channel 8 and WX8. 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						
		Number of Bit and Word I/O				
	I/O Address					Special
Slot		X	Y	WX	WY	Function
1	0001	00	00	08	00	NO
2	0000	00	00	00	00	NO
.	.	.	.	.	.	.
.	.	.	.	.	.	.
15	0000	00	00	00	00	NO
16	0000	00	00	00	00	NO

Figure 2.13 I/O Configuration Chart: Lo Density

In the second example, the 2501 Module is inserted in slot 1 in I/O base 0, logging in as a High Density, 7012 module (see Figure 2.14). Input data for channel 1 appears in word location WX1, data for channel 2 appears in word location WX2, etc. through channel 8 and WX8. Output data for channel 9-12 appears in word locations WX 9-12. 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						
		Number of Bit and Word I/O				
	I/O Address					Special
Slot		X	Y	WX	WY	Function
1	0001	00	00	12	04	NO
2	0000	00	00	00	00	NO
.	.	.	.	.	.	.
.	.	.	.	.	.	.
15	0000	00	00	00	00	NO
16	0000	00	00	00	00	NO

Figure 2.14 I/O Configuration Chart: Hi Density, 7012 Mode

In this third and final example, the 2501 Module is inserted in slot 1 in I/O base 0, logging in as a High Density, 7016 module (see Figure 2.15). Input data for channel 1 appears in word location WX1, data for channel 2 appears in word location WX2, etc., through channel 8 and WX8. Input error codes appear in word locations WX9-16, and output data and error codes appear in word locations WX17-20. 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						
		Number of Bit and Word I/O				
	I/O Address					Special
Slot		X	Y	WX	WY	Function
1	0001	00	00	20	04	NO
2	0000	00	00	00	00	NO
.	.	.	.	.	.	.
.	.	.	.	.	.	.
15	0000	00	00	00	00	NO
16	0000	00	00	00	00	NO

Figure 2.15 I/O Configuration Chart: Hi Density, 7016 Mode

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

> *NOTE:*
> *In the event a CTI analog module detects no user 24VDC or an onboard module failure, the module will assert the module fail line and report the module failure in the I/O Status Word, which is reported to the PLC CPU. CTI strongly recommends the user application monitor the I/O Module Status Words which are Status Words 11-26 and apply to Controllers TI/545, TI/555, TI/560 & 565, and the TI/575. The I/O Module Status Word can be used to report a module failure for an I/O Module in any of the SIMATIC® 505 I/O slots. Please refer to Siemens® 505 Programming Reference Manual for more information. If a module failure is reported by the status word, the module should be replaced with a working unit and the failed module sent in for repair.*

Power Cycling

The 2501 reacts in the following ways upon various power cycling scenarios:

Base Power (5V)	User Power (24V)	2501 in Last Value Mode	
		Unipolar Mode*	Bipolar Mode*
On	Transition off	Output to zero.	Output to zero.
On	Transition on	Output from zero to PLC value.	Output from zero to full scale (+), then PLC value.
Transition off	On	Maintains last value.	Maintains last value.
Transition on	On	Maintains last value.	Maintains last value.
Off	Transition on	Output stays at zero.	Output to full scale.

Base Power (5V)	User Power (24V)	2501 in Zero Mode	
		Unipolar Mode*	Bipolar Mode*
On	Transition off	Output to zero.	Output to zero.
On	Transition on	Output from zero to PLC value.	Output from zero to full scale (+), then to zero, then to PLC value.
Transition off	On	Maintains last value.	Maintains last value.
Transition on	On	Output to zero for several seconds, then to PLC value.	Output to zero, then to PLC value.
Off	Transition on	Output stays at zero.	Output from zero to full scale (+).

*See heading "Selecting Either Zero or Last Value Output at Power Up" for further explanation.

TROUBLESHOOTING

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
Indicator is not lit	Base power is off Defective module	Turn base on Return the module to CTI for repair
Indicator is blinking	Calibration data no longer stored in memory	Return the module to CTI for calibration
Incorrect inputs	Blown fuse Wrong addresses for word input	Replace fuse (see below) Check program for correct word input addresses
	Not logged-in Incorrect jumper settings	Read I/O configuration Refer to Section 2.3 of this Installation & Operation Guide for jumper settings
	Incorrectly calibrated	Return the module to CTI for recalibration
	Noisy signal	Check for proper shield termination at input connectors
	Offset scale enabled	If JP10 is enabled all inputs are scaled for offset operation

Figure 3.1 Troubleshooting Matrix

When it is inconvenient to visually check the status indicator, use the TISOFT "Display Failed I/O" or "Show PLC Diagnostics" support functions. Note that if the module power supply (user supply) fails, the module will still be logged into the PLC even though it is not operating. In this case, "Display Failed I/O" will not provide the information to accurately diagnose the problem.

CAUTION:
The module fuse F2 is user serviceable. If this fuse continuously blows, the module has a serious component failure and should be returned to CTI for repair, or the module is being supplied voltage in excess of ~31VDC.

In the event the user serviceable fuse F2 blows, its replacement should be a 0.5 A, 250V Time Lag 5x20mm fuse (Schurter 0034.3114 or equivalent).

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.

APPENDIX A. COMPATIBILITY WITH SIEMENS® 505-7012/7016

Overview

The CTI 2501 8 Analog Input / 4 Analog Output Module was designed to be a drop-in replacement for the Siemens® models 505-7012 and 505-7016. From set up of the module to wiring and PLC reporting, the user will find many similarities between the CTI and Siemens® modules.

Using the CTI 2501 in a 505-7012 and/or 505-7016 application

The CTI 2501 should fulfill all the following requirements for the 505-7012 and 505-7016 replacement(s), as outlined below:

Module setup

Since the CTI 2501 allows for both Unipolar and Bipolar setup, the module does have a slightly different module setup. See heading "Configuring the Module for Operation" to determine the details in module setup.

Wiring

The wiring of the output connector is the same between the modules. See heading "Wiring the Output Connector" for a detailed explanation of how this is accomplished.

If the module is used to supply voltage, the requirements of the input voltage to the module (20-30VDC) remains the same in order to supply the resistive load of the field device ($>1000\Omega$). However, the maximum load resistance for current output drops to 600Ω at 20VDC and then climbs linearly to 1000Ω at 24-30VDC.

Also noteworthy is the isolation achieved module to module with the same power supply by using the CTI 2501 versus the Siemens® modules. With the 2501, each module is dielectrically isolated from a common 24V power supply.

PLC Reporting

The word format is the same between the modules. See full length I.O.G. for a more detailed explanation on PLC reporting.

Power Cycling

When the user power is supplied and the base power is transitioning on, the 2501 has the option to either transition to hold the last output value until the next PLC update, as the Siemens® modules do, or to go to zero until the next PLC update. See heading "Selecting Either Zero or Last Value Output at Power Up" for further details.