CTI 2560 EIGHT CHANNEL
ISOLATED ANALOG OUTPUT MODULE
INSTALLATION AND OPERATION GUIDE

Version 2.0
CTI Part #062-00100

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PREFACE

This ***Installation and Operation Guide*** provides installation and operation instructions for the CTI 2560 Eight Channel Isolated Analog Output module for SIMATIC® 505 Series programmable controllers. We assume you are familiar with the operation of SIMATIC® 505 Series programmable controllers. Refer to the appropriate SIMATIC® user documentation for specific information on the SIMATIC® 505 Series programmable controllers and I/O modules.

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

Chapter 1 provides a description of the module.

Chapter 2 covers installation and wiring.

Chapter 3 is a guide to troubleshooting.

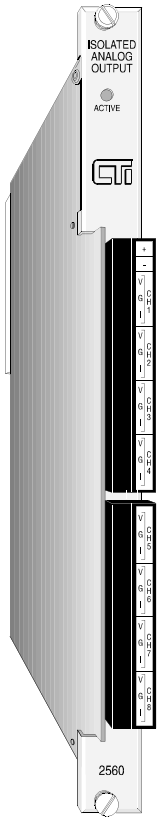

Figure 1 *The 2560 8-Channel Isolated Analog Output Module*

USAGE CONVENTIONS

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

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

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

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CHAPTER 1. DESCRIPTION

The CTI 2560 Eight Channel Isolated Analog Output Module is a member of the Control Technology Inc. (CTI) family of Input/Output (I/O) modules for SIMATIC® 505 Series programmable controllers. The Model 2560 is designed to translate a digital word from the Programmable Controller (PLC) into an equivalent analog voltage and current signal.

1.1 Front Panel Description

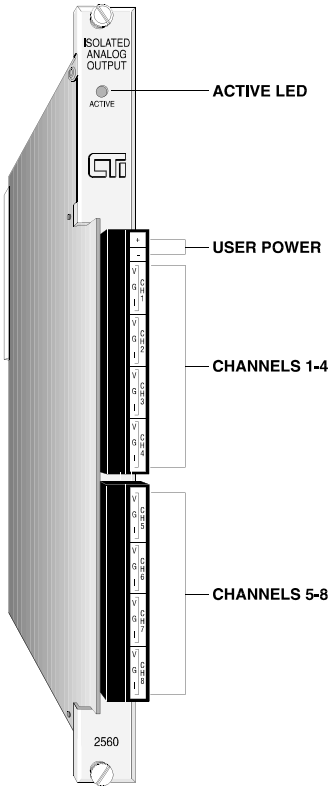


Figure 2 *Front Panel Description*

1.1.1 Active LED

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

1.1.2 Input Connector for Channels 1-4

This connector provides wiring terminals for channels 1-4 and for user supplied 24 VDC power supply.

1.1.3 Input Connector for Channels 5-8

This connector provides wiring terminals for channels 5-8.

1.2 Asynchronous Operation

The module operates asynchronously with respect to the PLC so that a scan of the PLC and a module output scan cycle do not occur at the same time. Note also that how an output signal changes is dependent on the update time of the module. The following figure illustrates this relationship:

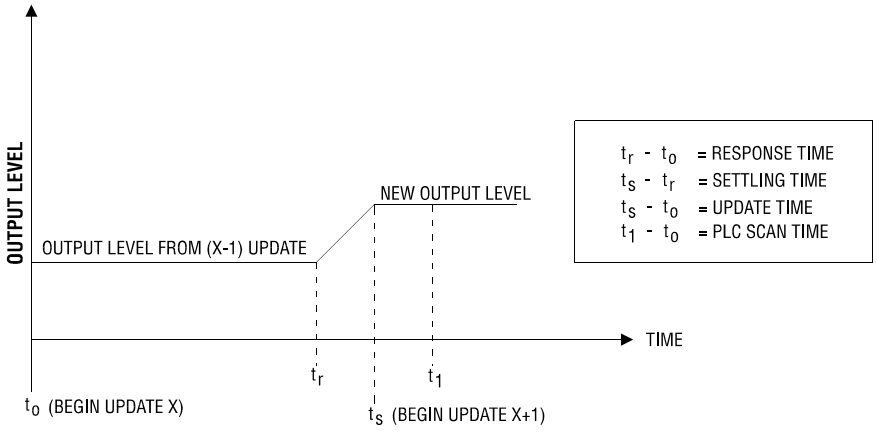


Figure 3 *Relation of Update Time Change in Signal Output*

Each of the eight cahnnels provide output signals ranging from 0 to 10 volts and from 0 to 20 milliamps. Both voltage and current outputs are available simultaneously so that either may be used for a particular channel. the current output is "sourcing" so if a short circuit occurs in the output circuit, the output current will bypass the field device in the circuit.

The PLC sends a 16-bit word to the module for translation to an analog signal. Data to be translated occupies 12 bits. The four remaining bits are unused and set to zero. The following figure illustrates a 16-bit word sent from the PLC to the module.

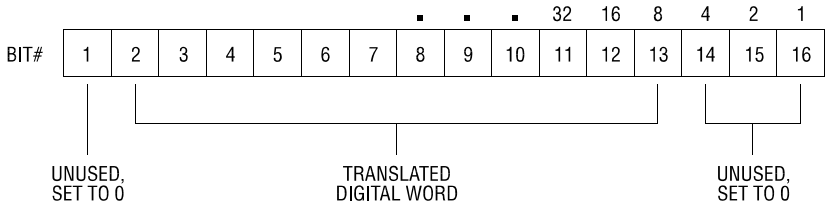


Figure 4 *Word Output from the PLC to the Module*

The module has a resolution of 8 counts out of 32000, or 1 part out of 4000. For the voltage range 0 to 10 volts, the minimum step is 2.5 millivolts. For the current range of 0 to 20 milliamps, the minimum step is 5 microamps. The following figure illustrates the relationship between the output

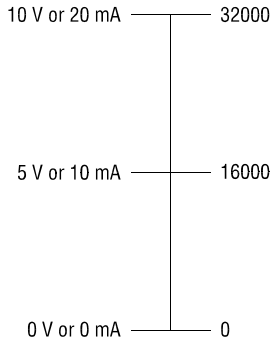


Figure 5 *Output Signal and Digital Word Relationship*

voltage (or current) range and the digital word.

Use the following equations to calculate the digital word needed for a particular analog voltage or current output:

$$\frac{\text{Desired Output Voltage (V)}}{\text{10 Volts}} \times 32000 = \text{Digital Word (WY)}$$

$$\frac{\text{Desired Output Current (mA)}}{\text{20.0 mA}} \times 32000 = \text{Digital Word (WY)}$$

The following example illustrates the effects of a change in output level:

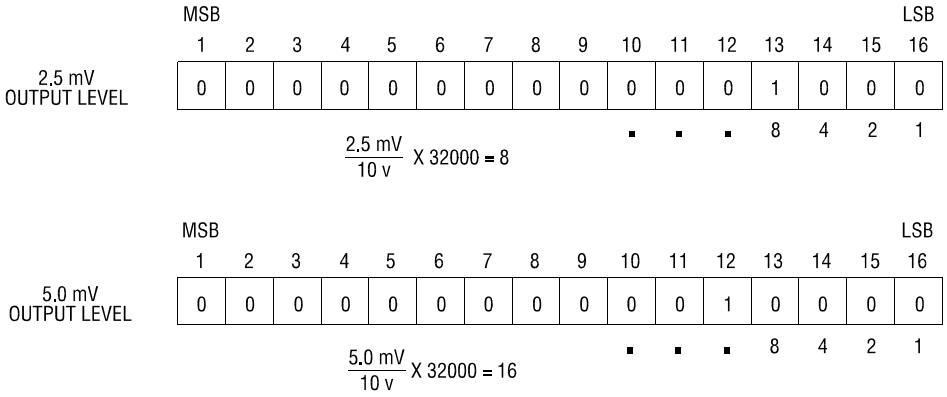


Figure 6 *Example of Change in Output Value*

CHAPTER 2. INSTALLATION

The installation of the Eight Channel Analog Output Module involves the following steps:

1. Planning the installation
2. Inserting the module into the I/O base
3. Wiring the module output screw terminal plug
4. Plugging the screw terminal plug onto the module header
5. Connecting the 24 VDC user power supply
6. Checking module operation

These steps are explained in detail in the following pages.

2.1 Planning the Installation

Planning is the first step in the installation of the module. Planning the installation involves:

1. Calculating the I/O base power budget
2. Selecting a proper user power supply and wiring
3. Routing the wiring to minimize noise
4. Selecting the proper wiring method for the type of output you will use

The following sections discuss each of these aspects of the installation.

2.1.1 Calculating the I/O Base Power Budget

The Model 2560 requires 1.7 watts of +5 VDC power from the I/O base. Before inserting the module into the I/O base, ensure that the base power supply capacity is not exceeded.

2.1.2 Choosing a Power Supply

The power supply should be a single voltage, 24 VDC nominal 0.5 amp., UL Class 2 device.

2.1.3 Wiring Consideration

The module requires separate wiring for the power supply and for the output signals. Power and signal wiring must be separated to prevent noise in the signal wiring. Output signals wiring must be shielded, twisted-pair cable, with 18 to 22 gauge stranded conductors. The cable shield should always be terminated to earth ground at the I/O base. It should not be terminated at the output connector. Use the following guidelines when wiring the module:

- Always use the shortest possible cables
- Avoid placing power supply wires and signal wires near sources of high energy
- Avoid placing low voltage wire parallel to high energy wire (if the two wires must meet, cross them at a right angle)
- Avoid bending the wire into sharp angles
- Use wireways for wire routing
- Be sure to provide a proper earth ground for the cable shield at the I/O base
- Avoid placing wires on any vibrating surfaces

2.1.4 Requirements for Signal Wire Carrying Current

You must calculate the loop wiring resistance for any current output circuits. The loop resistance is determined by the length and type of wire, as well as the field device series resistance.

The circuit resistance must not exceed 500 ohms. If a separate 10 volt power supply is used in the loop, the minimum resistance increases 500 ohms, and the maximum resistance becomes 1000 ohms. Any value over 1000 ohms prevents the module from operating accurately. The following figure provides a schematic for wiring a loop with a resistance of less than 500 ohms. It also shows a schematic for adding a power supply to allow loop resistances up to 1000 ohms. Use the following equation to determine the resistance of an output loop for a channel:

Resistance = (2 x CL x RFT) + TFL

where: CL is the cable length
RFT is the conductor resistance (ohms/unit length)

TFL is the resistance of the field device

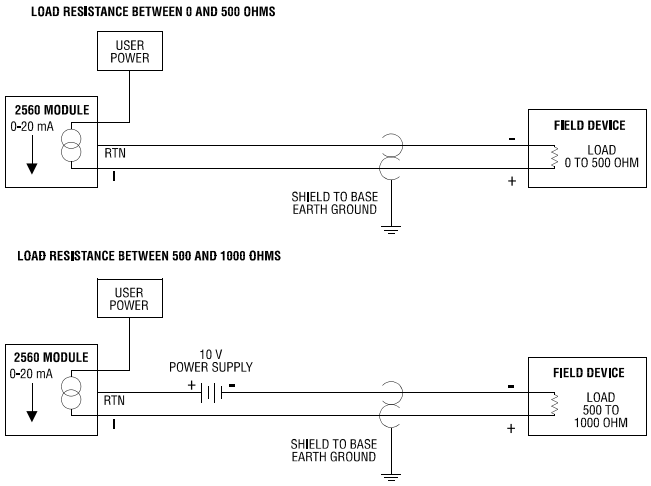


Figure 7 *Current Output Circuits*

2.1.5 Requirements for Signal Wire Providing Voltage

Applications using voltage signals require some special considerations to ensure the module's accuracy. Two additional parameters must be considered:

Resistive load of the field device

Capacitance of the cable wiring

The resistive load of the field device must be at least 10K ohms. The cable capacitiance must be less than 0.01 microfarad.

The cable capacitance is a function of the cable length. To determine the maximum cable length allowed, find the nominal value of cable capacitance per unit length as given by the manufacturer. Use this value in the following equation to determine the maximum cable length:

$$\text{Maximum Cable Length} = \frac{0.01 \text{ microfarads}}{\text{Nominal Cable Capacitance (per unit length)}}$$

NOTE:
Nominal capacitance is measured between the conductors. However, if one conductor is connected to the shield via a grounded power supply, then the nominal value will usually double in value.

The length of a cable and the cable conductor resistance are used to find the fixed error which would appear at the field device. Use the following equation to determine the fixed error:

$$\text{Fixed Error (\%)} = \frac{[1\text{-}R1] \times 100}{[R1 + 2 \times CL \times RC]}$$

where: R1 is the field device resistive load

CL is the cable length

RC is the conductor resistance per unit length

The following figure provides a schematic for a voltage output circuit.

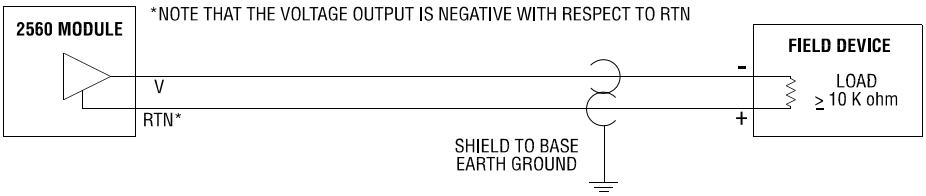


Figure 8 *Voltage Output Circuit*

2.2 Unpacking the Module

CAUTION:
HANDLING STATIC SENSITIVE DEVICES
The components on the Model 2560 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.

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

After discharging any static build-up, remove the module from the static bag. **Do not discard the static bag. Always use this bag for protection against static damage when the module is not inserted into the I/O backplane.**

WARNING:
*Ensure that the power supply is turned **OFF** before connecting the wires to the I/O base.*

2.3 Inserting the Module into the I/O Base

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.

2.4 Wiring the Output Connector Assembly

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 plug (see Figure 9). Wiring is connected through the removable screw terminal plug.

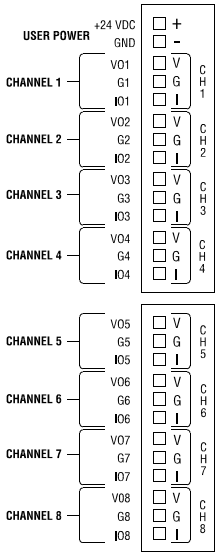


Figure 9 *Output Screw Terminal Plug Wiring*

2.4.1 Connecting Voltage Output Wiring

First, loosen the wire locking screws on the side of the output screw terminal plug. For voltage output circuits, connect the signal wire to the VO screw terminal, and the return wire to the G (channel ground) screw terminal. Insert the wires in the appropriate holes at the top of the plug directly above the screws. When the wires are inserted, tighten the screws.

2.4.2 Connecting Current Output Wiring

For current output circuits, connect the signal wire to the IO screw terminal, and the return wire to the G (channel ground) screw terminal. Insert the wires in the appropriate holes at the top of the plug directly above the screws. When the wires are inserted, tighten the screws. Repeat this procedure for the remaining current output channels.

NOTE:
Terminals labeled G1 through G8 are isolated grounds for each channel. These terminals are isolated from each other and from the backplane ground.

2.5 Inserting the Screw Terminal Plug

When all the output signal wires are connected to the screw terminal plug, carefully insert the plug into its header. Both the plug and header are keyed to prevent reverse wiring. When the screw terminal plug is fully inserted into the header, the locking tabs snap over the connector lip to secure the screw terminal plug to the header.

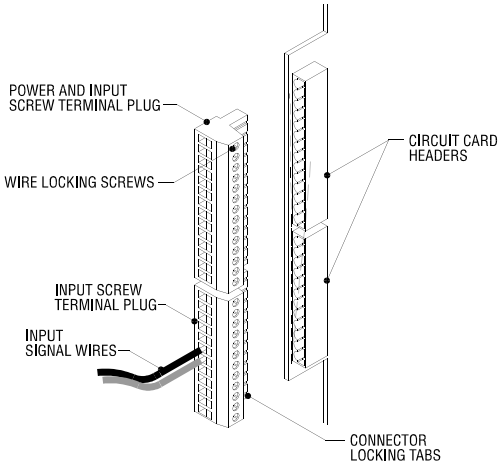


Figure 10 *Output Connector Assembly*

2.6 Connecting the 24 VDC User Power Supply

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

The power supply is connected to the top 2 positions of the top connector on the front of the module

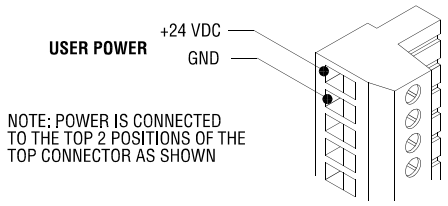


Figure 11 *Power Supply Connections*

as shown in the figure below.

2.7 Checking Module Operation

First turn on the base supply power. If diagnostics detect 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 SIMATIC® TISOFT Programming Manual. To diagnose and correct a module failure, refer to the next section on troubleshooting.

> **NOTE:**
> *If 24 VDC 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 SIMATIC® TISOFT Programming Manual. An example chart is shown in the following figure.

In this example, the 2560 Module is inserted in slot 1 in I/O base 0. Data for channel 1 appears in word location WY1, data for channel 2 appears in word location WY2, 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

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

                 I/O    NUMBER OF BIT AND WORD I/O   SPECIAL
SLOT  ADDRESS          X     Y     WX   WY      FUNCTION
 01 . . . . 0001 . . . . . . . . 00 . . 00 . . 00 . . 08 . . . . . . . NO
 02 . . . . 0000 . . . . . . . . 00 . . 00 . . 00 . . 00 . . . . . . . NO
                                  .
                                  .
                                  .
 15 . . . . 0000 . . . . . . . . 00 . . 00 . . 00 . . 00 . . . . . . . NO
 16 . . . . 0000 . . . . . . . . 00 . . 00 . . 00 . . 00 . . . . . . . NO
```

Figure 12 *I/O Configuration Chart*

module is ready for operation.

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

2.8 Bipolar Application Note

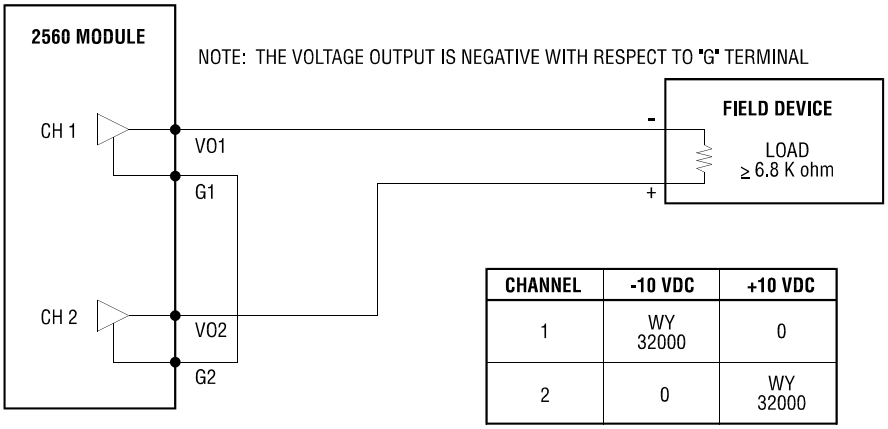
Bipolar Drive configuration is required for controlling the speed references and position references of some DC drive panels or servo motor systems. By using the following configuration, the Model 2560 can be used to solve these design problems.

The Model 2560 provides 1500 VDC isolation from channel-to-channel and channel-to-backplane. No external devices or separate power supplies are required to maintain this level of isolation. This design allows the 2560 to support Bipolar Drive applications in the configurations described below.

Two adjacent channels are employed by connecting the G1 and G2 terminals together. The output will swing from -10 VDC to +10 VDC with respect to the load.

The truth table indicates how to achieve the desired output levels. For any output voltage that is negative, Channel 2 is set to zero and the Channel 1 output is varied from 0 to 32000 for an output of 0 to -10 VDC. For any output voltage that is positive, Channel 1 is set to zero and the Channel 2 output is varied from 0 to 32000 for an output of 0 to +10 VDC.

The minimum load resistance that can be driven with this bipolar application is 6.8K ohm.



CHANNEL	-10 VDC	+10 VDC
1	WY 32000	0
2	0	WY 32000

Figure 13 *Typical Bipolar Application*

CHAPTER 3. TROUBLESHOOTING

If the module provides improper readings or the status indicator is not on, use the following chart to

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
Indicator is not lit	Not receiving power	Check power supply and connections
	Base or PC power is off	Turn base or PC on
Incorrect outputs	Wrong connections	Trace wiring to check connections
	Wrong addresses for word output	Check program for correct word output addresses
	Not logged-in	Read I/O configuration
	Incorrectly calibrated	Return the module to CTI for calibration
	24 VDC user supply not within specification	Repair /replace user supply
Incorrect output values	Output load < 10K ohm voltage mode or > 500 ohm current mode	Verify output load impedance is within specifications
No output	Blown fuse, or failed isolator	Contact CTI

Figure 14 *Troubleshooting Matrix*

determine the appropriate action.

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,

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

"Display Failed I/O" will not provide the information to accurately diagnose the problem.

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

SPECIFICATIONS

Output Channels:	8 isolated output channels
Response Time:	2 mSec total module (0.25 mSec per channel) (includes settling time)
Output Range:	0 to 10 VDC and 0 to 20 mA (sourcing)
Resolution:	12 bit (2.5 mV or 5 microamps per step)
Isolation:	1500 VDC channel-to-channel 1500 VDC channel-to-PLC
Capacitance Drive:	0.01 microfarads
Load Resistance:	Voltage: 10K Ω minimum, no maximum Current: 0Ω to 500Ω max. or up to 1000Ω max. with an external 10 V power supply present in circuit
Voltage Accuracy:	± 0.1% of full scale from 0˚ to 60˚C over total load range
Current Accuracy:	± 0.5% of full scale from 0˚ to 60˚C over total load range
User Supply:	20 to 28 VDC @ 0.5 amps (maximum ripple of ± 0.4 V) UL Class 2 power supply
Backplane Power Consumption:	1.7 Watts
Module Size:	Single-wide
Operating Temperature:	0˚ to 60˚C (32˚ to 140˚F)
Storage Temperature:	-40˚ to 85˚C (-40˚ to 185˚F)
Humidity, Relative:	5% to 95% non-condensing
Agency Approvals:	UL, UL for Canada FM (Class 1, Div 2)

Specifications subject to change without notice.

LIMITED PRODUCT WARRANTY

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

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

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

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

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

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

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

REPAIR POLICY

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

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