SIEMENS

APOGEE TX-I/O Modules and Island Bus

Technical Reference Manual

140-0914

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Building Technologies

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This equipment generates, uses, and can radiate radio frequency energy. If equipment is not installed and used in accordance with the instructions manual, it may cause interference to radio communications. Equipment has been tested and found to comply within the limits for a Class B digital device pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference. Residential area equipment users are required to take whatever measures necessary to correct the interference at their own expense.

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FCC Regulations

The manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible could void the user’s authority to operate the equipment.

For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the

user is encouraged to try to correct the interference by one or more of the following measures:

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

To the Reader

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TX-I/O Product Range Overview

	CAUTION
	This device includes electrical and electronic components and must not be disposed of as domestic waste. Product recovery and disposal must comply with all national and local regulations.

TX-I/O is a line of I/O modules with associated power and communication modules for use within the APOGEE system. The I/O modules reside on the TX-I/O *island bus*, which simultaneously carries the supply voltages for the I/O modules and the field devices and provides the communication bus between the island bus controller and the connected TX-I/O modules.

TX-I/O island bus communication requires one of the following controllers:

- PXC Modular
- PXC-36
- P1 Bus Interface Module (BIM)

Only one controller is permitted per island bus.

PXC Modular and PXC-36

The PXC Modular and PXC-36 can directly control an island bus.

- Either the PXC Modular or the PXC-36 provides the control database and communications for points on TX-I/O modules, but it does not supply power.
- When using the PXC Modular or PXC-36, a TX-I/O Power Supply module is required.
- For more information, see the *PXC Modular Series Technical Reference Manual* (145-046) or *PXC Compact Series Technical Reference Manual* (145-172).

P1 Bus Interface Module (BIM)

Any field panel containing Firmware Revision 2.8 or later can control an island bus through the P1 BIM.

- The P1 BIM connects TX-I/O modules to the P1 FLN.
- The P1 BIM provides both communications and power for TX-I/O modules, but it does not contain applications or perform control; the control database for the TX-I/O points resides in a field panel.
- The P1 Bus Interface Module (BIM) has an integrated power supply. If additional power is needed for the TX-I/O modules or sensor power, additional TX-I/O Power Supply modules may be connected to the TX-I/O island bus.

For more information, see the *P1 Bus Interface Module Technical Reference Manual* (145-972).

TX-I/O Modules

TX-I/O Modules are modular expansion I/O consisting of an electronics module and a terminal base; they receive power from a TX-I/O Power Supply, Bus Connection Module, or P1 BIM.

- The electronics module performs A/D or D/A conversion, signal processing, point monitoring, and command output.
- The terminal base provides for termination of field wiring and connection of the self-forming TX-I/O island bus.

The design of the TX-I/O Modules provides optimum diagnostics and results in a more efficient installation and maintenance workflow.

- Field wiring may be terminated prior to installation of electronics.
- Connected peripheral devices can be measured without affecting or being affected by the I/O module.
- *Hot-swappable electronic components* allow powered electronics to be disconnected and replaced without removing terminal wiring or disturbing the self-forming bus.

Local Override Feature

⚠ WARNING

Do not use the local override for safety shutdown operations, such as performing service or maintenance. Use suitable emergency switches instead.

I/O modules TXM1.8X-ML and TXM1.8U-ML include a local override feature.

- In principle, plug-in I/O modules with and without a local LCD panel/operator controls are compatible and interchangeable.
- Only outputs can be overwritten. Any attempt to overwrite an input results in an error.
- Local override also operates without a bus master, provided that the 24 Vdc module supply is present and the address key is plugged in.
- With a change from automatic mode to local override, the last state is retained. The PXC Modular, PXC-36, or P1 BIM resumes control when the system is switched back to Auto.
- The PXC Modular, PXC-36, or P1 BIM is notified of local overrides and the associated values, and they are permanently saved in the module.

Override Button

Pressing an override button in the middle enables or disables the local override (press until the override status LED changes to ON or OFF).

When local override is enabled:

- Pressing "+" increases an output value or activates the relay.
- Pressing "–" reduces an output value or disables the relay.

- Repeated or sustained pressure changes the value by several stages until the function stops at the highest/lowest stage.
- The I/O status LED and LCD display change accordingly.

Pressing "+" or "–" when local override is disabled results in an error.

TX-I/O Module Feature Summary

⚠ CAUTION

Active inputs and output are permitted on the same module when connected sensors are powered from that module.
When sensors are externally powered, active inputs and outputs should be on separate modules.

		TX-I/O Module Type and Product Number							
		Super Universal		Universal		Digital Input		DO Relay	
Module Function		TXM1. 8X-ML	TXM1. 8X	TXM1. 8U-ML	TXM1. 8U	TXM1. 8D	TXM1. 16D	TXM1. 6R-M	TXM1. 6R
General	Local Override	•		•				•	
	LCD Display	•		•					
AI	NI 1000 LS	•	•	•	•				
	PT 1000 385	•	•	•	•				
	LT 1000 375	•	•	•	•				
	NTC 10K (w/out diode)	•	•	•	•				
	NTC 100K	•	•	•	•				
	0-10 Vdc	•	•	•	•				
	4-20 mA	•	•						
AO	0-10 Vdc	•	•	•	•				
	4-20 mA	•[1]	•[1]						
DI	Static Contact (NC/NO)	•	•	•	•	•	•		
	Pulse accumulator	•	•	•	•	•	•		
	25 Hz Counter (with debouncing)	•	•	•	•				
	10 Hz Counter (with debouncing)					•[2]	•		
DO	ON/OFF							•	•
	Pulse ON							•	•

1) 4-20 mA functionality is only available on point terminations 5-8.

2) 10 Hz counter functionality (LPACI) is only supported on point terminations 1-8.

TX-I/O Module Specifications

Dimensions (L × W × D)	2.52” × 3.54” × 2.75” (64 mm × 90 mm × 70 mm)
Power Requirements	24 Vac +/-20% input @ 50 or 60 Hz
Ambient operating temperature	32°F to +122°F (0°C to 50°C), 5 to 95% rh, non-condensing
UL	UL 864 UUKL Smoke Control Equipment UL 864 UUKL7 Smoke Control Equipment UL 916 PAZX CSA 22.2 No. 205 PAZX7
Agency Compliance	CFR47 Part 15, Class A; CFR47 Part 15, Class B Australian EMC Framework (C-Tick) 2004/108/EC European EMC Directive (CE) 2006/95/EC European Low Voltage Directive (LVD)

Power Data by Module Type			
Product Number	**Power Consumption**	**24 Vdc Output Bus Voltage**	**24 Vac Supply Voltage**
TXM1.8D	1.1 W	-	-
TXM1.16D	1.4 W	-	-
TXM1.8U	1.5 W	-	96 VA
TXM1.8U-ML	1.8 W	-	96 VA
TXM1.8X	2.2 W	4.8 W max (~200 mA)	96 VA
TXM1.8X-ML	2.3 W	4.8 W max (~200 mA)	96 VA
TXM1.6R	1.7 W	-	-
TXM1.6R-M	1.9 W	-	-

Consumption Data for I/O Points

TX-I/O module consumption data is provided as an aid to transformer and TX-I/O Power Supply sizing and to estimate the heat emitted in the enclosure for the following devices:

- Transformers (intrinsic consumption)
- PXC Modular, PXC-36, or P1 BIM
- Other field panel controllers
- Power supply modules (intrinsic consumption)
- All individual I/O points
- Field devices (connected to the module supply or to separate transformers)

NOTE:
The 24 Vdc consumption from the modules of field devices other than current sensors must be counted separately. Admissible current for each TXM1.8X or TXM1.8X-ML module: 200 mA.

		TX-I/O Module Consumption Data (24 Vdc per I/O point, values in mA for supply sizing)							
		Super Universal		Universal		Digital Input		DO Relay	
Module Function		TXM1. 8X-ML	TXM1. 8X	TXM1. 8U-ML	TXM1. 8U	TXM1. 8D	TXM1. 16D	TXM1. 6R-M	TXM1. 6R
General	Intrinsic consumption [1]	35	30	60	35	25	25	30	20
	Unconfigured I/O point (Reserve for later configuration)	25	25	3	3	3.5	2.5	8	8
AI	Temperature sensors Ni, PT [3]	0	0	0	0				
	Temperature sensor NTC [3]	0	0	0	0				
	Resistance [3]	0.5	0.5	1	1				
	10 Vdc [2]	0.5	0.5	1	1				
	20 mA, Supply external or 24 Vac [2]	0.5	0.5						
	20 mA, 2-wire [2]	20	20						
	20 mA, 3-wire [2] [4]	25	25						
AO	10 Vdc [2]	2.5	2.5	3	3				
	20 mA [2]	18	18						
DI	Contact closed [2]	2	2	3	3	3.5	2.5		
DO	Relay, contact closed [2]							8	8

[1] Including module status LED; includes LCD and all override LEDs if applicable.

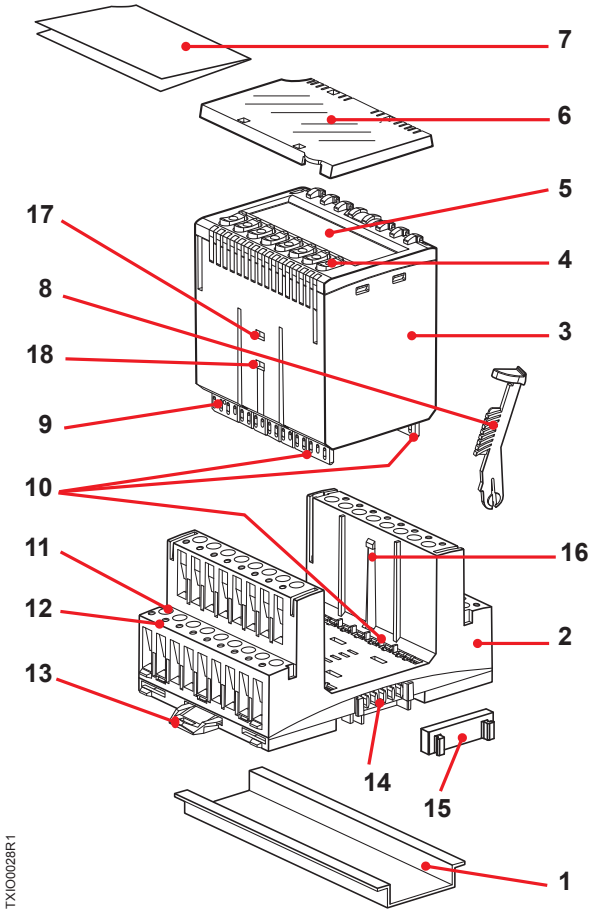
[2] Including I/O status LED.

[3] Included in intrinsic consumption (no I/O status LED for temperature inputs).

[4] Assumes 5 mA to supply the current sensor, which should be sufficient for most models. If in doubt, please refer to the sensor data sheet.

TX-I/O Module Assembly

The following figure shows the general TX-I/O Module components and hardware features.

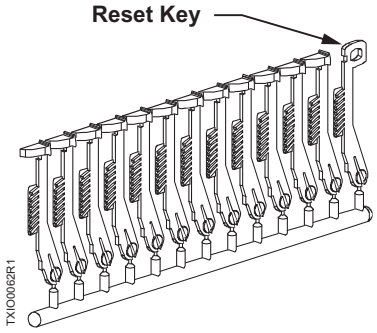


I/O Module Assembly.

1	Standard DIN mounting rail (not included)	10	Electrical contact between terminal base and plug-in module
2	Terminal base (plug-in base for the I/O module)	11	Terminal screws
3	Plug-in module (the functioning component of the I/O module assembly)	12	Test pickups (test points)
4	Local override facility (not applicable to all types)	13	Slide fitting to lock assembly into position on standard mounting rail
5	LCD display (not applicable to all types)	14	TX-I/O bus connector
6	Detachable label holder	15	TX-I/O bus connector cover
7	Module label (not included)	16	Module lock
8	Address key with mechanically encoded module address	17	Module disengage catch
9	Plug-in contacts between the terminal base and the plug-in module	18	Module release catch

Address Keys

The P1 Bus Interface Module (BIM) (10-module) and I/O modules are addressed using a TX-I/O address key.

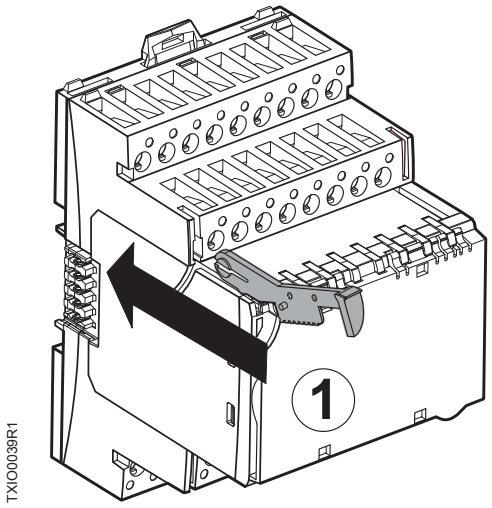


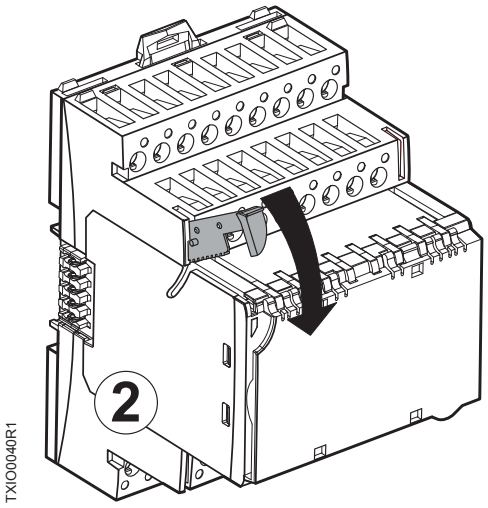
TX-I/O Address Keys.

The keys are available in sets of 24, up to a maximum value of 72 (2 sets of 12, 1-24, 25-48, and 49-72). The valid address range is 1 through 98.

- The I/O module address is mechanically encoded in the address key.
  - Without an address key, the module is inactive.
  - With an address key inserted, the module has full functionality.
- Based on the address, the PXC Modular, PXC-36, or P1 BIM configures the I/O module, indicates which field devices are connected to this module, and which function is required for the field devices.

	⚠ CAUTION
	The address key must be inserted firmly into the terminal base before swiveling it into the plug-in module.





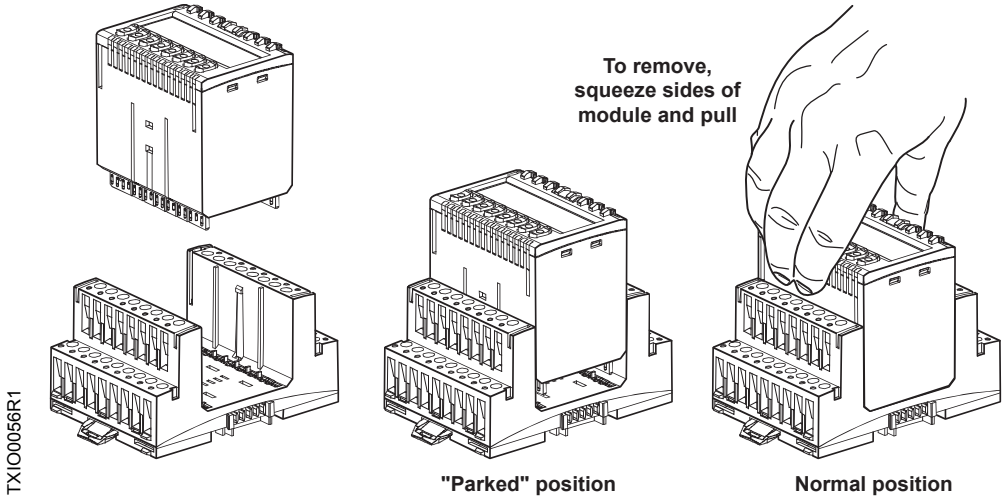
Swiveling the Address Key Out

When the address key is swiveled out, the I/O module is inactive, and it cannot be overridden locally. The state (automatic operation, tool override, or local override), configuration, and parameters of the individual I/O points are saved in the non-volatile memory of the plug-in module.

Swiveling the Address Key Back into Place

When a fault is repaired or an address key is swiveled back into place, operation resumes in the same state as before (automatic operation, tool override, or local override). The process values are only stored in tool override or local override.

Separating a Module from its Terminal Base



Separating a Module from its Terminal Base.

To Park a Module

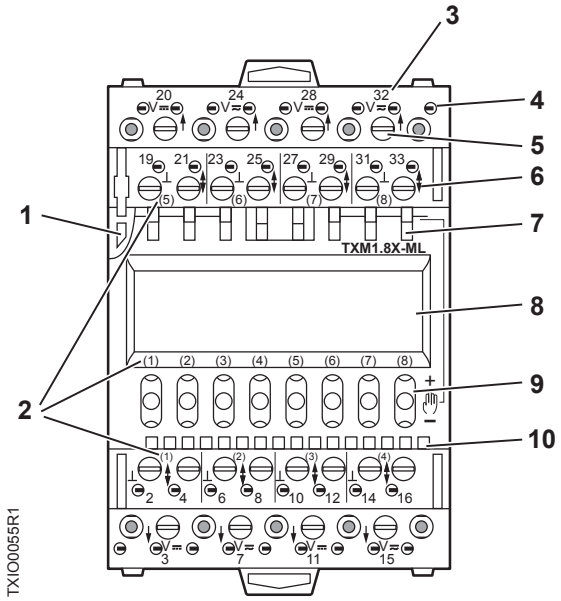
In the "parked" position the plug-in modules are fully isolated from the terminal bases. The connected field devices can be measured through the test pickups without being affected by the plug-in module electronics.

1. Squeeze module sides above the disengage catch and pull up slightly to disengage the I/O module from the terminal base.
2. The I/O module is retained in the terminal base (‘parked’), but all wiring connections are now floating.

To Remove a Module

Squeeze module sides above the release catch and pull up to remove the I/O module from the terminal base.

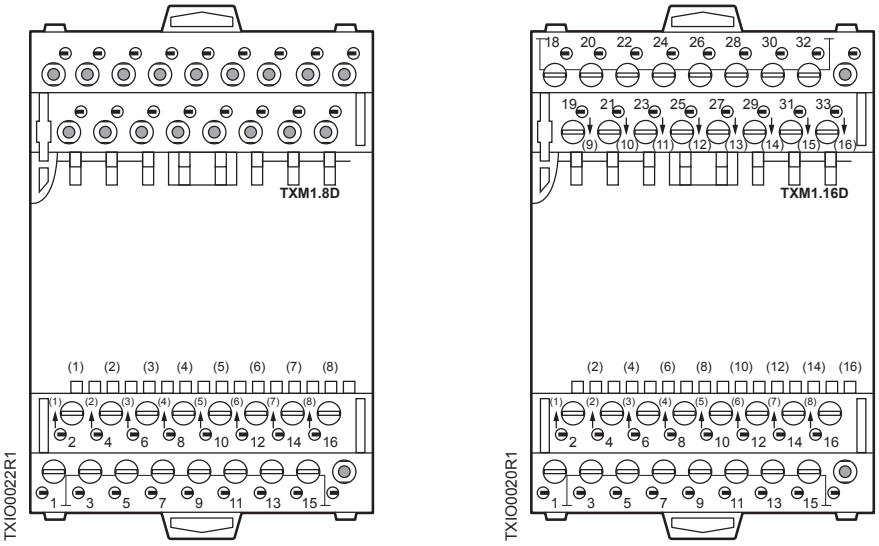
TX-I/O Module Product Diagram



TX-I/O Module Symbols and Status LEDs			
	LED, Symbol, or Feature	**LED or Symbol**	**Indication**
1	Address key and module status LED (green)	-	Module status as a whole (as opposed to the I/O points).
		ON	Normal operation. 24 Vac (supply voltage) input present; fuse is intact.
		OFF	Error. - No 24 Vac (supply voltage) input. - Fuse is blown.
		Flashing or pulsing	- Fault indication - No address key - Remote override
2	I/O point numbers	-	-
3	Terminal number	-	-
4	Test terminal	-	
5	Connection terminals	-	
6	⊥	-	System neutral.
	↕	-	Configurable point.
	↓	-	Output (arrow pointing OUT from center of module).
	↑	-	Input (arrow pointing IN toward center module).
	V⎓	-	24 Vdc output (field supply).
	V≂	-	24 Vac output (field supply).

TX-I/O Module Symbols and Status LEDs			
	LED, Symbol, or Feature	**LED or Symbol**	**Indication**
7	Override status LEDs (yellow)	ON	Manual operation; a local override is active.
		OFF	No voltage or manual operation off.
		Flashing or pulsing	- Override action - Remote override - Output: Local override is off, operation is not possible. - Input: Operation is not possible.
8	LCD signal display	-	Only on a TX-I/O modules with –ML suffix.
9	Local override switch	-	Only on a TX-I/O with –M or –ML suffix.
10	I/O status LEDs (green)	-	Status of the inputs and outputs (peripheral devices). LEDs are labeled with the I/O point number.
		ON	Binary value indication.
		OFF	No voltage or binary value indication.
		Flashing or pulsing	- Fault indication - Activity of field devices - Module unconfigured, no address key - Analog value indication

Digital Input Modules (TXM1.8D and TXM1.16D)



The TXM1.8D and TXM1.16D are dedicated to monitoring, respectively, 8 and 16 digital input points.

- They monitor status signals from normally open (NO) or normally closed (NC), latched voltage free/dry contacts.
- All 8 points on the TXM1.8D module as well as 8 of the 16 points on the TXM1.16D module may be used as pulse counters (LPACI) up to 10 Hz.
- Each input point has a green LED for status indication.

NOTE:
Potential free (dry contact) for all points.

Digital Input Grounding Connections

The neutral of a digital input (on Digital Input, Universal and Super Universal modules) can be connected to any neutral terminal on the same module. Several digital inputs can also share a neutral terminal on the same module.

Technical Data

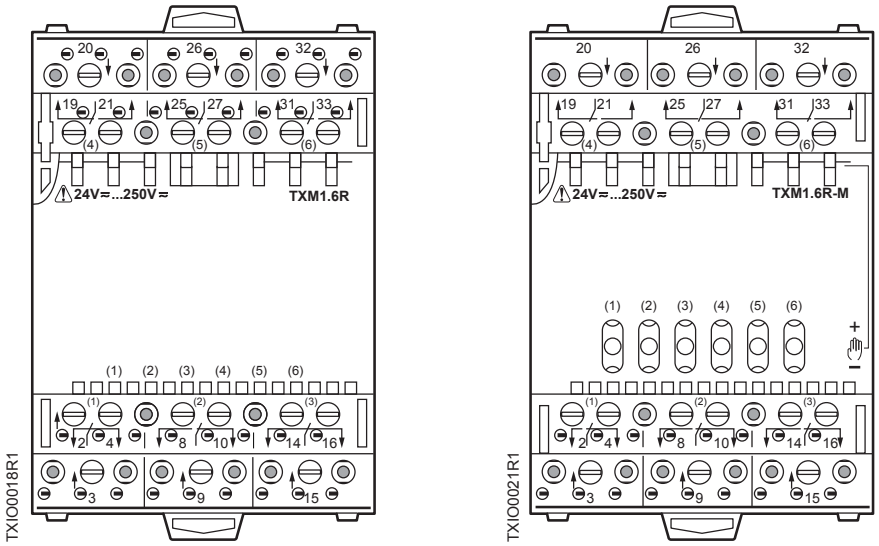
- Digital inputs are not electrically separated from the system electronics.
- Mechanical contacts must be volt-free.

Contact sensing voltage	21.5 to 25 Vdc
Contact sensing current	1.6 mA (initial current 10 mA)
Contact resistance with contacts closed	Max. 200Ω
Insulation resistance with contacts open	Max. 50KΩ

	Min. closing/ opening time [ms] including bouncing	Max. bounce time [ms]	Max. Counting frequency (symmetric)
Maintained contact	80	40	
Pulse contact	50	30	
Counter (LPACI)[1)]	40	30	10 Hz

1) 10 Hz counter functionality (LPACI) for TXM1.16D is only available on point terminations 1-8.

Digital Output Modules (TXM1.6R and TXM1.6R-M)



The TXM1.6R and TXM1.6R-M Digital Output modules provide six NO or NC (form C), maintained or pulsed, voltage free/dry contacts.

⚠ CAUTION

Digital Output contacts are not internally current-limited or protected against transients. If needed, externally install an NEC-approved current limiting device, Metal Oxide Varistor (MOV), or both. See the MOV table in the *APOGEE Wiring Guidelines for Field Panels and Equipment Controllers* (125-3002).

- Common terminals are not internally connected.
- The contacts are rated for a maximum of 250 Vac at 4A resistive or 3A inductive.
- Each I/O point has a green LED for status indication.
- The TXM1.6R-M module is also equipped with manual override switches. An orange LED per override switch indicates override status individually per point.

Digital Output Common Connections

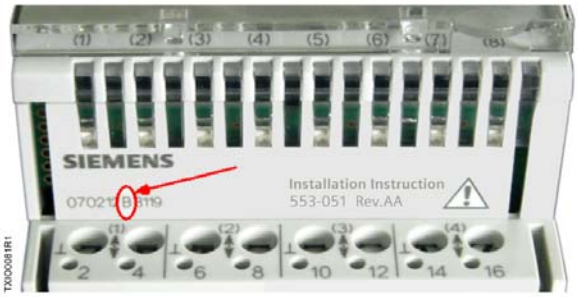
Digital Output common is isolated for each relay and must be externally wired to other DO common if needed.

	**⚠ DANGER** Digital Output modules connected to high voltage should incorporate a readily accessible disconnect device outside the panel. All low voltage and high voltage wiring must be routed separately within an enclosure so that low voltage and high voltage wiring cannot come in contact with each other. High- and low-voltage circuits cannot be located on adjacent terminals within a module.

	**⚠ DANGER** Separate knockouts should be used for high voltage and low voltage wiring. Leave at least 2 inches (50.8 mm) of space between the Class 2 wires and other wires in the panel.

Universal and Super Universal Input/Output Modules (TXM1.8U, TXM1.8U-ML, TXM1.8X, and TXM1.8X-ML)

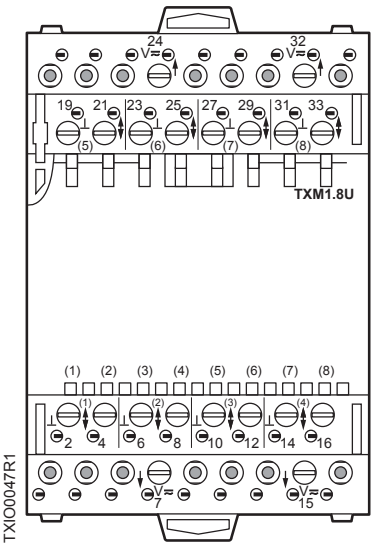
	**⚠ CAUTION** With B-series TX-I/O Modules, do not install externally-powered Universal Inputs on the same I/O module as Universal Outputs. Having both on the same module may cause inadvertent control of the output when TX-I/O island bus power is off. ● The module series letter is included in the manufacturing date code on the product label. The date code format is *YYMMDD*. For example, **070212B** indicates the product was manufactured February 12, 2007 and the product is a B-series.



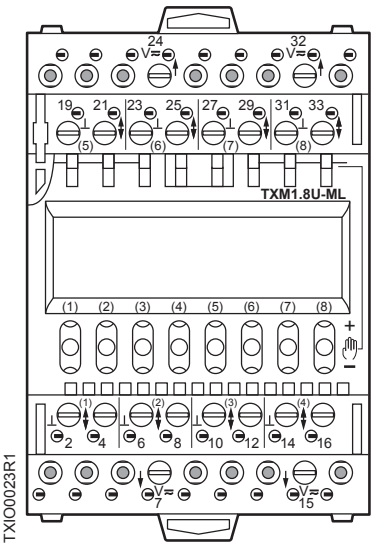
I/O Module Series in the Manufacturing Date Code.

The Universal and Super Universal Input/Output (I/O) modules provide 8 points, which can be individually software configured as analog output, analog input, or digital input to best meet the specific application needs.

Universal Modules

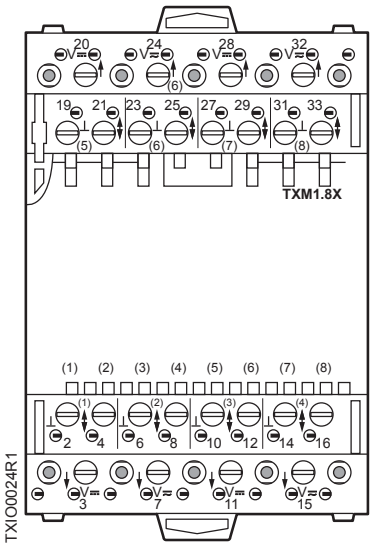


TXM1.8U

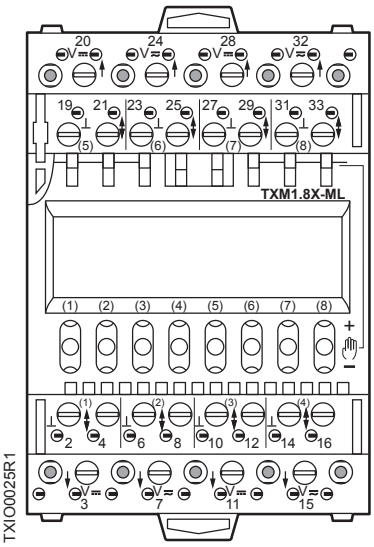


TXM1.8U-ML

Super Universal Modules



TXM1.8X



TXM1.8X-ML

All Universal and Super Universal I/O modules provide:

- AC supply voltage for peripheral devices such as valves and actuators
- Green LED status per I/O point that varies in intensity according to the voltage and current (directly proportional)

Supply Terminal Connections

NOTE:
The neutral of analog inputs and outputs must always be connected to the terminal associated with that I/O input.

- All supply terminals are connected in the I/O module, not in the terminal base.
- The neutral of a digital input (on Digital Input, Universal and Super Universal modules) can be connected to any neutral terminal on the same module. Several digital inputs can also share a neutral terminal on the same module.

AC/DC Output (Field Supply)

The following information applies to terminals 7, 15, 24, and 32.

Voltage	AC/DC 12 to 24V
Admissable current per module	Max. 4 A (total for all four terminals)
Fuse	4A, in TX-I/O Power Supply or Bus Connection Module

DC Output (Field Supply) (Super Universal modules only)

The following information applies to terminals 3, 11, 20, and 28.

Nominal voltage (derived in the module from the module supply voltage)	24 Vdc
Admissable current per module	Max. 200 mA (total for all four terminals)

Active Input and Output Support

⚠ CAUTION

Active inputs and output are permitted on the same module when connected sensors are powered from that module.
When sensors are externally powered, active inputs and outputs should be on separate modules.

NOTE:
The neutral of analog inputs and outputs must always be connected to the terminal associated with that I/O input.

Active input and output support includes the following:

- Analog input and output (0-10 Vdc)
- Analog input current 4-20 mA

- Analog output current 4-20 mA (four current outputs maximum per module on Points 5 through 8)
- 24 Vdc supply voltage for sensors at a maximum of 200 mA per module.

NOTE:
4 to 20 mA current handling capability is available on points 1 through 4 (AIs only) and points 5 through 8 (AIs or AOs).
Power consumption of analog points is included in the power consumption of the 8X module. Power consumption of other approved uses of supply voltage (for example, 1000 series RTS supply) must also be subtracted from the available 24 Vdc power provided by the TX-I/O Power Supply or P1 BIM.

Analog Input Support

Analog input sensor support includes:

- 1K Nickel – Landis & Gyr curve
- 1K Platinum – 375 and 385 coefficient
- 10K and 100K Thermistor – Type II Curve

Technical Data for Analog Inputs on TX-I/O Modules TXM1.8U, TXM1.8U-ML, TXM1.8X, and TXM1.8X-ML

Compensation of the line resistance: 1 Ohm, calibrated in the module, (except for NTC10K and NTC100K)

Signal type	Range	Resolution 2)	Sensor current (cyclic polling)
Temperature Pt1K 375	-50…150 (180)°C)1	10 mK	1.54 mA
Temperature Pt1K 385	-50...400 (600)°C)1	20 mK	1.96 mA
Temperature Ni1K (LG-Ni 1000)	-50…150 (180)°C)1	10 mK	1.54 mA
Temperature NTC 10K	(-40 ...115°C)1)	10 mK (25°C)	0.14 mA
Temperature NTC 100K	(-40 ...125°C)1)	10 mK (25°C)	0.14 mA
Voltage measuring U10	0 ... 10V3)	1 mV	
Current measuring I420	4 ... 20 mA	1 mA	
Load resistance			490 / 440 Ohm, pulsed (cyclic polling of the I/O points)

1) (Extended range) only with reduced hum injection (see below).

2) This section describes the measured resolution. It is different from the transmitted resolution that the bus delivers into the AI block and that is transformed by [Slpe] and [Icpt].

3) The range monitoring of signal type U10 is done with a short NEGATIVE signal of –3,1V, 0.05 mA (open circuit detection). If a field device has an open output, a negative voltage could appear there. This can damage any polarized components (e.g., capacitors).

Technical Data for Analog Outputs on TX-I/O Modules TXM1.8X and TXM1.8X-ML

Signal type	Range	Resolution
Voltage Y10S	0 љ10V	1 mV
Current	Max. 1 mA	
Current Y420 (I/O points 5 through 8 only)	4 ... 20 mA	1 µA
Voltage	ca. DC 15V	
Load resistance	0 ... 500 Ω	

Digital Input Support

Digital input support includes voltage free/dry contacts and pulse counters up to 20 Hz.

NOTE:
Potential free (dry contact) for all points.
The neutral of a digital input can be connected to any neutral terminal on the same module. Several digital inputs can also share a neutral terminal on the same module.

Technical Data

- Digital inputs are not electrically separated from the system electronics.
- Mechanical contacts must be volt-free.
- Counter inputs faster than 1 Hz that are routed for more than 32.8 ft (10 m) in the same trunk as analog inputs must be shielded.

Contact sensing voltage	21.5 to 25 Vdc
Contact sensing current	1.0 mA (initial current 6 mA)
Contact resistance with contacts closed	Max. 200Ω
Insulation resistance with contacts open	Max. 50KΩ

	Min. closing / opening time [ms] including bouncing	Max. bounce time [ms]	Max. Counting frequency (symmetric)
Maintained contact	60	20	
Pulse contact	30	10	
Mechanical Counter	20	10	25 Hz

Local Override/Identification Device

TXM1.8U-ML and TXM1.8X-ML modules are also equipped with a local override/identification device (LOID), which includes an LCD signal display. The LCD displays the following information for each IO point:

- Configured signal type
- Symbolic display of process value
- Notification of faulty operation, short circuit, or sensor open circuit

Orange LEDs indicate override status individually per point.

TX-I/O Module LCD Symbol Chart

The TX-I/O module LCD displays a symbol to indicate each point type and its current value.

TX-I/O Module LCD Display for Errors and Reminders (Displays in LCD Top Row)	
	Value above range limit
	Value below range limit
	Open circuit
	Short circuit
	Point type invalid for use with manual override
	No sensor (current)
	No output signal
	24 Vdc supply < 22 Vdc
	Inactive point
	Invalid value
	No voltage
	Unconfigured point

TX-I/O LCD Display by Point Type.			
Point Type (Displays in LCD Bottom Row)		Normal Operation (Displays in LCD Top Row)	
Analog Input, Current	▲A		Low or high value
Analog Input, Resistance	▲Ni ▲Pt ▲T1		Temperature
Analog Input, Voltage	▲V		Low or high value
Analog Output, Current	▼A		Low or high value
Analog Output, Voltage	▼V		Low or high value
Digital Input, Counter	▲Σ		Step indicator
Digital Input, N/C Contact	▲	 Inactive	 Active
Digital Input, N/O Contact	▲	 Inactive	 Active

TX-I/O Power Supply and Bus Modules

The TX-I/O™ Power Supply and Bus Modules provide power, communications, and expansion options for the TX-I/O Island Bus.

Power and Communication Modules

The TX-I/O Power Supply and Bus Connection Module provide the following functions for the island bus:

	Function		
Product	**TX-I/O Bus Communication**	**24 Vdc power**	**24 Vac power**
TX-I/O Power Supply (TXS1.12F4)	Signal pass-thru	Output 28.8 W (1.2A at 24 Vdc)	• NEC Class 2 Output , 96 VA max., fused at 4A • Class 1 Power Limited Input, 150 VA max.
Bus Connection Module (TXS1.EF4)	• Signal pass-thru • Allows for external connection of I/O signals.	Pass-thru	• NEC Class 2 Output, 96 VA max., fused at 4A • Class 1 Power Limited Input, 96 VA max.

The P1 Bus Interface Module (BIM) provides the following functions for the island bus:

	Function		
Product	**TX-I/O Bus Communication**	**24 Vdc power**	**24 Vac power**
P1 Bus Interface Module (10-module) (TXB1.P1)	Protocol translation	14.4 W (0.6A at 24 Vdc)	• NEC Class 2 Output, 96 VA max., fused at 4A • Class 1 Power Limited Input, 125 VA max (for US modules fused at 4V, EU modules fused at 10A).
P1 Bus Interface Module (4-module) (TXB1.P1-4)	Protocol translation	14.4 W (0.6A at 24 Vdc)	• NEC Class 2 Output, 96 VA max., fused at 4A • Class 1 Power Limited Input, 125 VA max.

Island Bus Expansion Module

The Island Bus Expansion (IBE) module provides the following functions for the island bus:

Product	TX-I/O Bus Communication	Function
Island Bus Expansion Module (TXA1.IBE)	• Signal pass-thru of Communication Data (CD) • Allows for external connection of the I/O signals	Increases the distance between the primary field panel and expansion field panels on the island bus

Product	TX-I/O Bus Communication	Function
	• RS-485 interface	

TX-I/O Power Supply Overview

The TX-I/O Power Supply bridges communication and power from one DIN rail to another and generates 28.8 W (1.2A at 24 Vdc) to power TX-I/O modules and peripheral devices.

- An LED provides an indication of 24 Vdc on the TX-I/O bus.
- Up to 4 TX-I/O Power Supplies can be operated in parallel, with a maximum of two per DIN rail.
- It can be located within a row of TX-I/O modules or at the beginning of a new DIN rail.

The TX-I/O Power Supply performs the following functions:

- Transfers 24 Vac at 4A to power TX-I/O modules and peripheral devices.
- Provides an input point for 24 Vac to power additional peripheral devices.
  - Isolates the 24 Vac peripheral device supply in case of overload or short-circuit.
  - The replaceable AC fuse can be accessed from an installed module.
  - Indicates the AC fuse status with an LED for easy diagnostics.
- Routes the bus signal between DIN rails (+24 Vdc Communication Supply (CS) and Communication Data (CD) signals).

Supply Terminal Connections

- 24 Vac supply terminals are fused (replaceable) for Class 2 (24 Vac at 50/60 Hz) through the TX-I/O Power Supply.
- 24 Vdc supply terminals are connected in the I/O module, not in the terminal base. 24 Vdc is supplied and overload protected in the TX-I/O Power Supply.

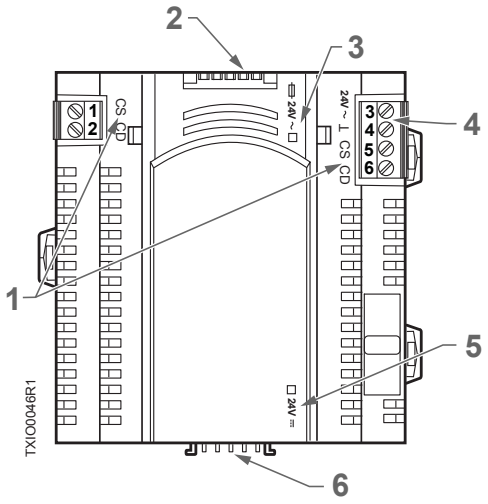
TX-I/O Power Supply Specifications

Dimensions (L × W × D)	3.78” × 3.54” × 2.75” (96 mm × 90 mm × 70 mm)
TX-I/O Bus Communication	Signal pass-thru
Power Requirements	24 Vac +/-20% input @ 50 or 60 Hz
Power Consumption (Maximum)	35 VA for DC power supply. (Does not include the 96 VA for the 24 Vac output.)
Power Output	28.8 W (1.2A at 24 Vdc)
24 Vac Power, TXS1.12F4[1]	Output: NEC Class 2, 96 VA max, fused at 4A Input: Class 1 Power Limited, 150 VA max.
TX-I/O Bus Extension (CS/CD)	164 ft (50 m) total max. using two 14-gauge twisted pair cable
Ambient operating temperature	32°F to +122°F (0°C to 50°C), 5 to 95% rh, non-condensing

UL	UL 864 UUKL Smoke Control Equipment UL 864 UUKL7 Smoke Control Equipment UL 916 PAZX CSA 22.2 No. 205 PAZX7
Agency Compliance	CFR47 Part 15, Class A; CFR47 Part 15, Class B Australian EMC Framework (C-Tick) 2004/108/EC European EMC Directive (CE) 2006/95/EC European Low Voltage Directive (LVD)

1) May be used for Smoke Control installations with Smoke Control Listed Enclosures and transformers or service boxes. The line to the 24 Vac input transformer must not exceed 1000 VA. NEC Class 2 wiring may be used up to 96 VA, and NEC Class 1 Power Limited wiring must be used above 96 VA and up to 1000 VA.

TX-I/O Power Supply Product Diagram



TX-I/O Power Supply Features, Symbols, and Status LEDs.			
	LED, Symbol, or Feature	**Status**	**Indication**
1	CS	-	24 Vdc Communication Supply for I/O modules and field devices.
	CD	-	Communication Data (Island bus signal).
2	TX-I/O bus connector (female)	-	Connection for the PXC Modular, or left covered if at the start of a TX-I/O bus. No field device supply.
3	**⎓ 24V~** Fuse LED for 24 Vac supply to peripheral devices	ON	Normal operation. 24 Vac (supply voltage) input present; fuse is intact.
		OFF	Error. - No 24 Vac (supply voltage) input. - Fuse is blown. (4A, 5 × 20 mm, 250V, medium-acting, ceramic fuse)

TX-I/O Power Supply Features, Symbols, and Status LEDs.			
	LED, Symbol, or Feature	**Status**	**Indication**
4	24V~	-	24 Vac, supply voltage for the Power Supply module and field devices.
	⊥	-	System neutral.
5	**24V⎓**(green) LED for 24 Vdc module supply/field supply voltage (conductor CS, measured on bus)	ON	Normal operation. 24 Vdc bus voltage is in the acceptable range.
		OFF	Error. 24 Vdc bus voltage is outside the acceptable range. - Insufficient or shorted I/O bus supply. - An AC/DC converter is faulty.
6	TX-I/O bus connector (male)	-	Connection for TX-I/O Modules. Includes field device supply.

Bus Connection Module Overview

The Bus Connection Module bridges communication and power from one DIN rail to another. It provides the bus signal, module supply voltage, and field device supply voltage to TX-I/O Modules on an additional DIN rail.

The Bus Connection Module performs the following functions:

- Passes 24 Vac at 4A to power TX-I/O modules and peripheral devices.
- Provides an input point for 24 Vac to power additional peripheral devices.
  - Isolates the 24 Vac peripheral device supply in case of overload or short-circuit.
  - The replaceable AC fuse can be accessed from an installed module.
  - Indicates the AC fuse status with an LED for easy diagnostics.
- Routes the bus signal between DIN rails (+24 Vdc Communication Supply (CS) and Communication Data (CD) signals).

Supply Terminal Connections

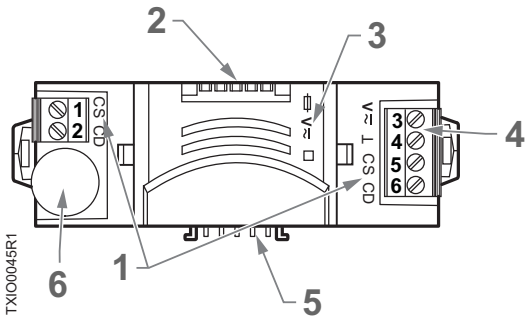
- 24 Vdc is supplied to terminals one and four (CS) and to both ends of the TX-I/O bus connector for distribution to connected TX-I/O modules and external devices.
- 24 Vac is passed through an internal fuse from terminals three and four (system neutral) to the male TX-I/O bus connector.
- External devices draw power from the 24 Vdc, 24 Vac, and system neutral terminals on the TX-I/O modules.
- 24 Vdc supply terminals are connected in the I/O module, not in the terminal base. 24 Vdc is current-limited in the Bus Connection Module.

TX-I/O Bus Connection Module Specifications

Dimensions (L × W × D)	1.26” × 3.54” × 2.75” (32 mm × 90 mm × 70 mm)
TX-I/O Bus Communication	Signal pass-thru
Power Requirements	24 Vac +/-20% input @ 50 or 60 Hz
Power Output	Pass-thru
24 Vac Power, TXS1.EF4[1]	Output and Input: NEC Class 2, 96 VA max. Output fused at 4A
TX-I/O Bus Extension (CS/CD)	164 ft (50 m) total max. using two 14-gauge twisted pair cable
Ambient operating temperature	32°F to +122°F (0°C to 50°C), 5 to 95% rh, non-condensing
UL	UL 864 UUKL Smoke Control Equipment UL 864 UUKL7 Smoke Control Equipment UL 916 PAZX CSA 22.2 No. 205 PAZX7
Agency Compliance	CFR47 Part 15, Class A; CFR47 Part 15, Class B Australian EMC Framework (C-Tick) 2004/108/EC European EMC Directive (CE) 2006/95/EC European Low Voltage Directive (LVD)

1) May be used for Smoke Control installations with Smoke Control Listed Enclosures and transformers or service boxes. The line to the 24 Vac input transformer must not exceed 1000 VA. NEC Class 2 wiring may be used up to 96 VA, and NEC Class 1 Power Limited wiring must be used above 96 VA and up to 1000 VA.

Bus Connection Module Product Diagram



Bus Connection Module Features, Symbols, and Status LEDs			
	LED, Symbol, or Feature	**Status**	**Indication**
1	CS	-	24 Vdc Communication Supply for I/O modules and field devices.
	CD	-	Communication Data (Island bus signal).
2	TX-I/O bus connector (female)	-	Connection for the PXC Modular, or left covered if at the start of a TX-I/O bus. No field device supply.

Bus Connection Module Features, Symbols, and Status LEDs			
	LED, Symbol, or Feature	**Status**	**Indication**
3	Fuse LED for 24 Vac supply to field devices	ON	Normal operation. 24 Vac (supply voltage) input present; fuse is intact.
		OFF	Error. - No 24 Vac (supply voltage) input. - Fuse is blown. (4A, 5 × 20 mm, 250V, medium-acting, ceramic fuse)
4	V≂	-	Field device supply.
	⊥	-	System neutral.
5	TX-I/O bus connector (male)	-	Connection for TX-I/O Modules. Includes field device supply.
6	Fuse	-	4A fuse for field supply.

Island Bus Expansion Module Overview

The TX-I/O Island Bus Expansion (IBE) module increases the distance between the primary field panel and expansion field panels on the island bus. Up to 4 expansion enclosures may be connected to the primary enclosure using IBEs, for a maximum of five IBEs on the island bus.

- The IBE converts the island bus four conductor signal (24V~ ⊥ CS CD) to three conductor RS-485 signal (+ - ⏚.)
- The IBE in the primary field panel supports a single chained RS-485 cable of up to two 200 ft (61 m) maximum length segments.
- An IBE may be installed in up to four expansion field panels which may be placed all on one RS-485 segment or distributed on both RS-485 segments.
- Only communication data (CD) is transferred across the RS-485 cable.
- AC power (24V~) and DC power (CS) are not transferred across the RS-485 cable.
- Signal common (⏚) does not provide galvanic isolation, but has a circuit interrupter to system neutral (⊥) on the island bus.
- All expansion field panels must be connected to the same building approved earth ground as the primary field panel.
- Each IBE must be installed on the male bus connector of the TX-I/O Power Supply or a Bus Connection Module which is connected to a TX-I/O Power Supply.
- An LED provides an indication of island bus communication.
- A programming tool is not required.

For information on expanding an island bus with the IBE, see the section *TX-I/O Island Bus Expansion* [→ 49].

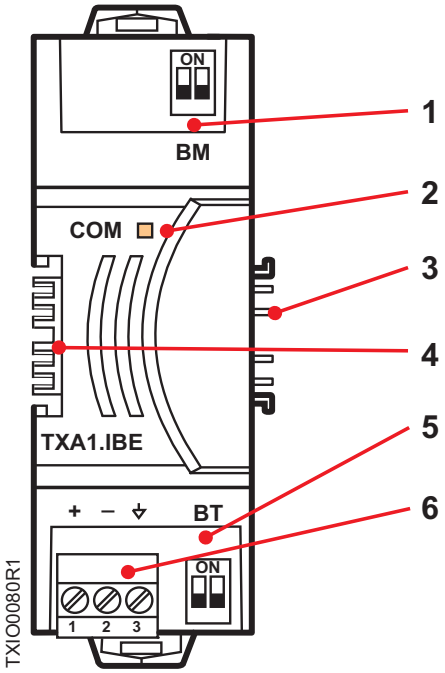
Communication Data (CD) signal quality is affected by the cable type. The existing cable type may be a factor planning a migration to an island bus with the IBE. For

information on cable type and maximum length, see the section *Island Bus Length as a Function of Signal and Power (CS/CD)*.

TX-I/O Island Bus Expansion Module Specifications

Dimensions (L × W × D)	1.26” × 3.54” × 2.75” (32 mm × 90 mm × 70 mm)
Operating Voltage	⊥and CS from island bus: 24 Vdc
Power Consumption (Maximum)	1.2 W (50 mA at 24 Vdc)
Maximum Distances	Island Bus Expansion: maximum of two segments up to 200 ft (61 m) each
System Restrictions	Maximum of 5 IBEs on the island bus: one IBE in the primary enclosure plus four expansion enclosures.
Ambient operating temperature	32°F to +122°F (0°C to 50°C), 5 to 95% rh, non-condensing
Shipping and storage environment	–13°F to 158°F (–25°C to 70°C)
UL	UL 864 UUKL Smoke Control Equipment UL 864 UUKL7 Smoke Control Equipment UL 916 PAZX CSA 22.2 No. 205 PAZX7
Agency Compliance	CFR47 Part 15, Class B Australian EMC Framework (C-Tick) 2004/108/EC European EMC Directive (CE)

Island Bus Expansion Module Product Diagram



Island Bus Expansion (IBE) Module.

Island Bus Expansion Module Features, Symbols, and Status LEDs			
	LED, Symbol, or Feature	**Status**	**Indication**
1	BM (bus master) DIP switches (Both switches must be set to the same position.)	OFF	Setting for IBE in the Primary Panel..
		ON	Setting for IBE in all Expansion Panels.
2	COM (yellow)	Blinking	Normal operation.
		ON	Short circuit on island bus; all modules are inactive.
		OFF	No supply, no communication. IBE not wired.
3	TX-I/O bus connector (male)	–	Connection for TX-I/O Modules.
4	TX-I/O bus connector (female)	-	Connection to the TX-I/O Power Supply, Bus Connection Module, or P1 BIM.
5	BT (bus terminator) DIP switches (Both switches must be set to the same position.)	OFF	Setting for any IBE **not** at the end of line. (Two RS-485 cables in connector.)
		ON	Setting for any IBE at the end of line. (Only one RS-485 cable in connector.)
6	TX-I/O island bus expansion connector (+ – ⏚)	-	RS-485 Signal A & B (+ - differential communication) pass-thru for Communication Data (CD) and Signal Common.

TX-I/O Island Bus

Admissible Number of Devices

TX-I/O Power Supply Module	A maximum of four TX-I/O Power Supply modules may be connected in parallel per system. When a P1 BIM is present, a maximum of three TX-I/O Power Supply modules may be operated in parallel with the appropriate P1 BIM, per system.
Bus Connection Points	Maximum number bus connection points per island bus: 16 *Example* 1 P1 BIM (10-module) + 3 TX-I/O Power Supply modules + 12 Bus Connection Modules = 16 bus connection points
TX-I/O Island Bus	Only one controller is used per island bus **PXC Modular** Up to 64 I/O modules or a maximum of 500 points **PXC-36** Up to four I/O modules (approximately 32 points) **P1 BIM (10-module)** Up to ten I/O modules or a maximum of 80 points **P1 BIM (4-module)** Up to four I/O modules or a maximum of 64 points
I/O Row	Up to two TX-I/O Power Supply modules may be connected in parallel per I/O row.

Creating Rows of I/O Modules

The following devices are combined to create rows of I/O modules in the island bus:

- TX-I/O Power Supply module (TXS1.12F4)
- Bus Connection Module (TXS1.EF4)
- I/O modules

Installation Rules and Limitations

The first device mounted on each row of I/O modules must deliver the bus signal, the I/O module power supply, and the field device supply. This would be a TX-I/O Power Supply, Bus Connection Module, or P1 BIM.

A maximum of four TX-I/O Power Supply modules may be connected in parallel per system.

When a P1 BIM is present, a maximum of three TX-I/O Power Supply modules may be operated in parallel with the P1 BIM, per system.

- If the capacity of the 24 Vdc supply (maximum 1.2 A) is exceeded by the requirements of the I/O modules and field devices, an additional TX-I/O Power Supply module is required (operating in parallel with the first one).

- If the capacity of the 24 Vac field supply (maximum 4 A) is exceeded by the field devices, an additional TX-I/O Power Supply or a Bus Connection Module is required.
- If a separate fuse or a field supply with a voltage other than 24 Vac is required (maximum 4 A), a Bus Connection Module is required.

See the *TX-I/O Module Specifications* [→ 9] for power consumption data.

Example

Consider the following island:

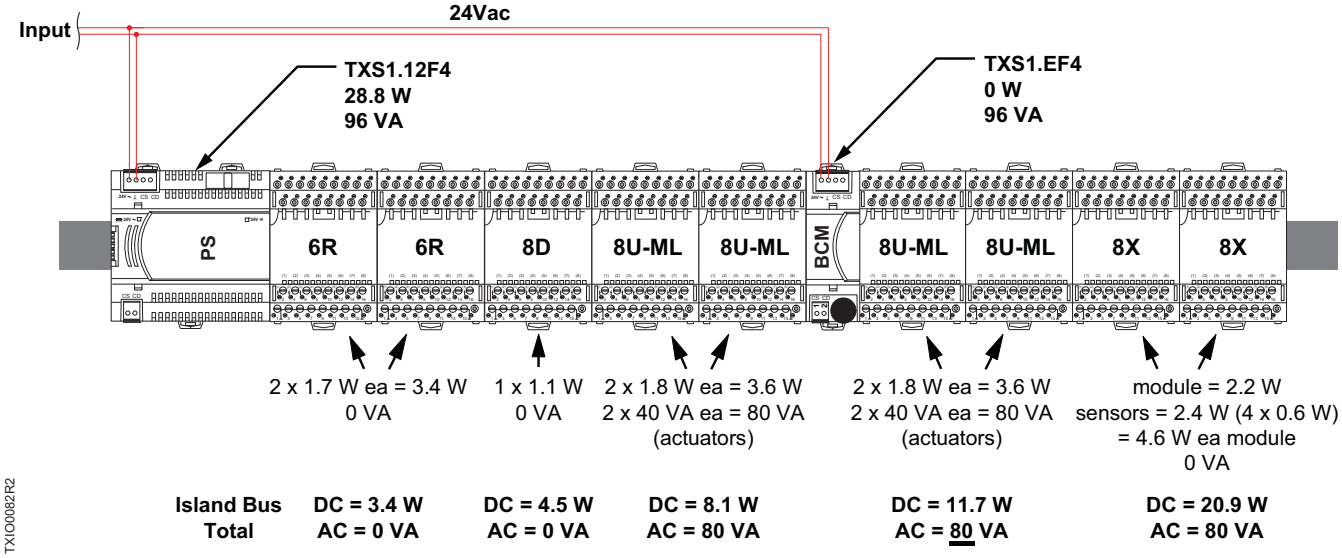
- Two TXM1.6R-M Relay Modules.
- One TXM1.8D Digital Input Module.
- Four TXM1.8U-ML Universal Modules. For each module:
  - Four points are configured as Voltage Outputs.
  - Four points are configured as Analog Inputs.
  - Four actuators, at 10 VA each, are being powered from the 24 Vac terminals on the modules.
- Two TXM1.8X Super Universal Modules.
  - Each module has four AO-I points.
  - Each module has four AI-I points using sensors, which are powered from the 24 Vdc terminals on the modules (25 mA (0.6 W) each).

The power requirements add up as follows:

	Module Power Requirement		TX-I/O Power Supply Remaining Power	
Module	**DC**	**AC**	**DC (28.8 W)**	**AC (96 VA)**
TXM1.6R	1.7 W	-	27.1 W	96 VA
TXM1.6R	1.7 W	-	25.4 W	96 VA
TXM1.8D	1.1 W	-	24.3 W	96 VA
TXM1.8U-ML	1.8 W	4 actuators × 10 VA	22.5 W	56 VA
TXM1.8U-ML	1.8 W	4 actuators × 10 VA	20.7 W	**16 VA**
Add a Bus Connection Module		Provides 96 VA on the male bus connection	20.7 W	**96 VA**
TXM1.8U-ML	1.8 W	4 actuators × 10 VA	18.9 W	56 VA
TXM1.8U-ML	1.8 W	4 actuators × 10 VA	17.1 W	16 VA
TXM1.8X	2.2 W	-	14.9 W	16 VA
	4 sensors × 0.6 W	--	12.5 W	16 VA
TXM1.8X	2.2 W	-	10.3 W	16 VA
	4 sensors × 0.6 W	--	7.9 W	16 VA
Total Requirement	**20.9 W**	**160 VA**		

- The DC power requirement of 20.9 W is within the capability of a single TX-I/O Power Supply module (28.8 W).
- The AC power requirement of 160 VA exceeds the capability of a single TX-I/O Power Supply module (96 VA).
  - A Bus Connection Module or a second TX-I/O Power Supply Module is required for this island.
  - Since additional DC power is not required, a Bus Connection Module is sufficient for this island.

NOTE:
The TX-I/O Power Supply and Bus Connection Module only supply 24 Vac to TX-I/O Modules on the male bus connector; 24 Vac power does not pass through these modules. If an island bus requires additional AC power, a Bus Connection Module or a second TX-I/O Power Supply must be installed at a point in the island bus ahead of the I/O modules whose Vac requirements exceed the output of the first TX-I/O Power Supply. See the following figure.



TX-I/O Island Bus Power Supply Example.

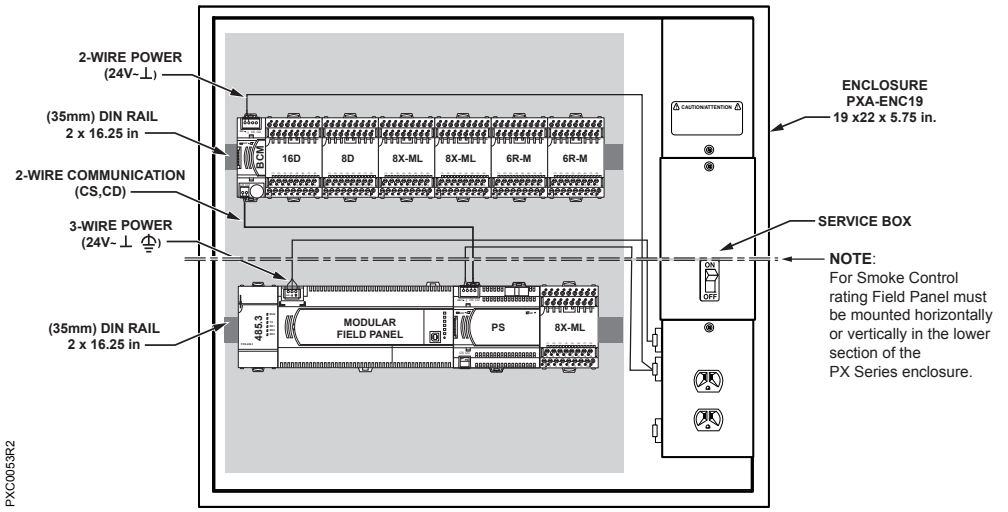
Row Orientation

TX-IO island bus rows can be mounted vertically or horizontally. The island bus establishes its own connection when TX-I/O devices are plugged into one another on the DIN rails. Components can also be temporarily removed from the DIN rail for easier wiring.

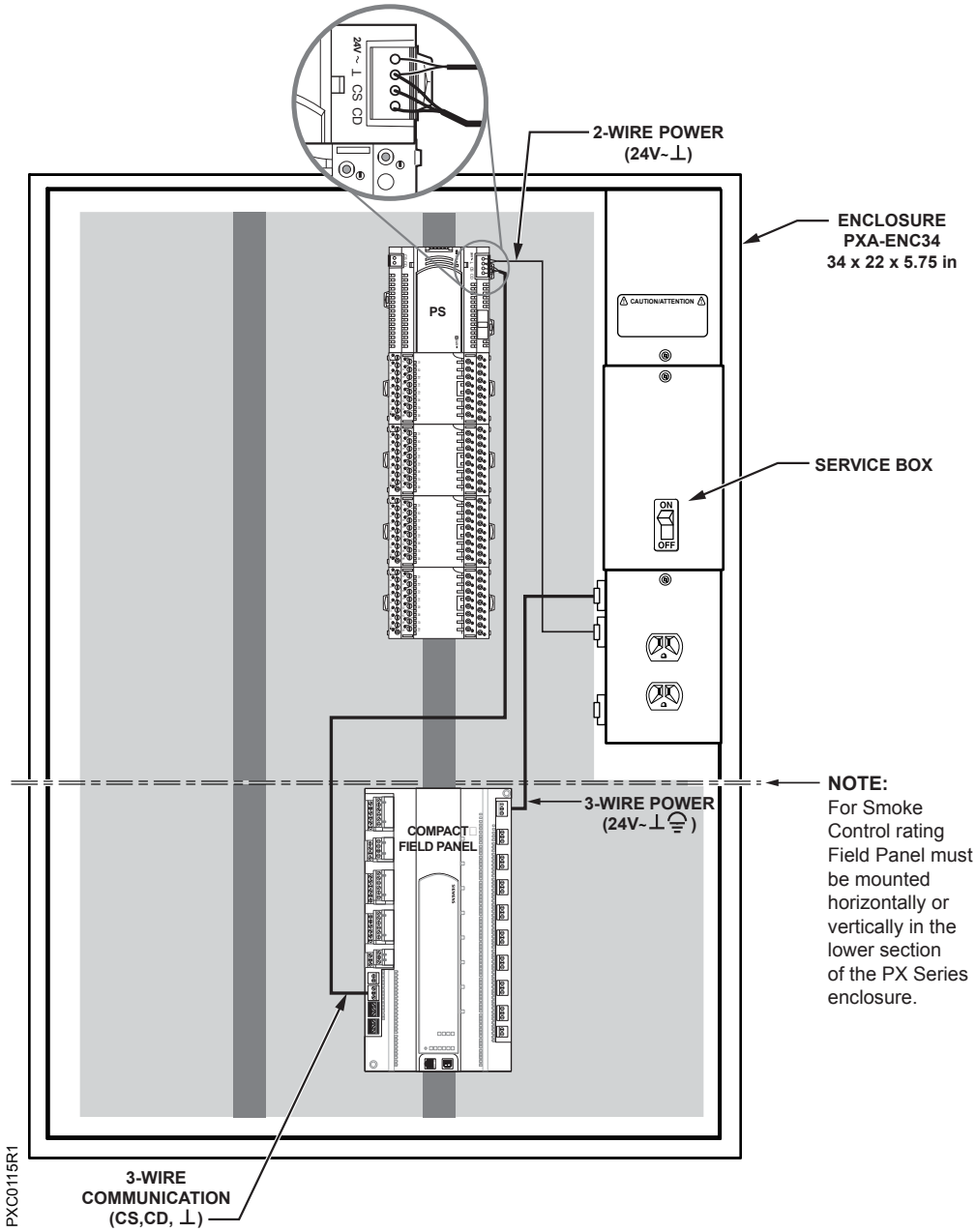
NOTE:
Allow a minimum clearance of 3 inches (7.6 cm) around the field panel ports and connectors for terminating wires.

NOTE:
The male bus connector on the TX-I/O Power Supply, Bus Connection Module, or P1 BIM carries the bus communication signal and power to the TX-I/O modules.

- For a horizontal DIN rail, island bus communication and power flow from left-to-right.
- For a vertical DIN rail, island bus communication and power flow from top-to-bottom.



Modular with TX-I/O Island Bus on Horizontal DIN Rails.



PXC-*36 with TX-I/O Bus on Vertical DIN Rails.*

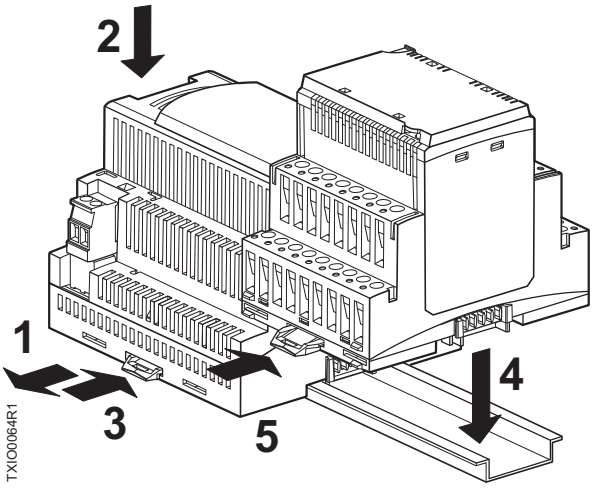
Installation and Commissioning

NOTE:
For Smoke Control applications, the field panel controller must be installed in the lower half of the enclosure.

Basic Steps for Connecting Devices to the DIN Rail

The island bus establishes its own connection when TX-I/O devices are plugged into one another on a DIN rail.

1. Slide out the mounting tabs.
2. Align the channel on the back of the device with the DIN rail.
3. Using a flat blade screwdriver, push in each mounting tab until it clips onto the DIN rail.
4. Align an I/O module with the Power Supply or Bus Connection Module, and slide the I/O module down over the TX-I/O island bus connector.
5. Push in each mounting tab until it clips onto the DIN rail.



Connecting Devices to the TX-I/O Island Bus.

Required Tools

Screwdrivers for I/O Modules

The I/O module connection terminals have slotted screws.

- No. 1 screwdriver
- Shaft diameter maximum 0.18” (4.5 mm)
- Minimum shaft length 1” (26 mm); however, 1.6” (40 mm) allows access to the screws while plug-in module is in the "parked" position.

Tightening Torque

When using electric screwdrivers for wiring terminals always set the torque to 0.5 to 0.6 Nm or 50 to 60 Ncm.

Test Terminals

Pin diameter of I/O module test terminals is 0.078” (2 mm).

Common Grounding Requirement

	**⚠ CAUTION**
	All devices not isolated by a Trunk Isolator/Extender (TIE) or isolation transformer must be connected to the same grounding point.

	**⚠ CAUTION**
	Do not connect TX-I/O components to a floating system neutral. Otherwise, equipment damage will occur. • System Neutral (⊥) must be continuous throughout the TX-I/O Bus. • System Neutral must be connected to building approved earth-ground (⏚) at a single point only at the 24 Vac transformer.

Third-party Transformer

- If powering from a third-party transformer, earth ground the secondary neutral to the same point for all panels powered by that transformer.
- If powering TX-I/O components from a third-party transformer, connect the transformer neutral to the building-approved earth ground.

I/O Module Insertion Required for Proper Grounding

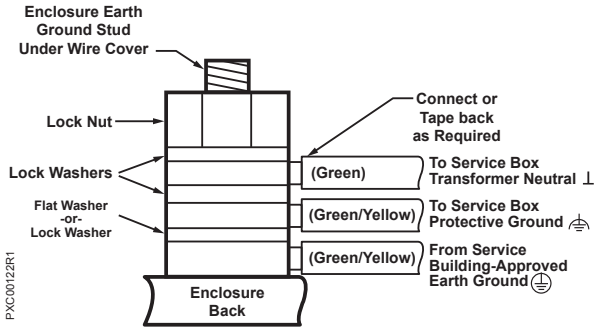
All measuring/neutral terminals are connected in the plug-in I/O module, not in the terminal base. When the plug-in I/O module is removed, these terminals are not connected.

PX Series Service Box Grounding

	**⚠ DANGER**
	The transformer secondary neutral (⊥) must be connected to the building approved earth ground (⏚) whenever the transformer primary is greater than 150 Vac.

	**⚠ CAUTION**
	To reduce system electrical noise, connect the secondary of the separately-derived power source to earth ground.

The PX Series Service Box has a grounded neutral system, which is internally grounded through the solid green wire. When required, the neutral system must be connected to the building approved earth ground at the enclosure where the Service Box is installed.

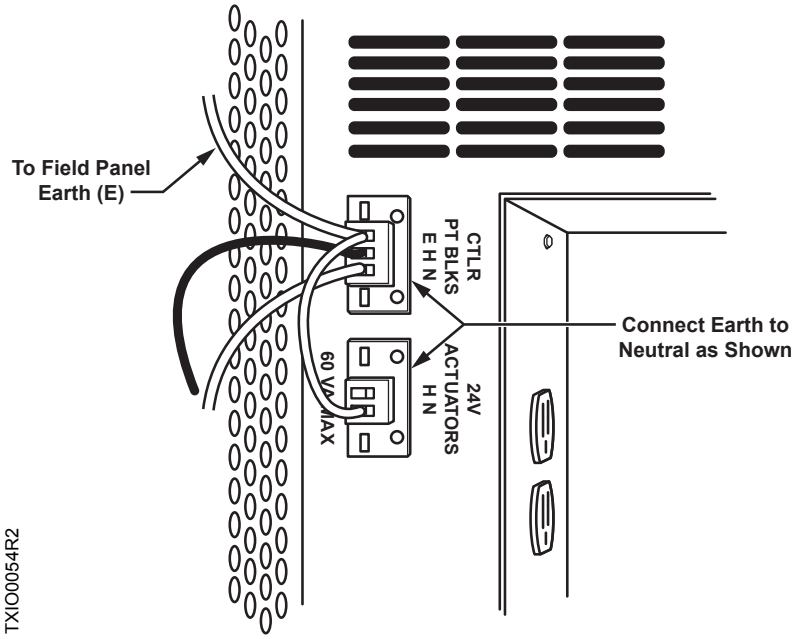


Detail of PX Series Enclosure Earth Ground Stud (Under Wire Cover).

For more information, see the *APOGEE Wiring Guidelines for Field Panels and Equipment Controllers* (125-3002).

MEC Service Box Grounding Modification

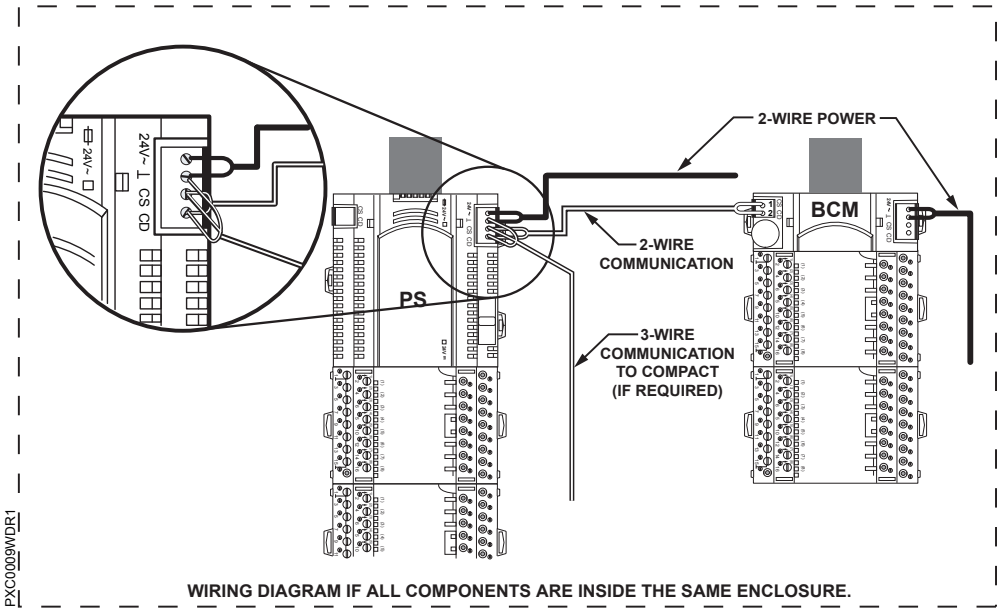
- The earth ground is installed in the primary field panel by a single jumper between the service box **E** terminal and **N** terminal.
- A jumper is not installed in any secondary field panel.



Service Box Common Grounding.

Power Supply Wiring

Bus Connection Module



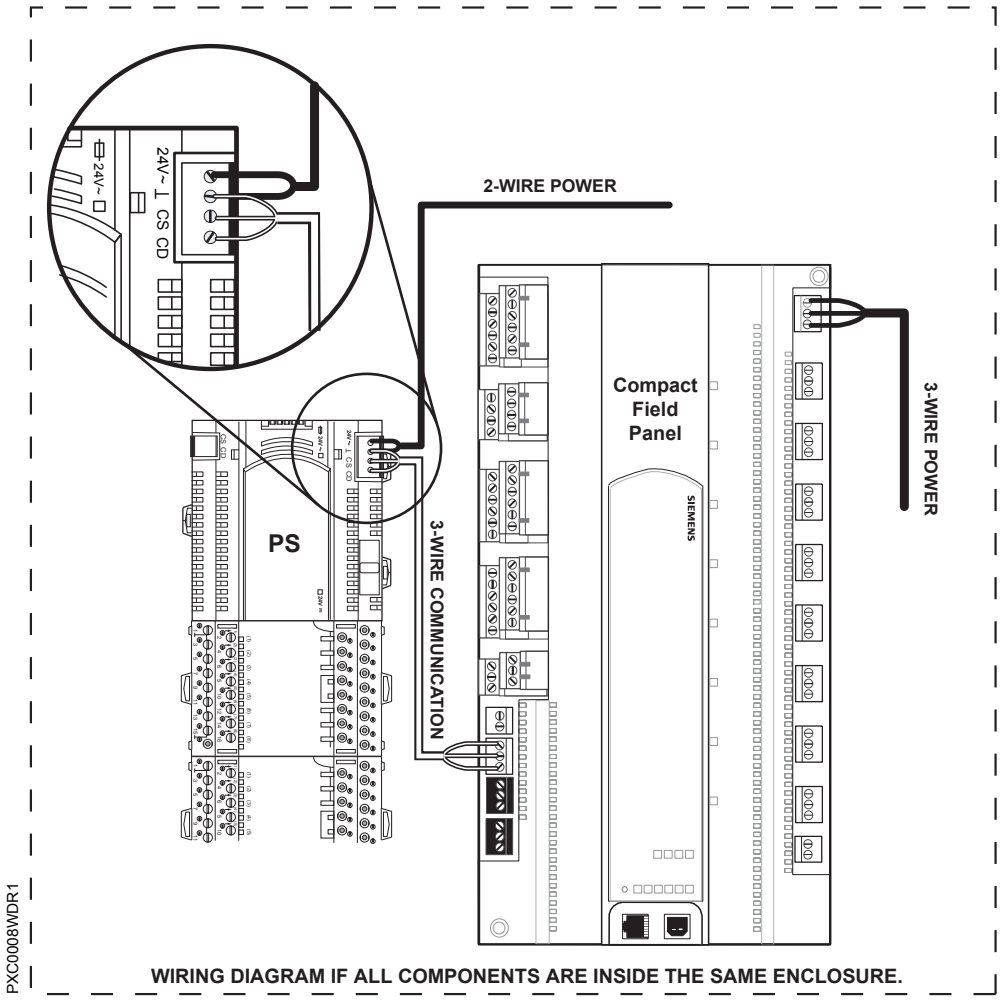
TX-I/O Power Supply to Bus Connection Module Wiring.

PXC-36

TX-I/O Modules do not need to be powered off of the same AC source as the PXC-36. The island bus driver circuit in the PXC-36 is isolated from the power supply of the PXC-36 itself.

The CD, CS, and System Common (⊥) signals from the TX-I/O Power Supply module that is connected to the TX-I/O Modules are brought back and tied to the PXC-36 at terminals 82, 83, and 84.

NOTE:
Good power and grounding practices must be exercised at both locations.



Compact 36 to TX-I/O Power Supply Wiring.

Commissioning Notes

	**⚠ WARNINGk**
	Do not use the local override for safety shutdown operations, such as performing service or maintenance. Use suitable emergency switches instead.

Removing and inserting modules without disconnecting the power

The plug-in modules can be removed from or plugged into the terminal bases without switching off the power. However, if large loads are connected to the terminals, it is possible that the contacts between the terminal base and plug-in module could be burnt.

Emergency operation via override

In the event of a bus communications failure, emergency manual operation is possible in I/O modules with local override switches. However, the 24 Vdc module supply must be present.

I/O Module Power-up Sequence

Power Off Status

TX-I/O modules shut down when the power supply to the module is below 16V.

- The LEDs and LCDs are off.
- The modules are inactive.

Power Up Sequence

The modules start up when the power supply to the module rises above 21.5V.

1. The module status LED lights up and the LCD briefly displays the address number.
2. The status LED indicates the last operating state before the module shut down.

If communication is OK:

- The TX-I/O module begins operation with the configured values.
- If the island bus is controlled by a P1 BIM, the TX-I/O module begins operation as before the shutdown.

If there's no communication:

- The module waits 4 seconds for communication.
- There's no control of outputs during this time.

If there's no communication after 4 seconds:

- The TX-I/O module begins operation with the backup values.
- If the island bus is controlled by a P1 BIM, the TX-I/O module begins operation with the backup values.

Island Bus Topology Rules

TX-I/O Island Bus topology includes the following:

- 24 Vdc power for Communication Supply (CS)
- Communication Data (CD) signal at 115,200 bps
- 24 Vac power 50/60 Hz (24V~) and System Neutral (⊥)

The following term is used when discussing the island bus topology:

- Lmax

Lmax

Lmax is the maximum length of all island bus cable (four conductor (24V~, ⊥, CS, CD) run between the primary enclosure and all other enclosures. Lmax depends on:

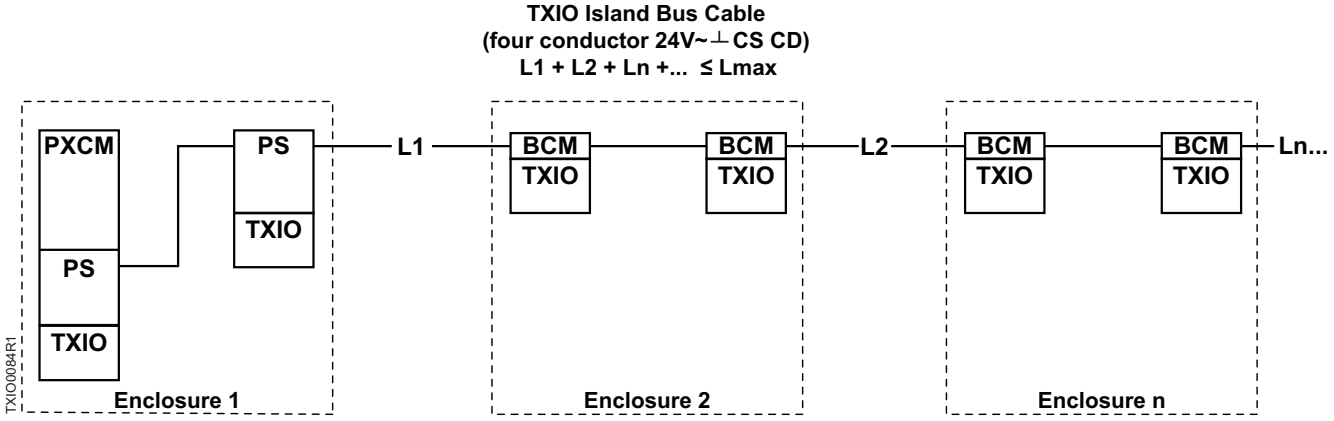
1. The type of cable used.
2. The maximum voltage drop of Communication Supply (CS) due to power distributed across the cable resistance.
3. The distortion effect of total cable capacitance on Communication Data (CD) signal quality as outlined below.

NOTE:
Lmax for any cable type is 164 ft (50 m) due to total capacitance.

Lmax Table.		
Cable Type	**Maximum Communication Supply**	**Maximum Length (Lmax) for Island Bus**
14 AWG (2.0 mm^2)	18W	164 ft (50 m)
16 AWG (1.3 mm^2)	10W	164 ft (50 m)
16 AWG (1.3 mm^2)	18W	100 ft (30 m)

See the *APOGEE Wiring Guidelines for Field Panels and Equipment Controllers* (125-3002) for more details on island bus cable specification and power distribution.

Island Bus Length as a Function of Signal and Power (CS/CD)



TX-I/O Island Bus Communication Topology.

Extending Communication

	**⚠ CAUTION** If wires go between enclosures or are in an enclosure with VFD or 100 kVa or larger motors, then use twisted pair cables and keep them a minimum of two feet away from any high voltage wires.

NOTE:
Depending on the module types and point configurations used, one service box transformer may have insufficient power for more than two TX-I/O Power Supplies. More power may be required if using a Modular Series with the maximum number of TX-I/O modules.

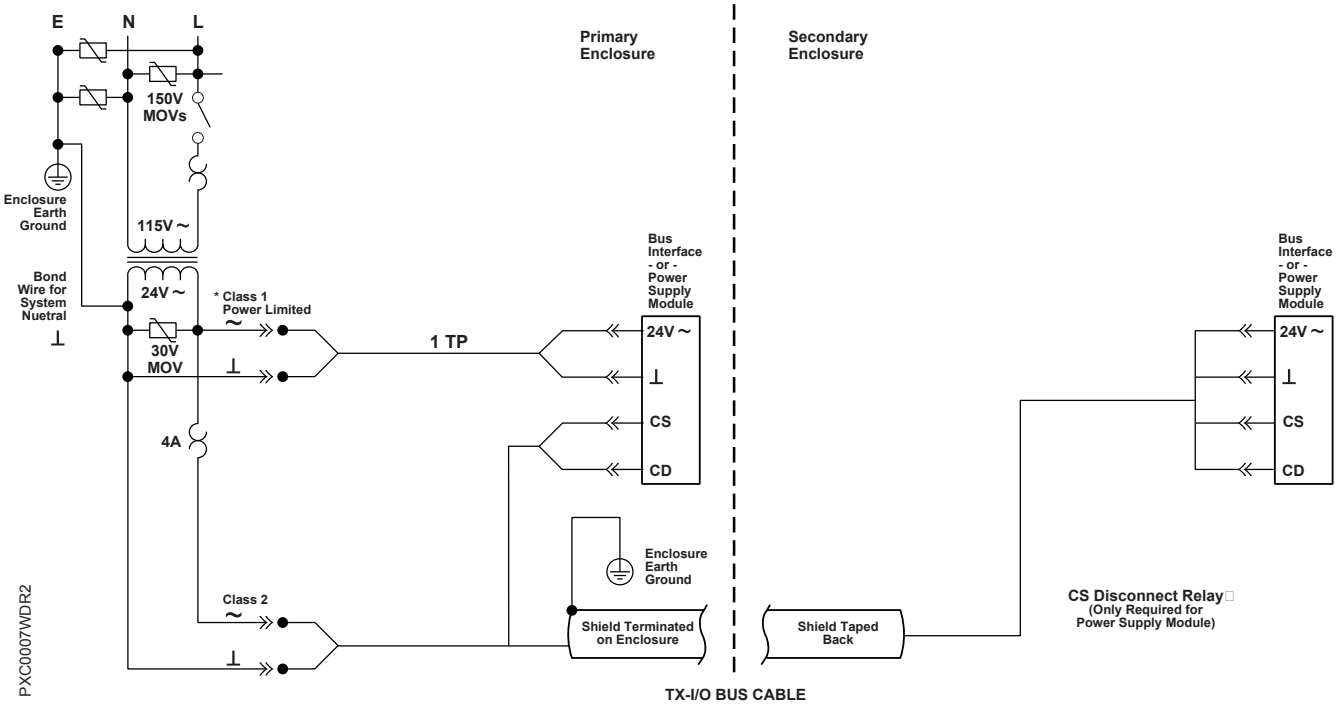
If an installation requires more than one DIN rail, connect the Communication Supply (CS) and Communication Data (CD) terminals from the Bus Connection Module to the CS and CD terminals on the first device of every additional DIN rail (either a TX-I/O Power Supply or Bus Connection Module).

TX-I/O Power Supplies and Bus Connection Modules include a second set of CS and CD contacts to simplify connection of additional DIN rails. Ensure that the system neutral is installed.

Extending TX-I/O Bus Communication Using a Single Transformer

The following conditions must be met in order to extend TX-I/O bus communication beyond the primary enclosure (which contains the PXC Modular, PXC-36, or P1 BIM) using a single transformer. The primary use for this configuration is powering one or more branches with low power requirements. See the following figure.

NOTE:
Only the Class 2 connector may be used to power equipment outside of the enclosure with the service box.



Extending TX-I/O Bus Communication Using a Single Transformer.

Configurations for a single 24 Vac transformer powering the extended TX-I/O Island Bus:

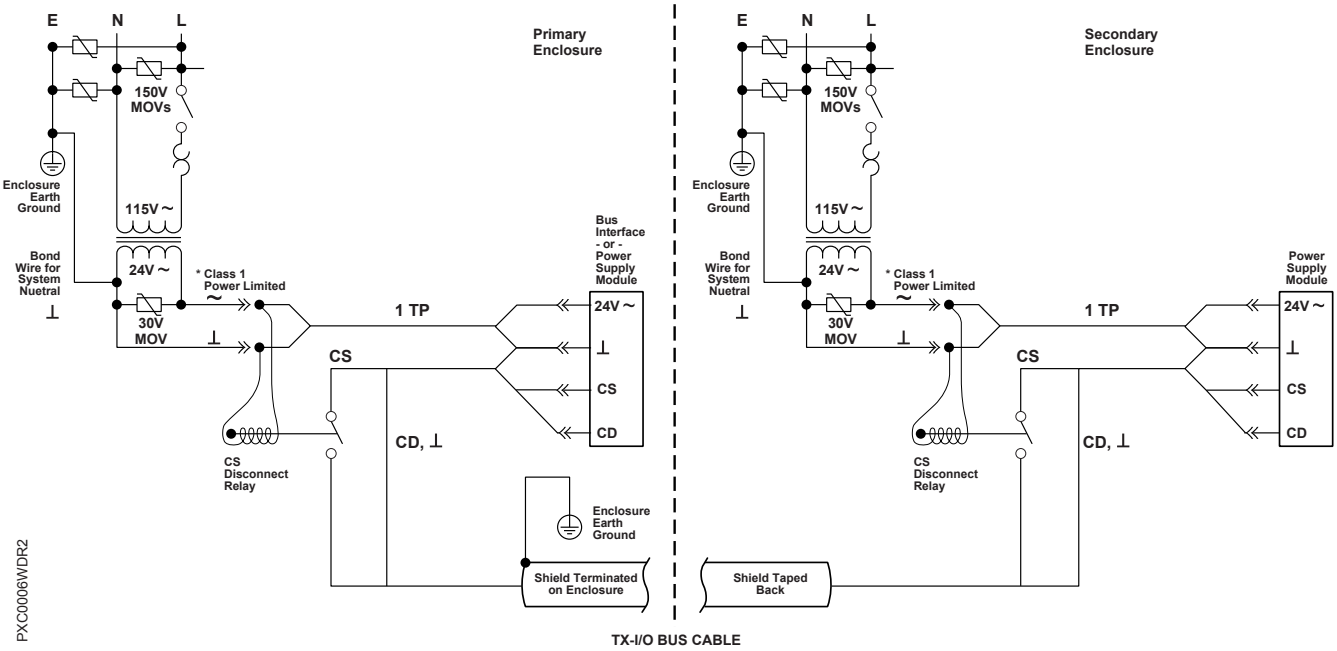
- Power Supply or Bus Connection Module in the primary enclosure is connected to 24 Vac at Class 1 power limited transformer secondary.
- Power Supply or Bus Connection Module in the secondary enclosure is connected to 24 Vac at Class 2 limited transformer secondary.
- Communication reference and module power Supply (CS) and Communication Data (CD) twisted together with system neutral (⊥) and optionally with 24 Vac.
- TX-I/O bus cable may be one twisted shielded 4C (CS/CD/⊥/~) or one twisted shielded pair (⊥/~) and one twisted shielded 3C (CS/CD/~).
- Shield connected to enclosure earth ground on enclosure with service box and taped back on other end.

Extending TX-I/O Bus Communication Using Multiple Transformers

The following conditions must be met in order to extend TX-I/O bus communication beyond the primary enclosure (which contains the PXC Modular, PXC-36, or P1 BIM)

using multiple transformers. The primary use for this configuration is powering several expansion enclosures with high power requirements. See the following figure.

NOTE:
Depending on the module types and point configurations used, one service box transformer may have insufficient power for more than two TX-I/O Power Supplies. More power may be required if using a Modular Series with the maximum number of TX-I/O modules.



Extending TX-I/O Bus Communication Using Multiple Transformers.

Use 24 Vac SPST relays powered by each transformer to disconnect Communication Supply (CS) from the TX-I/O bus when the transformer is shut off. Refer to the *Field Purchasing Guide* for part numbers.

⚠ CAUTION

Moving the power switch to OFF when using more than one transformer may not shut off power to the modules and may shut off power to modules in the other panels.

⚠ CAUTION

Each transformer secondary neutral must be connected to the same building approved earth ground at the transformer.

- System Neutral (⊥) must be continuous throughout the TX-I/O Bus.
- Do not connect TX-I/O components to a floating system neutral. Otherwise, equipment damage will occur.

TX-I/O Island Bus Expansion

The TX-I/O Island Bus Expansion module uses RS-485 to provide distances greater than 164 ft (50 m).

Admissible Number of Devices

TX-I/O Power Supply Module	A maximum of four TX-I/O Power Supply modules may be connected in parallel per system. When a P1 BIM is present, a maximum of three TX-I/O Power Supply modules may be operated in parallel with the P1 BIM, per system.
Bus Connection Points	Maximum number bus connection points per island bus: 16 *Example* 1 P1 BIM (10-module) + 3 TX-I/O Power Supply modules + 12 Bus Connection Modules = 16 bus connection points
TX-I/O Island Bus	Only one controller is used per island bus **PXC Modular** Up to 64 I/O modules or a maximum of 500 points **PXC-36** Up to four I/O modules (approximately 32 points) **P1 BIM (10-module)** Up to ten I/O modules or a maximum of 80 points. **P1 BIM (4-module)** Up to four I/O modules or a maximum of 64 points.
I/O Row	Up to two TX-I/O Power Supply modules may be connected in parallel per I/O row.
Limits for the Island Bus Expansion (IBE) Module	Maximum of 5 IBEs on the island bus: one IBE in the primary enclosure plus four expansion enclosures. Only one Island Bus Expansion (IBE) module per enclosure is permitted. Maximum number of segments per IBE: 2 segments of 200 ft each (61 m) (200 ft from the IBE in the primary enclosure to the IBE in the furthest expansion enclosure.) For each expansion enclosure, a maximum of four TX-I/O Power Supply modules may be connected in parallel, with up to two power supply modules connected in parallel per I/O row.

Island Bus Expansion Topology Rules

TX-I/O Island Bus Expansion (IBE) modules convert the island bus signal to RS-485 in order to transfer the Communication Data (CD) signal from the IBE installed in the primary field panel to any IBE installed in an expansion field panel. The IBE is used when the distance between the primary and expansion field panels would otherwise exceed the maximum island bus cable length (Lmax [→ 45]).

TX-I/O island bus expansion topology includes the following:

- 24 Vdc power for Communication Supply (CS)
- Communication Data (CD) signal at 115,200 bps
- 24 Vac power 50/60 Hz (24V~) and System Neutral (⊥)

The following terms are used when discussing the island bus expansion topology:

- Lprimary
- Lexpansion
- Lsegment

Lprimary

Lprimary is the total length of island bus cable used between the primary field panel and its extended panels.

- Lprimary must not exceed Lmax for the type of cable used.

Lexpansion

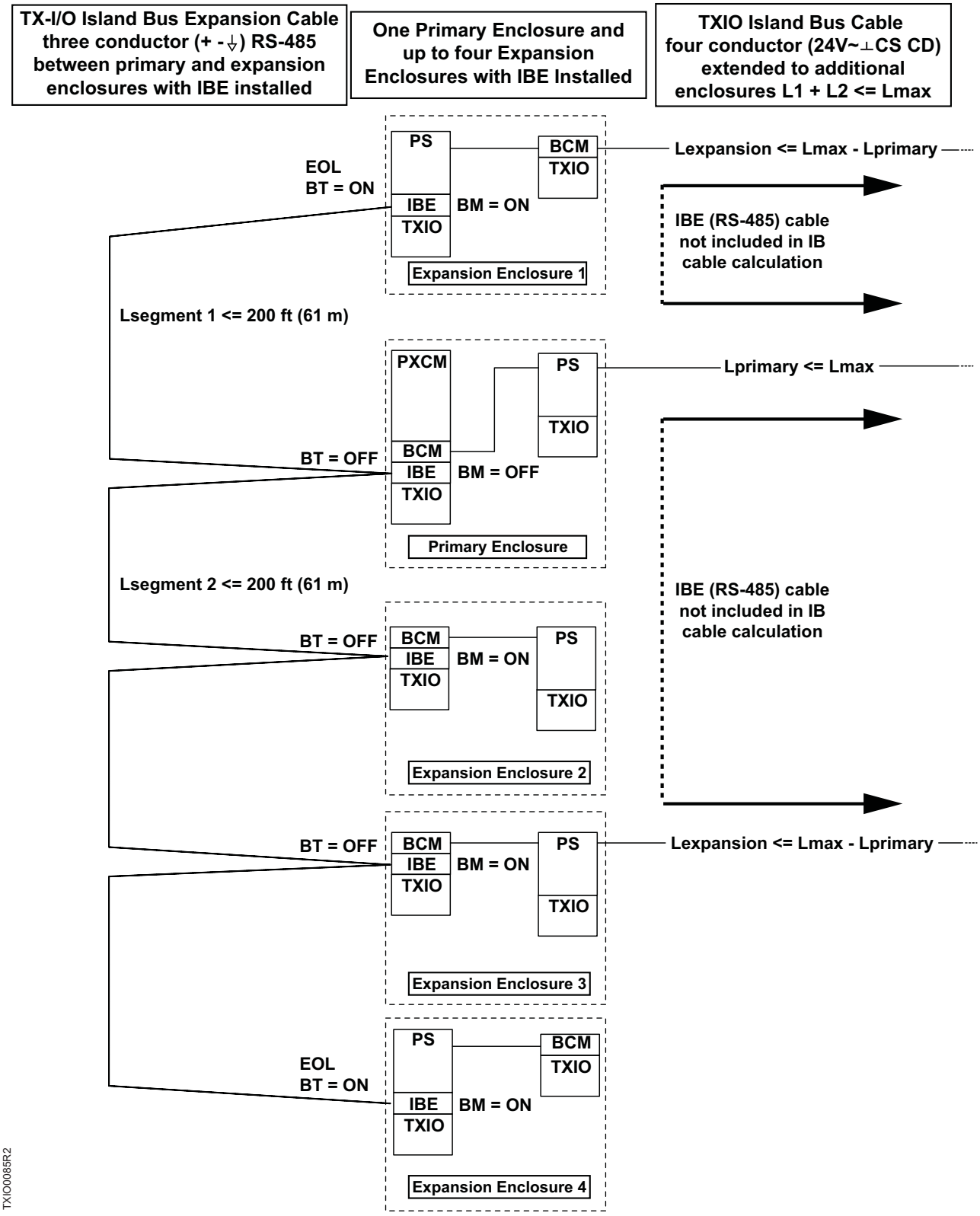
Lexpansion is the total length of island bus cable used between the expansion panel with the IBE and its extended panels.

- Lexpansion in any expansion field panel plus Lprimary must not exceed Lmax for the type of cable used.
- Lexpansion only adds to Lprimary. It does **not** add to any other Lexpansion.

Lsegment

Lsegment is the total length of RS-485 cable connecting the IBE installed in the primary field panel to the IBE installed in the furthest expansion field panel.

- A maximum of two segments (2 × Lsegment) may originate from the IBE installed in the primary field panel.
  - Each segment originating from the IBE may not exceed *Lsegment maximum*, which is 200 ft (61 m).
  - To ensure proper grounding, Lsegment must not exceed Lsegment maximum.
- Lsegment must be installed in chain topology. Do not use star or ring topology.
- Up to 4 expansion enclosures may be connected to the primary enclosure using IBEs.
- Lsegment lengths do not affect Lmax, Lprimary, or Lexpansion.

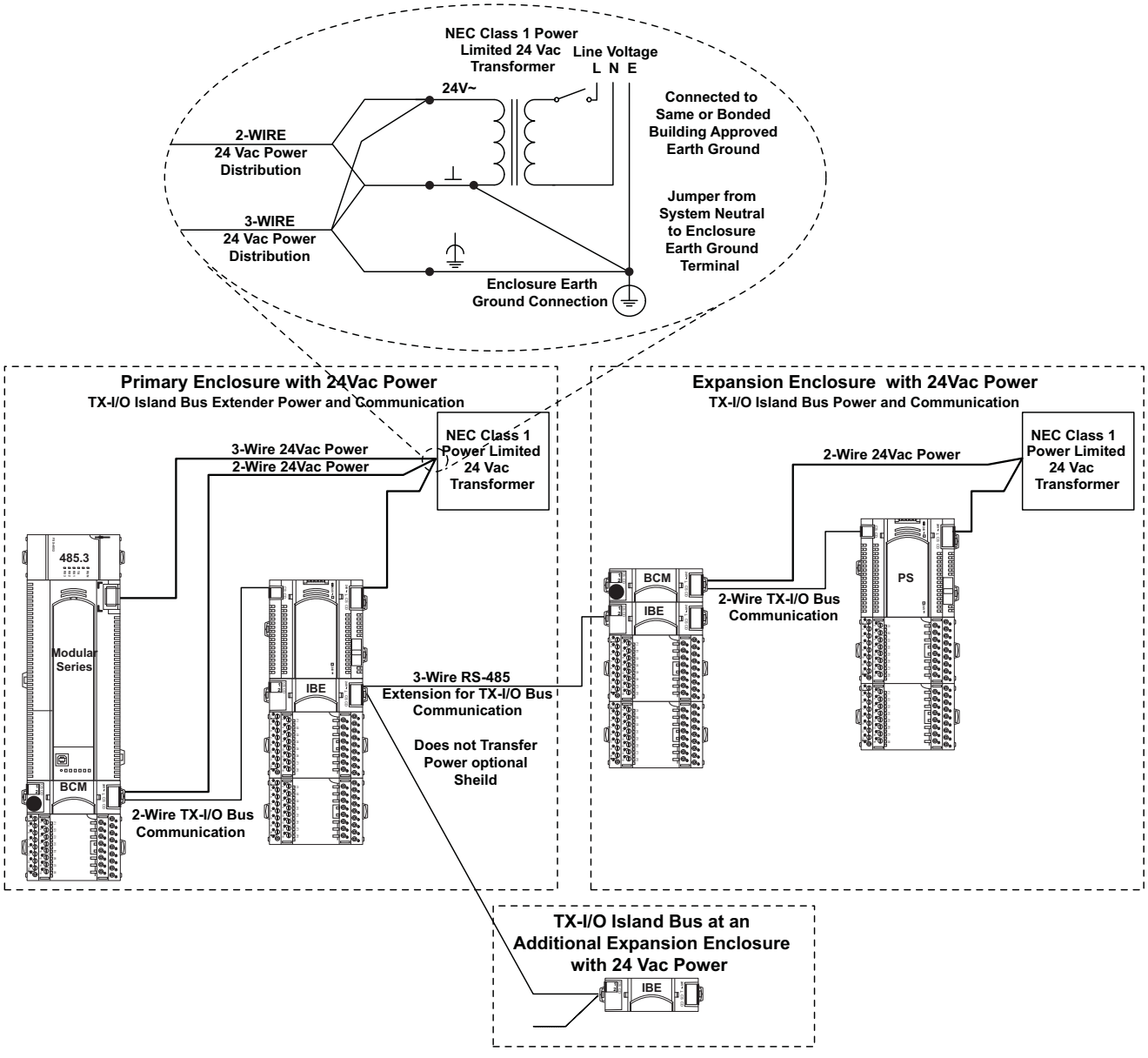


TX-I/O Island Bus Expansion Topology.

Island Bus Expansion Power Distribution

TX-I/O Island Bus Expansion (IBE) modules connect the primary panel with up to four expansion panels in cases where the distance between the panels which would otherwise cause the maximum island bus cable length to be exceeded.

Each field panel must have building approved earth ground.



TX-I/O Island Bus Expansion Power Distribution.

Observe the following power distribution topology:

- IBE modules do not transfer island bus AC or DC power over the RS-485 expansion cable.
- Each expansion field panel must supply its own 24 Vac source

- IBE communication common (⏚) is not galvanically isolated from System Neutral (⊥).
- Connect ⊥ for the primary field panel and all expansion field panels to the same or bonded building approved earth grounds.
- A circuit interrupter is installed in each IBE communication common; make connections on both sides.

Troubleshooting the TX-I/O Island Bus

The 24 Vac LED on the TX-I/O Power Supply or the P1 Bus Interface Module (BIM) is OFF.

1. Check for 24 Vac input.
2. Replace the fuse (4A, 5 × 20 mm, 250V, medium-acting, ceramic fuse).

All points on the TX-I/O island bus are failed.

- Verify all three signals, System Neutral (⊥), Communication Data (CD), and Communication Supply (CS) are connected throughout the entire TX-I/O island bus.

The I/O module status LED (under the address key) is flashing or the I/O point status LED is flashing on an open point. All points are operating normally.

⚠ CAUTION

The TX-I/O island bus must extend from the male bus connector of the TX-I/O Power Supply or Bus Connection Module.
• The TX-I/O Power Supply and Bus Connection Module only supply 24 Vac to I/O modules on the male bus connector.
• I/O modules on the female bus connector of the TX-I/O Power Supply or Bus Connection Module do not receive power and have a fault condition.

A point is failed or the point type displayed does not correspond to the point type defined in the database.

1. Using the job drawing or TX-I/O Island Bus layout sheet, verify that the address keys are in the correct module.
2. Reset the module to factory settings.
    a. Verify that the module is supplied with 24 Vdc.
    b. Remove keys that are in the wrong module.
    c. Insert and then remove the reset key.
    d. Cycle power to the module.
    e. Insert the correct address key.

A current point on a Super Universal Module is failed.

- Verify that the sensor supply wire is connected to the DC terminal (3, 11, 20, or 28).

Modules begin oscillating; island bus communication shuts down

- Reset: Switch off the 24 Vac supply of the PXC Modular, PXC-36, or P1 BIM.

Relays and current outputs have a power consumption that depends on the supply voltage (module supply 24 Vdc). The power consumption of an I/O island will rise when all relays are active and all current outputs deliver 20 mA. This causes a drop in the supply voltage.

If too many of these outputs are configured, the voltage may drop too much so that all modules switch off. When the voltage recovers, the modules switch on again, and so forth, 1 to 2 times per second.

In this case, the PXC Modular, PXC-36, or P1 BIM reacts by switching off the communication after 5 cycles (shortcut between CD and CS, the COM LED will light brightly).

Troubleshooting the LCD Display Indications

NOTE:
Physical points on an I/O module hold the last configuration until characterized with a different type—even when the logical point is deleted from the database. Use the reset key to remove the physical point configuration from all points on an I/O module.

When troubleshooting an I/O module that does not have an LCD display or manual override switches, you may wish to temporarily install a TXM1.8X-ML or TXM1.8U-ML plug-in module. This allows you to quickly review the module status and error indications. Do the following to temporarily replace the plug-in module:

1. Remove the address key from the I/O module.
2. Remove the plug-in module from its terminal base.
3. Insert the TXM1.8X-ML or TXM1.8U-ML plug-in module.
4. Insert the reset key.
   ⇨ All of the module status LEDs briefly light to indicate the temporary plug-in module has been reset.
5. Remove the reset key and reinsert the address key.
6. Troubleshoot using the LCD display indications.
7. When done, remove the TXM1.8X-ML or TXM1.8U-ML plug-in module.
8. Reinsert the original plug-in module and its address key.

LCD Display Indications.		
Symbol	**Status Indicator**	**Check**
Incorrect point type	The point type displayed does not correspond to the point type defined in the database.	Using the job drawing or field panel layout sheet, verify that the address keys are in the correct module.
Display is OFF *or* Display is ON, but communications are failed	Insufficient DC power. *also check* TX-I/O Power Supply LED (24V⎓) is bright green.	● Ensure CS and ⊥ are connected to the Bus Connection Module (BCM). ● Ensure CS/⊥ at the BCM is within 0.5 Vdc of CS/⊥ at the Power Supply. – The wire length may have attenuated the DC power. – Ensure the module diagnostics report is normal.
!	Field device supply (V≂) is missing or very low. *also check* The field device supply LED on the TX-I/O Power Supply (24V~) or Bus Connection Module (V≂) are bright green.	● Is a TX-I/O module connected to the wrong side of the Power Supply or Bus Connection Module? The TX-I/O island bus must extend from the male bus connector of the Power Supply or Bus Connection Module. ● Is the field device supply LED OFF? If so: – The 4A replaceable fuse may be blown. – The field device supply may be off. – Wires may be disconnected. ● Is the field device supply LED dimly lit? – The field device supply may be too low.
!▼	Point is configured as an output signal and no field device supply is available.	● Is a TX-I/O module connected to the wrong side of the Power Supply or Bus Connection Module? The TX-I/O island bus must extend from the male bus connector of the Power Supply or Bus Connection Module. ● Is the field device supply LED OFF? If so: – The 4A replaceable fuse may be blown. – The field device supply may be off. – Wires may be disconnected. ● Is the field device supply LED dimly lit? – The field device supply may be too low.
?	Invalid process value (current output)	● Ensure the output current loop is intact. ● The ? symbol has higher priority than the ! symbol.
✕▲	No sensor (current input)	● Ensure the sensor power wire is landed on the sensor power terminals of an 8X module (3, 11, 20, or 28) and not on field device supply terminals (7, 15, 24, or 32) of 8U or 8X modules. ● Verify the external wire at the sensor. ● An internal sensor wire may have a break.
⇧	Value above range limit	● NTC resistance is too low (temperature over range). ● RTD resistance is too high (temperature over range). ● The voltage or current input is too high.

LCD Display Indications.		
Symbol	**Status Indicator**	**Check**
	Value below range limit	• NTC resistance is too high (temperature under range) or there is an open circuit. • RTD resistance is too low (temperature under range). • The voltage or current input is too low.
	Open circuit (NTC, RTD, voltage)	• Check for an open wire or failed sensor. • Not available on current, NTC or digital inputs or outputs.
	Short circuit (NTC, RTD)	• Check for a shorted wire or failed sensor. • Not available on current, voltage or digital inputs or outputs.
	Point type not supported in manual override	• Displays when pressing the override button on an input. • The LED indicates the value or state of the input.
	Inactive point	Temporarily displayed during the normal power-up sequence.
	Point is unconfigured; the field device supply is valid	Normal display for unconfigured points.

Resetting an I/O Module to Factory Settings

Use this procedure in the following situations:

- If an I/O module was previously configured with a different address key or a different point database, such as a different sensor type.
- You want to force the PXC Modular, PXC-36, or P1 BIM to reconfigure a module.

Do the following to reset a module to the factory settings:

1. Verify that the module is supplied with 24 Vdc.
2. Remove the address key.

   ⇨ The module's status LED starts dual-pulsing.
3. Insert the reset key.

   ⇨ All of the module status LEDs briefly light to indicate the module has been reset.
4. Remove the reset key.
5. Cycle power to the module.
6. Reinsert the address key.

⇨ After the reset, the modules operate with the factory default function for each I/O point. Any previous local override settings are deleted.

Replacing a TX-I/O Plug-in Module

NOTE:
If reusing an I/O module, reset the module to factory settings before you begin.

The plug-in module of a TX-I/O module assembly can be replaced at any time by the same or a compatible I/O module type, even while the system is running.

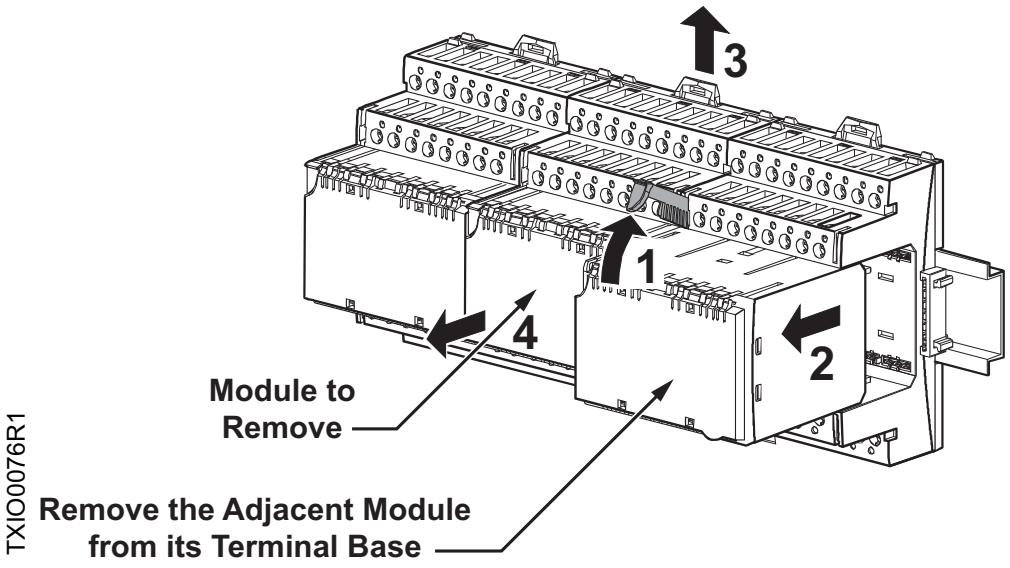
1. Swivel the address key outward to switch off the load to the I/O module.
   ⇨ Leave the base of the key plugged into the terminal base .
2. Remove the plug-in module from its terminal base.
3. Insert the new plug-in module.
4. Swivel the address key back into position.

⇨ As soon as the new module starts communicating with the PXC Modular, PXC-36, or P1 BIM, it is configured according to the module address and starts operation shortly afterward.

Replacing a TX-I/O Module Assembly

NOTE:
If reusing an I/O module, reset the module to factory settings before you begin.

NOTE:
When replacing a complete TX-I/O module assembly, the adjacent plug-in module on the male bus connector must first be removed from its terminal base. Otherwise, the module assembly catches on the bus connector.



TX-I/O Module Removal.

1. Working on the adjacent TX-I/O module on the male bus connecter, swivel the address key out of the plug-in module.
   ⇨ Leave the base of the key plugged into the terminal base.
2. Remove the adjacent I/O module from its terminal base.
3. Working on the TX-I/O module being removed, pull the mounting tabs outward.
4. Remove the complete TX-I/O module assembly (plug-in module and terminal base).
   ⇨ Removing the terminal base interrupts the Island Bus communication and power.
5. Insert the new TX-I/O module assembly without an address key.
6. Push in the mounting tabs on the terminal base.
7. Move the address key from the old module to the new one and swivel it into position.
8. Plug the adjacent I/O module back into its terminal base, and swivel the address key back into position.

⇨ As soon as the new module starts communicating with the PXC Modular, PXC-36, or P1 BIM, it is configured according to the module address and starts operation shortly afterward.

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