Pulse Input Modules

This section describes the Pulse Input Modules available for use with Tricon v9–v10 systems. For important operational restrictions, see Pulse Input Installation and Operation on page 192.

Table 46 Pulse Input Modules

Model	Points	Type	Module Description
3510	8	TMR	Pulse Input
3511	8	TMR	Pulse Input

Pulse Input Modules provide eight very sensitive, high-frequency inputs, which are used with non-amplified magnetic speed sensors common on rotating equipment such as turbines or compressors. The module senses voltage transitions from magnetic transducer input devices. The transitions are accumulated during a selected window of time (rate measurement), and the resulting count is used to generate a frequency or RPM which is transmitted to the Main Processors. The pulse count is measured to 1 microsecond resolution.

The type of speed sensor typically used with the Pulse Input Module consists of an inductive coil and rotating teeth. The sensor is physically close to the teeth of a gear on the rotating shaft. As the shaft rotates and the teeth move past the sensor, the resulting change in the magnetic field causes a sinusoidal signal to be induced in the sensor. The magnitude of the output voltage depends on how fast the teeth pass the sensor, the distance between the sensor and the teeth, and the construction of the sensor. A typical gear has 30 to 120 teeth spaced at equal distances around its perimeter. The output frequency is proportional to the rotational speed of the shaft and the number of teeth.

CAUTION

Pulse Input Modules use fully differential, input-signal-conditioning circuitry which are AC-coupled and of high bandwidth. The circuitry is designed for high-frequency operation and is sensitive to any type of waveform distortion which could result in erroneous measurements. The modules count transitions by examining only one edge of each pulse, which means that ringing on the input signal can result in many additional transitions being counted. The module is capable of counting over 20,000 transitions per second.

Pulse Input Modules have three isolated input channels. Each input channel independently processes all data input to the module and passes the data to the Main Processors, where it is voted just prior to processing to ensure the highest integrity.

Each module provides complete ongoing diagnostics on each channel. Failure of any diagnostic on any channel activates the module's Fault indicator, which in turn activates the chassis alarm signal. The Fault indicator points to a channel fault, *not* a module failure. The module is guaranteed to operate properly in the presence of a single fault and may continue to operate properly with certain kinds of multiple faults.

Pulse Input Modules include the hot-spare feature and require a separate field termination (a cable interface to a remotely located External Termination Panel). Each Pulse Input Module is mechanically keyed to prevent improper installation in a configured chassis.

Pulse Input Schematic

This figure is a simplified schematic for models 3510 and 3511, which are Pulse Input Modules.

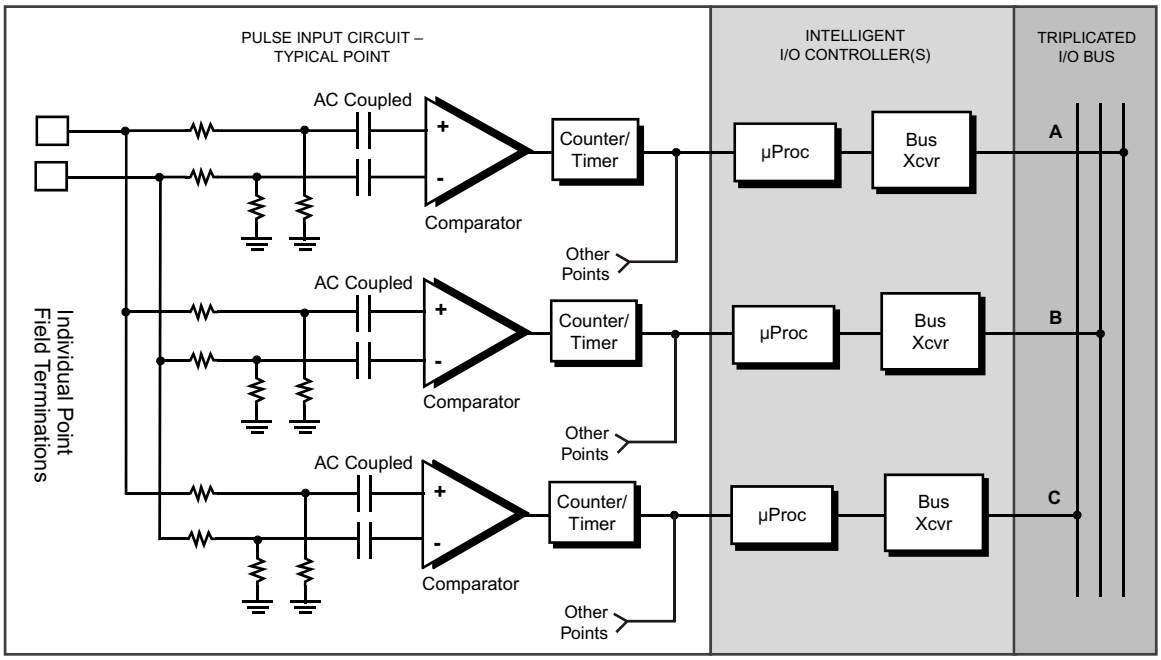


Figure 52 3510 and 3511 Simplified Schematic

Pulse Input Front Panels

This figure shows the front panels of models 3510 and 3511.

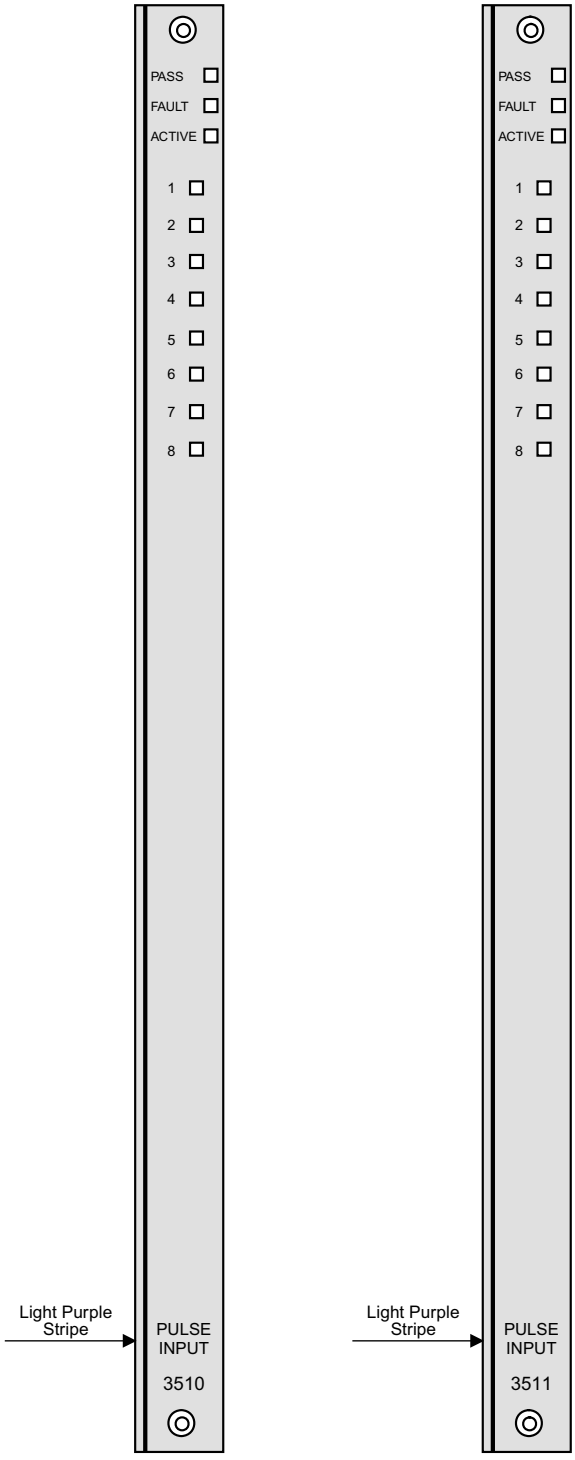


Figure 53 3510 and 3511 Front Panels

3510 Specifications

This table lists the specifications for model 3510, which is a Pulse Input Module. Although the input frequency range for the module is 20 to 20,000 hertz, operation below 20 hertz and above 20,000 hertz is possible. For expected accuracy and input sensitivity, contact the IPS Global Client Support (GCS) center.

CAUTION

- Rapidly or continuously changing inputs may cause mis-compare readings because the measured values of the three channels may in fact be different by more than 0.5 percent of full scale, which can sometimes cause a fault to be declared in error.
- If the input readings differ by a minimum of 0.5 percent of full scale and continue for a minimum period of 10 input samples, the probability of a fault increases.

Table 47 3510 Pulse Input Specifications

Feature	Specification
Color code	Light purple
Number of input signals	8, non-commoned
Input frequency range	20 Hz to 20,000 Hz
Accuracy: @ 1,000 Hz to 20,000 Hz	±0.01%
Accuracy: @ 100 Hz to 999 Hz	±0.1%
Accuracy: @ 20 Hz to 99 Hz	±1.0%
Input diagnostic fault coverage	
Minimum input change	0.5% of full scale
Input change sample period	1 scan or 210 ms, whichever is greater
Minimum period of mis-compares	10 samples
Status indicator: Input activity	1 per point
Status indicator: Module status	Pass, Fault, Active
Logic power	< 20 watts
Input characteristics (AC-coupled, balanced differential)	
Update rate	50 ms, typical
Load impedance	> 8 kΩ, 20K typical
Common mode range	-100V to +100V peak-to-peak
Normal mode range	2.0 V to 200 V peak-to-peak, below 20 Hz 1.5 V to 200 V peak-to-peak, 20 Hz to 15000 Hz 2.0 V to 200 V peak-to-peak, above 15000 Hz
Over-range protection	±150 VDC continuous
Hysteresis	150 millivolts, typical

3511 Specifications

This table lists the specifications for model 3511, which is a Pulse Input Module. Although the input frequency range for the module is 20 to 20,000 hertz, operation below 20 hertz and above 20,000 hertz is possible. For expected accuracy and input sensitivity, contact the IPS Global Client Support (GCS) center.

CAUTION

- Rapidly or continuously changing inputs may cause mis-compare readings because the measured values of the three channels may in fact be different by more than 0.5 percent of full scale, which can sometimes cause a fault to be declared in error.
- If the input readings differ by a minimum of 0.5 percent of full scale and continue for a minimum period of 10 input samples, the probability of a fault increases.

Table 48 3511 Pulse Input Specifications

Feature	Specification
Color code	Light purple
Number of input signals	8, non-commoned
Input frequency range	20 Hz to 20,000 Hz
Accuracy:@ 1,000 Hz to 20,000 Hz	±0.01%
Accuracy:@ 100 Hz to 999 Hz	±0.1%
Accuracy:@ 20 Hz to 99 Hz	±1.0%
Input diagnostic fault coverage	
Minimum input change	0.5% of full scale
Input change sample period	1 scan or 210 ms, whichever is greater
Minimum period of mis-compares	10 samples
Status indicator: Input activity	1 per point
Status indicator: Module status	Pass, Fault, Active
Logic power	< 20 watts
Input characteristics (AC-coupled, balanced differential)	
Update rate	25 ms, typical
Load impedance	> 8 kΩ, 20K typical
Common mode range	-100V to +100V peak-to-peak
Normal mode range	1.5V to 200V peak-to-peak
Over-range protection	±150 VDC continuous
Hysteresis	150 millivolts, typical
Sensitivity	Typical: 0.5V peak-to-peak, sine wave Worst case: 1.5V peak-to-peak, sine wave

Pulse Totalizer Input Module

This section describes the Pulse Totalizer Input Module available for use with Tricon v9–v10 systems. For important operational restrictions, see Pulse Input Totalizer Installation and Operation on page 193.

Table 49 Pulse Totalizer Input Modules

Model	Voltage	Points	Type	Module Description
3515	24 VDC	32	TMR	Pulse Totalizer Input

The model 3515 Pulse Totalizer Input (PTI) Module includes 32 individual 31-bit counters that each operate independently. The counters are used with active-flow sensors or per-unit sensors to measure a quantity (count) which is transmitted to the Main Processors. At the time specified by the control program, the Main Processors can clear a single counter or all counters. Typically, the PTI module is used for batch processes. To avoid counter overflow, the control program should clear each counter before the start of each batch.

The PTI module has three isolated input channels. Each input channel independently processes all input data and passes the data to the Main Processors, where it is voted before processing to ensure the highest integrity.

Each PTI module provides complete ongoing diagnostics on each channel, including channel-to-channel count comparison. Failure of any diagnostic on any channel activates the module's Fault indicator, which in turn activates the chassis alarm. The Fault indicator points to a channel fault, not a module failure. The PTI module is guaranteed to operate properly in the presence of a single fault, and may continue to operate with certain kinds of multiple faults. The PTI module can operate with or without a hot-spare module. If you use a hot-spare module, it re-educates all counter values from the active module.

Pulse Totalizer Schematic

This figure is a simplified schematic for model 3515, which is a Pulse Totalizer Input Module.

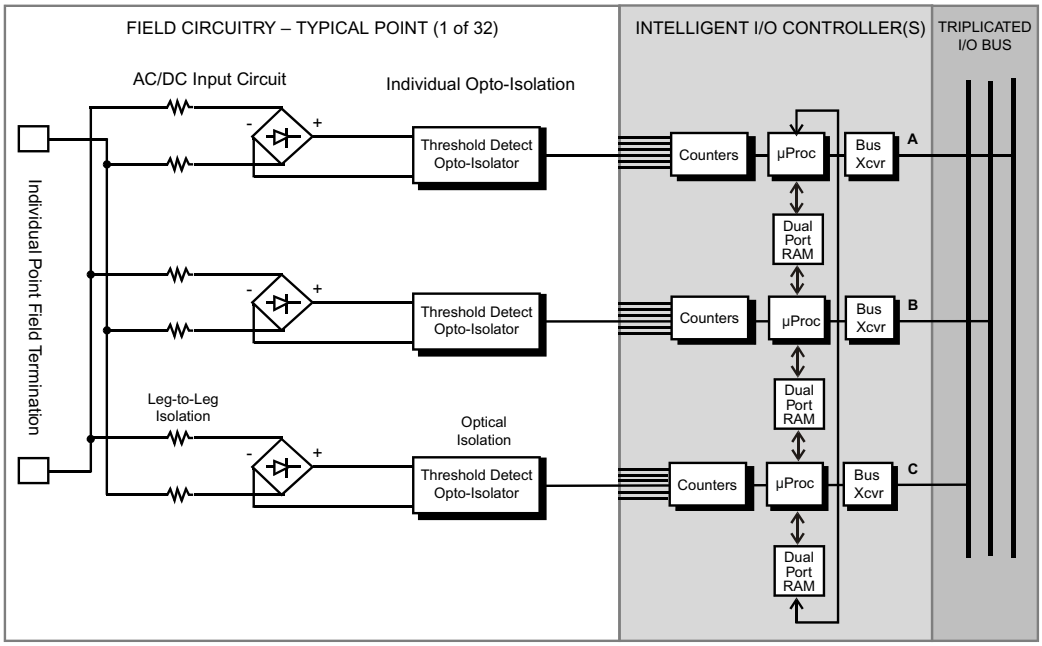


Figure 54 3515 Simplified Schematic

Pulse Totalizer Input Front Panel

This figure shows the front panel of model 3515.

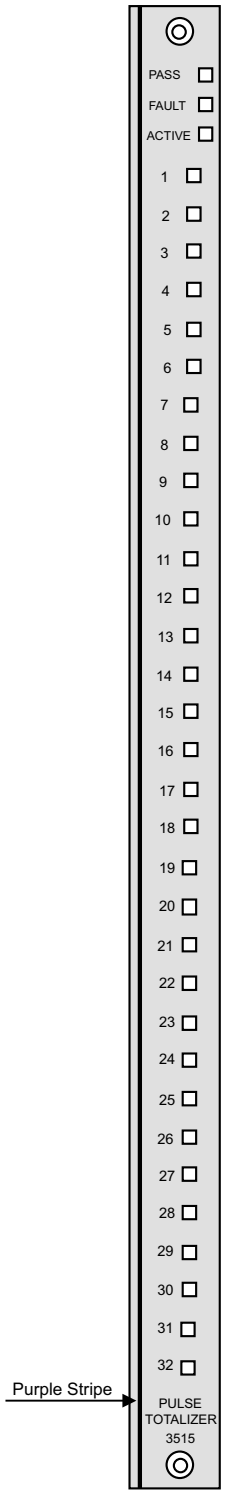


Figure 55 3515 Front Panel

3515 Specifications

This table lists the specifications for model 3515, which is a Pulse Totalizer Input Module.

Table 50 3515 Pulse Totalizer Input Specifications

Feature	Specification
Color Code	Purple
Number of input points	32, non-commoned
Input frequency range	0 Hz to 1 KHz
Minimum input pulse width	300 µs
Accuracy: Active module	+/- 2 counts
Accuracy: Hot-spare module, maximum error counts during hot replacement	1–10 >= 100 Hz 0–1 <= 100 Hz
Maximum count	2147483647 (2^{31} - 1)
Counter overflow (worst case @ 1 KHz)	596 hours (24 days)
Count overflow indication	Count goes to negative integer
Count reset	Individual reset per counter
Recommended input voltage range	20–42.5 VDC
Maximum input voltage	42.5 VDC
Count up switching level	Rising edge, Off to On
Switching voltage: Off to On	15 VDC typical, 18 VDC worst case
Switching voltage: On to Off	8 VDC typical, 6 VDC worst case
Typical hysteresis	4 VDC
Normal turn-on current	6 mA to 9 mA
Count input delay	< 15 ms
Point isolation, opto-isolated	1000 VAC minimum 1500 VDC minimum
Status indicator: On or Off state	1 per point
Status indicator: Module status	Pass, Fault, Active
Logic power	< 10 watts
Nominal field power load	0.5 watts per On point, 1.5 watts @ maximum field voltage

Thermocouple Input Modules

This section describes the Thermocouple Input Modules available for use with Tricon v9–v10 systems. For important operational restrictions, see Thermocouple Input Installation and Operation on page 194.

Table 51 Thermocouple Input Modules

Model	Module Description	Type
3706A	Non-Isolated Thermocouple Input	TMR
3708E	Isolated Thermocouple Input	TMR

A thermocouple input module has three independent input channels. Each input channel receives variable voltage signals from each point, performs thermocouple linearization and cold-junction compensation, and converts the result to degrees Celsius or Fahrenheit. Each channel then transmits 16-bit signed integers representing 0.125 degrees per count to the three Main Processors on demand. To ensure correct data for every scan, a value is selected using a mid-value selection algorithm.

Each module is configured by TriStation for the thermocouple type and engineering units you select. Each module can support one of a variety of thermocouple types, as indicated in the specifications. Engineering units are in Celsius or Fahrenheit.

TriStation programs the Isolated Thermocouple Module for upscale or downscale burnout detection depending on the hardware specification in the TriStation control program. The Non-Isolated Thermocouple Module provides upscale or downscale burnout detection depending on the field termination selected. If a thermocouple burnout occurs, or if the thermocouple input voltage is out of range, the Main Processors receive the integer value +32,767 for upscale burnout detection or –32,767 for downscale.

Triplicated temperature transducers residing on the field termination module support cold-junction compensation. Each channel of a thermocouple module performs auto-calibration and reference-junction compensation every five seconds using internal-precision voltage references. On the Isolated Thermocouple Module, a cold-junction indicator announces the failure of a cold-junction transducer. On the Non-Isolated Thermocouple Module, a Fault indicator announces a transducer fault.

Sensing of each thermocouple input is performed in a manner which prevents a single failure on one channel from affecting another channel. Each module performs complete ongoing diagnostics on each channel.

Thermocouple Modules include the hot-spare feature which allows online replacement of a faulty module. Like all I/O modules, Thermocouple Modules require a cable interface to a remotely located external termination panel. Each module is mechanically keyed to prevent improper installation in a configured chassis.

32-Point Thermocouple Modules

This figure is a simplified schematic for model 3706A, which is a non-isolated Thermocouple Input Module.

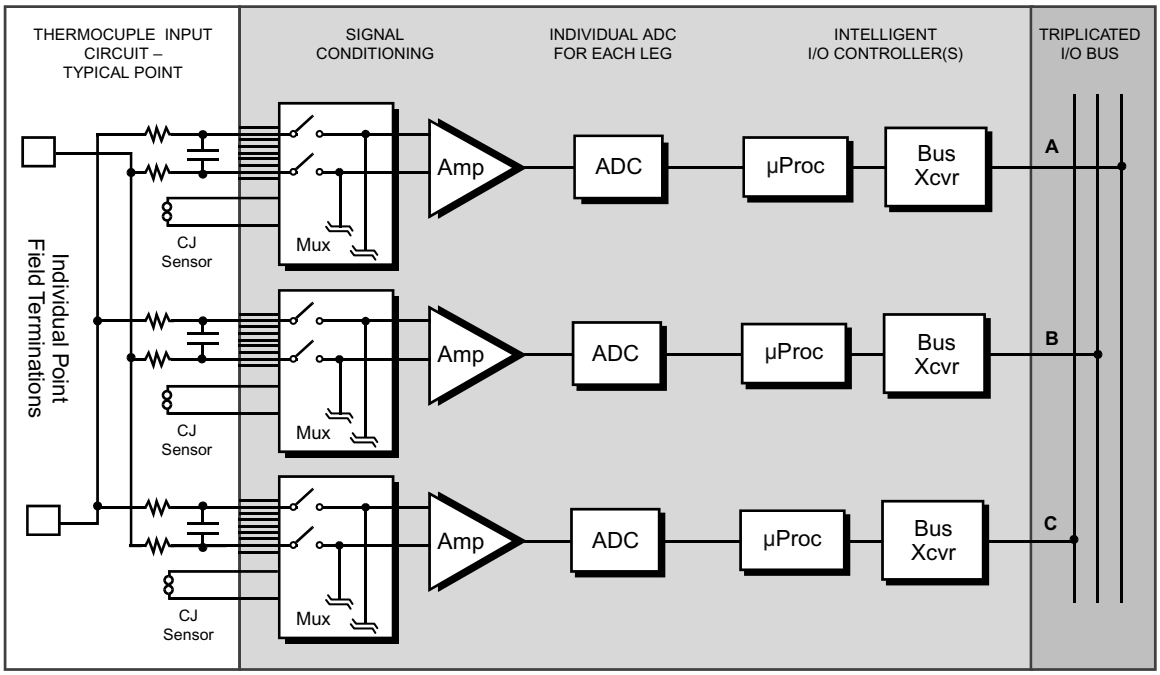


Figure 56 3706A Simplified Schematic

This figure shows the front panel of model 3706A.

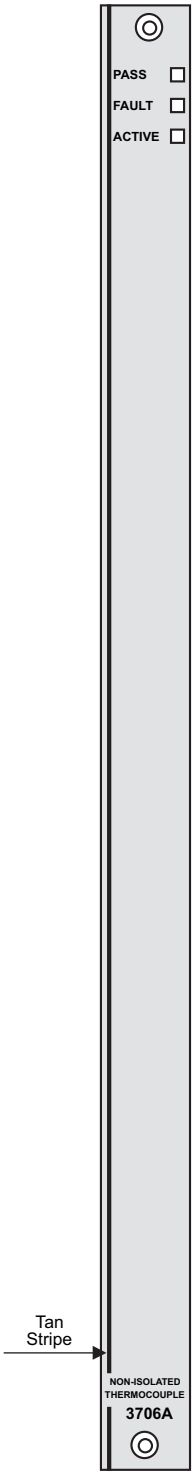


Figure 57 3706A Front Panel

3706A Specifications

This table lists the specifications for model 3706A, which is a Thermocouple Input Module.

WARNING If the common mode voltage range of a channel is exceeded, Triconex does not guarantee proper operation of the module and accuracy of other channels.

CAUTION Rapidly or continuously changing inputs may cause mis-compare readings because the measured values of the three channels may be different by more than 0.5 percent of full scale, which may cause a fault to be declared in error.

Table 52 3706A Thermocouple Input Specifications

Feature	Specification
Color code	Tan
Thermocouple types supported	J, K, T
Open detect	Upscale/downscale selected on termination module
Number of input signals	32 differential, DC-coupled
Input update rate[1]	50 ms maximum
Accuracy of thermocouple types and temperature ranges supported	See table, 3706A Accuracy on page 137.
Input resistance (load)	22 MΩ (DC), typical
Input point protection	110 VAC continuous without damage
Noise rejection: Common mode	-85 dB @ 0 – 60 Hz minimum -95 dB @ 60 Hz typical
Noise rejection: Normal mode	-17 dB @ 60 Hz
Common mode range (See Warning)	±10 VDC maximum (channel-to-channel or channel-to-ground)
Channel-to-channel isolation	200 kΩ, typical
Reference-junction compensation range	32° to 140° F (0° to 60° C)
Module status indicators	Pass, Fault, Active
Input diagnostic fault coverage[2]	
Minimum input change	0.5% of full scale
Input change sample period	50 milliseconds
Minimum period of mis-compares	256 samples
Logic power	< 10 watts

1. Later versions of NITC firmware (Meta 4873 or greater) freeze inputs for 1 second upon detection of hot-spare insertion.
2. If the input readings differ by a minimum of 0.5 percent of full scale and continue for a minimum period of 256 input samples, the probability of a fault increases.

3706A Accuracy

Accuracy specifications account for errors related to reference-junction compensation but do not account for errors caused by temperature gradients between the temperature transducers and thermocouple terminations. Customers are responsible for maintaining a uniform temperature across the Thermocouple Field Termination Module.

Table 53 Accuracy of Model 3706A Thermocouple Types

TC Type	Temperature Range	Accuracy @ 32˚ to 140˚ F (0˚to 60˚ C)	
		Ta=77˚ F (25˚ C)	Ta=32˚to 140˚ F (0˚to 60˚ C)
		Typical	Maximum
J	-250° to 32° F (-157° to 0° C)	± 5.0° F (2.8° C)	± 7.0° F (3.9° C)
	>32° to 2000° F (0° to 1093° C)	± 4.0° F (2.3° C)	± 5.0° F (2.8° C)
K	-250° to 32° F (-157° to 0° C)	± 6.0° F (3.4° C)	± 9.0° F (5.0° C)
	>32° to 2500° F (0° to 1371° C)	± 4.0° F (2.3° C)	± 6.0° F (3.4° C)
T	-250° to 32° F (-157° to 0° C)	± 5.0° F (2.8° C)	± 9.0° F (5.0° C)
	>32° to 752° F (0° to 400° C)	± 3.0° F (1.7° C)	± 5.0° F (2.8° C)

16-Point Isolated Thermocouple Modules

This figure is a simplified schematic for model 3708E, which is an isolated Thermocouple Input Module.

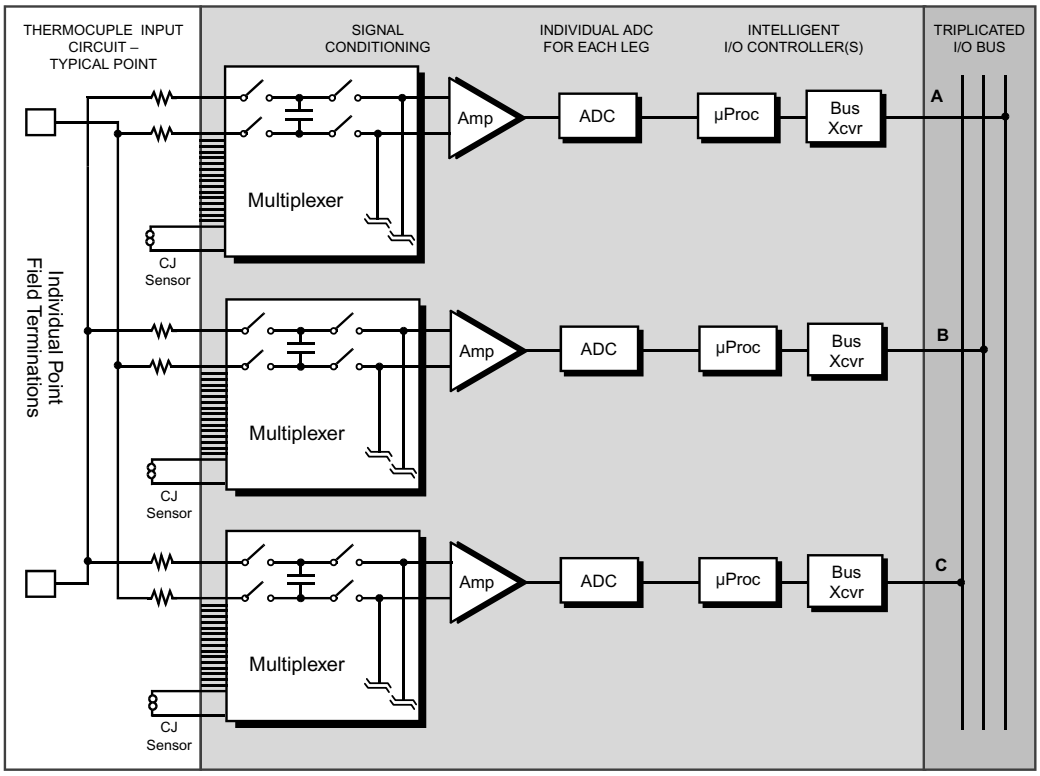


Figure 58 3708E Simplified Schematic

This figure shows the front panel of model 3708E.

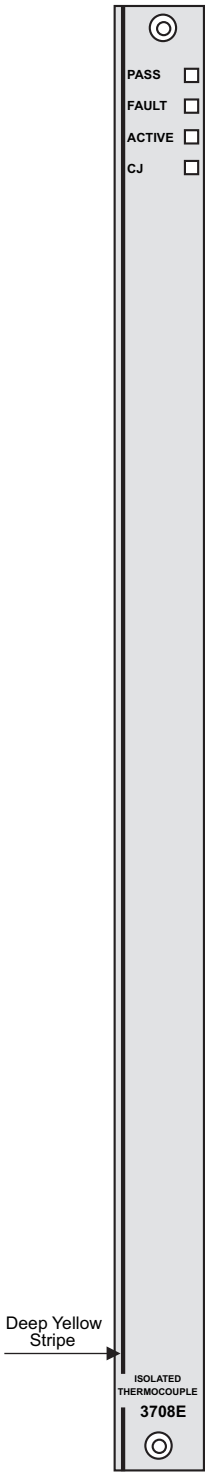


Figure 59 3708E Front Panel

3708E Specifications

This table lists the specifications for model 3708E, which is an isolated TMR Thermocouple Input Module.

CAUTION

- If the common-mode voltage range of a channel is exceeded, Triconex does not guarantee proper operation of the module and accuracy of other channels.
- If the input readings differ by a minimum of 0.5 percent of full scale and continue for a minimum period of 256 input samples, the probability of a fault increases.

Table 54 3708E Thermocouple Input Specifications

Feature	Specification
Color code	Deep yellow
Thermocouple types supported	J, K, T, E
Open detect	Upscale, Downscale, (TriStation-configured)
Number of input signals	16 differential, isolated
Input update rate	50 ms maximum
Accuracy of thermocouple types and temperature ranges supported	See table, 3708E Accuracy on page 141.
Input resistance (load)	30 MΩ (DC) minimum
Input point protection	110 VAC continuous without damage
Noise rejection: Common mode	-100 dB @ DC minimum -90 dB @ 60 Hz minimum
Noise rejection: Normal mode	-3 dB @ 8 Hz typical -17 dB @ 60 Hz typical
Common mode range	±200 VDC maximum (channel-to-channel or channel-to-ground)
Channel-to-channel isolation	20 kΩ, typical
Reference-junction compensation range	32° to 140° F (0° to 60° C)
Status indicator: Module status	Pass, Fault, Active
Status indicator: Cold Junction sensor status	CJ (On = CJ Fault)
Input diagnostic fault coverage	
Minimum input change	0.5% of full scale
Input change sample period	50 ms
Minimum period of mis-compares	256 samples
Logic power	< 15 watts

3708E Accuracy

Accuracy specifications account for errors related to reference-junction compensation but do not account for errors caused by temperature gradients between the temperature transducers and thermocouple terminations. The customer is responsible for maintaining a uniform temperature across the thermocouple termination module.

Table 55 Accuracy of Model 3708E Thermocouple Types

TC Type	Temperature Range	Accuracy @ 32˚ to 140˚ F (0˚ to 60˚ C)	
		Ta=77˚ F (25˚ C)	Ta=32˚to 140˚ F (0-60˚ C)
		Typical	Maximum
J	-238° to 32° F (-150° to 0° C)	± 3.0° F (1.7° C)	± 9.0° F (5.0° C)
	>32° to 1400° F (0° to 760° C)		± 5.5° F (3.1° C)
K	-238° to 32° F (-150° to 0° C)	± 4.0° F (2.3° C)	± 8.0° F (4.5° C)
	>32° to 2284° F (0° to 1251.1° C)		± 7.0° F (3.9° C)
T	-250° to 32° F (-161° to 0° C)	± 3.0° F (1.7° C)	± 8.5° F (4.8° C)
	>32° to 752° F (0° to 400° C)		± 4.5° F (2.5° C)
E	-328° to 32° F (-200° to 0° C)	± 3.0° F (1.7° C)	± 8.0° F (4.5° C)
	>32° to 1830° F (0° to 999° C)		± 5.0° F (2.8° C)

HART Interface Modules

This section describes HART interface modules available for use with Tricon v10.4 or later systems.

HART is an industry standard field bus that superimposes a Frequency Key Shifted (FSK) signal onto the 4-20 mA loop. The Tricon 2071H HART Multiplexer Module that is incorporated into each of the HART Interface Modules capacitively couples the HART signal to the AI or AO signals. The HART signals are approximately ±0.5 mA at 1200 and 2200 Hz. These frequencies are high enough that the low-bandwidth loop is unaffected and the HART electronics can impose and extract the HART signals easily.

HART communication through the HART multiplexer is separate from the Tricon system and is certified not to interfere with the 4-20 mA safety signals of the Analog Input and Analog Output modules.

Table 56 HART Interface Modules

Model	Interface Module Description	Compatible I/O Modules	Type
2770H	HART Analog Input Interface Module	3700A, 3721	TMR
2870H	HART Analog Output Interface Module	3805E, 3805H	TMR

For installation information, see Installing HART Interface Modules in the Model 8121 Enhanced Low Density Expansion Chassis on page 195 and Installing HART Interface Modules in Systems Upgraded from v6–v8 on page 199.

Chassis Requirements for HART Communication

Only Tricon v10.4.*x* and later systems can use HART interface modules; earlier Tricon systems must upgrade to Tricon v10.4.*x*. The chassis requirements for using HART interface modules in a system upgraded to Tricon v10.4.*x* differ depending on the original system version, as described in this table.

Table 57 Tricon Chassis Usage for HART Communication

If Your Original System Version Is...	Upgrade to...	Install HART Interface Modules in Chassis...
Tricon v10.4.*x* or later (High-Density)	n/a	• Model 8121 Enhanced Low-Density Expansion Chassis
Tricon v10.0.*x* – 10.3.*x* (High-Density)	Tricon v10.4.*x*	• Model 8121 Enhanced Low-Density Expansion Chassis
Tricon v9.x (High-Density)	Tricon v10.4.*x*	• Model 8121 Enhanced Low-Density Expansion Chassis
Tricon v6.*x* – v10.*x* (Low-Density)	Tricon v10.4.*x*	• Model 8100-*x* Main Chassis • Model 8101 Low-Density Expansion Chassis • Model 8102 Low-Density RXM Chassis • Model 8121 Enhanced Low-Density Expansion Chassis

HART Analog Input Interface Modules

This is a simplified schematic of the Model 2770H HART Analog Input Interface Module from the field device to the HART controller.

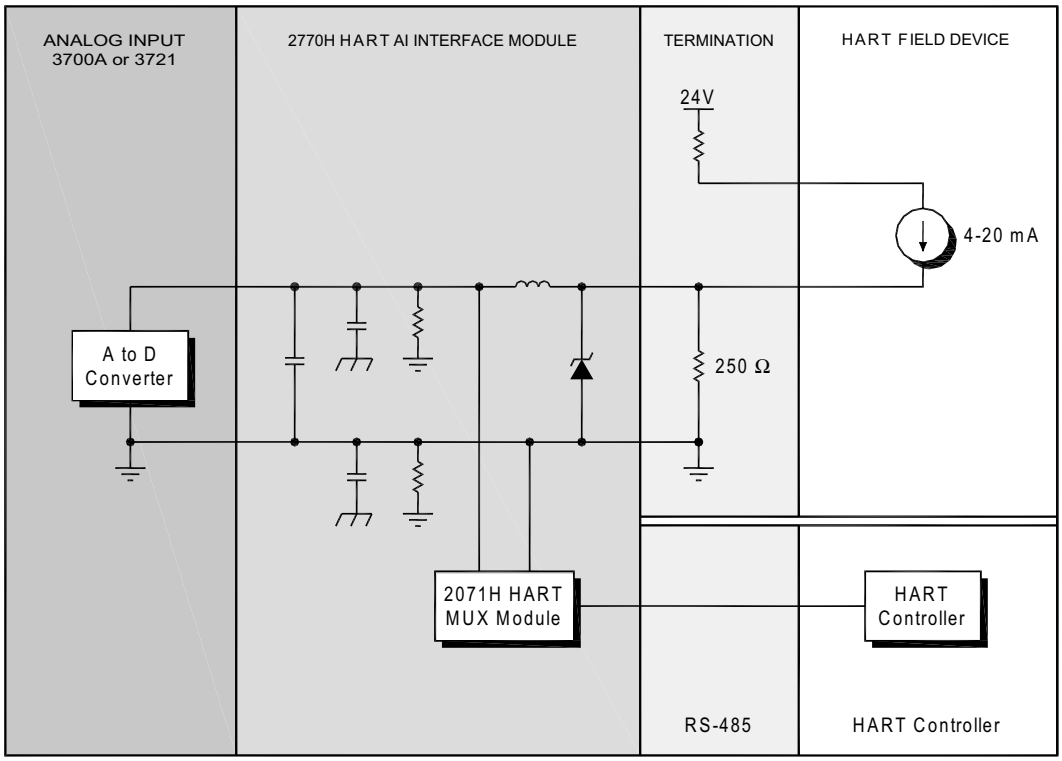


Figure 60 2770H Simplified Schematic

This figure shows the front panel of the Model 2770H HART Analog Input Interface Module.

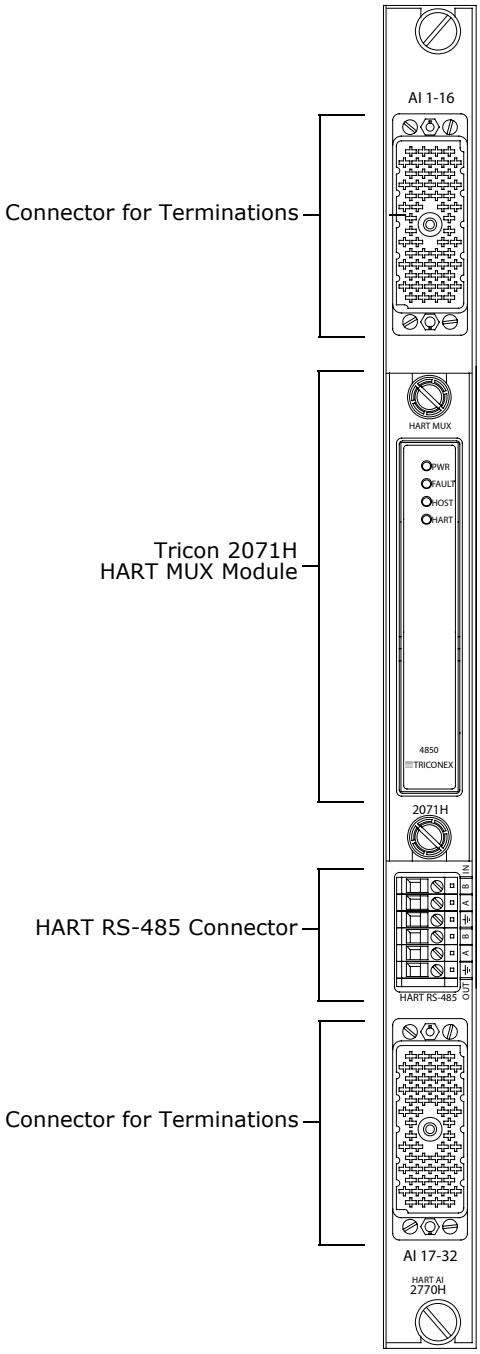


Figure 61 2770H Front Panel

2770H Specifications

This section includes specifications for model 2770H, which is an Analog Input Interface Module that provides HART communication to field devices connected to 3700A and 3721 Analog Input Modules.

Table 58 2770H HART Analog Input Interface Module Specifications

Feature	Specification
Compatible Analog Input Modules	3700A, 3721
Number of input signals	32
Input type	4-20 mA, 0 to 5 VDC
HART MUX Module[1]	2071H (includes the Triconex 4850 HART Multiplexer)
Status indicator: HART MUX module[1]	PWR, FAULT, HOST, HART
HART protocol	HART Field Communication Protocol, Revision 5.0–7.0
Logic power	< 5 Watts

1. For more information about the Triconex 4850 HART Multiplexer, including PC software installation and configuration, see the *Triconex 4850 HART Multiplexer Instruction Manual, INM4850-TR*.

HART Analog Output Interface Modules

This is a simplified schematic of the Model 2870H HART Analog Output Interface Module from the AO module to the field device.

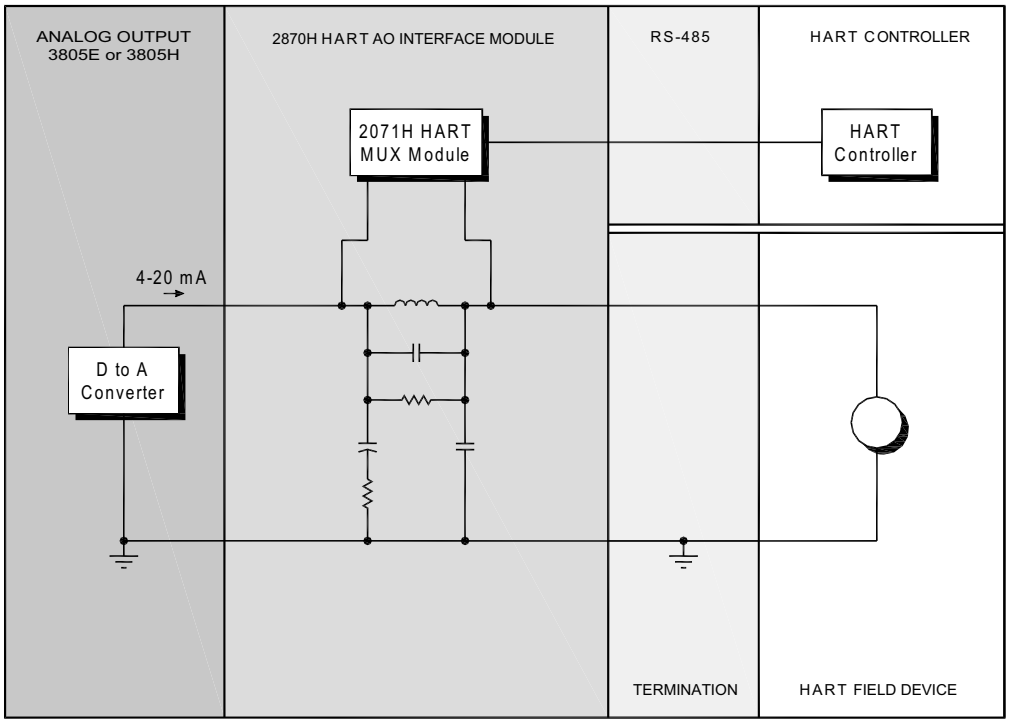


Figure 62 2870H Simplified Schematic

This figure shows the front panel of the Model 2870H HART Analog Output Interface Module.

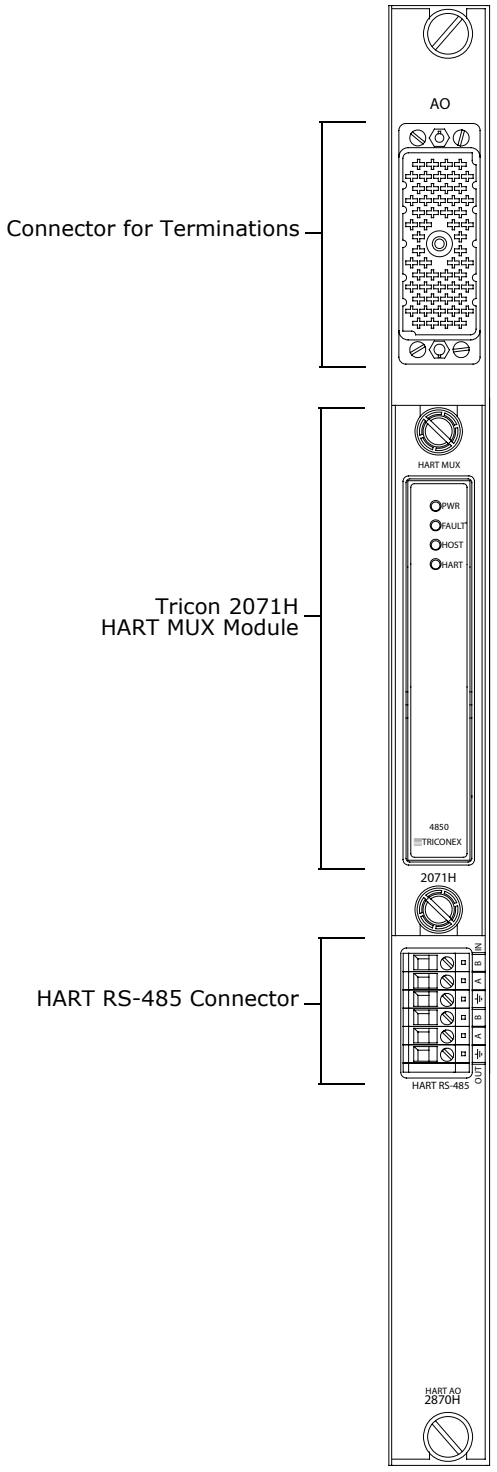


Figure 63 2870H Front Panel

2870H Specifications

This section includes specifications for model 2870H, which is an Analog Output Interface Module that provides HART communication to field devices connected to 3805E or 3805H Analog Output Modules.

Table 59 2870H HART Analog Output Interface Module Specifications

Feature	Specification
Compatible Analog Output Modules	3805E, 3805H
Number of output signals	8
Output type	4-20 mA, 0 to 5 VDC
HART MUX Module[1]	2071H (includes the Triconex 4850 HART Multiplexer)
Status indicator: HART MUX module[1]	PWR, FAULT, HOST, HART
HART protocol	HART Field Communication Protocol, Revision 5.0–7.0
Logic power	< 5 Watts

1. For more information about the Triconex 4850 HART Multiplexer, including PC software installation and configuration, see the *Triconex 4850 HART Multiplexer Instruction Manual, INM4850-TR*.

Advanced Communication Module (ACM)

The ACM (Advanced Communication Module) acts as an interface between a Tricon controller and a Foxboro Intelligent Automation (I/A) Series DCS, appearing to the Foxboro system as a safety node on the I/A Series Nodebus. The ACM communicates process information at full network data rates for use anywhere on the I/A Series DCS, transmitting all Tricon controller aliased data (including system variables and system aliases) and diagnostic information to operator workstations in display formats that are familiar to Foxboro operators.

The ACM includes these features:

- Handling of critical I/O points and passing of results to the I/A Series system using the Object Management Database (OMDB).
- Processing of Tricon alarms and propagation to user-defined I/A Series destinations, such as consoles and printers.
- Propagation of Tricon alarms as I/A Series messages.
- Reading and writing of aliased data to satisfy I/A Series system requests.
- Enabling of Time Synchronization from the I/A Series environment.
- Retrieval of Tricon sequence of events (SOE) data.
- Display of Tricon diagnostic data on I/A Series workstations.
- Write protection to lock out changes to the Tricon safety system from all I/A Series sources.
- Hot-spare module capability for redundant communication with the I/A Series Nodebus.

For more information, see the *ACM User's Guide* and *Communication Guide for Tricon v9–v10 Systems*. For additional requirements, see Replacing ACMs on page 225.

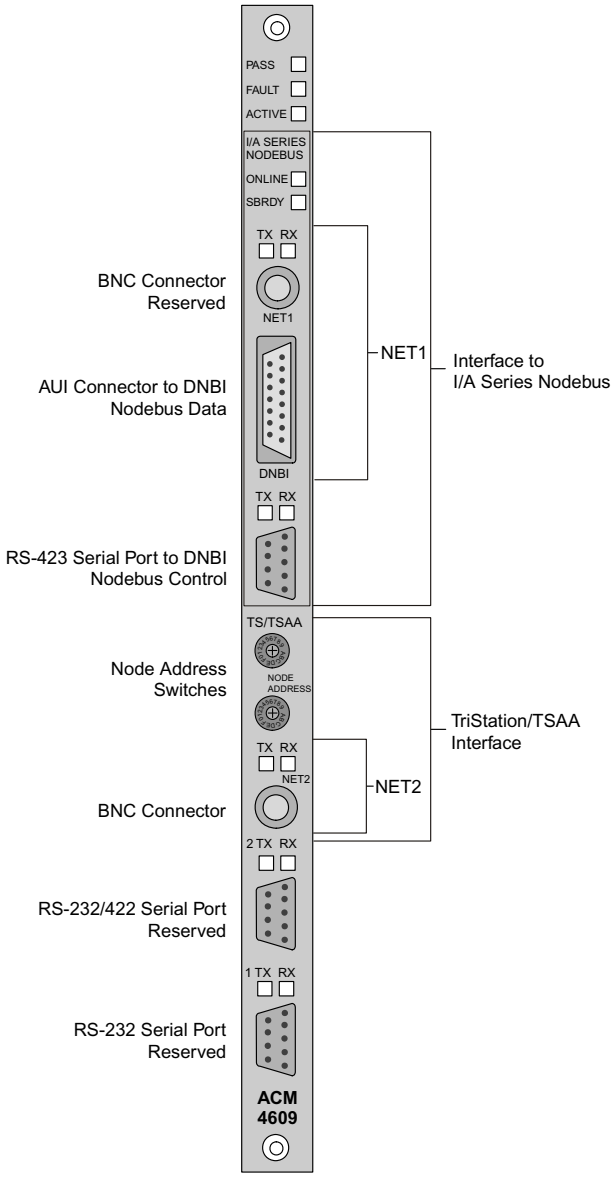


Figure 64 ACM Front Panel

ACM and I/A Series Connection

The ACM connection to the I/A Series Nodebus is through two dedicated ports—one for Nodebus data and one for Nodebus control. The ACM also includes a network port labeled TS/TSAA, which can be used for communication with a TriStation PC.

WARNING

- Triconex strongly recommends that you install a hot-spare for each ACM in your Tricon controller. Because the ACM is not a TMR module, a single fault can cause a momentary loss of communication with the distributed control system (DCS)—until the spare ACM becomes active. Without a spare, communication can be lost until the ACM is replaced and initialized from the DCS. (Failure of the ACM does not compromise the operation of the rest of the Tricon controller.)
- In hazardous indoor locations, apparatus used with the ACM must be FM-certified for Class I, Division II.

For more information about communication setup, see the *Communication Guide for Tricon v9–v10 Systems*.

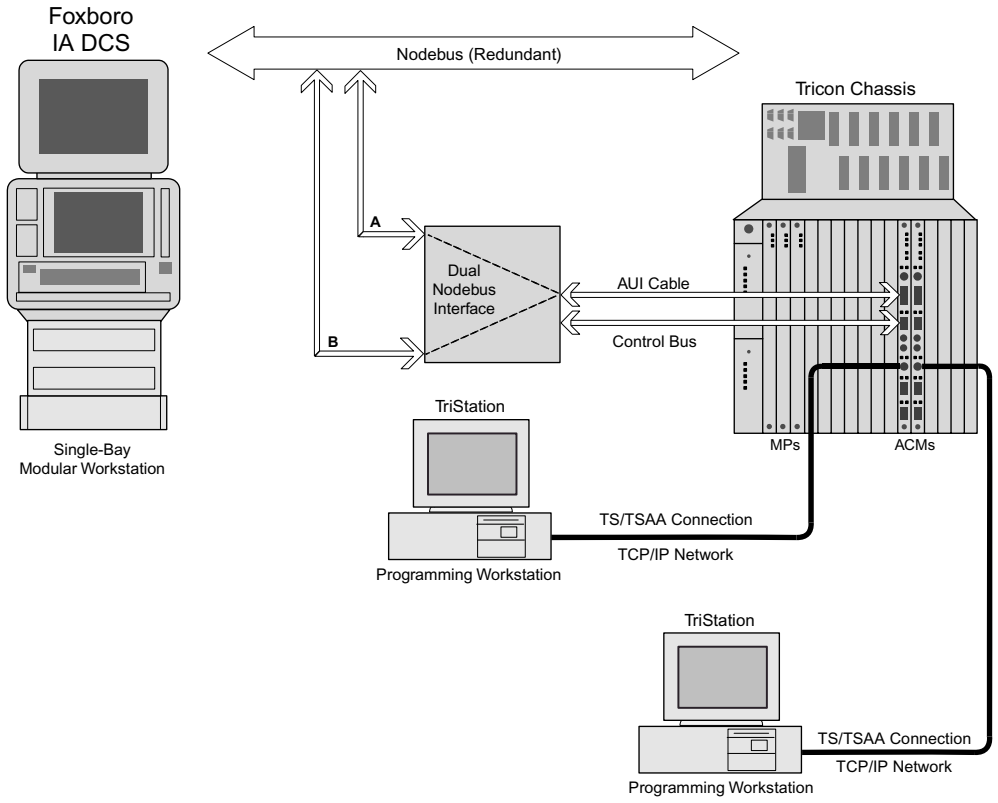


Figure 65 Tricon ACM and Foxboro I/A DCS Interface

4609 Specifications

This table lists the specifications for the ACM model 4609.

Table 60 4609 ACM Specifications

Feature	Specification
Nodebus port: BNC connector	1 for RG58, 50-ohm thin cable (reserved)
Nodebus port: 15-pin D connector	1 for AUI cable to DNBI
Nodebus port: 9-pin RS-423 connector	1 for Control Bus to DNBI
TS/TSAA port	1 BNC connector for RG58, 50-ohm thin cable to network
Serial port (reserved): 9-pin serial ports	RS-232/RS-422 (reserved)
Serial port (reserved): Port isolation	500 VDC (network and RS-232 ports)
Communication speed: BNC connectors	10 megabits
Communication speed: 15-pin D connector	10 megabits
Communication speed: 9-pin Nodebus connector	2400 baud
Status indicator: Module status	Pass, Fault, Active
Status indicator: Nodebus activity	ONLINE
Status indicator: Nodebus spare	SBRDY
Status indicator: Port activity	TX (Transmit) — 1 per port RX (Receive) — 1 per port
Logic power	< 20 watts

Enhanced Intelligent Communication Module (EICM)

The Enhanced Intelligent Communication Module (EICM) enables a Tricon controller to communicate with Modbus devices (masters or slaves), with a TriStation PC, and with a printer. A single Tricon High-Density controller supports up to two EICM modules which reside in one logical slot. This arrangement provides a total of six Modbus ports, two TriStation ports, and two printer ports. (The hot-spare feature is not available for the EICM, though you *can* replace a faulty EICM while the controller is online.)

Each EICM has four serial ports and one parallel port which can operate concurrently. The four serial ports are uniquely addressed and support either the Modbus or TriStation interface. Modbus communication can be performed in either RTU or ASCII mode. The parallel port provides a Centronics interface to a printer.

Each EICM supports an aggregate data rate of 57.6 kilobits per second, which means the total data rate for all four ports must be less than or equal to 57.6 kilobits per second.

Any standard Modbus device can communicate with a Tricon controller using the EICM provided that aliases are assigned to the tagnames (points) used in the control program. For more information, see the *TriStation Developer's Guide*.

For additional information, see the *Communication Guide for Tricon v9–v10 Systems* and Replacing EICMs on page 226.

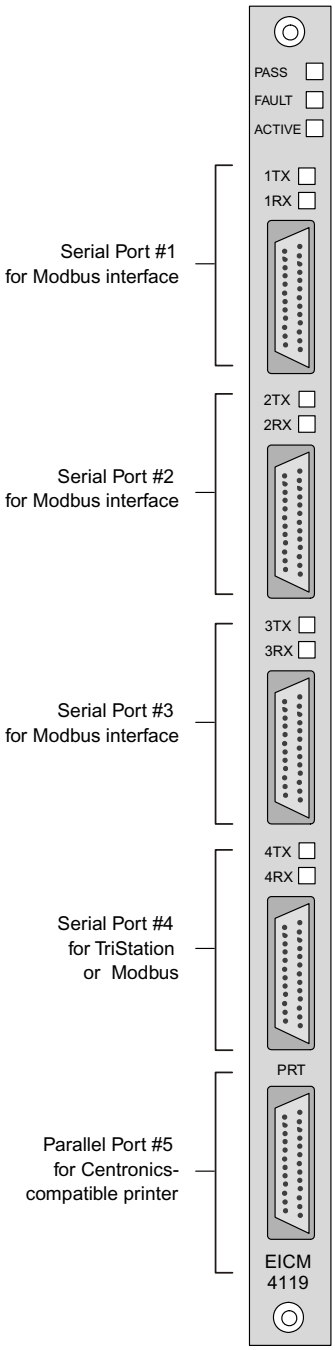


Figure 66 EICM Front Panel

4119 and 4119A Specifications

This table lists the specifications for model 4119 and 4119A EICM.

Table 61 4119 and 4119A EICM Specifications

Feature	Specification
Serial port	RS-232, RS-422 or RS-485, isolated to 500 VDC
Parallel ports	Centronics, isolated to 500 VDC
Protocol	TriStation, Modbus
Modbus function supported: 01	Read Coil status
Modbus function supported: 02	Read input status
Modbus function supported: 03	Read holding registers
Modbus function supported: 04	Read input registers
Modbus function supported: 05	Modify coil status
Modbus function supported: 06	Modify Register content
Modbus function supported: 07	Read exception status
Modbus function supported: 08	Loopback diagnostic test
Modbus function supported: 15	Force multiple coils
Modbus function supported: 16	Preset multiple registers
Communication speed	1200, 2400, 9600 or 19,200 baud
Status indicator: Module status	Pass, Fault, Active
Status indicator: Port activity	TX (Transmit)—1 per port RX (Receive)—1 per port
Status indicator: Logic power	< 10 watts

Hiway Interface Module (HIM)

The HIM (Hiway Interface Module) acts as an interface between a Tricon controller and a Honeywell TDC-3000 control system by means of the Hiway Gateway and Local Control Network (LCN). The HIM can also interface with a Honeywell TDC-2000 control system by means of the Data Hiway.

The HIM enables higher-order devices on the LCN or Data Hiway, such as computers and operator workstations, to communicate with a Tricon controller. The HIM module allows redundant BNC connections directly to the Data Hiway and has the same functional capacity as up to four extended Data Hiway Port (DHP) addresses.

The HIM provides eight Hiway addresses, implements the same slot structure as the DHP, and typically refreshes all data in less than 0.5 seconds. Although the HIM is not a TMR module, it fully supports the hot-spare feature, which allows online replacement of a faulty module.

For more information, see the *HIM User's Guide*.

For additional information, see Replacing HIMs on page 227.

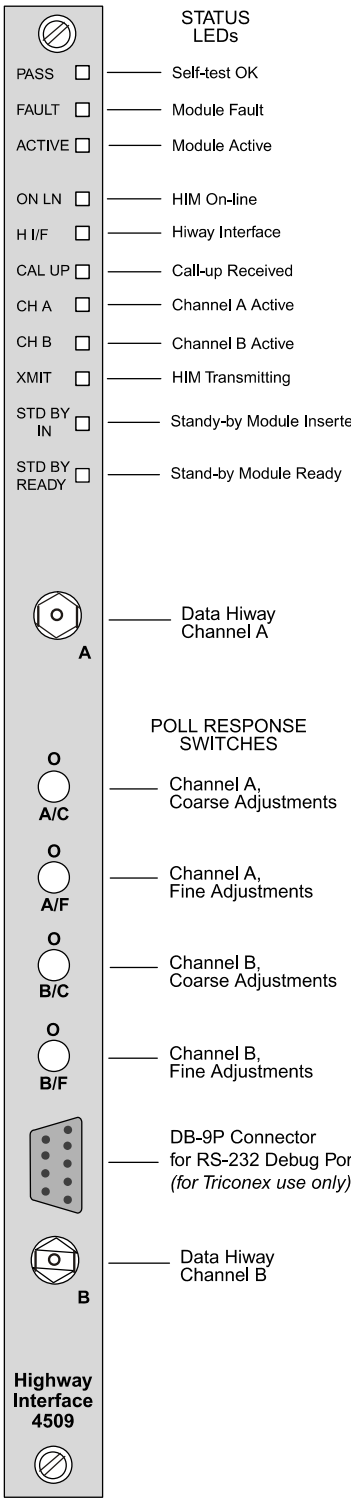


Figure 67 HIM Front Panel

4509 Specifications

This table lists HIM model 4509 specifications.

Table 62 HIM Model 4509 Specifications

Feature	Specification
Data hiway channels	2 isolated (AC-coupled)
Poll response switches	2 per channel
Baud rate	250 Kbaud
Status indicator: Module status	Pass, Fault, Active
Status indicator: HIM on-line	On Ln
Status indicator: Hiway interface	H I/F
Status indicator: Call-up received	Cal Up
Status indicator: Channel A active	Ch A
Status indicator: Channel B active	Ch B
Status indicator: HIM transmitting	Xmit
Status indicator: Standby module inserted	Std By In
Status indicator: Standby module ready	Std By Ready
Power Module load	< 10 watts
Isolation	500 VDC

Network Communication Module (NCM)

The Network Communication Module (NCM) enables a Tricon controller to communicate with other Tricons and with external devices on an Ethernet network. The NCM provides two BNC connectors as ports: NET 1 supports Peer-to-Peer and Time Synchronization protocols for safety networks comprised of Tricons only. NET 2 supports open networking to external systems using Triconex applications such as TriStation, SOE, OPC Server, and DDE Server or user-written applications.

The NCMG module has the same functionality as the NCM as well as the ability to synchronize time based on a GPS system.

The NCM is compatible with the Ethernet (IEEE 802.3 electrical interface) and operates at speeds up to 10 megabits. The NCM and the host computer can be connected by coaxial cable (RG58) at typical distances up to 607 feet (185 meters). Distances up to 2.5 miles (4,000 meters) are possible using repeaters and standard (thick-net) cabling. For more information, contact the IPS Global Client Support (GCS) center.

Two NCMs can be placed in one logical slot of the Tricon controller chassis, but they function independently, *not* as hot-spare modules.

The Main Processors typically refresh data on the NCM once per scan.

For additional information, see the *Communication Guide for Tricon v9–v10 Systems* and Replacing NCMs on page 228.

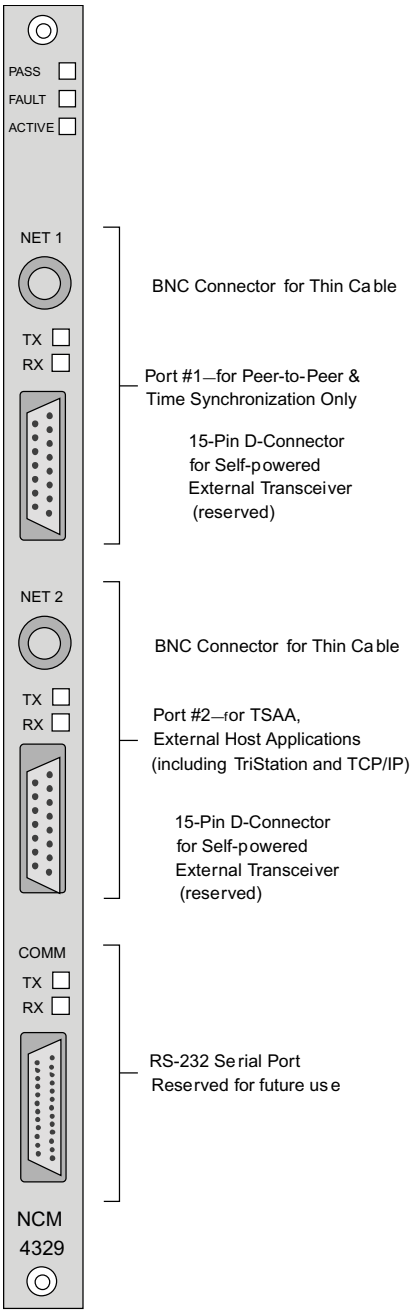


Figure 68 NCM Front Panel

4329 and 4329G Specifications

This table lists specifications for NCM models 4329 and 4329G.

Table 63 NCM Model 4329 and 4329G Specifications

Feature	Description
Network ports	Two BNC connectors using RG58 50-ohm thin cable
External transceiver ports	Not used
Serial port	One RS-232-compatible port
Port isolation	500 VDC, network and RS-232 ports
Protocols supported	Peer-to-Peer, Time Synchronization, TriStation, and TSAA
Communication speed	10 megabits
Status indicator: Module status	Pass, Fault, Active
Status indicator: Port activity	TX (Transmit) — 1 per port RX (Receive) — 1 per port
Logic power	< 20 watts

Safety Manager Module (SMM)

The SMM (Safety Manager Module) acts as an interface between a Tricon controller and a Honeywell Universal Control Network (UCN), which is one of three principal networks of the TDC-3000 Distributed Control System.

The SMM appears to the Honeywell system as a safety node on the UCN and communicates process information at full network data rates for use anywhere on the TDC-3000. The SMM transmits all Tricon controller aliased data (including system variables and system aliases) and diagnostic information to operator workstations in display formats that are familiar to Honeywell operators.

For supported TDC-3000 release levels, contact the IPS Global Client Support (GCS) center or the Honeywell Tac Center. For more information, see the *SMM User's Guide*.

The SMM includes these features:

- Handles critical I/O points and passes results to the DCS
- Processes Tricon controller alarms and propagates them to user-defined DCS destinations
- Reads/writes aliased data to satisfy DCS requests
- Reads Tricon controller diagnostics for display by the DCS
- Write protection to lock out changes to the Tricon controller from all TDC-3000 sources
- Time Synchronization from the DCS
- Peer-to-Peer communication for plants with many Tricon controllers, each containing an SMM—the DCS can use shared data to alert downstream Tricon controllers of significant process changes
- Sequence of Events—transmits Tricon controller event data to Universal Stations for display or History Modules for recording, to help determine the cause of plant trips and increase process up-time
- Hot-spare capability for uninterrupted communication with Honeywell networks

For additional requirements, see Replacing SMMs on page 229.

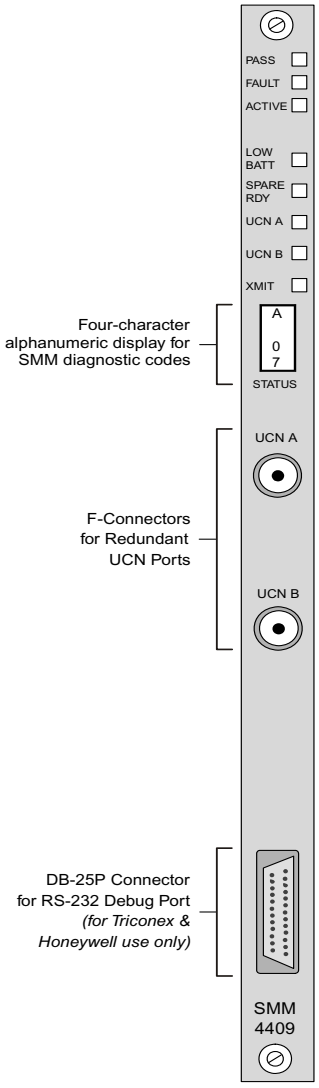


Figure 69 SMM Front Panel

4409 Specifications

This table lists the SMM model 4409 specifications.

Table 64 4409 SMM Specifications

Feature	Description
UCN ports	2 isolated, AC-coupled
UCN data rate	5 MB per second
Status indicator: Module status	Pass, Fault, Active
Status indicator: Low Battery	Fault Batt
Status indicator: Hot-spare ready	Spare Rdy
Status indicator: Port activity	UCN A, UCN Port A Active UCN B, UCN Port B Active
Status indicator: SMM transmitting	Xmit
Status indicator: Module node and diagnostic information	Status
Logic power	< 20 watts
Isolation (all ports)	500 VDC
Battery backup for database memory	6 months, typical

Tricon Communication Module (TCM)

The Tricon Communication Module (TCM), which is compatible with only Tricon v10.0 and later systems, allows the Tricon to communicate with TriStation, other Tricon or Trident controllers, Modbus master and slave devices, and external hosts over Ethernet networks.

Each TCM contains four serial ports, two network ports, and one debug port (for Triconex use).

Each serial port is uniquely addressed and can be configured as a Modbus master or slave. Serial port 1 supports either the Modbus or the Trimble GPS interface. Serial port 4 supports either the Modbus or the TriStation interface. Each TCM supports an aggregate data rate of 460.8 kilobits per second, for all four serial ports.

Programs for the Tricon use variable names as identifiers but Modbus devices use numeric addresses called *aliases*. Therefore an alias must be assigned to each Tricon variable name that will be read by or written to a Modbus device. An alias is a five-digit number which represents the Modbus message type and the address of the variable in the Tricon. An alias number is assigned in TriStation.

Any standard Modbus device can communicate with the Tricon through the TCM, provided that aliases are assigned to the Tricon variables. Alias numbers must also be used when host computers access the Tricon through other communication modules, such as the NCM.

TCM models 4353 and 4354 have an embedded OPC server, which allows up to ten OPC clients to subscribe to data collected by the OPC server. The embedded OPC server supports the Data Access standard and the Alarms and Events standard.

Each TCM contains two network ports—NET 1 and NET 2. Models 4351, 4351A, 4351B, and 4353 have two copper Ethernet ports. Models 4352, 4352A, 4352B, and 4354 have two fiber-optic Ethernet ports. See Table 67 for the list of supported protocols on the TCM network ports.

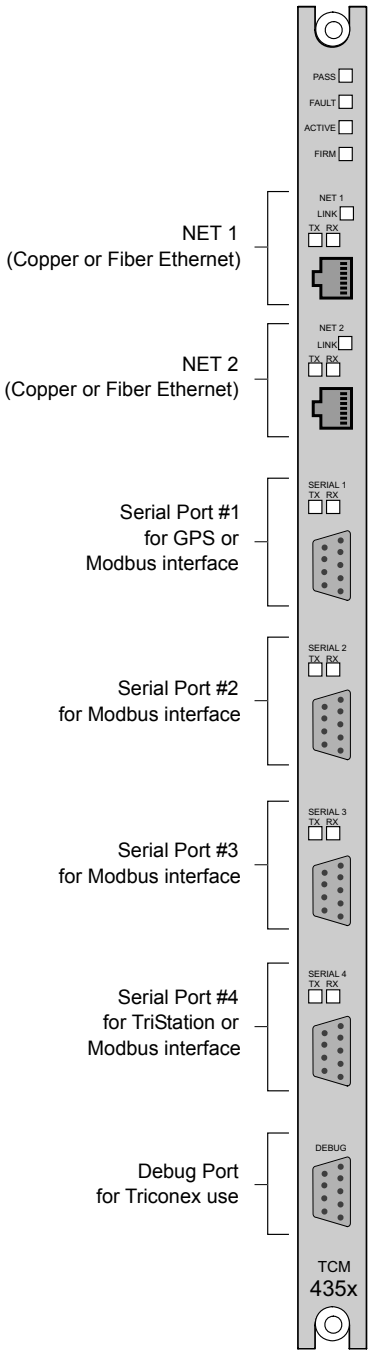


Figure 70 TCM Front Panel

A single Tricon system supports a maximum of four TCMs, which must reside in two logical slots located in chassis 1 or chassis 2 only. Different TCM models cannot be mixed in one logical

slot. Each Tricon system supports a total of sixteen Modbus masters or slaves—this total includes network and serial ports. The hot-spare feature is not available for the TCM, though you can replace a faulty TCM while the controller is online.

This table describes TCM model and Tricon system version compatibility.

Table 65 TCM Model and Tricon System Version Compatibility

Tricon System Version	Compatible TCM Models
10.0	4351, 4352
10.1–10.2	4351A, 4352A
10.3 or later	4351B, 4352B, 4353, 4354

For additional information, see the *Communication Guide for Tricon v9–v10 Systems* and Replacing TCMs on page 230.

TCM Specifications

This table lists specifications for TCM models 4351, 4351A, 4351B, 4352, 4352A, 4352B, 4353, and 4354.

CAUTION

Different TCM models cannot be mixed in the same logical slot. Additionally, models 4351A, 4351B, 4352A, 4352B, 4353, and 4354 TCMs cannot be installed into a system with 4351 or 4352 TCMs, even if they are installed in different chassis.

Table 66 TCM Specifications

Feature	Description	
Serial ports	4, RS-232/RS-485 ports, DB-9 connectors	
Network ports	2, 10/100BaseT Ethernet ports, RJ-45 connectors (models 4351, 4351A, 4351B, and 4353) 2, fiber-optic mode Ethernet ports, MT-RJ connectors with 62.5/125 um fiber cables (models 4352, 4352A, 4352B, and 4354)	
Port isolation	500 VDC	
Communication protocols	TriStation, Embedded OPC Server (models 4353 and 4354), Modbus, Modbus TCP, TCP/IP, SNTP, TSAA (with support for IP Multicast), Trimble GPS, Peer-to-Peer, Triconex Time Synchronization, Jet Direct (network printing)	
Modbus functions supported	01 — Read Coil Status 02 — Read Input Status 03 — Read Holding Registers 04 — Read Input Registers 05 — Modify Coil Status	06 — Modify Register Content 07 — Read Exception Status 08 — Loopback Diagnostic Test 15 — Force Multiple Coils 16 — Preset Multiple Registers

Table 66 TCM Specifications *(continued)*

Feature	Description
Communication speed	Copper Ethernet ports: 10/100 Mbps (model 4353 only supports 100 Mbps connections) Fiber Ethernet ports: 100 Mbps Serial ports: up to 115.2 Kbps per port, aggregate data rate of 460.8 Kbps for all four ports
Status indicators	PASS, FAULT, ACTIVE, FIRM LINK — 1 per network port TX (Transmit) — 1 per port RX (Receive) — 1 per port
Logic power	< 10 watts

This table lists the protocols and standards supported on TCM ports for models 4351, 4351A, 4351B, 4352, 4352A, 4352B, 4353, and 4354.

Table 67 TCM Protocols/Standards

Protocol or Standard	Network Ports (Models 4351 and 4352)	Network Ports (Models 4351A, 4351B, 4352A, and 4352B)	Network Ports (Models 4353 and 4354)	Serial Ports (All Models)
TriStation	NET 2	NET 1, NET 2	NET 1, NET 2	Port 4
TSAA (UDP/IP)	NET 2	NET 1, NET 2	NET 1	—
TSAA with IP Multicast (UDP/IP)	—[1]	NET 1, NET 2 (models 4351B and 4352B)	NET 1	—
Peer-to-Peer (UDP/IP)	NET 1	NET 1, NET 2	NET 1	—
Peer-to-Peer (DLC)	NET 1	NET 1	NET 1	—
Embedded OPC Server (OPC Data Access and OPC Alarms and Events)	—	—	NET 2	—
Modbus Slave (ASCII or RTU)	—	—	—	Any port
Modbus Master (RTU)	—	—	—	Any port
Modbus Master or Slave (TCP)	NET 2	NET 1, NET 2	NET 1	—
GPS Time Synchronization	—	—	—	Port 1
Triconex Time Synchronization via DLC	NET 1	NET 1	NET 1	—
Triconex Time Synchronization via UDP/IP	NET 1	NET 1, NET 2	NET 1	—

Table 67 TCM Protocols/Standards *(continued)*

Protocol or Standard	Network Ports (Models 4351 and 4352)	Network Ports (Models 4351A, 4351B, 4352A, and 4352B)	Network Ports (Models 4353 and 4354)	Serial Ports (All Models)
SNTP Triconex Time Synchronization	NET 2	NET 1, NET 2	NET 1, NET 2	—
Network Printing using Jet Direct	NET 2	NET 1, NET 2	NET 1	—

1. — means the protocol or standard is not supported on these ports.

Fiber-Optic Cables

If you are installing a TCM with fiber connectors (model 4352, 4352A, 4352B, or 4354), you will need to provide your own fiber-optic cables. You cannot purchase fiber-optic cables from Triconex.

The fiber cable you purchase should have these qualities:

- be a multimode 62.5/125 um cable
- have a maximum length of 1.24 miles (2 kilometers)
- comply with ANSI/TIA/EIA-568-B.3 standards

3

Installation and Maintenance

System Configuration 164
Installation Guidelines 168
Chassis and Module Installation 178
RXM Chassis Installation 203
Controller Grounding 208
Implementation and Maintenance 214
Module Replacement 220

System Configuration

This section includes specifications for a Tricon system, which includes a Main Chassis and additional Expansion or Remote Expansion (RXM) Chassis, as required.

Topics include:

- Configuration Specifications on page 164
- Communication Configuration on page 165
- Planning Power for a Tricon System on page 166

Configuration Specifications

This table includes specifications for determining the number and types of components that can be installed in a Tricon high-density and low-density system. A low-density system uses a pre-v9 chassis, which means fewer I/O modules can be included in a system.

Table 68 Configuration Guidelines

Component	High-Density Configuration	Low-Density Configuration
Maximum number of chassis	15	15
Maximum number of I/O and communication modules	118 • Main Chassis = 6 modules with hot-spares and 1 communication module • Expansion Chassis = 8 modules with hot-spares • RXM Chassis = 6 modules with hot-spares	76 • Main Chassis = 4 modules with hot-spares • Expansion Chassis = 5 modules with hot-spares • RXM Chassis = 4 modules with hot-spares
Communication modules	Must be installed in the Main Chassis or Chassis 2. Chassis 2 must be an Expansion or Primary RXM Chassis.	
Maximum I/O Bus length	100 feet (30 meters)	100 feet (30 meters)
Analog Input points (includes Thermocouple Input and Pulse Totalizer Input points)	1024	1024
Analog Output points	512	512
Digital Input points	2048	2048
Digital Output points	2048	2048
Pulse Input points	80	80

Communication Configuration

This table describes rules and guidelines for using communication modules. For more information, including installation and configuration instructions, see the *Communication Guide for Tricon v9–v10 Systems*.

Table 69 Communication Rules

Component	Description
Chassis	At least one communication module (TCM, ACM, EICM, or NCM) must be included in the Main Chassis or in Chassis 2, because these modules enable the TriStation PC to communicate with the Tricon controller. • If communication modules are housed in Chassis 2, this chassis must be an I/O Expansion Chassis or a primary RXM Chassis that is connected directly to the Main Chassis using I/O communication cables (model 9001) rather than standard I/O bus cables. • You cannot install an NCM and a TCM in the same Tricon system. You also cannot install an EICM and a TCM in the same system.
COM Slot	The COM slot can only be used for a TCM, EICM, or NCM.
TCM	Up to two logical slots can be configured for TCMs. Matched pairs of TCMs can be installed in the left and right positions of each logical slot, and they can be located in the main chassis or Chassis 2. Model 4351A, 4351B, 4352A, and 4352B TCMs cannot be installed into a system with model 4351 or 4352 TCMs, even if they are installed in different chassis.
NCM	Up to two logical slots can be configured for NCMs. Matched pairs of NCMs can be installed in the left and right positions of each logical slot. If only one logical slot is used, the slot can be in the Main Chassis or Chassis 2. If two logical slots are used, they must be Slot 6 and 7 in the Main Chassis, and Peer to Peer cannot be used.
EICM and ACM	One logical slot is available for EICMs or ACMs, respectively. Matched pairs of these modules can be installed in both the left and right positions of one logical slot.
HIM	Up to two logical slots can be configured for HIMs. Both slots must be in the Main Chassis.
SMM	Up to three logical slots can be configured for SMMs. A matched pair of SMMs can be installed in the left and right positions of each logical slot. All three slots must be in the Main Chassis or Chassis 2.

Planning Power for a Tricon System

The Tricon Power Modules provide adequate support for most controller configurations, however, limitations may apply to a Main Chassis containing multiple communication modules because these modules consume more power than others. This section explains how to determine the logic power consumption and cooling requirements of a Tricon controller.

Data in this section is based on a fault condition where only one of the redundant Power Modules is operational. Under normal operating conditions, both Power Modules share the load.

WARNING

Do not use the model 8312 Power Module in Tricon systems that are located in hazardous locations and must meet ATEX requirements. If you have 230 V line voltage and your system must meet ATEX requirements, use the model 8311 24 VDC Power Module along with the ATEX-certified 24 VDC power supply from Phoenix Contact—part number QUINT-PS-100-240AC/24DC/10/EX.

Determining Logic Power for Tricon Controller Chassis

Logic power refers to the number and kinds of modules that the Power Modules of a chassis can support without being overloaded. Table 70 (on page 167) identifies the logic power for each module. The total cannot exceed 175 watts, because each Power Module supplies a maximum of 175 watts at the rated maximum temperature of 140° F (60° C).

This calculation is based on the assumption that only one of the redundant Power Modules is operational. Under normal operating conditions, both Power Modules share the load and make more power available at all temperatures. This load-sharing allows the Power Modules to normally run at less than 50 percent of their rated maximum output thereby significantly increasing their service lifetime.

CAUTION

Avoid putting multiple high-power I/O modules into a Main Chassis. Each Main Chassis must house three Main Processors and a communication module which means multiple high-power I/O modules could exceed logic power limitations.

To determine logic power, add:

- logic power for primary modules
- logic power for hot-spare modules

Determining Cooling Requirements

Cooling requirements are determined by calculating the heat load dissipated by all the Tricon modules in the system. Table 70 (on page 167) identifies logic and field power usage for each module. For maximum reliability of the Tricon controller, the ambient temperature must be below 104° F (40° C). Please contact Triconex for further assistance with cooling needs.

To determine cooling requirements, add:

- logic power and field power for all the primary modules
- field power for all hot-spare modules

Table 70 Logic and Field Power of Tricon Modules

Type	Model No.	Maximum Logic Power (Watts)[1]	Maximum Field Power Primary/Spare (Typical)[2]
Main Processor	3008 3006/3007	10 15	
Power Modules	8310, 8311, 8312	—	30 (15)[3]
RXM Modules	420x, 421x	5	
Analog Input	370x/A	10	Negligible
Analog Input (High-Density)	3704E	10	Negligible
Analog Input (Isolated)	3703E	15	Negligible
Analog Input	3720, 3721	10	Negligible
Analog Output	3805E/H	15	22 (6) / 22 (6)
Analog Output	3806E	15	27 (12) / 27 (12)
Analog Output, BiPolar	3807	20	27 (12) / 27 (12)
Digital Input (High-Density)	3504E	10	Negligible
Digital Input (Single)	3564	10	39 (16) / 39 (16)
Digital Input (TMR)	350xE/T	10	96 (48) / 96 (48)
Digital Output (AC)	360xE/T	10	112 (20) / 32 (10)
Digital Output (DC)	360xE/T	10	112 (20) / 32 (10)
Digital Output (Dual)	3664	10	52 (16) / 20 (8)
Digital Output (Supervised, 16 points)	3624	10	32 (16) / Negligible
Digital Output (Supervised, 8 points)	361xE	10	26 (8) / 10 (4)
Digital Output (Supervised or Non-Supervised, 32 points)	3625	13	110
Pulse Input	351x	20	Negligible
Pulse Totalizer Input	3515	10	96 (24) / 96 (24)
Relay Output	3636R/T	15	Negligible
Thermocouple (Isolated)	3708E	15	Negligible
Thermocouple (Non-Isolated)	3706A	10	Negligible
HART Analog Input Interface	2770H	5	Negligible

Table 70 Logic and Field Power of Tricon Modules *(continued)*

Type	Model No.	Maximum Logic Power (Watts)[1]	Maximum Field Power Primary/Spare (Typical)[2]
HART Analog Output Interface	2870H	5	Negligible
Advanced Communication Module	4609	15	
Enhanced Intelligent Communication Module	4119, 4119A	10	
Hiway Interface Module	4509	10	
Network Communication Module	4329, 4329G	20	
Safety Manager Module	4409	20	
Tricon Communication Module	4351, 4351A, 4351B, 4352, 4352A, 4352B, 4353, 4354	7	

1. To convert watts to British thermal units, use the formula: BTU = watts x 3.414.
2. Hot-spare Digital Output Modules consume less field power than primary Digital Output Modules.
3. Represents power loss internal to the Power Modules.

Installation Guidelines

This section includes installation guidelines for the Tricon controller.

Topics include:

- General Installation Guidelines on page 168
- Plant Power and Grounding on page 169
- Tricon Field, Power, and Ground Wiring on page 170
- Application-Specific Installation Guidelines on page 172

General Installation Guidelines

Due to the critical applications the Tricon is typically used in, it has been designed to operate under worst-case conditions in the harsh environments typically found in industrial environments.

To ensure adequate operational margins are maintained even under these worst-case conditions, the Tricon should be installed in a controlled environment per the general guidelines contained in:

IEC 61131, Part 4, Programmable controllers, User Guidelines

Section 7 of this standard includes checklists to help control the following environmental conditions:

- Temperature
- Contaminants

- Shock and vibration
- Electromagnetic interference

Typical guidelines include:

- Locate the Tricon away from obvious sources of heat: space heaters, solar radiation, etc.
- Locate or isolate the Tricon from obvious sources of corrosive gases or dust.
- Locate or isolate the Tricon from obvious sources of shocks or periodic vibrations: rotating machinery, engines, compressors, presses, etc.
- Locate or isolate the Tricon from obvious sources of electromagnetic interference: large motors or motor controllers, power converters, radio controlled equipment, welding equipment, etc.

Plant Power and Grounding

All plant and control room power distribution and safety grounding (protective earthing) must be done per the applicable national electric codes, typical examples include:

IEC 60364, Electrical Installations of Buildings

National Fire Protection Association, 2002 Edition of the National Electrical Code Handbook

For new construction, or where simple retrofits are feasible, the plant and/or control room safety grounding system should employ a supplemental Zero Reference Signal Plane or Grid (ZRSG). Installation of such a system for the plant or control room is not required for a successful Tricon application, but does represent modern best industry practice and should be followed wherever possible. Even when not implemented at the plant or control room level, the concepts of a modern ZRSG should be included in the Tricon cabinet and interconnecting cable routing. The ZRSG implementation should be extended to include all equipment racks and interconnecting cable paths: metal conduits, cable trays, wireways, etc. Detailed installation guidelines can be found in:

EPRI TR- 102400, Volume 2, Handbook for Electromagnetic Compatibility of Digital Equipment in Power Plants, Implementation Guide for EMI Control

IEC 61000, Part 5, Section 2, Electromagnetic compatibility (EMC), Installation and mitigation guidelines, Earthing and cabling

IEEE Std 1100-1999, IEEE Recommended Practice for Powering and Grounding Electronic Equipment

Tricon Field, Power, and Ground Wiring

All Tricon power distribution and safety grounding (protective earthing) must be done per the applicable national electric codes, plus the information contained in this manual, typical examples include:

IEC 60364, Electrical Installations of Buildings

National Fire Protection Association, 2002 Edition of the National Electrical Code Handbook

Typically, the Tricon will be installed in an equipment rack or cabinet located in a control room. All wiring internal to that cabinet and leading to from that cabinet should be segregated into different types and bundled accordingly, for example:

- Measurement signals - typically very sensitive, low voltage signals from sensors: RTDs, TCs, speed or flow sensors, etc. These signals will typically require shielded twisted pair cabling.
- Measurement and low power control signals - typically sensitive, low voltage signals to/form intelligent sensors or control devices: 4-20 ma loops, 24 VDC discrete signals, etc. These signals will typically require twisted pair cabling.
- High power control signals and conditioned power distribution - typically not sensitive, higher voltage signals: 48-120 volt discrete signals, 24-120 VDC I/O power distribution, etc. These signals should always use twisted pair cabling.
- Input coming power and misc. circuits - typically noisy, higher power circuits - 115 VAC discrete signals, AC power distribution, cabinet fans or lights, etc. These signals should always use twisted pair cabling, and the Grounding Electrode Conductor (the green wire) should be twisted along with the power leads wherever possible.
- Earth bonding connections.

All cable routing and installation should be done to minimize EMI, detailed guidelines can be found in:

EPRI TR- 102400, Volume 2, Handbook for Electromagnetic Compatibility of Digital Equipment in Power Plants, Implementation Guide for EMI Control

IEC 61000-5-2, Electromagnetic compatibility (EMC), Installation and mitigation guidelines, Earthing and cabling

IEEE Std 1100-1999, IEEE Recommended Practice for Powering and Grounding Electronic Equipment

Typical guidelines include the following:

- Use ferrous metal cabinets, cable trays, and conduits.
- When the RS-485 I/O Bus is used to connect to a remote Expansion Chassis, the I/O Bus cables must be routed in dedicated metallic conduit or equivalently isolated from other noise sources.
- Electrically bond all surfaces of the cabinet and it's contents together with multiple conductive metal strapping, not simple wire. Particular attention should be paid to doors, and removable panels. In turn the cabinet must be bonded to the control room or plant safety ground system or ZRSG.

- Routinely use twisted pair cabling; use shielded twisted pair cabling for all sensitive signals. Allow the minimum amount of un-twisted wire that accommodates connection.
- Signals of different types should never be bundled together.
- Bundles of different types should be separated by a minimum of 10 times the largest lead diameter.
- Bundles of different types of signals should only cross at right angles to each other.
- All wires and/or bundles should be routed along the ZRSG; for example, along the cabinet walls, within a cable tray or conduit, along building steel or the floor ground grid.
- Where an inline filter or power conditioning is used, the input and output leads should never be routed in the same bundle.
- Maintain shield continuity and ensure that shield leads are not broken. Allow the minimum amount of unshielded wire that accommodates connection. Terminate the shield at both ends, use capacitive coupling at one end if potential ground loops are suspected.
- Where ferrites or line filters are to be installed on signals or cables entering or leaving the cabinet, they must be installed as close to the cabinet egress point as possible. Cables must be routed to minimize coupling between the filtered and non-filtered signals. The non-filtered wire lengths in the cabinet must be minimized to the maximum extend possible.

CAUTION

For applications with uninterruptible power supplies (UPS) that use AC inverters, Triconex recommends that you install an AC line filter at the cabinet power entry point for each AC power source. Select the size of the filter based on the worst-case AC load in the cabinet, and install the filter according to the Tricon Field, Power, and Ground Wiring on page 170 guidelines. Suitable filters include the Schaffner FN 350 series, or the Corcom SK series.

WARNING

Always turn field power off before removing ELCO connectors from the backplane of the Tricon chassis. Dangerous voltage may be present when field power is on and can cause damage to the Tricon backplane and termination panel.

Application-Specific Installation Guidelines

The following guidelines apply when installing the Tricon in application-specific locations.

Class 1 Division 2 Hazardous Locations

For North American hazardous location applications, the Tricon and associated equipment must be mounted in an enclosure that provides protection from fire and from personal injury resulting from access to live parts. The enclosure must require access via a tool, and if non-metallic, have the appropriate flammability rating.

The chassis alarm contacts must not be used in hazardous locations.

The replacement of batteries, fuses, I/O Modules, Main Processors, Power Modules, Communications Modules, or I/O Interface cables must not be attempted unless the area is known to be free of ignitable gas concentrations.

All communication cabling connected to the Main Processor and Communications modules must be nonincendive as described in Appendix D, Nonincendive Circuit Parameters. Communication cabling that extends through a hazardous area must be certified as being nonincendive.

Only these components, which are approved for use in Class 1 Division 2 hazardous locations, can be used:

- 2770H, HART Analog Input Interface Module
- 2870H, HART Analog Output Interface Module
- 3006, Main Processor
- 3008, Main Processor
- 3502E, 48V Digital Input Module
- 3503E, 24V Digital Input Module
- 3504E, 24V H.D. Digital Input Module
- 3505E, 24V Low Threshold. Digital Input Module
- 3511, Pulse Input Module
- 3515, Pulse Totalizer Module
- 3564, Single 24V Digital Input Module
- 3604E, 24VDC Digital Output Module
- 3607E, 48VDC Digital Output Module
- 3614E, 24VDC Supervised Digital Output Module
- 3615E, 24VDC Low Power Supervised Digital Output Module
- 3617E, 48VDC Supervised Digital Output Module
- 3624, 24VDC Supervised Digital Output Module
- 3625, 24VDC Supervised/Non-Supervised Digital Output Module

- 3664, 3674; 24V Dual Digital Output Module
- 3700A, 0-5V Analog Input Module
- 3701, 0-10V Analog Input Module
- 3703E, Isolated Analog Input Module
- 3704E, 0-5/0-10VDC Analog Input
- 3706A, TC Input Module
- 3708E, Isolated TC Input Module
- 3720, 3721; Analog Input Module
- 3805E/H, Analog Output Module
- 3806E, H.C. Analog Output Module
- 3807, BiPolar Analog Output Module
- 4119A, Enhanced Intelligent Communications Module
- 4200, 4201; Fiber Optic Remote Extender Module
- 4210, 4211; Single Mode Fiber Optic Remote Extender Module
- 4329, 4329G; Network Communications Module
- 4351, 4351A, 4351B, 4352, 4352A, 4352B, 4353, 4354; Tricon Communication Module
- 4409, Safety Manager Module
- 4509, Highway Interface Module
- 4609, Advanced Communication Module
- 8110, Main Chassis
- 8112, RXM Chassis
- 8111, Expansion Chassis
- 8121, Enhanced Low Density Expansion Chassis
- 8310, 120 V Power Module
- 8311, 24 VDC Power Module
- 8312, 230 VAC Power Module
- v9 External Termination Panels compatible with the above I/O modules

WARNING You must take additional explosion protection measures for field circuits when the field apparatus are in a hazardous area.

Zone 2 European Hazardous Locations

For European (ATEX) hazardous location applications, the Tricon and associated equipment must be installed in an enclosure that provides an IP54 minimum degree of protection per the requirements of EN 60529, Specification of protection provided by enclosures (IP Code). Simply stated, the enclosure must provide protection against dust and splashing water.

Additionally, the enclosure must meet the applicable requirements of EN 60079-15 or EN 50021. The following points must be taken into account:

- Mechanical strength
- Non-metallic enclosures and non-metallic parts of enclosures
- Earthing or equipotential bonding connection facilities

The following warning label must be placed on the outside of the enclosure:

DO NOT REMOVE OR REPLACE MODULES OR CABLES WHILE ENERGIZED UNLESS THE AREA IS KNOWN TO BE FREE OF IGNITABLE GAS CONCENTRATIONS.

All connecting screws must be securely tightened, so that loosening and separating are prevented.

The chassis alarm contacts must not be used in hazardous locations.

Male ELCO connectors must have a gasket installed, and it must be replaced before the end of its five-year life span. (Triconex part number 3000793-001 is a kit containing 25 gaskets.)

The replacement of batteries, fuses, I/O Modules, Main Processors, Power Modules, Communications Modules, or I/O Interface cables must not be attempted unless the area is known to be free of ignitable gas concentrations.

All communication cabling connected to the Main Processor and Communications modules must be nonincendive as described in Appendix D, Nonincendive Circuit Parameters. Communication cabling that extends through a hazardous area must be certified as being nonincendive.

Only these components, which are approved for use in Zone 2 hazardous locations, can be used:

- 2770H, HART Analog Input Interface Module
- 2870H, HART Analog Output Interface Module
- 3008, Main Processor
- 3503E, 24V Digital Input Module
- 3504E, 24V H.D. Digital Input Module
- 3505E, 24V Low Threshold Digital Input Module
- 3511 Pulse Input Module
- 3515, Pulse Totalizer Module
- 3564, Single 24V Digital Input Module
- 3604E, 24VDC Digital Output Module
- 3624, 24VDC Supervised Digital Output Module

- 3625, 24VDC Supervised/Non-Supervised Digital Output Module
- 3664, 3674; 24V Dual Digital Output Module
- 3700A, 0-5V Analog Input Module
- 3703E, Isolated Analog Input Module
- 3706A, TC Input Module
- 3708E, Isolated TC Input Module
- 3720, 3721; Analog Input Module
- 3805E/H, Analog Output Module
- 3806E, H.C. Analog Output Module
- 3807, BiPolar Analog Output Module
- 4119A, Enhanced Intelligent Communications Module
- 4200, 4201; Fiber Optic Remote Extender Module
- 4210, 4211; Single Mode Fiber Optic Remote Extender Module
- 4351, 4351A, 4351B, 4352, 4352A, 4352B, 4353, 4354; Tricon Communication Module
- 4329, 4329G; Network Communications Module
- 4409, Safety Manager Module
- 4509, Highway Interface Module
- 4609, Advanced Communication Module
- 8110, Main Chassis
- 8112, RXM Chassis
- 8111, Expansion Chassis
- 8121, Enhanced Low Density Expansion Chassis
- 8310, 120 V Power Module
- 8311, 24 VDC Power Module
- v9 External Termination Panels compatible with the above I/O modules

⚠ WARNING

- You must take additional explosion protection measures for field circuits when the field apparatus are in a hazardous area.
- When the Model 8121 Enhanced Low Density Expansion Chassis is used in Zone 2 hazardous locations, the signal ground and the chassis ground must be bridged together.
- In Zone 2 hazardous locations, an isolator must be used with the Model 2870H HART Analog Output Interface Module.

European Union Applications

To ensure compliance with European Low Voltage and EMC Directives, follow these installation guidelines:

- Any Tricon chassis containing an SMM or SRXM must be installed in an EMI/RFI shielded cabinet, and EMI/RFI filtering must be installed on all cables entering or leaving those cabinets. All other chassis can be installed in standard metal enclosures.
- Field power supplies must be approved for use in safety extra-low-voltage (SELV) circuits according to the requirements of EN 61010-1, Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements.

Acceptable EMI/RFI cabinets and cable filters include the following:

- Rittal PS or TS cabinet with EMI/RFI shielding (for example, TS8), or equivalent
- Fair-Rite Products snap-on ferrite suppression cores (type 43 material) or equivalent (a separate snap-on filter is required for each cable entering or leaving the EMI/RFI cabinet)

Fire and Gas Detection Applications

For all fire and gas detection applications, refer to the Tricon *Safety Considerations Guide for Tricon v9–v10 Systems* for additional installation guidelines.

For fire and gas detection applications, redundant field and system power sources and/or supplies must be used.

Functional Safety Applications

For all functional safety applications, refer to the Tricon *Safety Considerations Guide for Tricon v9–v10 Systems* for additional installation guidelines.

Nuclear 1E Applications

For all nuclear 1E applications, contact the IPS Global Client Support (GCS) center for the latest detailed installation instructions.

Only those modules qualified for nuclear 1E applications can be used; contact the IPS Global Client Support (GCS) center for the latest items on the Nuclear Qualified Equipment List (NQEL).

Semiconductor Manufacturing - Health and Safety Applications

For semiconductor manufacturing applications, compliance with these additional installation guidelines is highly recommended:

- Field and logic power supplies should be approved for use in safety extra-low-voltage (SELV) circuits according to the requirements of IEC 61010-1.
- For installations with voltages greater than 30 Vrms/36 VDC, the controller and associated equipment must be installed in a locked cabinet restricting access to trained personnel only, with a hazardous-voltage warning label attached prominently.
- For installations with ambient temperatures exceeding 94° F (35° C), the controller and associated equipment should be installed in a locked cabinet restricting access to trained personnel only, with a hot-surface warning label attached prominently.
- For applications in which continuous, correct system operation must be assured, the controller and associated equipment should be installed in a locked cabinet restricting access to trained personnel only, with a general-hazard warning label attached prominently.

For a physical description of labels, see Appendix C, Warning Labels.

Chassis and Module Installation

This section explains how to mount the chassis, modules, and other Tricon components. When unpacking the Tricon controller, check the items in the package against the shipping list to verify that everything you ordered is included. Keep the boxes and packing materials in case you need to return items to Triconex for any reason.

WARNING

For ATEX applications, male ELCO connectors must have a gasket installed, and it must be replaced before the end of its five-year life span. (Triconex part number 3000793-001 is a kit containing 25 gaskets.)

CAUTION

The Tricon controller can be repaired while operating. However, the integrity of the controller can only be assured if the operator follows repair procedures correctly. If in doubt about the procedures, the operator should take whatever steps are necessary to ensure the safety of the plant and personnel, then call Triconex for assistance in implementing the repair procedures.

Topics include:

- Rear-Mounting the Chassis on page 179
- Rack-Mounting the Chassis on page 179
- Dimensions and Clearances for Installation on page 180
- Allowing for Convection Cooling on page 181
- Connecting Multiple Chassis on page 181
- Using Slot Covers on page 181
- I/O Bus Address of Chassis on page 182
- Power Module Installation on page 184
- Slot Keys for Modules on page 186
- Setting the MP Node Setting on page 191
- Installing Modules on page 192
- Digital Output Field Wiring Precautions on page 192
- Pulse Input Installation and Operation on page 192
- Pulse Input Totalizer Installation and Operation on page 193
- Thermocouple Input Installation and Operation on page 194
- Installing Model 3807 BiPolar Analog Output Modules on page 194
- Installing HART Interface Modules in the Model 8121 Enhanced Low Density Expansion Chassis on page 195
- Installing HART Interface Modules in Systems Upgraded from v6–v8 on page 199
- Enclosing the Chassis on page 202

Rear-Mounting the Chassis

Commonly, one or more Tricon chassis are rear-mounted on a subplate with the mounting brackets installed at the rear of the chassis. The subplate is then put into a 20 inches (51 centimeters) deep industrial enclosure built to NEMA Type 12 specifications. A Tricon chassis (either the Main Chassis or an Expansion Chassis) requires a footprint of 19 inches wide by 22.75 inches high (48.3 centimeters wide by 57.8 centimeters high) on a subplate or panel.

Rack-Mounting the Chassis

A Tricon chassis can be rack-mounted on a standard 19 inches (47.5 centimeters) EIA (Electronics Industries Association) Standard #RS-310-C rack by installing the mounting brackets at the front of the chassis. When there is more than one Tricon chassis in an enclosure, Triconex recommends having at least 1.75 inches (4.45 centimeters) vertical clearance between them for cables. Figure 71 shows dimensions and clearances for Tricon chassis installation.

Triconex offers auxiliary Chassis Mounting Brackets (model 8405) for rack-mounted installations. This pair of brackets provides additional rear support to the chassis during shipment of pre-mounted chassis enclosure controllers.

CAUTION

- Auxiliary mounting brackets are intended only to provide additional support at the rear of a front rack-mounted chassis. Do not use auxiliary brackets in place of Triconex-supplied standard chassis-mounting brackets.
- Do not tighten the hex head screws securing the adjustable mounting brackets to the rear of the chassis until you have fully secured the chassis by the front mounting brackets and secured the auxiliary brackets to the rear mounting rails. Failure to comply with this procedure could result in a deformed chassis which can cause improper seating of modules.

Dimensions and Clearances for Installation

This figure shows the dimension of the chassis and the required clearances. When mounting a chassis into vented or unvented enclosures, sufficient clearance must be provided so that the ambient temperature of the Tricon controller is not exceeded. For more information, see Allowing for Convection Cooling on page 181.

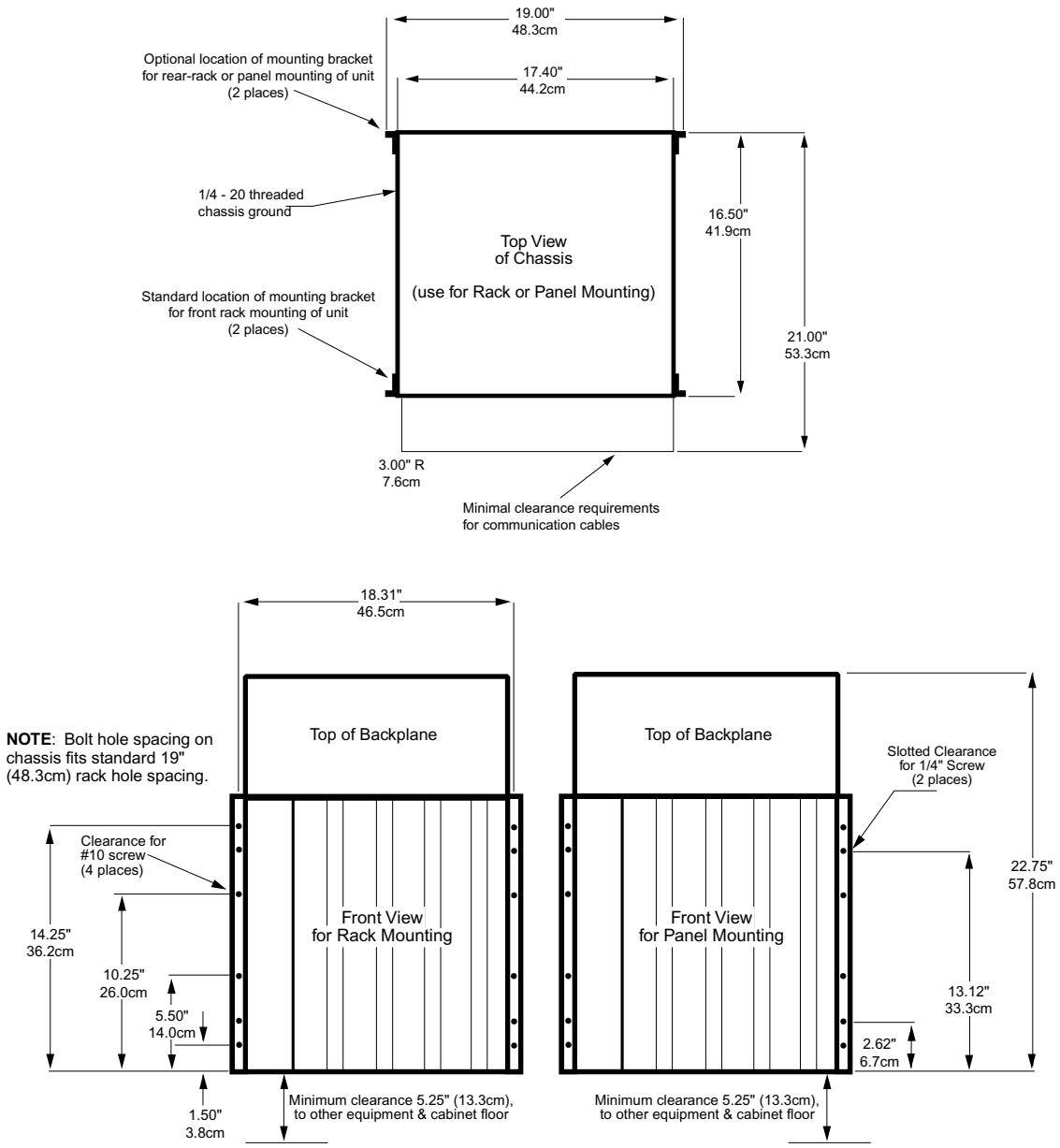


Figure 71 Dimensions and Clearances for Chassis Installation

Allowing for Convection Cooling

Whether the chassis is rack-mounted or panel-mounted, allow at least 5.25 inches (13.3 centimeters) between the outer panels of the Tricon chassis and the top and bottom panels of the enclosure. This space allows adequate convection cooling for all the chassis in the enclosure, and an acceptable ambient temperature for the Tricon chassis located at the top of the enclosure. Except under extraordinary circumstances, such as an ambient temperature above 140° F (60° C), no additional cooling or fans are required.

When mounting a chassis into vented or unvented enclosures, you must provide for heat management so that the specified ambient temperature of the Tricon controller is not exceeded.

For additional information about cooling, please contact the IPS Global Client Support (GCS) center.

Connecting Multiple Chassis

When a system requires more than a Main Chassis, each additional chassis must be connected by using a set of three cables that allow a physical extension of the triplicated I/O bus. Each chassis includes six I/O ports, which means each chassis can be connected to two other chassis. The communication speed between the I/O ports is 375 kilobits per second, which is the same rate as the internal Tricon controller I/O bus. This means the three control channels are physically and logically extended to the Expansion Chassis without sacrificing performance.

These cables can be used:

- Model 9000 is the I/O Bus Expansion Cable used to connect Expansion Chassis or a primary RXM Chassis to the Main Chassis.
- Model 9001 is the I/O COMM Bus Expansion Cable used when communication modules are housed in Expansion Chassis 2. The I/O communication cables are available only in a length of six feet.

If the distance between chassis is greater than 100 feet (30 meters), fiber-optic cables can be used to connect to an RXM Chassis.

Using Slot Covers

All unused chassis slots should be covered with Blank I/O Slot Panels (model 8105) to minimize exposure to dust and other particulate matter.

I/O Bus Address of Chassis

The I/O bus address identifies the chassis number in a Tricon system and is set with jumpers on the backplane. Typically, each Tricon chassis shipped from the factory has a different address for each chassis based on the sales order.

The address of the Main Chassis is always set to 1 and should not be changed. The address of an Expansion or RXM Chassis can be from 2 to 15. If necessary, Triconex recommends the chassis be returned to the factory to change the setting.

This figure shows the location of the jumpers on the backplane and an example of the jumper settings. Table 71 (on page 183) shows the binary addresses and jumper settings for each address.

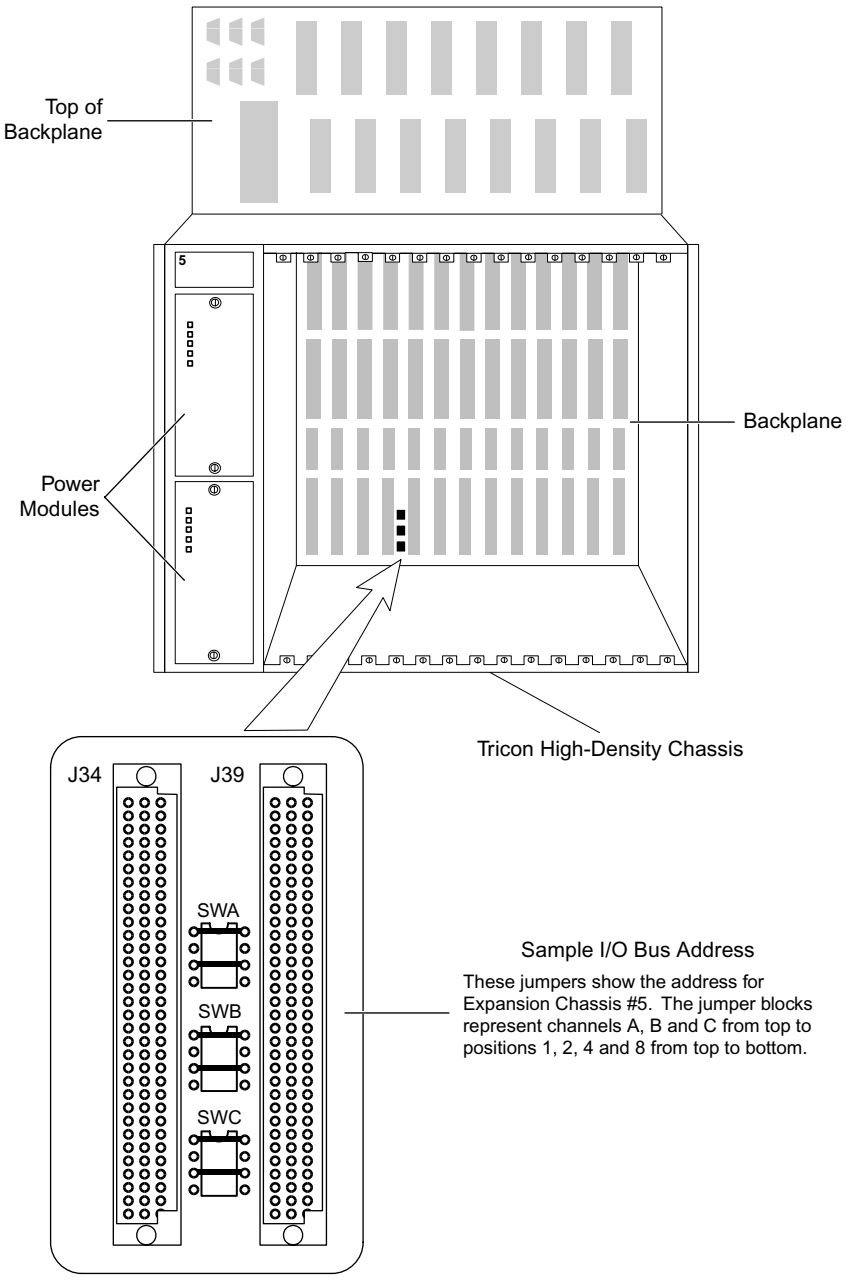
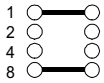
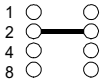
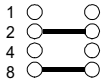
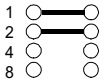
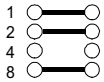
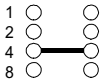
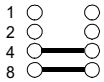
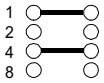
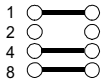
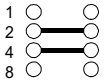
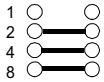
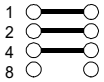
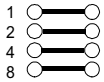
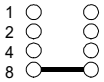


Figure 72 Example of I/O Bus Address for Chassis 5

Jumper Settings for the I/O Bus Address

The I/O bus address is represented as a binary number which is set on three jumper blocks on the backplane of the chassis. This table lists the binary number for each chassis address and shows the jumper installation for the setting.

Table 71 I/O Bus Address in Binary and as a Jumper Setting

Chassis Address	Address in Binary	Jumper Setting	Chassis Address	Address in Binary	Jumper Setting
1	0001		9	1001	
2	0010		10	1010	
3	0011		11	1011	
4	0100		12	1100	
5	0101		13	1101	
6	0110		14	1110	
7	0111		15	1111	
8	1000				

Power Module Installation

Each Tricon chassis (Main, Expansion, and RXM) includes two Power Modules, which can be any combination of models (8310, 8311, or 8312). Under normal circumstances, both Power Modules are active, and each contributes power to the Tricon controller; only the Pass and Status indicators are On. Either Power Module is capable of running the Tricon controller for an indefinite length of time.

If one of the Power Modules or its supporting power line fails, the second module increases its output to maintain power for the Tricon controller. If incoming power is interrupted or if one of the modules fails, its Fault indicator goes On. You can disconnect a failed Power Module from field power, remove it from the Tricon controller chassis, and replace it without shutting down the Tricon controller.

A minimum of 240 watts of incoming power is required for each Power Module in a chassis.

CAUTION

To maintain the security and integrity, source each Power Module separately, and provide independent circuit breakers or switches for each circuit.

Alarm Circuitry on Power Modules

The alarm circuitry on each Power Module operates independently. You should wire the warning system in a dual-redundant configuration, so that activation does not depend upon power from only one power source. This figure provides an example of this type of wiring.

WARNING

Do not use alarm contacts in hazardous locations.

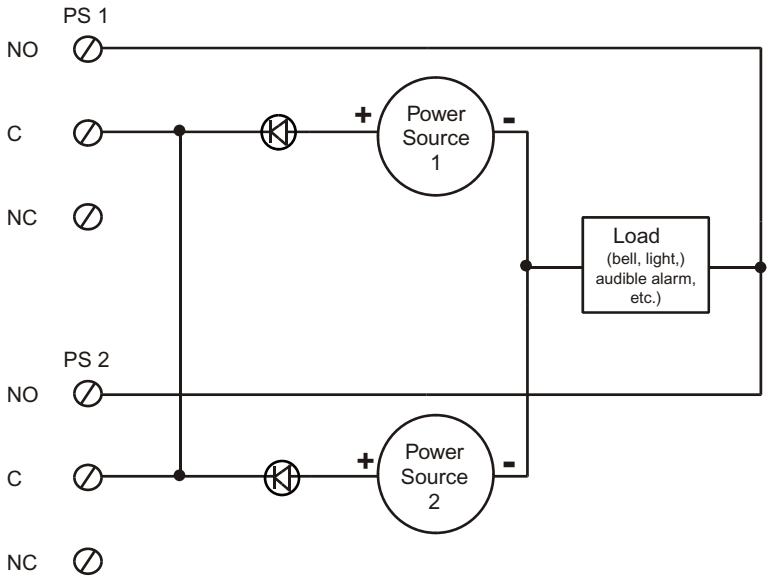


Figure 73 Alarm Sample Wiring

For specifications, see Power Modules on page 33.

Wiring to Separate Power Source

To ensure the advantages of dual redundant and independent Power Modules, each Power Module should be wired to a separate power source. Wiring to a separate power source permits the replacement of one Power Module, without interrupting field power to the other, so that the Tricon controller can continue operations without a break in service.

The terminals for incoming power and alarm applications are on the backplane above the Power Modules.

Each independent power source, equipped with its own fuse and switch, can be shared by multiple Tricon controller chassis. You should connect every chassis to two independent power sources.

Wiring to a UPS

In critical applications, it is best to connect at least one Power Module to an Uninterruptible Power Supply (UPS) which can be shared by multiple Tricon chassis. The UPS must be rated for the total number of chassis to be powered, and for the duration of the maximum expected down time.

Supply Wiring Specifications

Supply wiring should be sized according to applicable local electrical codes, taking into account the current ratings (as specified in 120 Volt Power Module Specifications on page 36), temperatures, wiring lengths, and other applicable considerations.

Do not operate the Tricon controller without a safety earth.

Alarm Wiring

Each system includes two sets of redundant alarm contacts, one per Power Module, that can be specified as needed. Typically, alarm wiring is connected to a local or remote annunciator. These devices can be wired in parallel with the alarm wiring so that the designated alarm goes off whenever either Power Module signals an alarm condition.

Do not use alarm contacts in hazardous locations.

These are the alarm contacts:

- Normally open contact
- Common
- Normally closed contact

This figure shows typical power wiring.

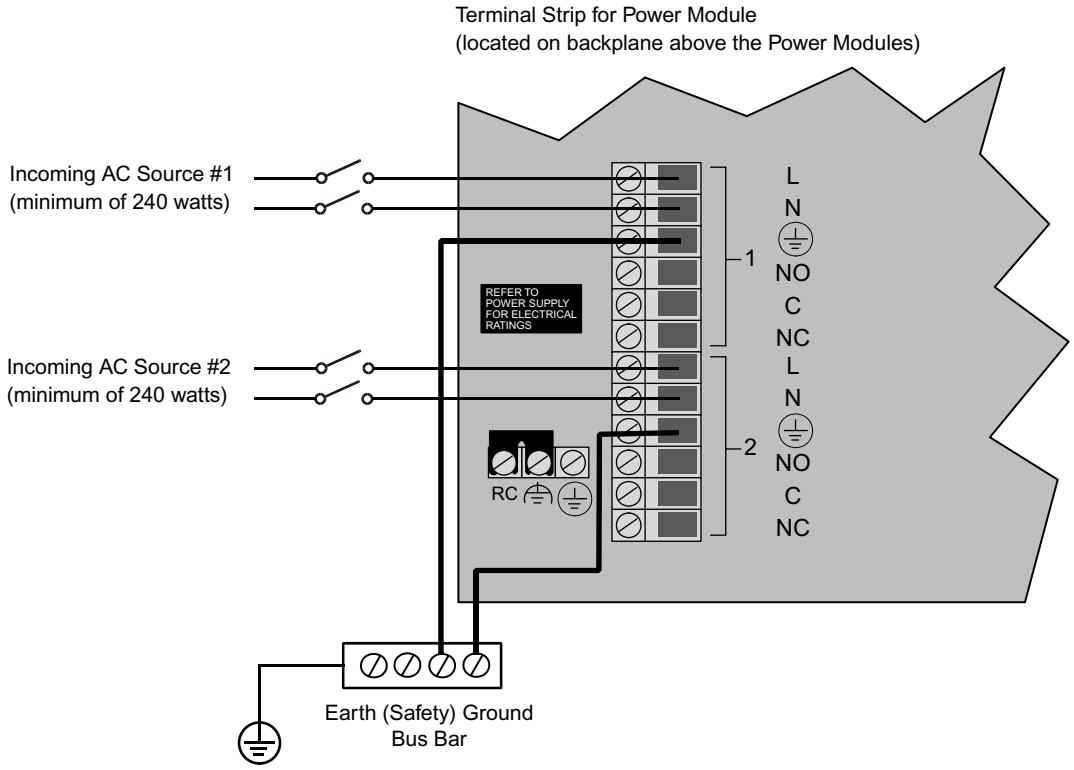


Figure 74 Typical Power Module Wiring

Slot Keys for Modules

Each slot in the Tricon chassis is fitted with metal slot keys to restrict the type of module that can be installed. The keys correspond to slotted spaces on each module. The spacers are located about 2 inches (5 centimeters) in from the module front panel between the aluminum spine and the printed circuit board. All modules of a particular type, for example, all 24-volt Digital Input Modules, are identically keyed.

If you try to install a module in an incorrect slot, the module does not slide the last 5 cm (2 in) into the chassis. *Do not apply force to overcome the obstruction caused by the keys.*

Installing Power Module Keys

Each Power Module slot is fitted at the top with a key that allows only one type of module to be installed. If you replace the installed Power Modules with a different voltage model, you must install the appropriate keys for the new modules. To do so, remove the screws for the existing keys and pull the keys off their shelves. Then place each new key onto its shelf, insert the two screws, and screw them upward from the bottom of the shelf.

Table 72 Power Module Key Positions

Model	Module Name	Top Key
8310	120 VAC/VDC Power Module	001
8311	24 VDC Power Module	003
8312	230 VAC Power Module	004

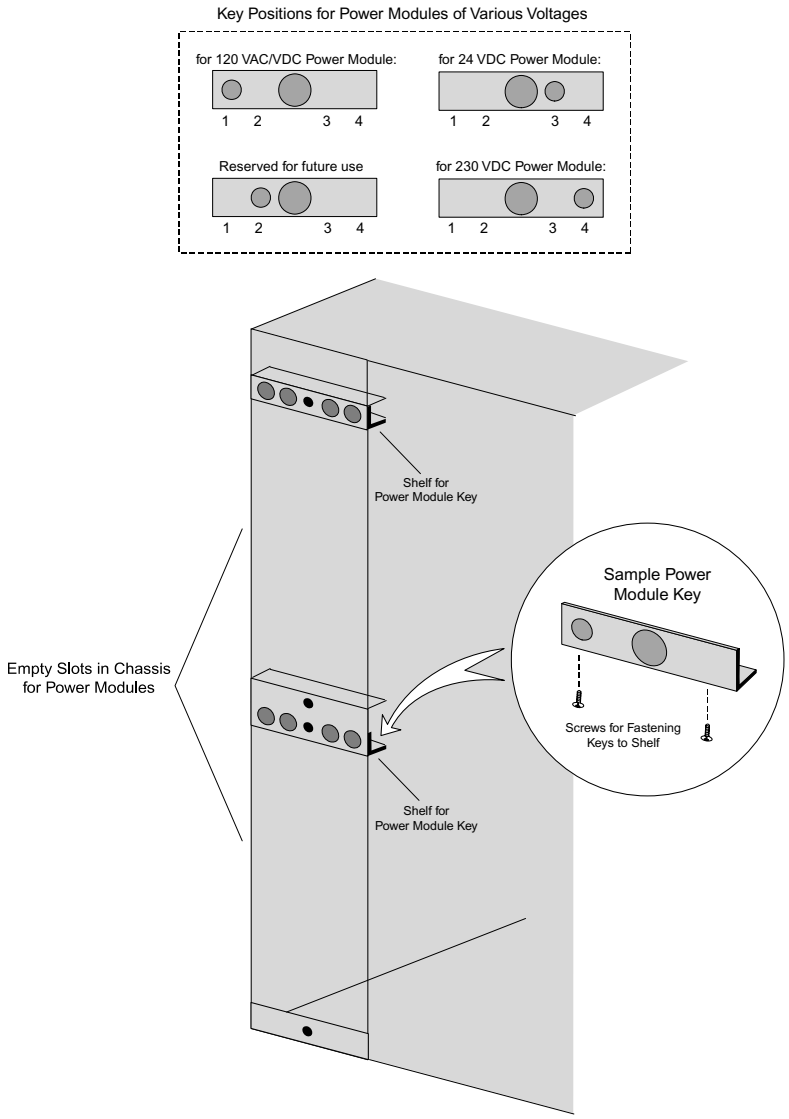


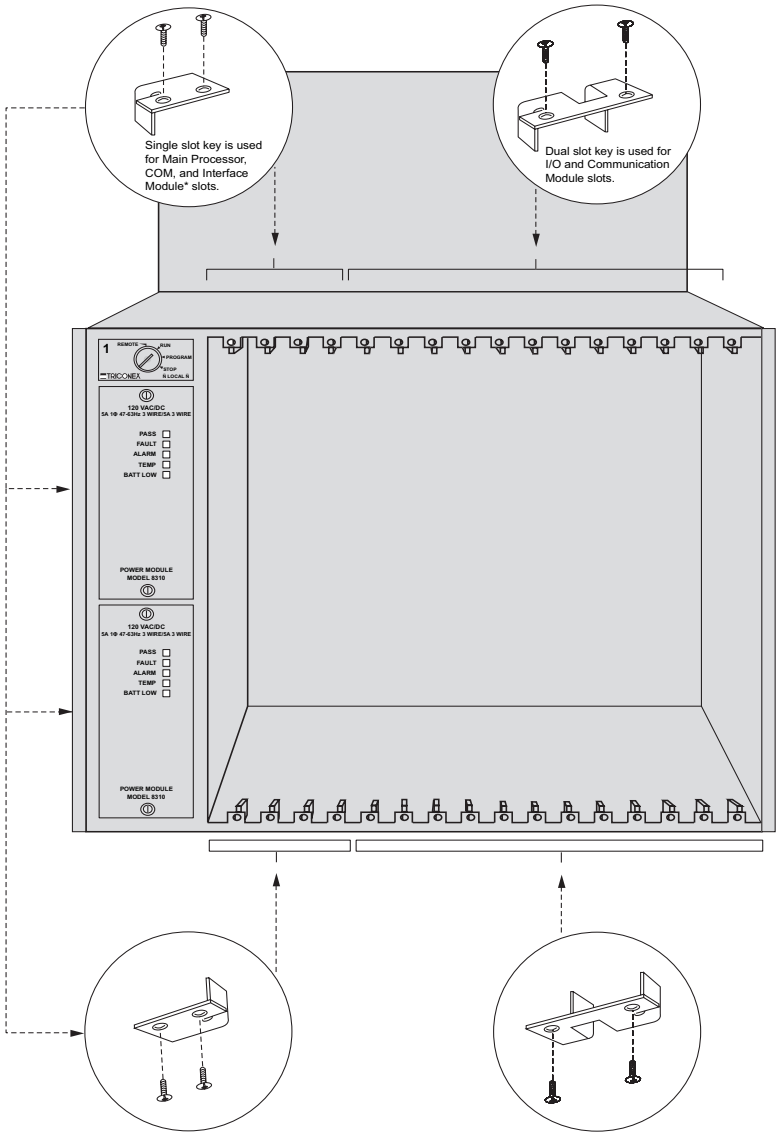
Figure 75 Power Module Key Positions

Installing Single and Dual Keys

Each Main Processor slot, COM slot, and Interface Module slot is fitted at the top and bottom with single keys. Each I/O and Communication Module slot is fitted at the top and bottom with dual keys.

To install a new module that uses different keys, remove the screws for the existing keys, then install the keys that come with the new module. Screw the keys for the top of the slot downward through the top of the chassis; screw the keys for the bottom of the slot upward from the bottom of the chassis, as shown in this figure.

For slot key numbers by module, see Slot Key Numbers on page 189.



*Interface Modules cannot be installed in a Model 8110 Main Chassis—they are mentioned in this figure for illustrative purposes only. See the "HART Interface Modules" section for chassis compatibility.

Figure 76 Keys for Single and Dual Slots

Slot Key Numbers

This table lists the keys for Main Processors and the COM (used for TCM, EICM, or NCM) slots.

Table 73 Main Processor, COM, and Blank Slot Keys

Model	Module Name	Top Key	Bottom Key
3008	Main Processor (MP) Module	007	002
3006, 3007	Main Processor (MP) Module	007	007
	COM Slot (TCM. EICM, or NCM)	001	003
	Blank Logical Slot[1]	001	008

1. Use this key combination or part number 2000508-001 to prevent the insertion of modules into any unused slots in your controller.

This table lists the keys for I/O and communication module slots.

Table 74 I/O and Communication Module Slot Keys

Model	Module Name	Top Key	Bottom Key
3501E/T	115 VAC/DC Digital Input (TMR)	004	004
3502E	48 VAC/DC Digital Input with Self-Test (TMR)	004	005
3503E	24 VAC/DC Digital Input with Self-Test (TMR)	004	006
3504E	24 VDC /48 VDC High Density Digital Input (TMR)	004	007
3505E	24 VDC Low Threshold Digital Input with Self-Test (TMR)	004	006
3510	Pulse Input, AC Coupled (TMR)	004	001
3511	Pulse Input, AC Coupled (TMR)	004	001
3515	Pulse Totalizer Input	004	002
3564	24 VDC Digital Input (Single)	004	006
3601E/T	115 VAC Digital Output (TMR)	006	004
3603B	120 VDC Digital Output (TMR), non-commoned	006	006
3603E/T	120 VDC Digital Output (TMR), commoned	006	006
3604E	24 VDC Digital Output (TMR)	006	007
3607E	48 VDC Digital Output (TMR)	006	003
3611E	115 VAC Supervised Digital Output (TMR)	005	002
3613E	120 VDC Supervised Digital Output (TMR)	005	005
3614E	24 VDC Supervised Digital Output (TMR)	005	004
3615E	24 VDC Low-Power Supervised Digital Output (TMR)	005	004
3617E	48 VDC Supervised Digital Output (TMR)	005	003
3623/T	120 VDC Supervised Digital Output (TMR)	005	005