

AutoEXEC

**Hybrid, Multi-Run Flow Computer and
Remote Telemetry Unit for Natural Gas and / or
Petroleum Liquids**

User Guide

P/N 1-0443-048

Revision P



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Revision History

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Chapter 1

Product Overview

General

The Thermo Scientific AutoEXEC flow computer provides unsurpassed levels of security, speed, expandability, and USB connectivity in a configurable, powerful natural gas and petroleum liquids remote telemetry unit (RTU). The flow computer utilizes a Freescale™ ColdFire® 32-bit high performance industrial grade (-40°C to +85°C) microprocessor to meet computational and communications requirements. Its computational speed is greater than 300 million instructions per second (MIPS), yet it requires minimal power. This performance capability, in conjunction with its 32-bit hardware floating point capabilities, gives the flow computer the ability to solve complicated mathematical equations rapidly and accurately.

Basic System Power Distribution

The flow computer is available with a DC input (9–30 Vdc). The power supply produces a regulated 12 Vdc that is put onto the backplane for use by the I/O cards. The power supply is protected against high surge voltages and designed to meet UL and ATEX requirements (reference the appropriate certification tag for specific ratings). The I/O cards generate their own voltages as needed. The 12 Vdc on the backplane terminal blocks is available for use by external devices such as a radio.

Display

A 4 x 16 liquid crystal display (LCD) is mounted on the front of the flow computer. The LCD may display the flow computer configuration and/or dynamic (current) data. It is connected to the main chassis with a pluggable ribbon cable.

The CPU

The CPU contains the primary logic functions of the flow computer and has the following features:

- Connection to the backplane
- Interface to the LCD
- Flash memory for program storage and data storage, 8 M x 16
- SRAM memory for data storage, 1 M x 16, battery backed
- DDR SDRAM memory for high-speed execution of main program, 16 M x 32
- Serial Flash for data storage, 4 MB
- Real-time clock (RTC)
- Field replaceable Lithium battery backup; voltage monitor for the RTC and SRAM circuits allows for data and configuration retention in the event of power failure
- Low DC input power alarm circuit
- Two RS232 serial ports with Electrostatic Discharge (ESD) protection that can be used for PC unit configuration or for communication with other serial devices
- Two Ethernet communication ports with ESD protection, allowing for Internet connection
- One “device” type USB port with ESD protection, allowing for connection to a PC (future)
- Flexbus connection to the backplane, allowing for high-speed connection to two optional I/O boards (currently, the optional communication board is the only board that requires connection to the Flexbus)
- Power consumption of 4 W

Backplane

Each instrument is equipped with a backplane that provides an interface for the following:

- The power supply: Plugs into the backplane and provides 12 Vdc to all the boards plugged into the backplane.
- The CPU: Plugs into the backplane and communicates with all the I/O boards through a RS485 full duplex port that runs the length of the backplane and has a terminal block for connection to an expansion chassis.
- DIN connectors for six I/O boards: This can be any combination of I/O boards (the communication board can only be inserted into the two slots closest to the CPU because these two support the Flexbus).

Expansion

The basic capacity of the flow computer can be expanded by adding optional I/O boards and expansion chassis. An expansion chassis houses up to seven additional I/O boards and a power supply (no CPU), increasing the number of I/O points. The expansion chassis communicates over a RS485 full duplex communication bus.

Optional I/O boards provide the interface between the field devices and the logic card assemblies. I/O board connections terminate in cage-clamp type screw terminals. Stranded wire sizes to 12 AWG can be used. The boards can be hot swapped, allowing users to replace them without disconnecting the wiring.



Warning The communication expansion board cannot be hot swapped. Power must be disconnected to the flow computer before replacement. ▲

The optional I/O boards are listed below. Each board is discussed in detail in “[Optional I/O Boards](#)” (Chapter 2). Specifications are provided in [Appendix B](#).

- Analog input board
- Analog output board
- Combo board
- Digital input board
- Digital output board
- Honeywell DE board
- Liquid flow board
- Liquid combo board
- Pulse input board

Radio / Host Port Options

The following radio and host port options are available for use with the AutoEXEC flow computer:

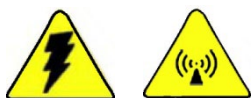
- Multiple MDS radio models
- Thermo Scientific AutoWAVE radio
- Thermo Scientific V.22/212A modem
- Thermo Scientific 202 modem

Using this Manual

This manual provides a technical description of the product, basic keypad operating procedures, installation and wiring instructions, and maintenance and troubleshooting procedures. For instructions on using the Thermo Scientific AutoCONFIG™ instrumentation configuration software with this instrument, refer to the AutoCONFIG software startup guide (p/n 1-0485-068) and the AutoCONFIG software help system (p/n 1-0485-060).

The information in this manual is designed to aid personnel to correctly and safely install, operate, and/or maintain the system described; however, personnel are still responsible for considering all actions and procedures for potential hazards or conditions that may not have been anticipated in the written procedures. **If a procedure cannot be performed safely, it must not be performed until appropriate actions can be taken to ensure the safety of the equipment and personnel.** The procedures in this manual are not designed to replace or supersede required or common sense safety practices. All safety warnings listed in any documentation applicable to equipment and parts used in or with the system described in this manual must be read and understood prior to working on or with any part of the system.

The following admonitions are used throughout this manual to alert users to potential hazards or important information. **Failure to heed the warnings and cautions in this manual can lead to injury or equipment damage.**



Warning Warnings notify users of procedures, practices, conditions, etc. which may result in injury or death if not carefully observed or followed. The triangular icon displayed varies depending on the type of hazard. ▲



Caution Cautions notify users of operating procedures, practices, conditions, etc. which may result in equipment damage if not carefully observed or followed. ▲

Note Notes emphasize important or essential information or a statement of company policy regarding an operating procedure, practice, condition, etc. ▲



Security Consideration

Warning ThermoFisher Scientific strongly recommends changing passwords before first use/login on this equipment. ▲

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Chapter 2

Hardware Description

Overview

The AutoEXEC hardware combines a high level of functionality and expandability to provide a cost effective solution to remote data acquisition, control, and processing tasks. Additionally, power consumption is extremely low due to the almost exclusive use of low power CMOS components.

The hardware is designed to provide a high degree of flexibility in configuring a unit to match the specific site at which it is to be installed. This flexibility is provided using several levels of expansion.

Optional I/O boards may be connected to the backplane via the RS485 bus, providing additional expansion in the following increments:

- 16 analog inputs per analog input board
- 16 digital inputs per digital input board
- 16 relay outputs per digital output board
- 4 pulse/accumulator inputs per pulse input board
- 4 analog outputs per analog output board
- 8 Honeywell smart transmitters per Honeywell DE board
- 6 pulse/frequency inputs per liquid flow board
- 4 pulse/accumulator inputs, 4 analog inputs, 1 analog output, 4 digital inputs, and 4 digital outputs per combo board
- 4 pulse/density inputs, 4 analog inputs, 2 analog outputs, 2 digital inputs, 2 digital outputs, 4 24V power outputs, and 2 RTD inputs per liquid combo board

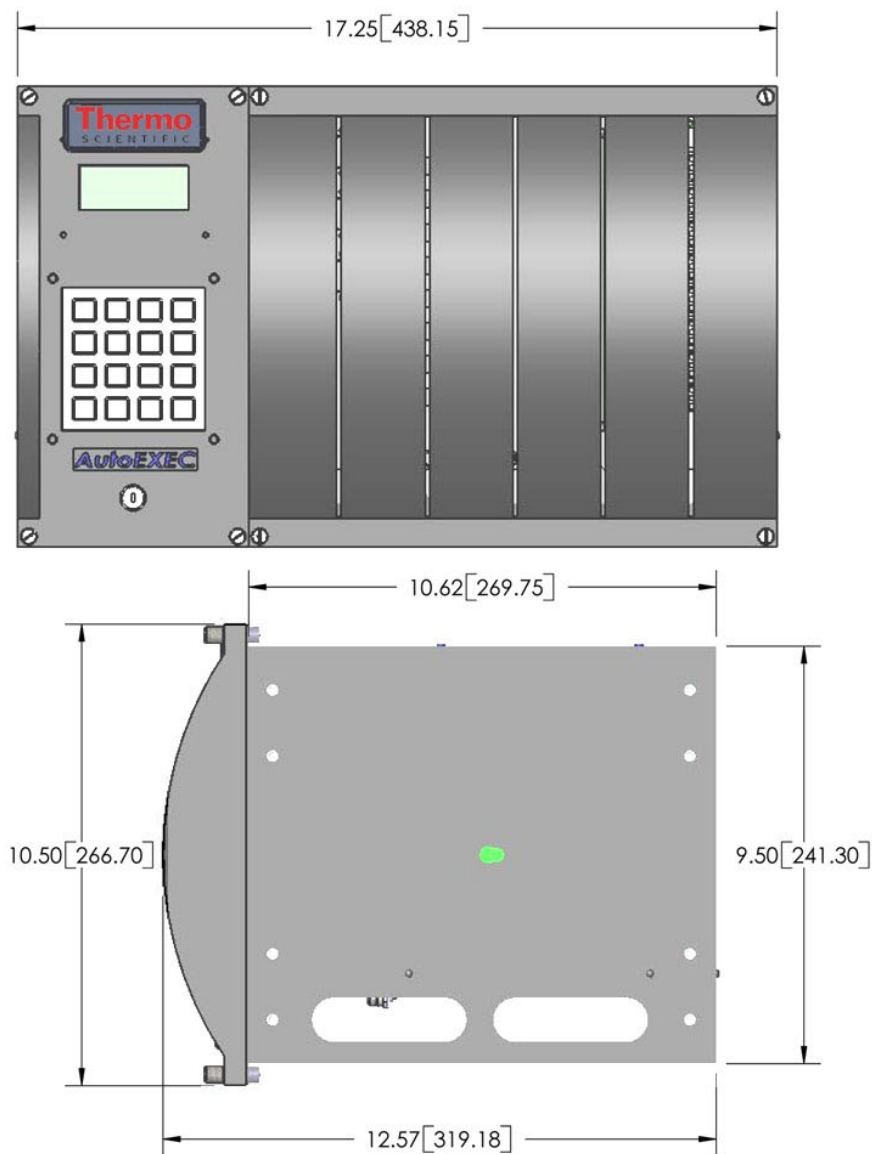
Each I/O board has terminal blocks for field wiring termination, and built-in surge protection prevents damage to the input circuitry.

See [Appendix A](#) for a list of replacement part numbers for the hardware described in this chapter.

Enclosure

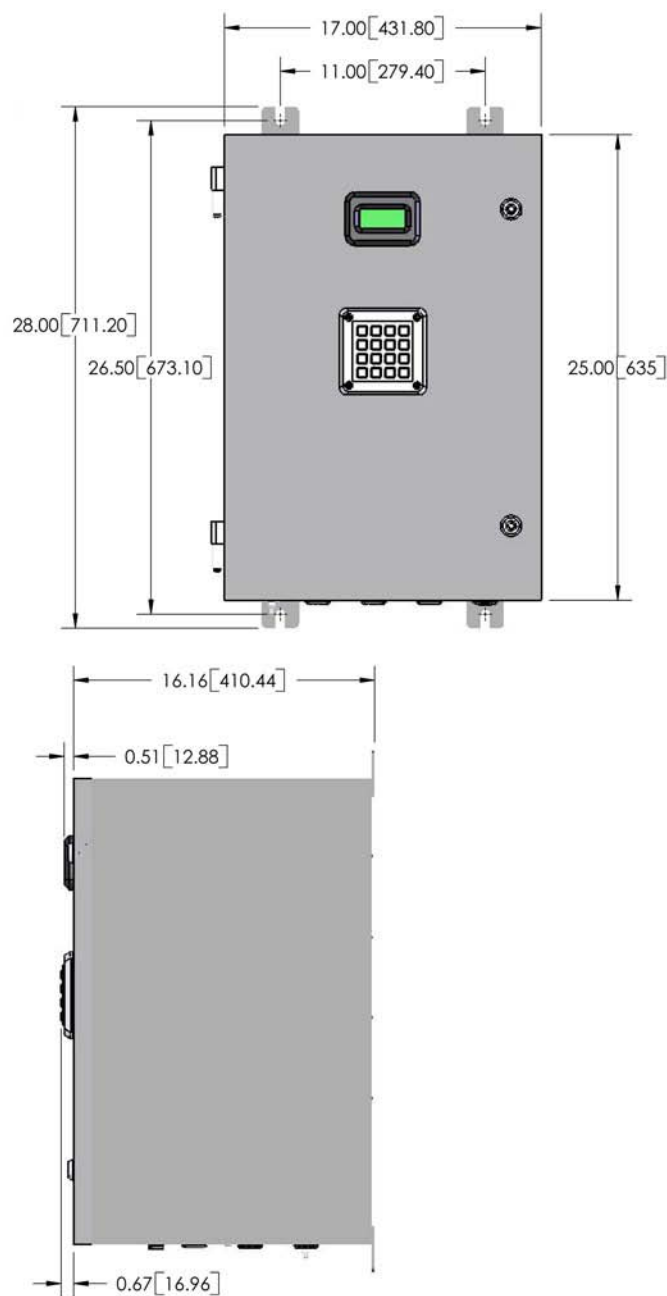
The instrument has two enclosure types. The standard enclosure comes in wall, panel, or rack mount configurations (see Figure 2-1). The Type 4X enclosure is available in aluminum or stainless steel (see [Figure 2-2](#)). All enclosures come standard with display and keypad.

A key lock assembly is included with the enclosure to prevent unauthorized access. Unless otherwise requested, all enclosures will use a common key.



Dimensions are in inches[millimeters].

Figure 2–1. Dimensions: Standard enclosure (wall, panel, & rack mount configurations)



Dimensions are in inches[millimeters].

Figure 2–2. Dimensions: Type 4X enclosure (pole mount configuration)

Power

Operating voltage for the flow computer is 9–30 Vdc. Power monitoring circuitry provides a low DC voltage alarm indication at 11.0 Vdc. The negative power lead is tied to case ground. The input power lines are protected against voltage transients caused by lightning surges, short circuits, and polarity reversals on input power.

Power consumption of the basic flow computer is about 10 W for a typical unit, including I/O loop power. However, overall power consumption depends upon the I/O configuration and must be determined on an individual flow computer basis. Every effort has been made to keep power consumption to a minimum. Power consumption for a typical expansion chassis is about 7 W.

The backplane has one regulated output that is brought out to the terminal block. The output supplies +12 Vdc to a radio, modem, or other communication subsystem.

Power supply connections are shown in Figure 2-3.

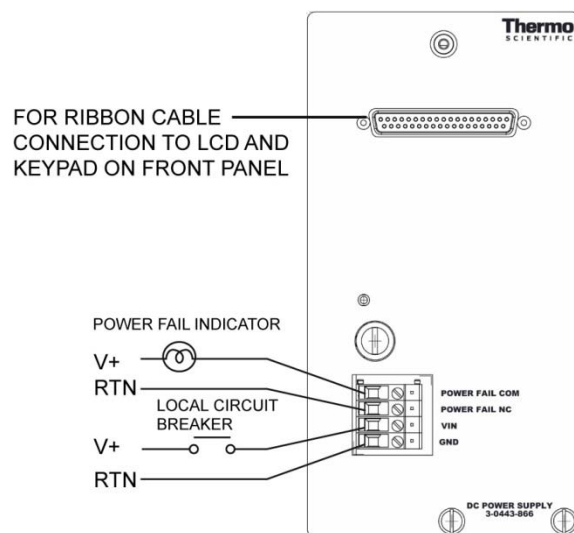


Figure 2-3. Power supply connections

The CPU

The CPU contains a Lithium backup battery. To conserve the battery, remove it from the holder if the flow computer will be out of service for an extended period. Install the battery before configuring the unit.

The board has two RS232 fully compatible serial ports. The DCE serial port is used for local connection to a PC for calibration, configuration, and data download. The DTE serial port supports all control signals required to interface to a radio, modem, or other communication device. The host port is configured for 9600 bps operation and can be factory configured for the following bit rates: 1200, 2400, 4800, 9600, 19200, 38400, or 57600.

The RS485 interface bus on the backplane allows for communication with remote I/O boards. Through this interface, the CPU can poll the remote boards for current I/O data or output control commands.

Jumper settings are listed in the table below.

Table 2–1. Jumper settings on the CPU

Jumper	Description
J3	Test mode. Do not store extra jumpers here.
J4–J6	No current use. Store extra jumpers here.

The connections on the CPU face plate and the J3 and J4-J6 jumpers are shown in Figure 2-4.

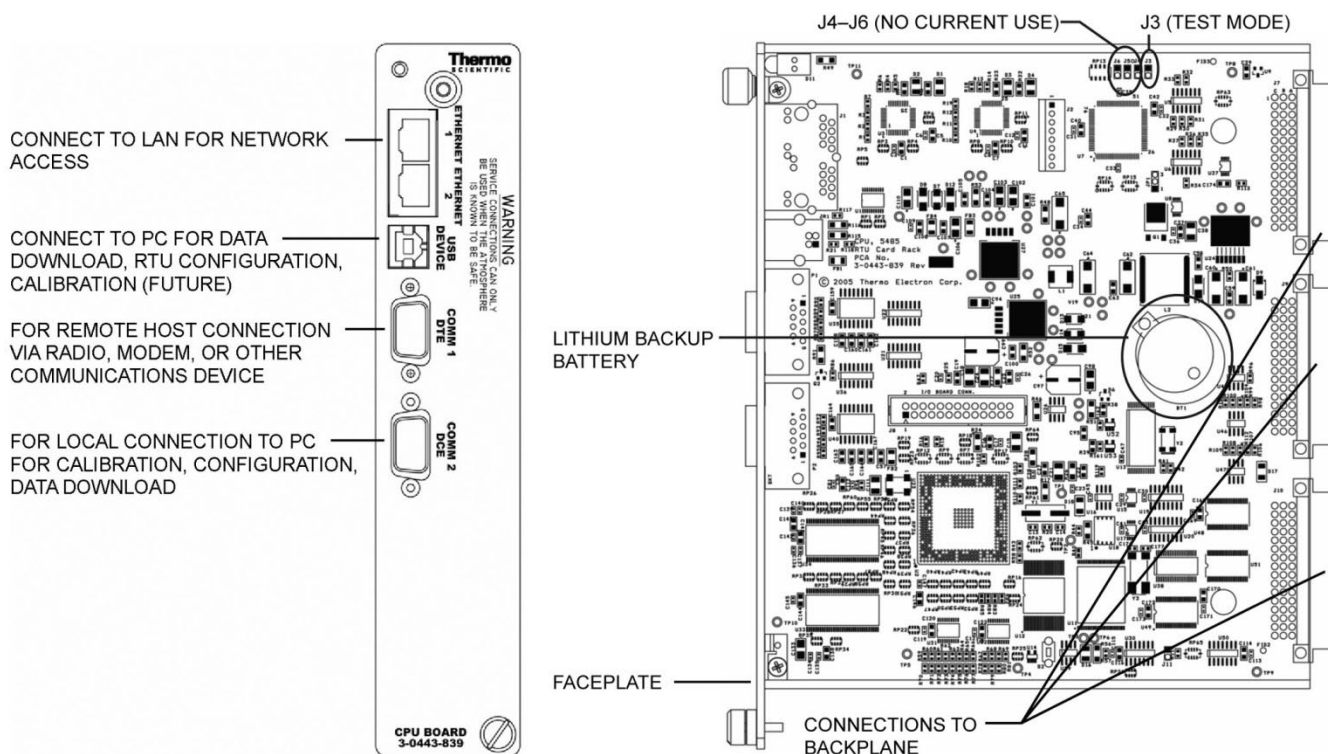


Figure 2–4. CPU (P/N 3-0443-839)

Optional I/O Boards

The following optional I/O boards are available with the AutoEXEC flow computer:

- Analog input board
- Analog output board
- Communication expansion board
- Combo board
- Honeywell DE communication board
- Digital input board
- Digital output board
- Liquid combo board
- Liquid flow board
- Prover board
- Pulse input board

Board Addressing

When adding an I/O board, assign a unique address to it so that it will not conflict with other boards that are installed. Do this by setting the two rotary switches (X10 and X1) on the board. For example, to set a board to 15, set the X10 switch to 1 and the X1 switch to 5. The boards can have any secondary number assignment from 1 to 96 (97 to 99 reserved for diagnostics), as long as there is not any duplication. Once you have installed the board, use the AutoCONFIG software to perform an I/O scan (Miscellaneous > System Control > I/O Rescan > **Restart**).

Activity Indication

Several AutoEXEC I/O boards have a green LED that indicates activity. The LED can be interpreted as shown in the table below.

Table 2–2. I/O board activity indicator LED

LED	Indication
Blinking slowly	Board is receiving messages from the system CPU and communication is established.
Blinking quickly	Board does not recognize messages from the CPU. Communication is not established.

Analog Input Board

The analog input board has 16 single-ended analog input channels, each of which accepts a 0–5 Vdc input signal and features a high common mode rejection ratio. The board utilizes a CMOS 14-bit analog-to-digital converter. An onboard DC/DC converter provides 24 Vdc loop and 12 Vdc excitation voltages.

Note 4–20 mA inputs are converted to 1–5 Vdc inputs by installing a 250-ohm dropping resistor across the inputs of the analog terminal board. ▲

Power consumption is 50–60 mA at 12 V (0.72 W) without external load and 450 mA at 12 V (5.4 W) at full external load. Each input has termination for analog signal input, excitation + (12 or 24 Vdc), and ground.

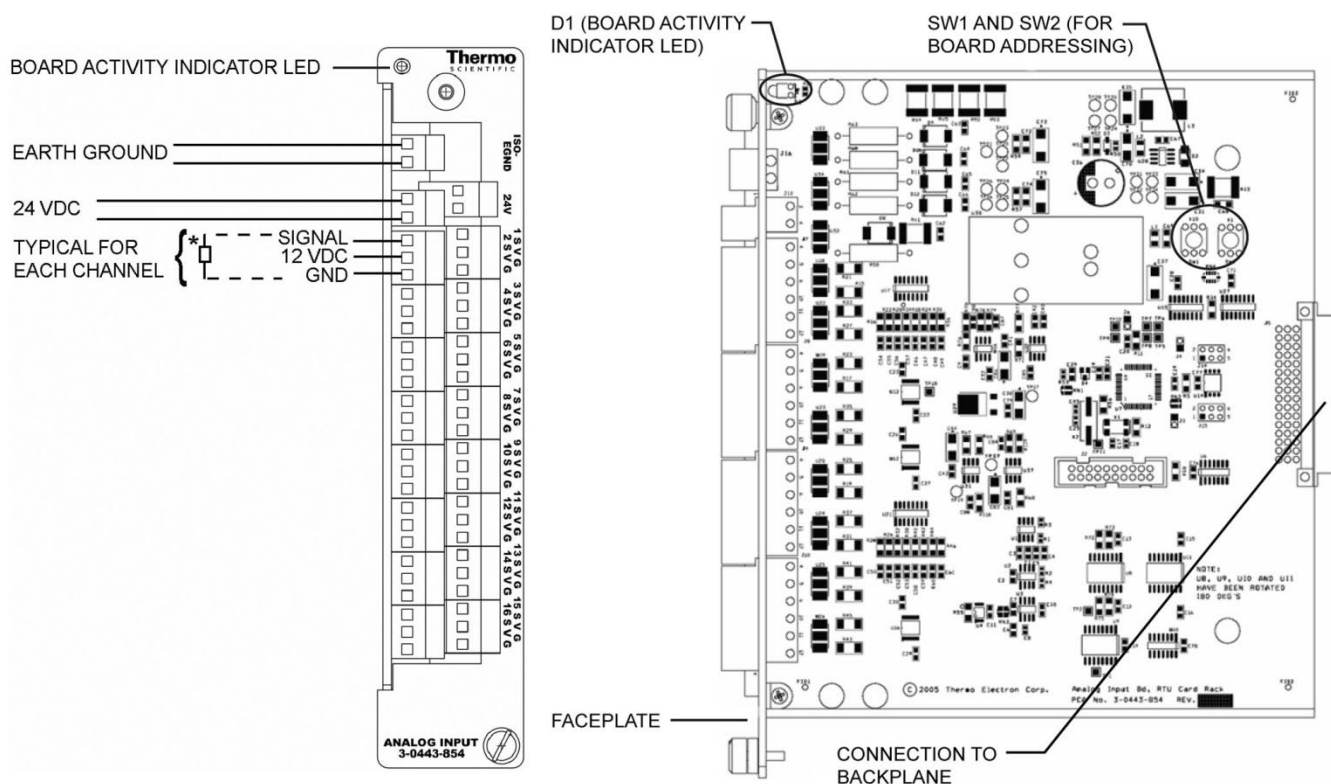


Figure 2–5. Analog input board (P/N 3-0443-854)

Note Reference Figure 2-6. Transducer power can be supplied from elsewhere as long as the power has the common ground as the analog input board. ▲

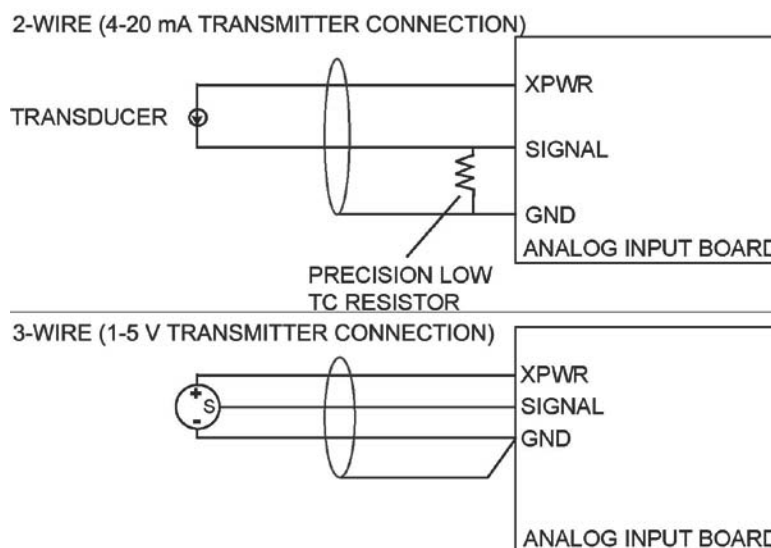


Figure 2-6. Analog input field wiring diagrams

Analog Output Board

Each analog output from the flow computer represents 0–100% of a representative output. The value of the analog output signal may be set manually, by local entry or download from the master computer, or automatically by the output of the 3 Mode Controller.

The analog output (AO) board ([Figure 2-7](#)) provides four 12-bit resolution channels of 4–20 mA current output. The current output accuracy is 0.1% of full scale. Each output current channel can drive up to a 700-ohm load. Converting the 4–20 mA output to 1–5 volts requires a 250-ohm $\pm 0.01\%$ precision resistor with power rating of 1 W or better.

The AO board is powered from the backplane board. It generates an isolated 24 Vdc that is used to supply power to the four 4–20 mA current output channels. Each current output channel is equipped with a latched pluggable 3-position terminal block, providing termination for current out signal, current out signal return, and shield. The board also provides field isolated earth-ground termination, which must be isolated from the system earth-ground. A minimum of 12 AWG strain conductor is recommended for the termination. Note that for the most effective surge protection, the grounding conductor should be as short as possible.

Power consumption is dependent on the number of 4–20 mA channels being used and the output current of each channel. Maximum power consumption is four channels times 20 mA per channel times 24 Vdc, which equals 1.9 W. Quiescent current is insignificant.

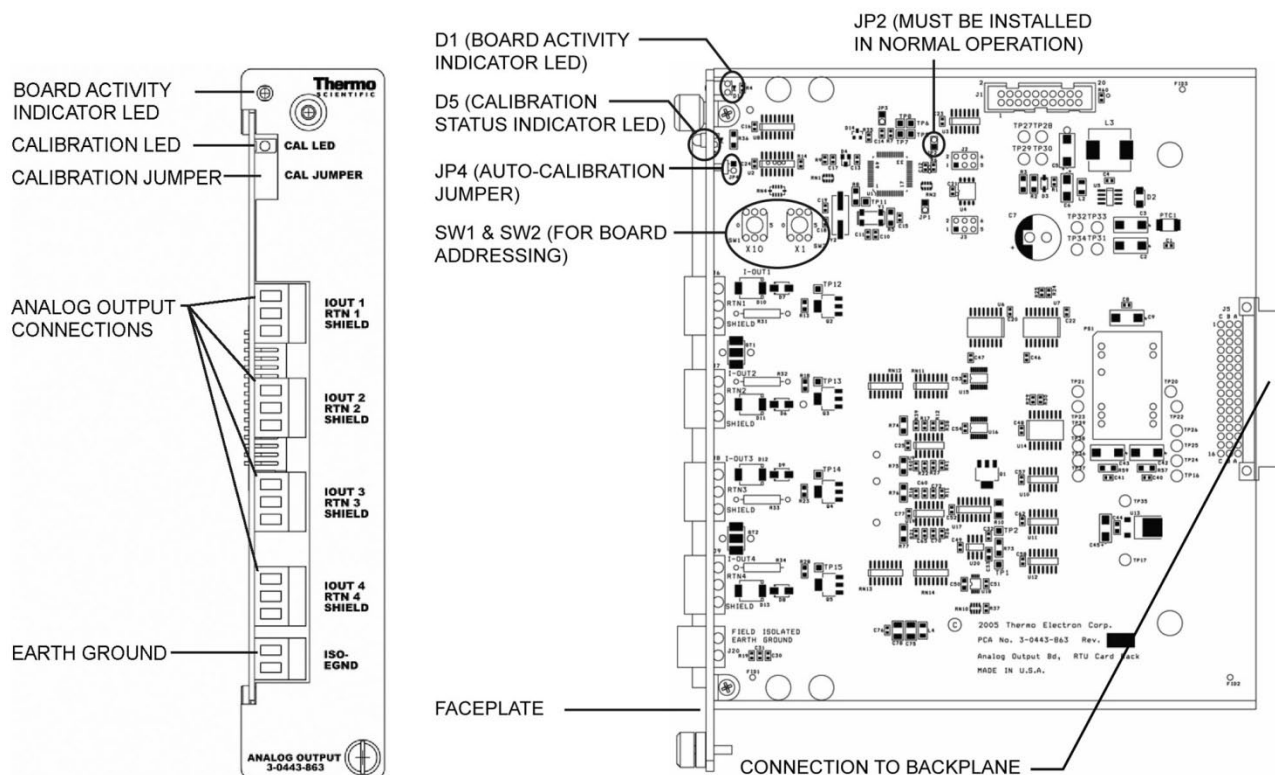


Figure 2–7. Analog output board (P/N 3-0443-863)

Table 2–3. Jumper definition table

Jumper Designator	Function	Function Description
JP1	JTAG mode	For firmware development use only.
JP2	Normal operation mode	Must be installed in normal operation.
JP3	Bootloader mode	For firmware upgrade. Factory use only.
JP4	Calibration mode	For maintenance use.

Table 2–4. Header & terminal block definition table

Header Designator	Function	Function Description
J1	JTAG port	For firmware development use only.
J2	UART COMM port 1	Available if JP2 is not installed. For factory use only.
J3	Flash program port	For firmware upgrade. Requires proper interface cable (p/n 3-0420-024).
J5	System connections	Interconnect to system backplane board.
J6	Channel 1 current output	Signal description: I_OUT1, RTN1, SHIELD
J7	Channel 2 current output	Signal description: I_OUT2, RTN2, SHIELD
J8	Channel 3 current output	Signal description: I_OUT3, RTN3, SHIELD
J9	Channel 4 current output	Signal description: I_OUT4, RTN4, SHIELD
J20	Field isolated earth ground terminal	2-position terminals used to terminate to an isolated earth ground.

Auto-Calibration Circuit

The AO board features an onboard auto-calibration circuit. With jumper JP4 installed, the board will go into calibration mode. The board activates its auto-calibration routine and sequentially calibrates each output channel. The channels' calibration constants are stored in onboard non-volatile Flash memory.

Calibration progress and status is indicated through the red calibration status LED, D5. Status is indicated as follows.

Table 2–5. Calibration status indicator LED

LED	Indication
Blinking at slow rate	Calibration is in progress (should not be more than 30 seconds).
Solid	Board has passed calibration and is still in calibration mode. Remove jumper JP4 to return to normal operation mode.
Blinking at fast rate	Board failed to calibrate.
Off	Board is in normal operation mode.



Caution For successful calibration and to comply with safety requirements, follow these guidelines:

- The surrounding area must be non-hazardous.
- Loads must be disconnected on all output channels. For sensitive applications, manually lock in all processes before proceeding. ▲

Communication Expansion Board

The communication expansion board adds six RS232 compatible serial ports to the flow computer (see [Figure 2-8](#)). The ports support modem control handshake signals and are configured as DTE. In addition to the RS232, the board has two RS485 full duplex/half duplex ports, supporting communication up to 1 Mbaud. It also has two USB ports. One is a host connector and can be used for connection to a USB flash drive or peripheral device such as a printer. The other USB is an OTG connector and is for future development. All signals are protected against ESD damage. Configuration is through software control and four jumpers (JP1–JP4) that are used for setting up the RS485 ports. Power consumption is 0.1 W. The following signals are supported:

- Received data
- Transmitted data
- Request to send
- Clear to send
- Signal ground

Note If connecting to a Thermo Scientific AutoMITTER / AutoMITTER PRO transmitter, refer to [Appendix C](#) for CSA certified systems or [Appendix D](#) for ATEX and Brazilian certified systems. ▲

Hardware Description

Optional I/O Boards

DB9 CABLE TO REMOTE DEVICE SUCH
AS A CHROMATOGRAPH OR AutoMITTER

FOR FULL DUPLEX, 4-WIRE RS485
CONNECTIONS, USE TWO TWISTED
PAIRS AND CONNECT THE SHIELDS

CONNECTION TO USB FLASH DRIVE
FOR HISTORICAL DATA DOWNLOAD OR TO
PERIPHERAL DEVICE SUCH AS A PRINTER

FUTURE

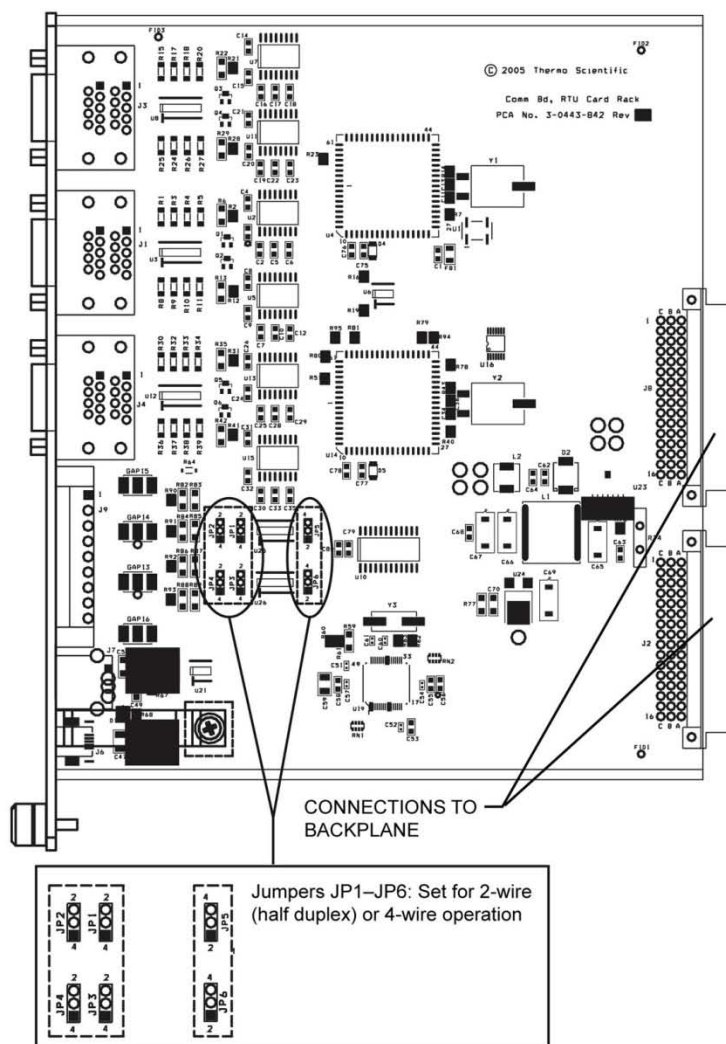
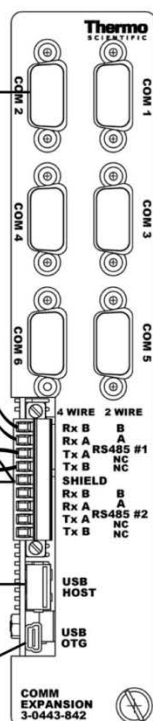


Figure 2–8. Communication expansion board (P/N 3-0443-842)

Combo Board

The combo board provides five functions that previously required five separate I/O boards (see Figure 2-9). For some applications, this can reduce installation costs significantly. The circuitry used for the combo board is the same as the individual function boards, but there are fewer channels per function. The five functions are:

- Analog input
- Analog 4–20 mA output
- Digital output
- Pulse input
- Digital input

The I/O lines are protected by gas tubes, which are ceramic devices where high voltages are shorted to ground and any arcing is contained within the device. This only occurs during very abnormal circumstances such as nearby lightning strikes. The mounting screw must be securely tightened for the gas tubes to function correctly during an overvoltage situation.

Power consumption is 80 mA at 12 V (0.96 W).

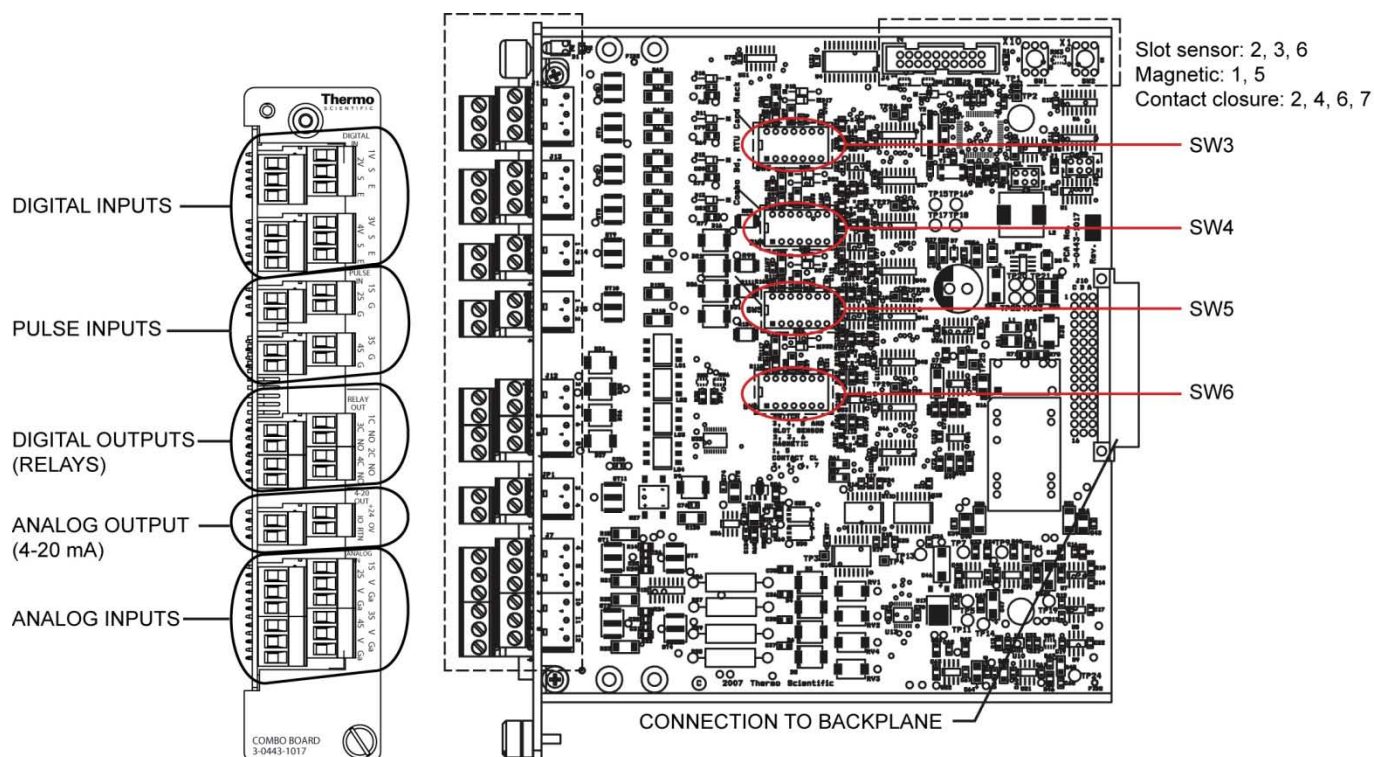


Figure 2–9. Combo board (P/N 3-0443-1017)

Analog Inputs on the Combo Board

There are four single-ended analog inputs on the combo board, each of which accepts a 0–5 Vdc input signal. For sensor excitation, 12 Vdc is provided. 4–20 mA inputs may be converted to 1–5 Vdc inputs by installing an external 250-ohm 0.1% resistor.

Power consumption is 50–60 mA at 12 V (0.72 W) without external load and 450 mA at 12 V (5.4 W) at full external load. Each input has termination for analog signal input, excitation + (12 or 24 Vdc), and ground. Note that all the analog grounds (Ga) are connected together and connected to chassis ground (E) through a 10 ohm resistor. The four channels are not isolated from each other.

See Figure 2-10.

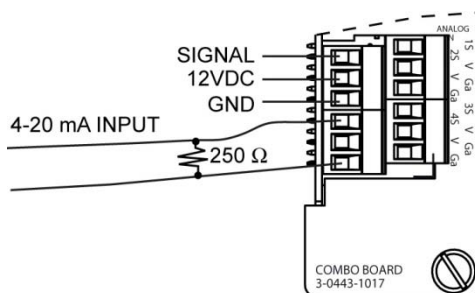


Figure 2-10. Sectioned view of combo board: Two applications for analog inputs

Analog 4–20 mA Output on the Combo Board

The one analog 4–20 mA output supports 9–30 Vdc and loop resistances of 0–700 ohms. The output is isolated from the rest of the circuitry except for a 90-volt gas tube. If there is a high voltage pulse on the output relative to the chassis, the gas tube will conduct to protect the flow computer circuitry. Onboard is an isolated 24 Vdc source capable of sourcing 30 mA.

See Figure 2-11.

4-20 mA SINKING (USING CUSTOMER SUPPLIED VOLTAGE SOURCE)

4-20 mA SOURCING (USING ISOLATING 24 VDC SOURCE)

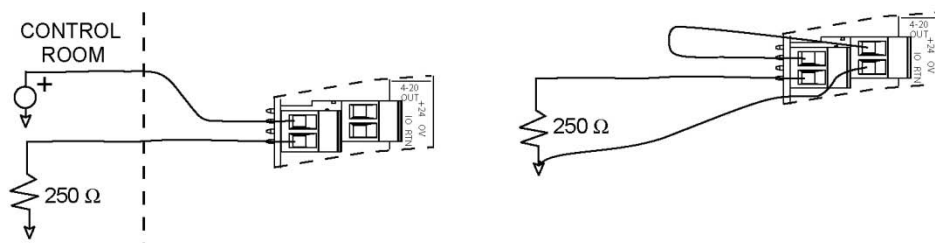


Figure 2-11. Sectioned view of combo board: Two applications for 4–20 mA outputs

Digital Outputs on the Combo Board

The digital output function on the combo board consists of four opto-coupled solid state switches rated for 50 V at 2 A and are form 1A configuration (Normally Open). The output relays are opto-isolated solid state devices, so there is no arcing or contact bounce.

See Figure 2-12.

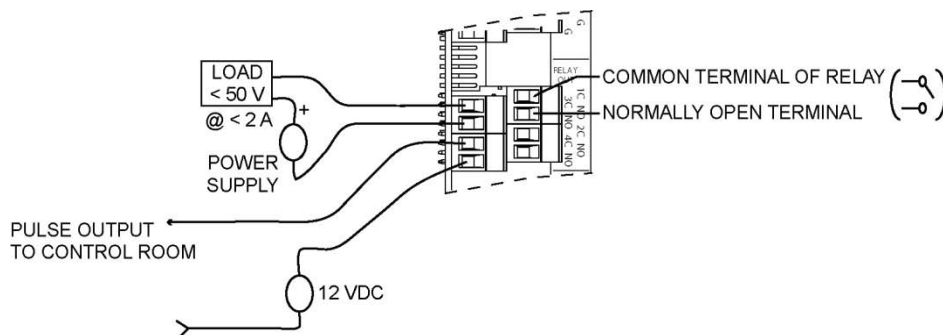


Figure 2-12. Sectioned view of combo board: Two applications for digital (relay) outputs

Pulse Inputs on the Combo Board

The pulse input function has four pulse inputs rated for 0–5 V. The following pulse input signals may be received: turbine meters, positive-displacement transmitters, slot sensors, and contact closures. Each input has termination for pulse signal input and ground, and power consumption is 15 mA.

See Figure 2-12.

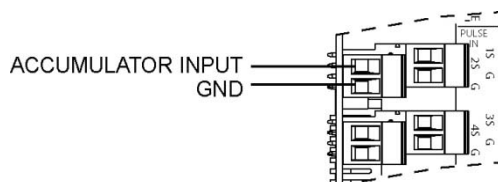


Figure 2-13. Sectioned view of combo board: Pulse input connections

DIP switches are provided for each of the four channels as follows:

- SW3 configures channel 1
- SW4 configures channel 2
- SW5 configures channel 3
- SW6 configures channel 4

Configure the DIP switches as shown in the table below.

Table 2–6. Pulse input DIP switch configuration

Switches on (rest off)	Input type
2, 3, 6	Slot sensor
1, 5	Magnetic
2, 4, 6, 7	Contact closure

Digital Inputs on the Combo Board

The digital input function has four inputs rated for 0–12 V. Each point accepts an input in the form of a dry contact closure that can be used to control switches, relays, and solenoids. Power consumption is 0.2 W, and 12 Vdc wetting voltage is provided onboard. Each input has termination for wetting voltage, signal in, and cable shield.

See Figure 2-14.

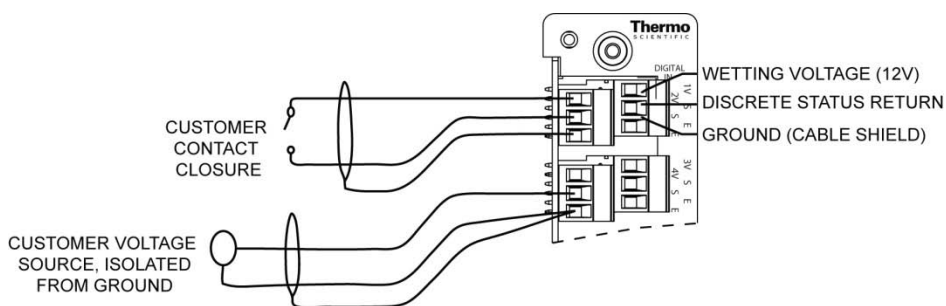


Figure 2–14. Sectioned view of combo board: Two applications for digital inputs

DE Communication Board

Each DE communication board supports eight Honeywell transducers using DE protocol. The board uses a low power LPC2138 32-bit microprocessor to process the serial input data streams from the transmitters. The processor and its associated circuitry act as software asynchronous receivers, providing five input samples per bit received from each of the transmitters. These samples are processed to filter out and eliminate spurious noise spikes that may occur on the communication line.

The DE communication board provides 24 Vdc loop excitation voltage to the transducers. Each signal line is protected against 6000 volt /3000 amp surge transients. Power consumption is 0.2 W.

See the figure below for connection information.

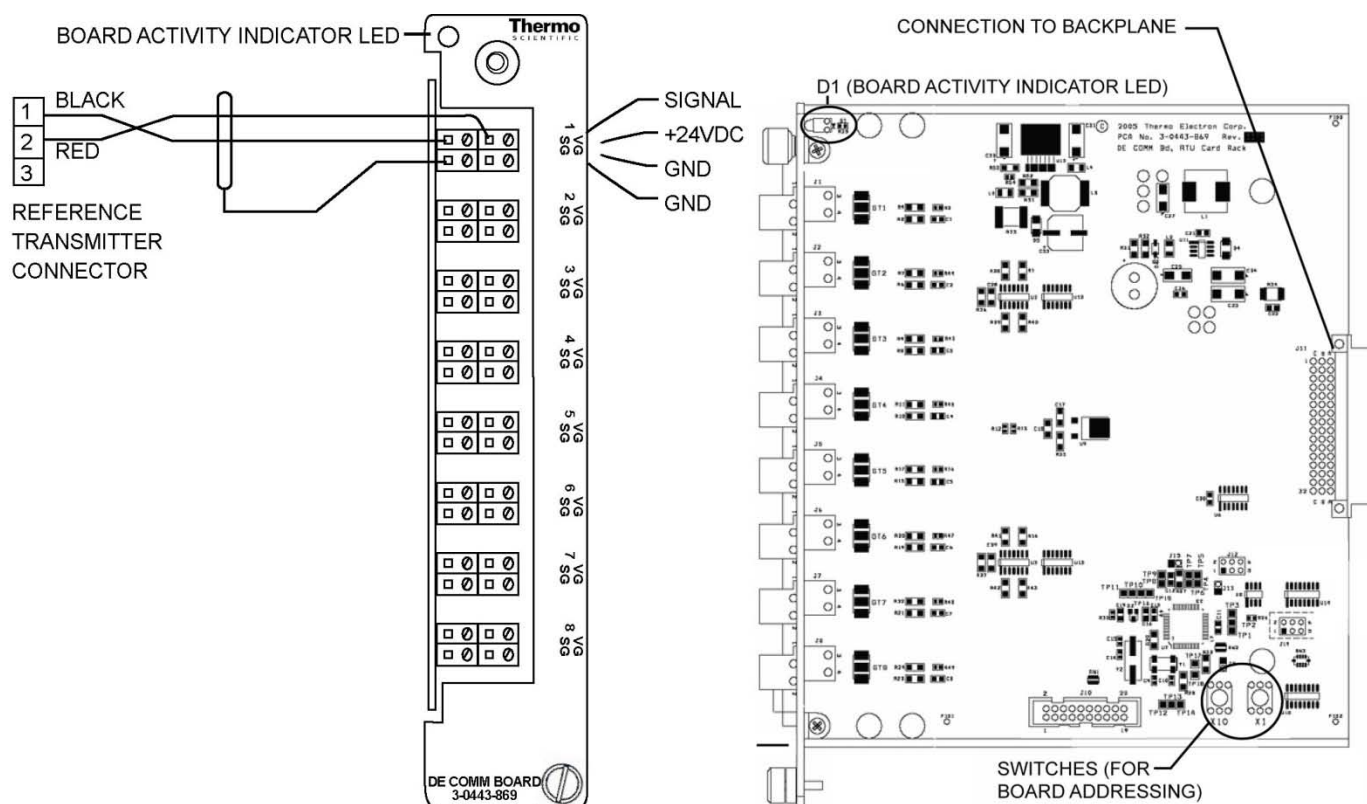


Figure 2–15. DE communication board (P/N 3-0443-869)

Digital Input Board

The digital input board has 16 digital input points. Each point accepts an input in the form of a dry contact closure that can be used to control switches, relays, and solenoids. Power consumption is 0.2 W, and 12 Vdc wetting voltage is provided onboard. Each input has termination for wetting voltage, signal in, and cable shield.

See the figure below for connection information.

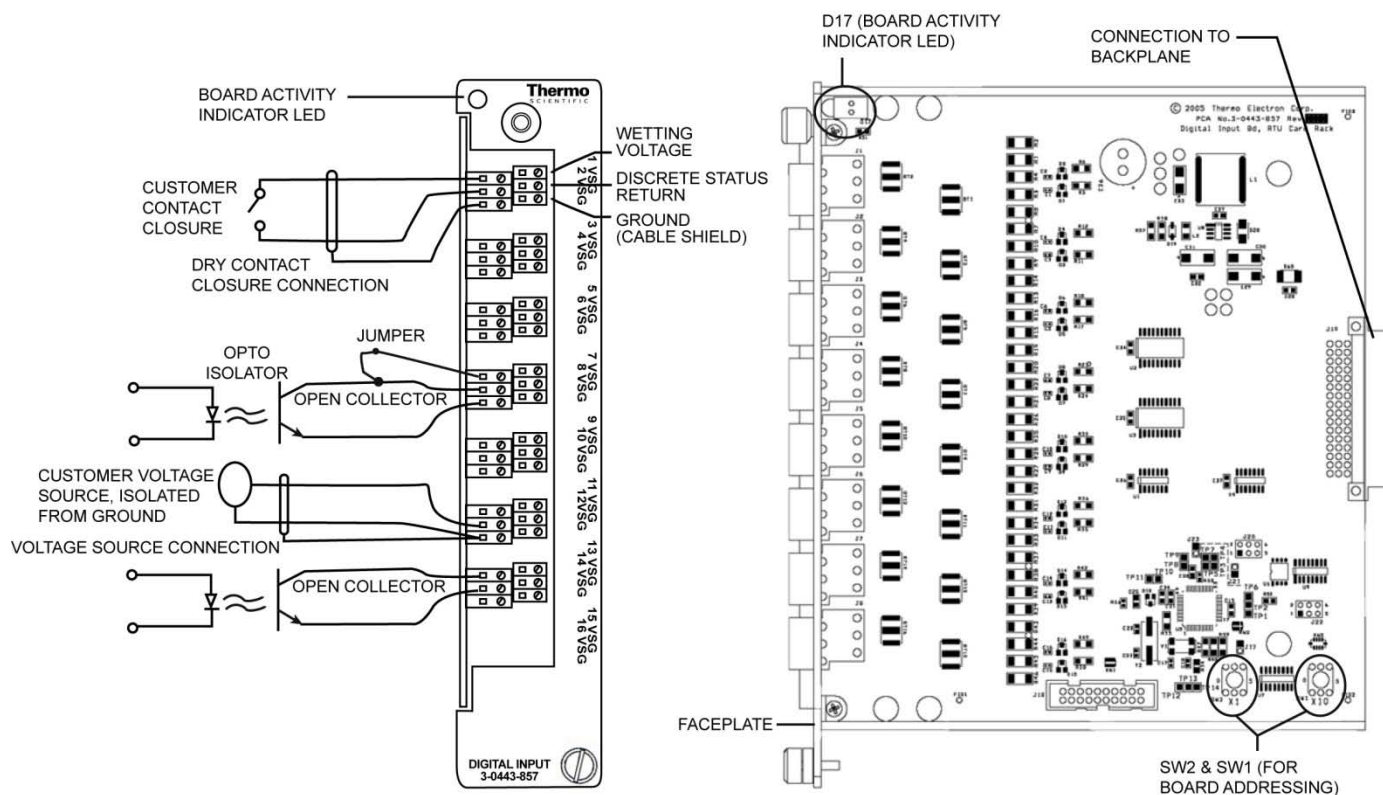


Figure 2-16. Digital input board (P/N 3-0443-857)

Digital Output Board

The digital output board provides 16 relay outputs rated to 5 A at 250 Vac each (250 Vac at 3 A for ATEX and hazardous area installations). Each relay is sealed and magnetically latching. Relay control can be either latched or momentary. Field connections are provided on the board. Each connection has a 240 V MOV for relay protection of transients caused by switching inductive loads. Clamp style terminations are provided on each PCA for connection of wires up to 12 GA. Power consumption is 0.2 W.

See the figure below for connection information.

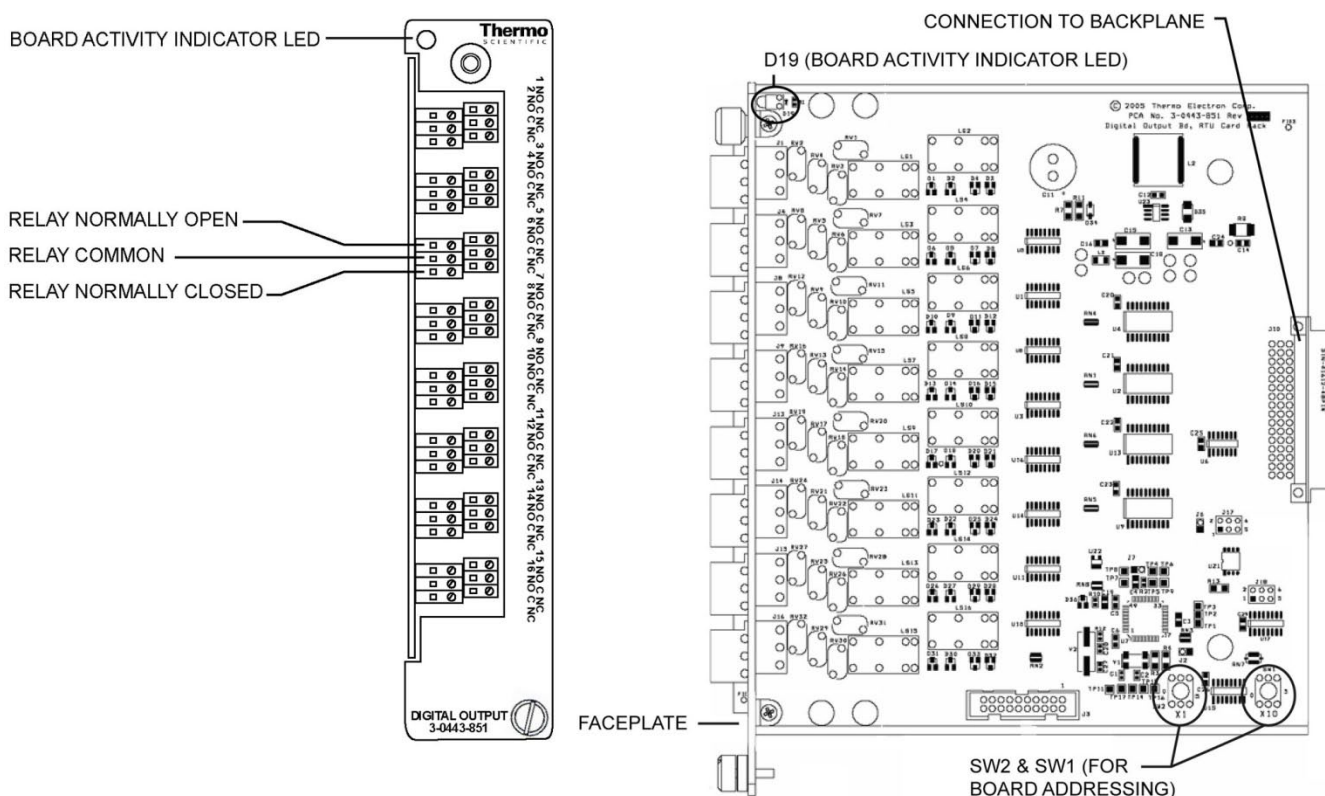


Figure 2-17. Digital output board (P/N 3-0443-851)

Liquid Combo Board

The liquid combo board provides additional density/prover and RTD functions beyond the functions supported by the current combo board (p/n 3-0443-1017). This added functionality allows the flow computer to be used in both gas and liquid applications. For some applications, this can reduce installation costs significantly. Functions supported by the board include:

- RTD inputs
- Analog inputs
- 24 V outputs
- 4–20 mA analog outputs
- Digital inputs
- Digital outputs
- Pulse/density inputs

All the I/O ports are isolated from backplane. Both analog input and pulse/density input can take current input or voltage input, and the signal can be differential or single ended. The 24 V outputs have fuse protection and the fuse is field replaceable. To support prover function, the prover board (p/n 3-0443-860) is needed.

The I/O lines are protected by gas tubes, which are ceramic devices where high voltages are shorted to ground and any arcing is contained within the device. This only occurs during very abnormal circumstances such as nearby lightning strikes. The mounting screw must be securely tightened for the gas tubes to function correctly during an overvoltage situation.

Power consumption is about 200 mA at 12 V (2.4 W) without any 24 V output load.

See [Figure 2-18](#).

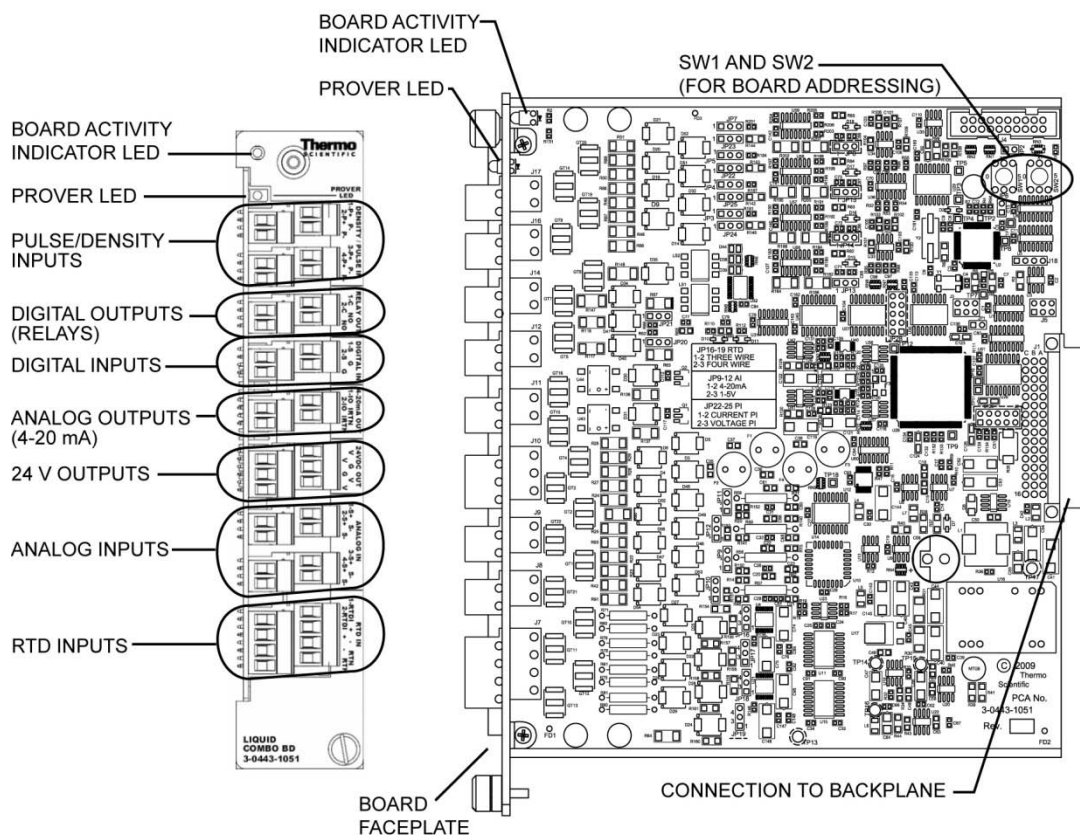


Figure 2-18. Liquid combo board (P/N 3-0443-1051)

RTD Inputs on the Liquid Combo Board

The RTD inputs on the liquid combo board support a 3-wire and 4-wire configuration, which is determined by terminal block connections and settings of the onboard jumpers. In both configurations, the lead resistance is cancelled out. With circuitry based on ratiometric measurement, the RTD inputs have good over-temperature performance and noise immunization. When calibrating to improve performance, it is recommended to calibrate with the expected configuration and connection.

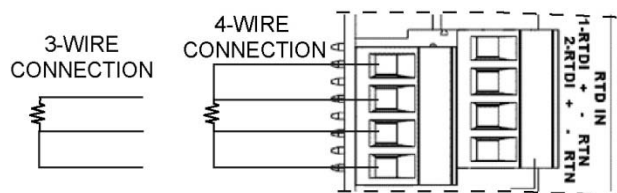


Figure 2-19. Sectioned view of liquid combo board: RTD connections for 3-wire and 4-wire configurations (must be used with proper jumper settings)

Table 2–7. Jumper settings for 3-wire and 4-wire configurations (must be used with proper terminal block connections)

Channel	4-Wire	3-Wire
1	JP18 @ 2-3 JP19 @ 2-3	JP18 @ 1-2 JP 19 @ 1-2
2	JP16 @ 2-3 JP17 @ 2-3	JP16 @ 1-2 JP17 @ 1-2

Analog Inputs on the Liquid Combo Board

There are four analog inputs available, each of which can accept input voltages of 0–5 V or currents of 4–20 mA depending on the jumper setting. A 250-ohm precision resistor is onboard, and 24 Vdc is provided for sensor excitation. The four channels are not isolated from each other.

Table 2–8. Jumper settings for analog inputs on the liquid combo board

Channel	Voltage Input	Current Input
1	JP12 @ 2-3	JP12 @ 1-2
2	JP11 @ 2-3	JP11 @ 1-2
3	JP10 @ 2-3	JP10 @ 1-2
4	JP9 @ 2-3	JP9 @ 1-2

24 V Outputs on the Liquid Combo Board

The board provides four channels of 24 V output for sensor excitation. Channels are limited to a maximum of 40 mA each and 120 mA total. Each channel is fuse protected, and the fuse is field replaceable. (The prover LED on the board may also be used to indicate the fuse status. Refer to [Table 2–12](#)).

Analog 4–20 mA Outputs on the Liquid Combo Board

The two analog 4–20 mA outputs support 9–30 Vdc and loop resistances of 0–700 ohms. The output is isolated from the rest of the circuitry except for a 90-volt gas tube. If there is a high voltage pulse on the output relative to the chassis, the gas tube will conduct to protect the flow computer circuitry.

Digital Inputs on the Liquid Combo Board

When JP20 or JP21 is set at POS 1-2, that channel circuitry provides 12 V pull-up to support contact closure input. With JP20 or JP21 set at POS 2-3, the channel can accept digital inputs rated for 0–12 V.

Table 2–9. Jumper settings for digital inputs on the liquid combo board

Channel	No Pull-up	12 V Pull-up
1	JP21 @ 2-3	JP21 @ 1-2
2	JP20 @ 2-3	JP20 @ 1-2

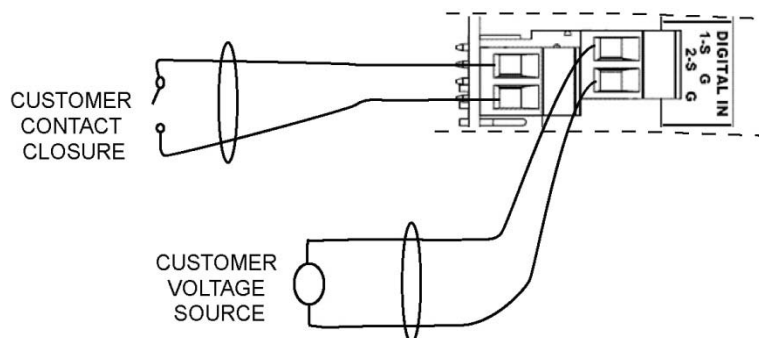


Figure 2–20. Sectioned view of liquid combo board: Two applications for digital inputs with different onboard jumper settings

Digital Outputs on the Liquid Combo Board

The digital output function on the liquid combo board consists of two opto-coupled solid state switches rated for 50 V at 2 A at room temperature. The two output relays are opto-isolated solid state devices, so there is no arcing or contact bounce.

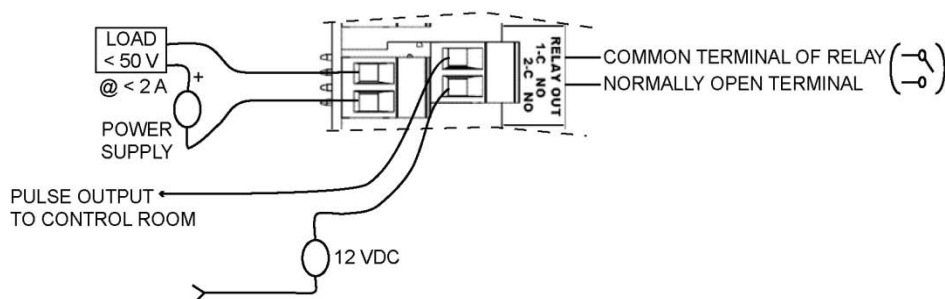


Figure 2–21. Sectioned view of the liquid combo board: Two applications for digital (relay) outputs

Pulse/Density Inputs on the Liquid Combo Board

The pulse/density input function supports four inputs. Unlike the pulse input, combo, and liquid flow boards, the liquid combo board does not have an amplifier to support magnetic inputs. Contact closure and slot sensor inputs are supported.

The input can be a current or voltage pulse depending on how the onboard jumpers are set. With proper jumper settings, current pulse can also be converted to differential voltage pulse via the onboard 250-ohm resistor. It is recommended that the absolute voltage value of the inputs on the terminals be between 0 and 21.8 volts relative to the AutoEXEC system ground. Since a certain threshold is set for pulse detection, the amplitude of the pulse must be over 3 V; less than 12 V is recommended.

The jumper settings for different configurations are shown in the following table.

Table 2–10. Jumper settings for pulse/density inputs of liquid combo board

Channel	Voltage Pulse	Current Pulse	No Pull-up	5 V Pull-up	Weak LP Filter (up to 10 kHz)	Strong LP Filter (up to 400 Hz)
1	JP23 @ 2-3	JP23 @ 1-2	JP7 @ 2-3	JP7 @ 1-2	JP8 @ 2-3	JP8 @ 1-2
2	JP22 @ 2-3	JP22 @ 1-2	JP5 @ 2-3	JP5 @ 1-2	JP15 @ 2-3	JP15 @ 1-2
3	JP25 @ 2-3	JP25 @ 1-2	JP4 @ 2-3	JP4 @ 1-2	JP14 @ 2-3	JP14 @ 1-2
4	JP24 @ 2-3	JP24 @ 1-2	JP3 @ 2-3	JP3 @ 1-2	JP13 @ 2-3	JP13 @ 1-2

Prover LED

When in prover mode, the prover LED is used to indicate prover status. The LED indications are shown in the following table.

Table 2–11. Prover LED indications for prover status

LED	Indication
Off	Board is in normal operation mode.
Blinking at fast rate	Proving mode is enabled at one channel, waiting for operation start.
Blinking at slow rate	Proving operation started.
Solid	Proving operation stopped; proving run completed.

When not in prover mode, the prover LED can be used to indicate the condition of the 24 V output fuse.

Table 2–12. Prover LED indications for 24 V output fuse

LED	Pattern	Indication
Blinking once	Channel 1 F1 should be replaced.
Blinking twice	Channel 2 F2 should be replaced.
Blinking three times	Channel 3 F3 should be replaced.
Blinking four times	Channel 4 F4 should be replaced.

Note If more than one channel has a failed fuse, the blinking pattern of the LED shows the condition of the channel with the larger index only. The good fuse typically has resistance around 12 ohms, and a failed one has resistance in megohms. ▲



Warning The fuse is field replaceable (p/n 5-0470-084). Replacement should be performed only by qualified personnel following related safety procedures. ▲

Liquid Flow Board

The liquid flow board provides termination for six field input signals for accumulator, density, and proving functions (see Figure 2-22). The following pulse input signals may be received: turbine meters, positive-displacement transmitters, slot sensors, and contact closures. Each input has termination for pulse signal input and ground. Power consumption is 55 mA at 12 V (0.66 W).

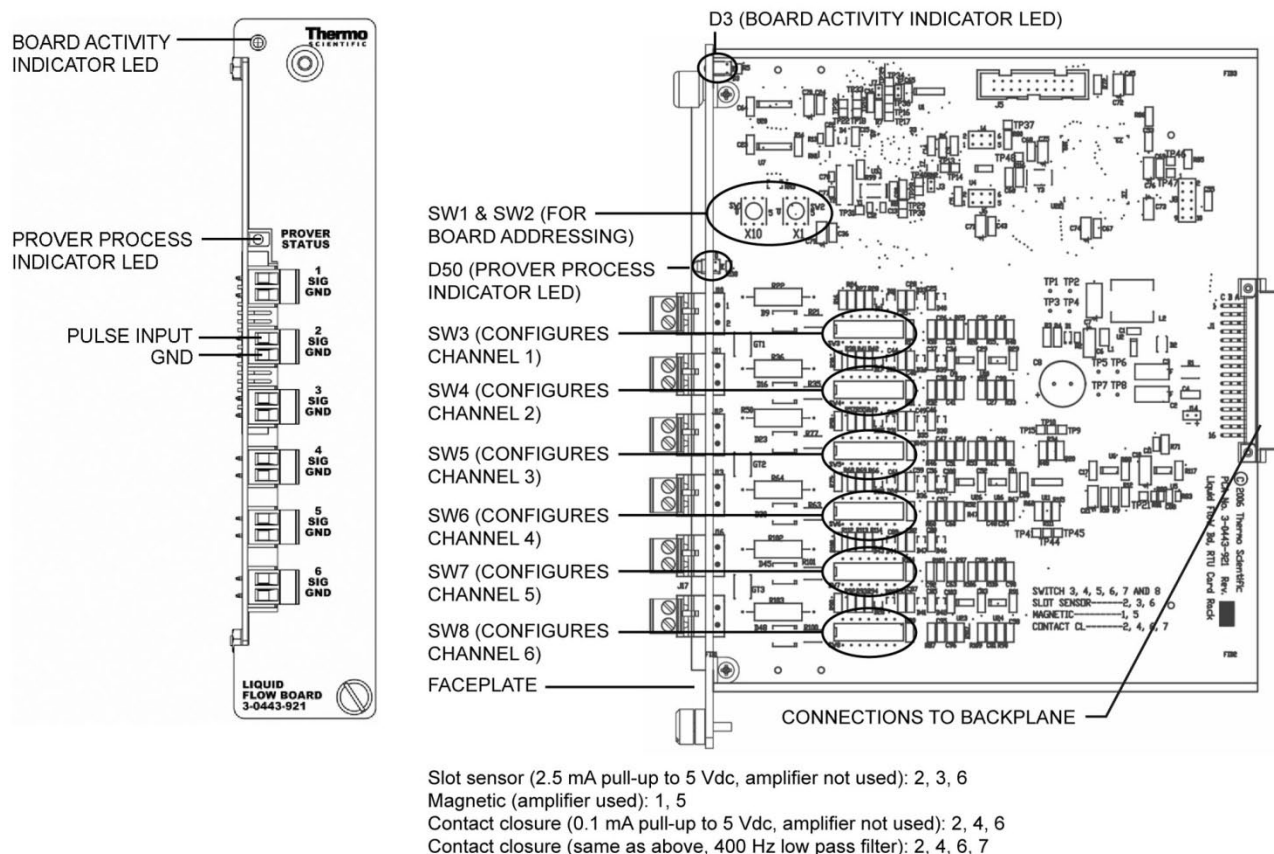


Figure 2-22. Liquid flow board (p/n 3-0443-921)

Configuration & Adjustments

DIP switches are provided for each of the six channels as follows:

- SW3 configures Channel 1
- SW4 configures Channel 2
- SW5 configures Channel 3
- SW6 configures Channel 4
- SW7 configures Channel 5
- SW8 configures Channel 6

Configure the DIP switches as shown in the table below.

Table 2–13. Liquid flow board DIP switch configuration

Switches on (rest off)	Input type
2, 3, 6	Slot Sensor (2.5 mA pull-up to 5 Vdc, amplifier not used)
1, 5	Magnetic (amplifier used)
2, 4, 6	Contact closure (0.1 mA pull-up to 5 Vdc, amplifier not used)
2, 4, 6, 7	Same as above, 400 Hz low pass filter

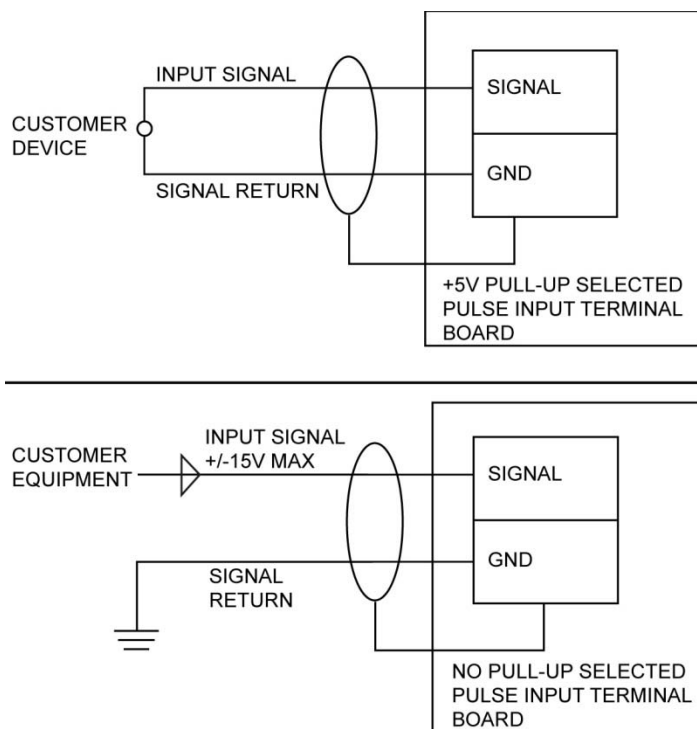


Figure 2–23. Pulse input field wiring of liquid flow board

Operation The liquid flow board provides accumulator and density information for liquid flow applications. In order to prove liquid applications, the liquid flow board must be working with the prover board (p/n 3-0443-860).

Prover calibration progress and status is indicated through the status LED, D50. Status is indicated as follows.

Table 2–14. Prover LED indications for prover status

LED	Indication
Off	Board is in normal operation mode.
Blinking at fast rate	Proving mode is enabled at one channel, waiting for operation start.
Blinking at slow rate	Proving operation started.
Solid	Proving operation stopped; proving run completed.

Prover Board The prover board provides termination of two field input signals. The two signals are the start and stop switches located on a liquid flow loop used for calibrating inline turbine meters. The switches must be isolated from any other circuitry. The output of an opto-isolator is acceptable. Pulse width should be 2 ms or longer.

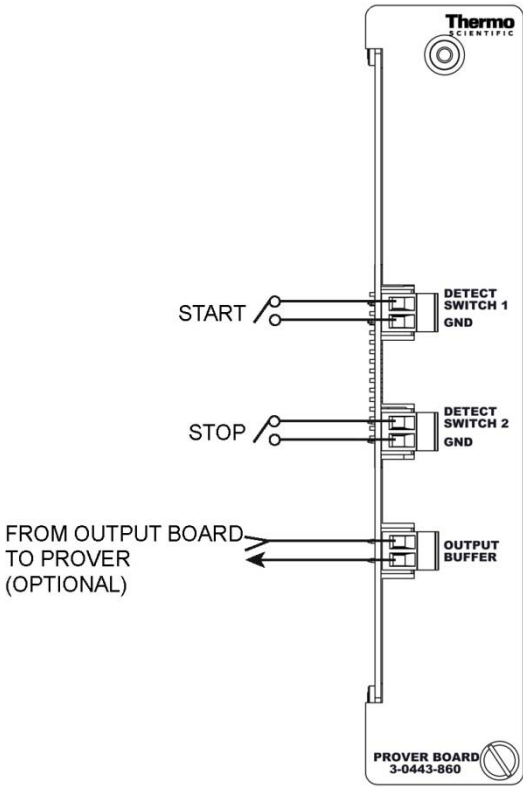


Figure 2–24. Prover connections

The board can be plugged into any I/O card slot for proving purposes, and you can remove it from the system once proving is complete. Some prover installations use a digital output channel to control the prover. This output signal should not be routed in the same cable as the start and stop input signal, or crosstalk may result in incorrect operation. If the output must be routed in the same cable, then connect OUTPUT BUFFER in line with the output to reduce the crosstalk.

Dual switch, SW1, should be set to LOW DAMPING. If the prover operates incorrectly, setting SW1 to HIGH DAMPING may improve performance. HIGH DAMPING is used primarily for noisy mechanical switches.

Pulse Input Board

The pulse input board provides termination of four pulse (accumulator) field input signals. The following pulse input signals may be received: turbine meters, positive-displacement transmitters, slot sensors, and contact closures. Each input has termination for pulse signal input and ground, and power consumption is 15 mA.

See the figures below for connection information.

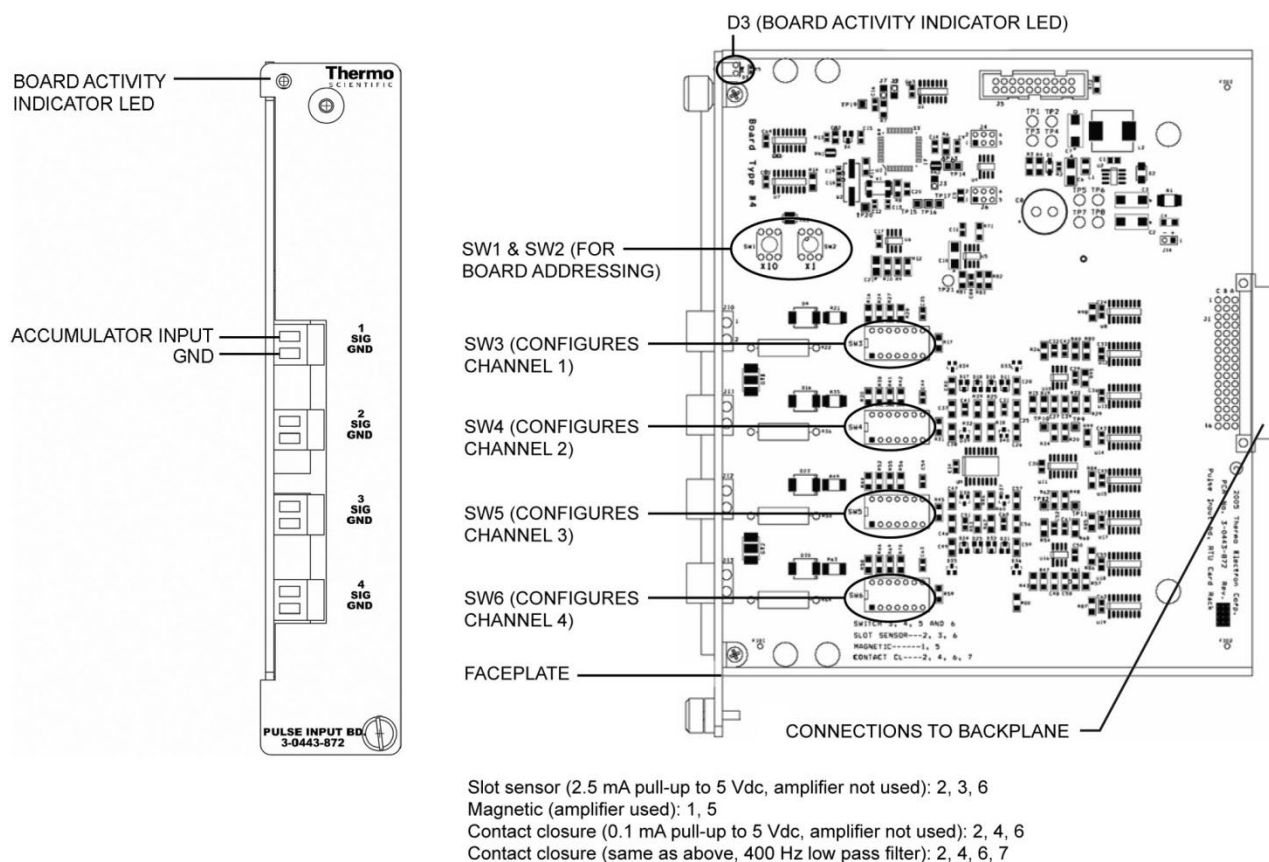


Figure 2–25. Pulse input board (p/n 3-0443-872)

Configuration & Adjustments

DIP switches are provided for each of the four channels as follows:

- SW3 configures Channel 1
- SW4 configures Channel 2
- SW5 configures Channel 3
- SW6 configures Channel 4

Configure the DIP switches as shown in the table below.

Table 2–15.

Switches on (rest off)	Input type
2, 3, 6	Slot Sensor (2.5 mA pull-up to 5 Vdc, amplifier not used)
1, 5	Magnetic (amplifier used)
2, 4, 6	Contact closure (0.1 mA pull-up to 5 Vdc, amplifier not used)
2, 4, 6, 7	Same as above, 400 Hz low pass filter

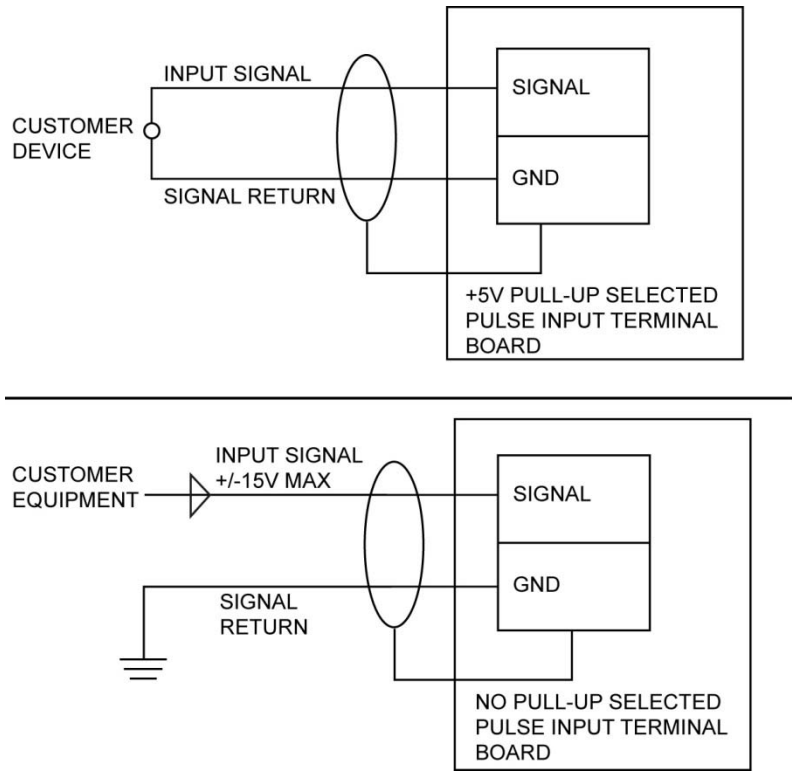


Figure 2–26. Pulse input field wiring

Chapter 3

System Installation & Wiring

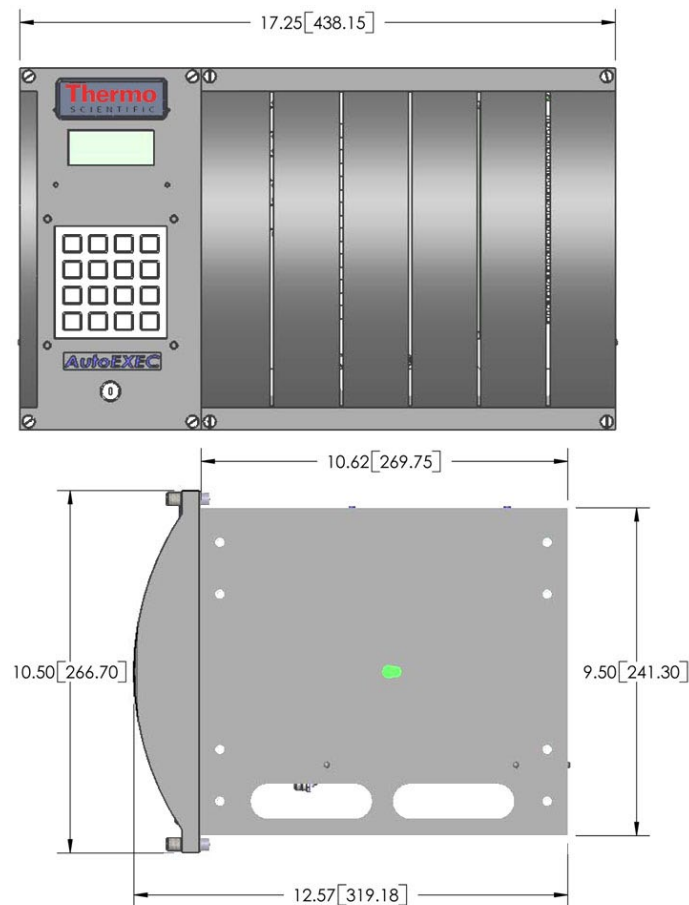
Standard Enclosures

The standard enclosure can be ordered with a wall, panel, or rack mounting kit. These configurations are designed for use in a non-hazardous location. They have been evaluated to conform to CE Low Voltage Directive and electromagnetic emission and interference.

Mounting

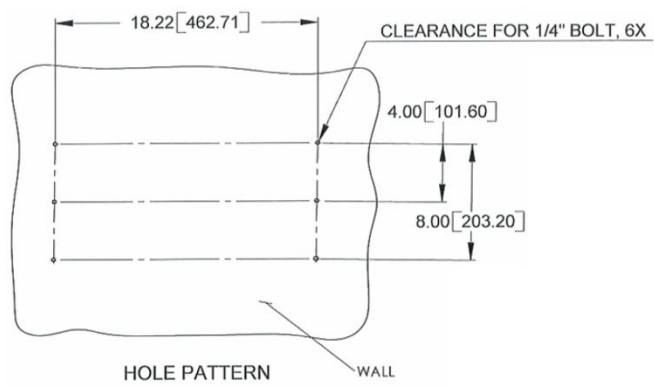


Warning Installation must be carried out in accordance with local site requirements and regulations. ▲



Dimensions are in inches[millimeters].

Figure 3–1. Dimensional drawing, standard enclosure



Item	P/N	Description
1	3-0443-939	Assembly, enclosure & mounting brackets
2	4-0443-883	Card cage mounting brackets
3	6-2430-543	Screw, 8-32 x 5/16, BH, SS
4	6-2130-003	Washer, #8, int. tooth

- NOTES: UNLESS OTHERWISE SPECIFIED.
- 1. USE SUPPLIED HARDWARE TO SECURE MOUNTING BRACKETS TO CHASSIS.
 - 2. USE BOM 3-0443-939-01 FOR WALL MOUNT ASSEMBLY.

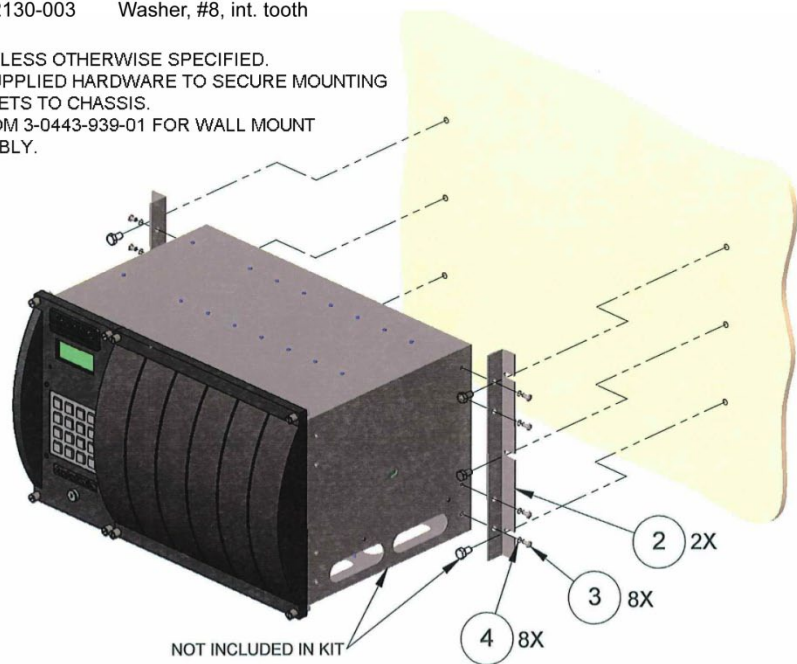


Figure 3–2. 3-0443-939-01: Wall mount configuration

Item	P/N	Description
1	3-0443-939	Assembly, enclosure & mounting brackets
2	4-0443-883	Bracket, enclosure mounting
3	6-2430-543	Screw, #8-32 x 5/16", pan hd., Phil, SS
4	6-2130-003	Washer, lock, #8, int. tooth

NOTES: UNLESS OTHERWISE SPECIFIED.

1. USE SUPPLIED HARDWARE TO SECURE MOUNTING BRACKETS TO CHASSIS.
2. USE BOM 3-0443-939-02 FOR RACK MOUNT ASSEMBLY.

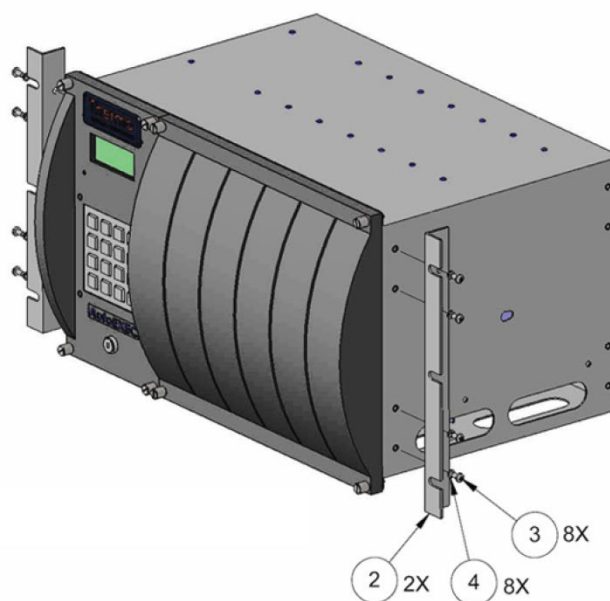
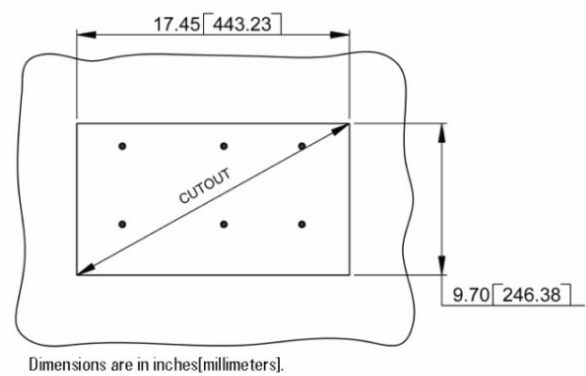


Figure 3-3. 3-0443-939-02: Rack mount configuration



Item	P/N	Description
1	3-0443-939	Assembly, enclosure & mounting brackets
2	KT100313-02	Kit, panel mount jackscrew

- NOTES: UNLESS OTHERWISE SPECIFIED.
1. INSTALL THE AutoEXEC UNIT INTO THE PANEL CUTOUT FROM THE FRONT SIDE OF THE PANEL.
 2. SECURE THE TAB ON THE JACKSCREW INTO MATING SLOT IN THE CHASSIS.
 3. USING A SCREW DRIVER, TIGHTEN SCREW UNTIL THE AutoEXEC CHASSIS IS SECURED FLUSH AGAINST THE PANEL.
 4. USE BOM 3-0443-939-03 FOR PANEL MOUNT ASSEMBLY.

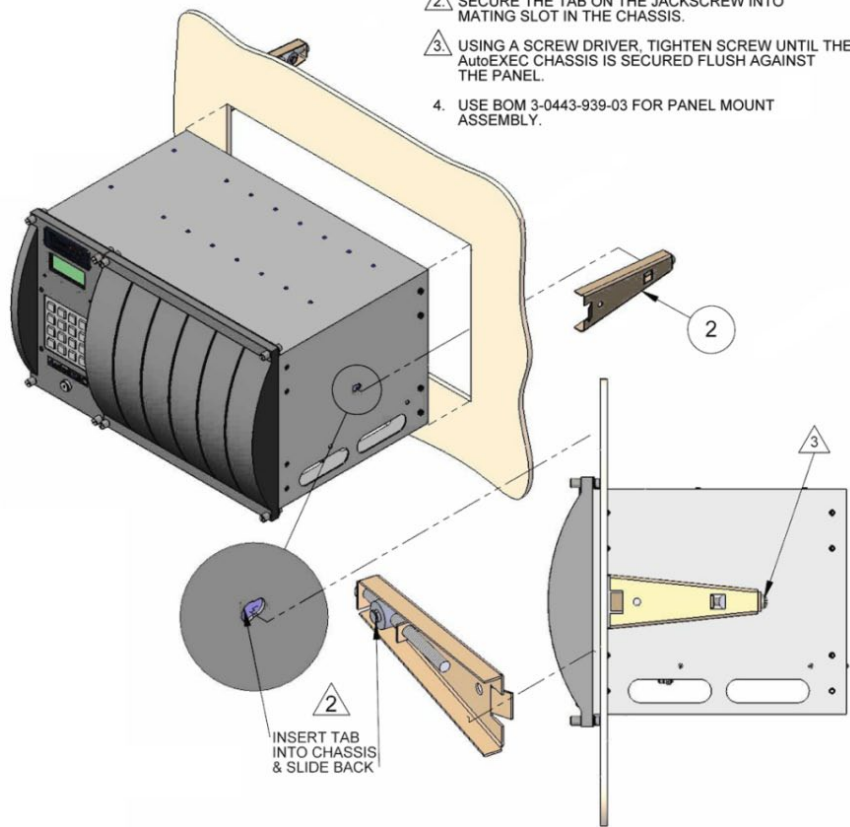


Figure 3-4. 3-0443-939-03: Panel mount configuration

Power Supply Wiring

Connect the chassis ground terminal to earth ground before making any other connections to the flow computer. The ground terminal is located on the bottom of the enclosure and is marked with the ground symbol inside the enclosure. Use a minimum of 12 AWG stranded wire and a length as short as possible.

The following instructions apply to the standard enclosure with a basic or expansion chassis.

1. Connect the power supply and the flow computer with 14–18 AWG wire.
2. Route the power line from the source to the flow computer through the bottom of the flow computer enclosure.
3. Connect the positive leg of the power source to the terminal block on the power supply, J10-3 (VIN). Connect the negative leg of the power source to J10-4 (GND).

Type 4X Enclosures

The Type 4X enclosure can be ordered with a pole mounting kit. This configuration has been evaluated to conform to UL, Canadian, ATEX, and Brazilian standards. Refer to the appropriate certification tag for ratings.

For United States installations, wire all circuits connected to the flow computer (unless otherwise specifically identified) using the Class I, Div. 2 Wiring Methods specified in Article 501-4(b) of the National Electric Code, NFPA 70.

For Canadian installations, wire all circuits connected to the flow computer (unless otherwise specifically identified) using the Class I, Div. 2 Wiring Methods specified in Section 18-152 of the Canadian Electrical Code.

For European installations, wire all circuits connected to the flow computer (unless otherwise specifically identified) using methods specified in the European Standard EN60079-14.

For Brazilian installations, wire all circuits connected to the flow computer (unless otherwise specifically identified) using methods specified in IEC 60079-14.



Warning Do not make or break any connections while circuit is active. ▲



Warning Ensure the area is non-hazardous before making any connections or performing any routine calibrations or services to the flow computer. ▲



Warning Ensure the area is non-hazardous before making connections to the following ports:

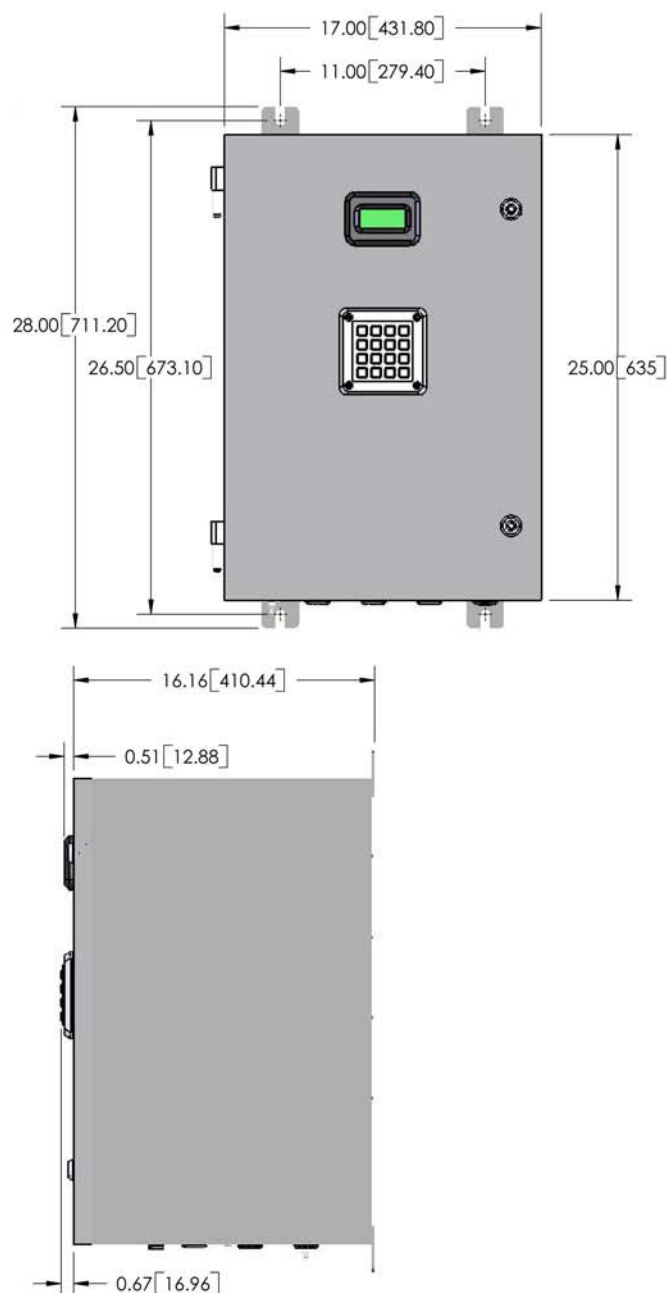
- Local RS232 port, the 6-pin circular connector located at the bottom of the enclosure
- USB ports labeled as USB Host and USB OTG located on the faceplate of the communication expansion board. ▲



Warning Customer equipment and devices must be suitable for the location where they are to be installed. ▲

Note For radio or modem installation, reference [Chapter 4](#). ▲

Mounting



Dimensions are in inches[millimeters].

Figure 3–5. Dimensional drawing, Type 4X enclosure

Item	P/N	Description
1	49-1009-0	2" pipe clamp (pole mount)
2	6-2082-609	1/4"-20 spring nut
3	4-0443-994	Channel, 1.625, SS, (B-Line B22ss4)
4	6-2481-243	1/4-20 X 3/4" cap screw
5	6-2080-043	1/4-20 nut
6	61-1002-0	1/4" flat washer
7	6-2280-403	1/4" lock washer
8	412-5081-106	3/8-16 X 1" lg. cap screw
9	60-1013-0	3/8-16 nut
10	6-2140-003	3/8" flat washer
11	6-2290-603	3/8" lock washer

NOTES: UNLESS OTHERWISE SPECIFIED.

1. USE SUPPLIED HARDWARE TO SECURE CHANNELS AND PIPE CLAMPS TO UNIT & POLE.
2. NOTE- VIEWS SHOW ONLY THE TOP BRACKET ASSEMBLY. REPEAT ASSEMBLY STEPS FOR BOTTOM BRACKET INSTALLATION.

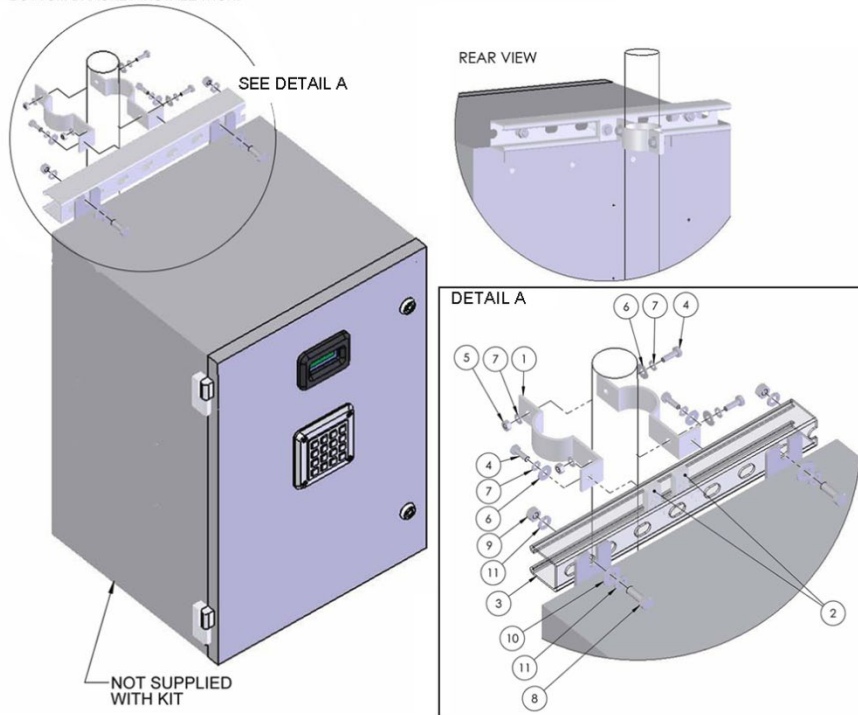


Figure 3-6. 3-0443-995: Pole mount configuration

Power Supply Wiring

Connect the enclosure ground terminal to earth ground before making any other connections to the flow computer. The ground terminal is located on the bottom of the enclosure and is marked with the ground symbol inside the enclosure. Use a minimum of 12 AWG stranded wire and a length as short as possible.

The following instructions apply to the Type 4X enclosure with a basic chassis (see [Figure 3-7](#)) or an expansion chassis (see [Figure 3-8](#)).

1. The positive leg of the 12–30 Vdc power supply must be protected with a 5 A current limiting device. Install the power supply and current limiter in a non-hazardous area.
2. Connect the power supply and the flow computer with 14–18 AWG wire, following the appropriate wiring methods.
3. Route the power line from the source to the flow computer through the bottom of the enclosure.
4. Connect the positive leg of the power supply to the power distribution terminal block, TB1-3 (POS). Connect the negative leg of the power supply to TB1-6 (NEG).

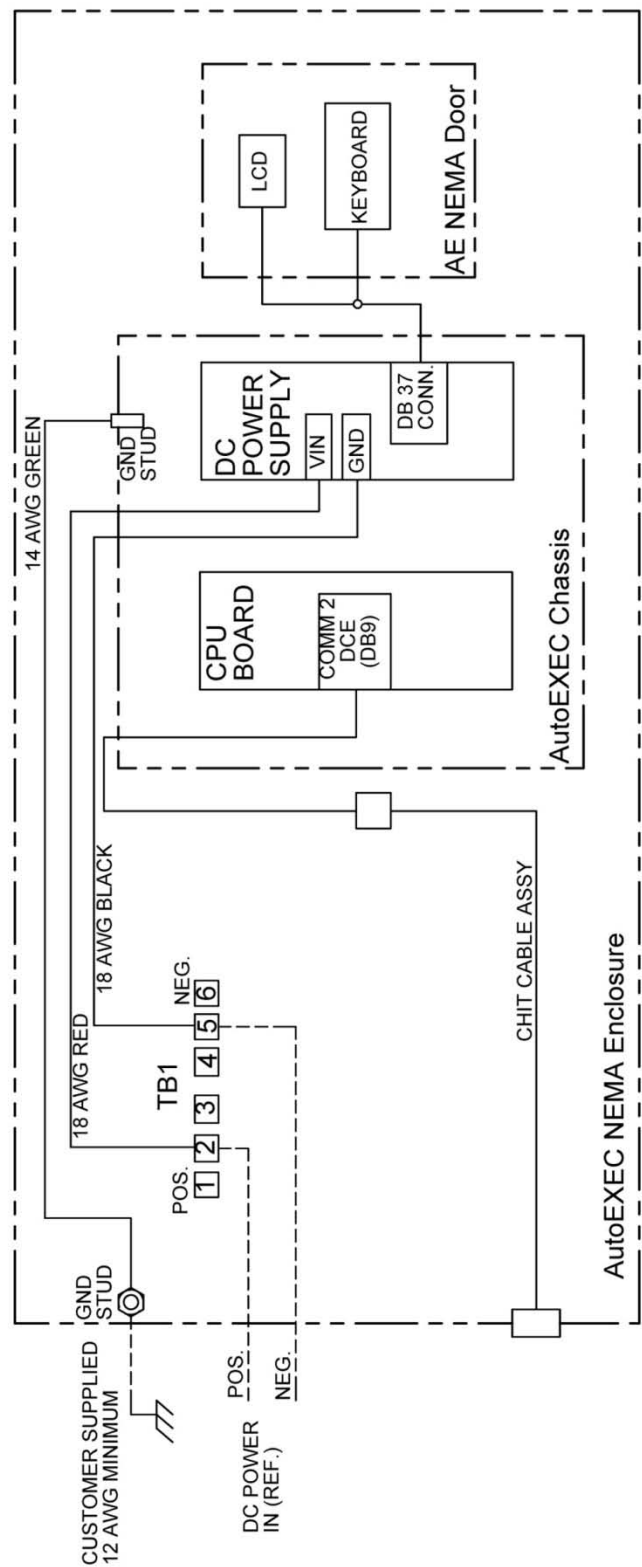


Figure 3-7. Wiring diagram for Type 4X enclosure with basic chassis

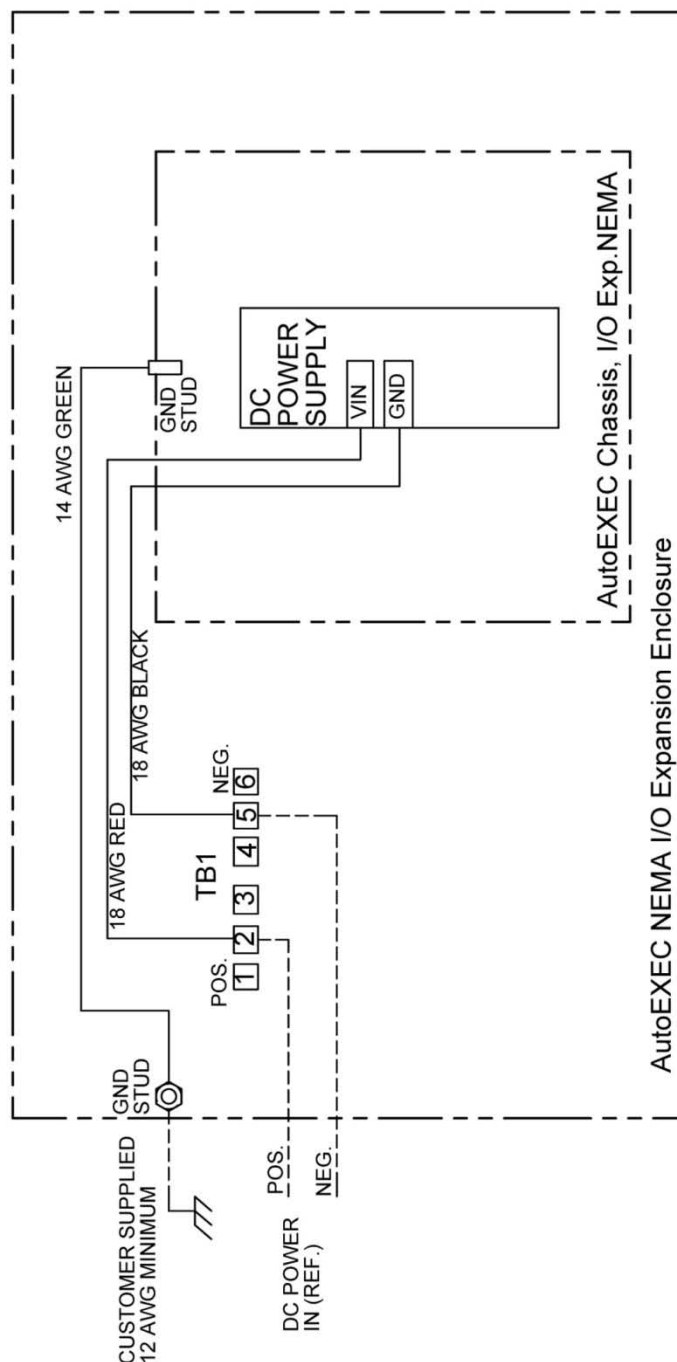
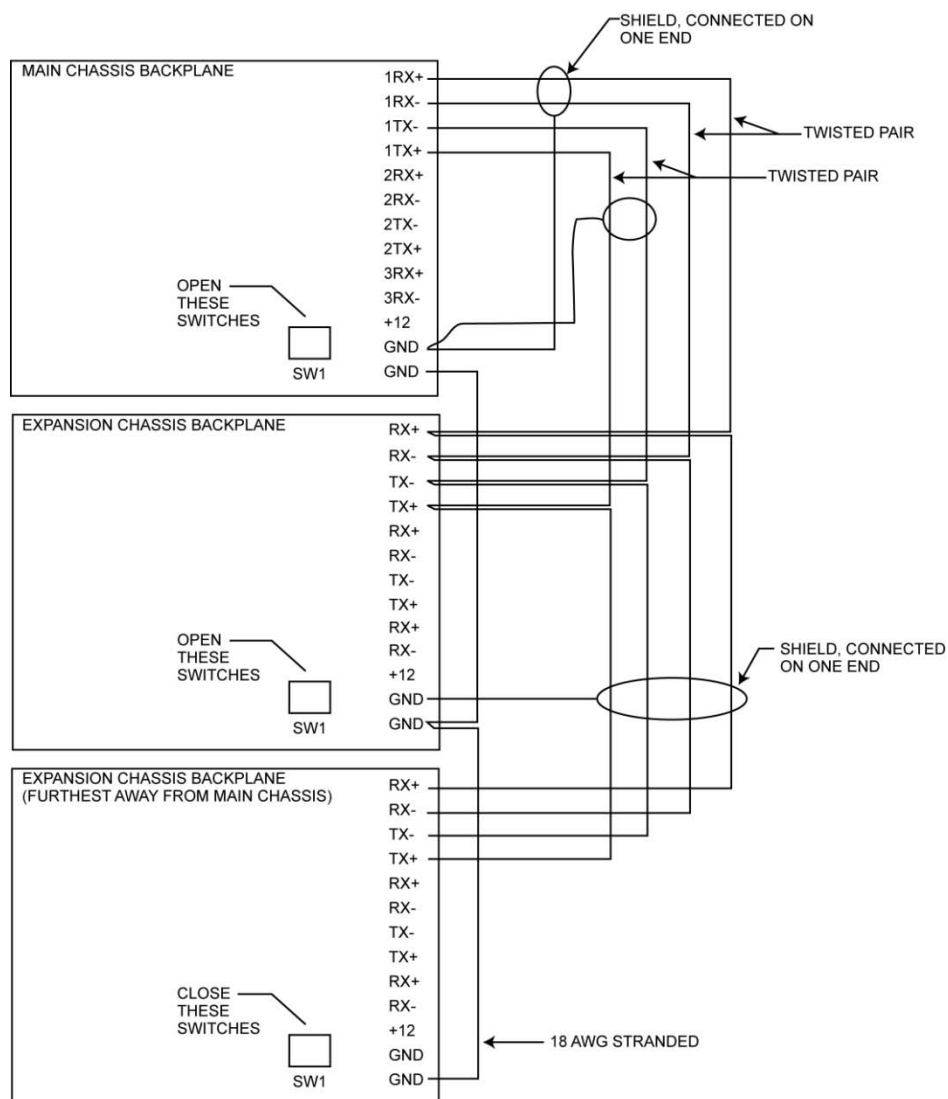


Figure 3–8. Wiring diagram for Type 4X enclosure with expansion chassis

Daisy-Chained Expansion Chassis

The capacity of the AutoEXEC flow computer can be expanded by adding an expansion chassis. Up to seven expansion chassis may be daisy-chained together. Communication is via the RS485 full duplex communication bus on the expansion backplane.

Follow the appropriate mounting and power supply wiring instructions provided in this chapter, and reference the figure below for chassis interconnects.



NOTE: THE +12V OUTPUTS ARE USED FOR EXTERNAL RADIOS. THEY SHOULD NOT BE WIRED TOGETHER.

Figure 3–9. Full duplex RS485 chassis interconnects

Hazardous Area Installations

The AutoEXEC flow computer has been designed to satisfy the requirements of Clause 1.2.7 of the essential Health and Safety Requirements such that it will not give rise to physical injury when handled properly. The instrument does not produce excessive surface temperature, nor does it emit infra red, electromagnetic, or ionizing radiation.

Before starting installation work, ensure all power connections are isolated and take precautions to prevent power from being restored while work is taking place. Hazardous area installations forbid the use of tools or equipment that could produce an explosion hazard by causing a spark or imposing excessive mechanical stress.

The instrument must be installed in a manner to avoid exposure to thermal or mechanically induced stresses, and in addition, the instrument should not be exposed to chemically aggressive substances beyond the expected levels. The instrument is not intended to be exposed to significant conditions of dust buildup.



Caution Aggressive substances may require extra protection. ▲

In cases where impact or other mechanical forces may be expected, appropriate methods of protection must be used. Additional protection may be required if the flow computer is to be installed in locations where it may be subject to damage.

Where the equipment may be exposed to excessive external stresses, e.g. vibration, heat, or impact, the equipment must be protected by additional means of protection.

When the flow computer is operated in a hazardous environment, the system must be turned off before any board can be removed or installed.

If this equipment is not utilized in a manner specified by the manufacturer, the protection of the equipment may be impaired.

Marking

The AutoEXEC flow computer is marked for use in hazardous areas in accordance with the ATEX and IEC Directives. It is marked as follows.

The **standard enclosure (rack/panel mount)** installed in the safe area is marked on the label as shown below.

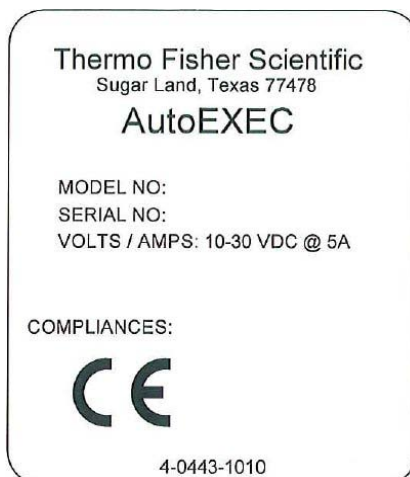


Figure 3-10. Flow computer certification tag for safe area

The **Type 4X/IP65 enclosure (pole mount)** installed in the hazardous area is marked on the label as shown below.



Figure 3-11. Flow computer certification tag for hazardous area

The AutoEXEC flow computer is marked for use in hazardous areas in accordance with Brazilian standards. It is marked as follows.

[TÜV 11.0077] Ex nA nL IIB T4 Gc IP65

Installed in the hazardous area

[TÜV 11.0077] is marked on the label as shown below.



Figure 3–12. Flow computer certification tag for hazardous area (Brazil)

Repair

In the event of a fault condition, the AutoEXEC flow computer cannot be serviced by the customer. No repair to faulty assemblies should be attempted. Faulty assemblies must be replaced with identical replacements. All repairs or part replacements must be done by Thermo Fisher or its appointed repair agent. Contact Thermo Fisher for instructions.

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Chapter 4

Modem & Radio Options

212A Modem Installation

If you did not order a modem option, you can install one after receiving the instrument. The modem ready kit number for the Thermo Scientific 212A/202 modem is 3-0443-999-01.



Warning Only approved modems (Thermo Scientific 212A/202) may be installed. Installing any other model may create a potentially hazardous condition. ▲

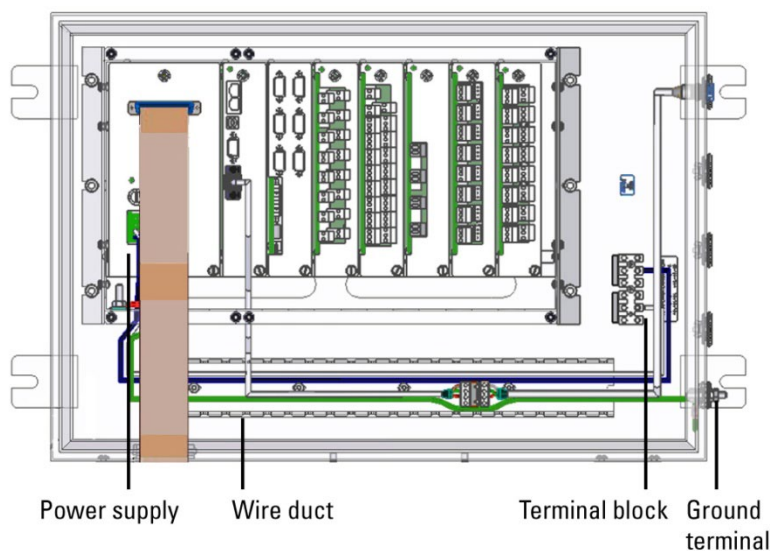


Warning Ensure power is off and the area is non-hazardous before making any connections. ▲



Warning Installation must be carried out in accordance with local site regulations and requirements. ▲

1. Open the enclosure door and remove the wire duct cover. An interior view of the enclosure is shown in Figure 4-1.



Bottom of enclosure (wires and cables outside the enclosure not shown)

Figure 4–1. Interior view of enclosure

2. Install the cover plate RFI. The item numbers referenced are shown in Figure 4-2.
 - a. From the exterior of the enclosure, insert the screw (item 1), and fasten it with the washers and nut (items 2, 3, and 4).
 - b. Locate the holes for the cover plate RFI (item 6).
 - c. On the exterior of the enclosure, align the mounting gasket and cover plate RFI (items 5 and 6) with the holes.
 - d. Insert a screw (item 7) through each corner of the gasket and cover plate into the enclosure.
 - e. From the interior of the enclosure, fasten with a washer and nut (items 8 and 9).

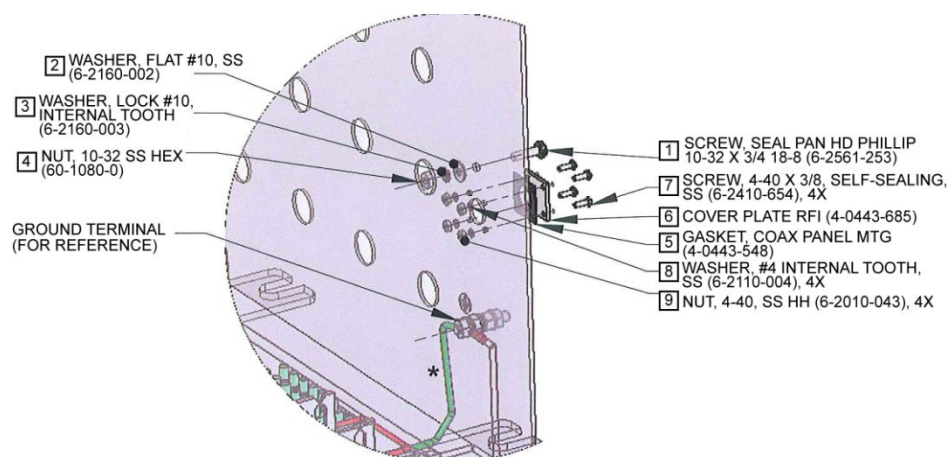


Figure 4-2. Installing the cover plate RFI

3. Mount the modem (item 10) onto the universal mounting bracket (item 13) using the standoffs and washers (items 11 and 12).

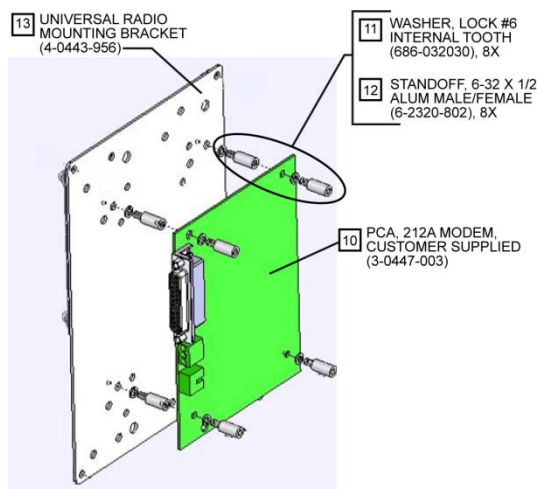
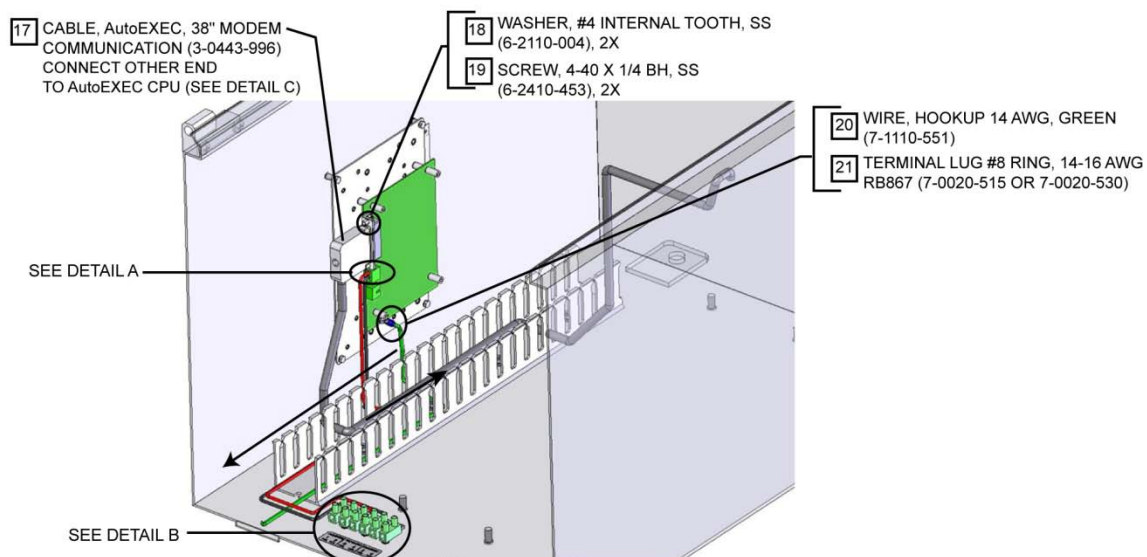


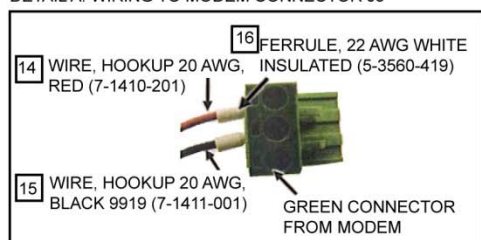
Figure 4-3. Mounting the modem onto the universal bracket

4. Reference Figure 4-4 for the following steps.
 - a. Connect modem power:
 - Remove the green connector (J5) from the modem.
 - Crimp the red and black wires (items 14 and 15) with a ferrule (item 16). Attach and secure the wires to the green connector.
 - Reinstall the green connector (with wires attached) onto the modem.
 - Connect the red wire (item 14) to TB1 position 1–3 (POS) and the black wire (item 15) to TB1 position 4–6 (NEG).
 - b. Connect the communication cable (item 17):
 - Using the washers and screws (items 18 and 19), connect the communication cable (item 17) to the modem at J4.
 - Feed the remaining cable length through the wire duct in the direction shown in the figure.
 - Connect the other end of the cable to COMM 1 on the CPU.
 - c. Connect the modem ground wire (item 20):
 - Remove the grounding screw from the modem.
 - Install and secure the green wire (item 20) with the terminal lug ring (item 21) attached to the modem using the screw you just removed. Feed the remaining wire length through the wire duct toward the ground terminal as shown in the figure.
 - Remove the nut and washer from the ground terminal on the enclosure, and use them to secure the other end of the green wire (item 20) with the terminal lug (item 22) attached.

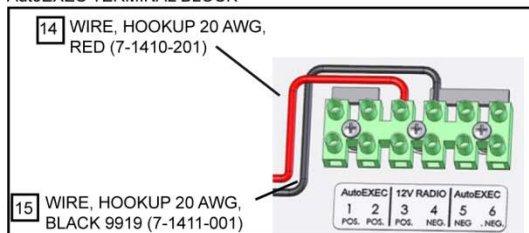
NOTE: MODEM ASSEMBLY IS SHOWN MOUNTED IN THE ENCLOSURE; HOWEVER, THESE STEPS CAN BE PERFORMED PRIOR TO MOUNTING.



DETAIL A: WIRING TO MODEM CONNECTOR J5



DETAIL B: WIRING FROM MODEM CONNECTOR J5 TO AutoEXEC TERMINAL BLOCK



DETAIL C: COMMUNICATION CABLE TO AutoEXEC CPU COMM 1

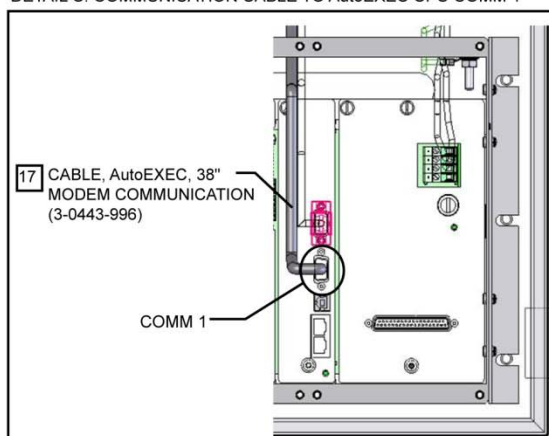


Figure 4-4. Modem connections

5. Mount the modem assembly in the enclosure using the screws and washers (items 11 and 14).

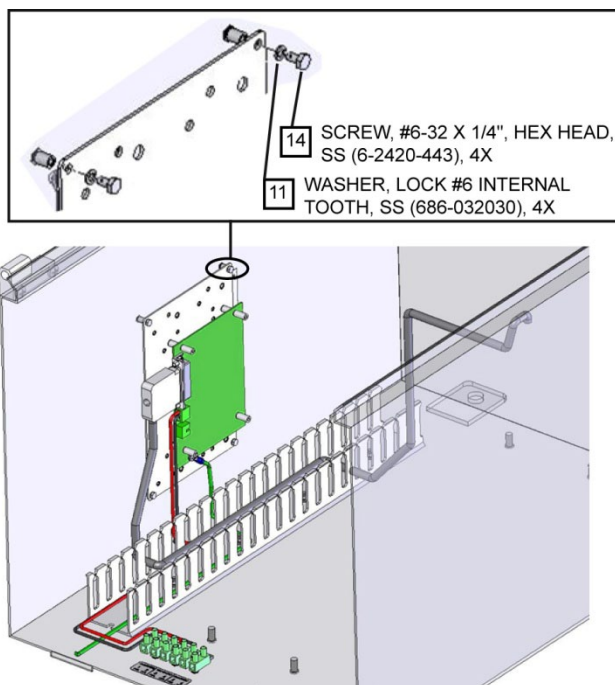


Figure 4-5. Mounting the modem assembly

6. Secure wires and cabling with cable ties as necessary and replace the wire duct cover.
7. Shut the enclosure door.

An example of a complete installation and the 212A modem wiring diagram are shown below.

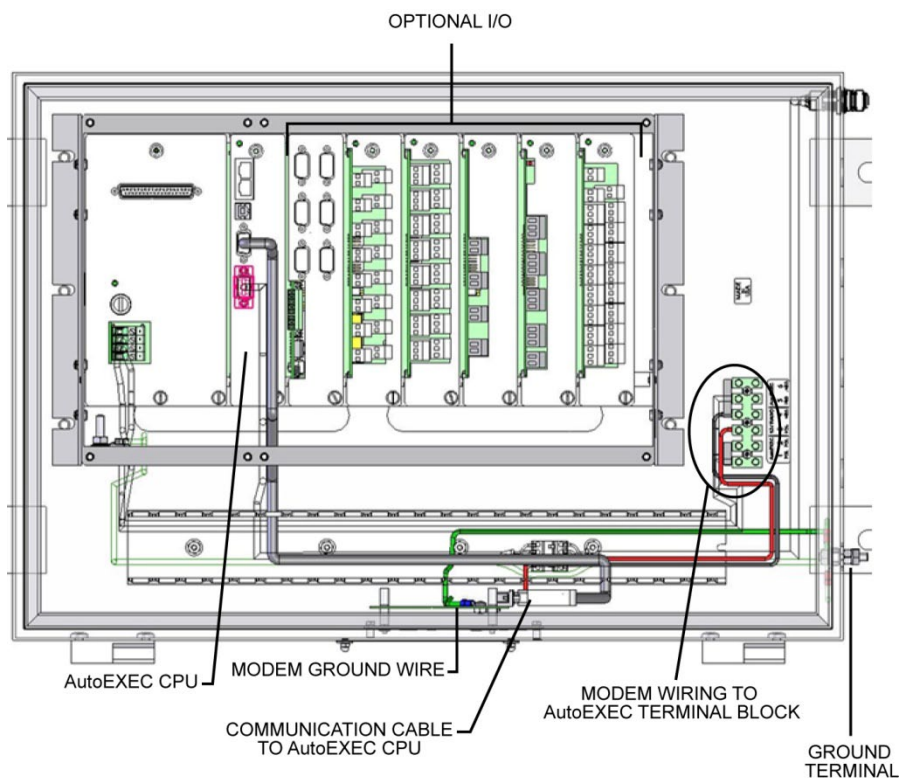


Figure 4-6. 212A modem installed in Type 4X enclosure

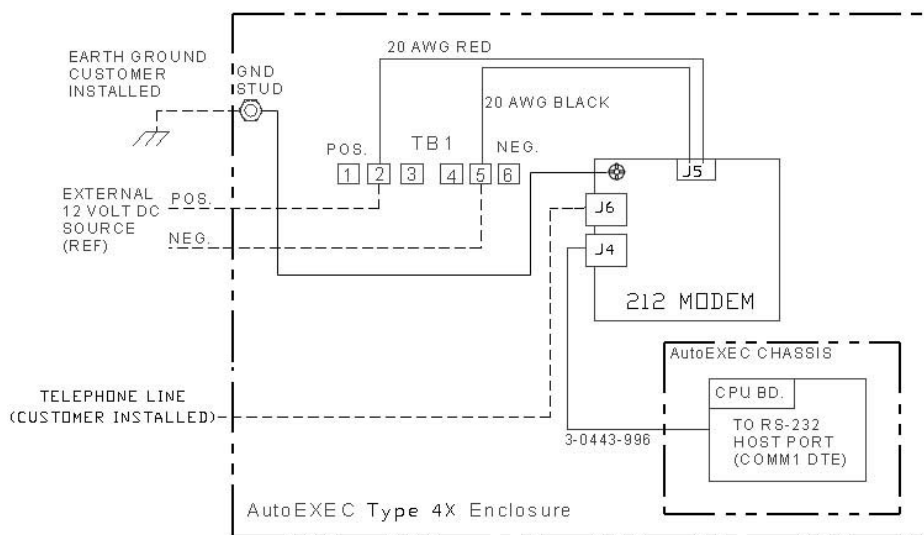


Figure 4-7. 212A modem wiring diagram

202 Modem Installation

If you did not order a modem option, you can install one after receiving the instrument. The modem ready kit number for the Thermo Scientific 212A/202 modem is 3-0443-999-01.



Warning Only approved modems (Thermo Scientific 212A/202) may be installed. Installing any other model may create a potentially hazardous condition. ▲

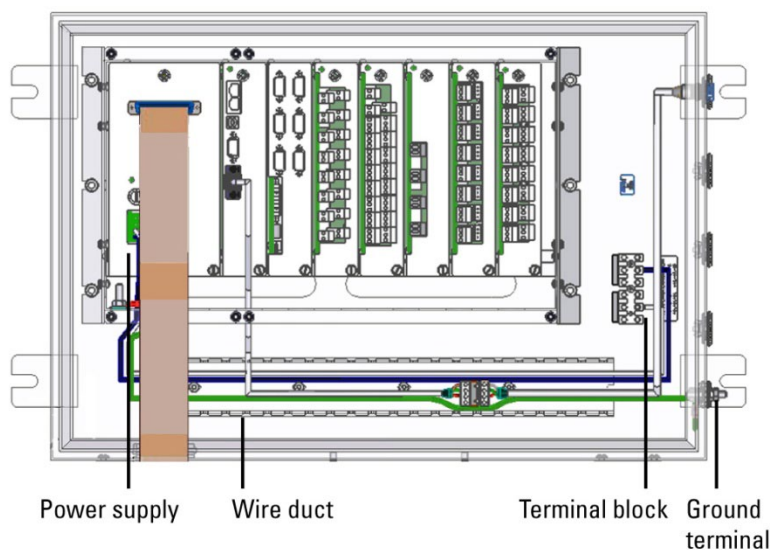


Warning Ensure power is off and the area is non-hazardous before making any connections. ▲



Warning Installation must be carried out in accordance with local site regulations and requirements. ▲

1. Open the enclosure door and remove the wire duct cover. An interior view of the enclosure is shown in Figure 4-8.



Bottom of enclosure (wires and cables outside the enclosure not shown)

Figure 4-8. Interior view of enclosure

2. Install the cover plate RFI. The item numbers referenced are shown in Figure 4-9.
 - a. From the exterior of the enclosure, insert the screw (item 1), and fasten it with the washers and nut (items 2, 3, and 4).
 - b. Locate the holes for the cover plate RFI (item 6).
 - c. On the exterior of the enclosure, align the mounting gasket and cover plate RFI (items 5 and 6) with the holes.
 - d. Insert a screw (item 7) through each corner of the gasket and cover plate into the enclosure.
 - e. From the interior of the enclosure, fasten with a washer and nut (items 8 and 9).

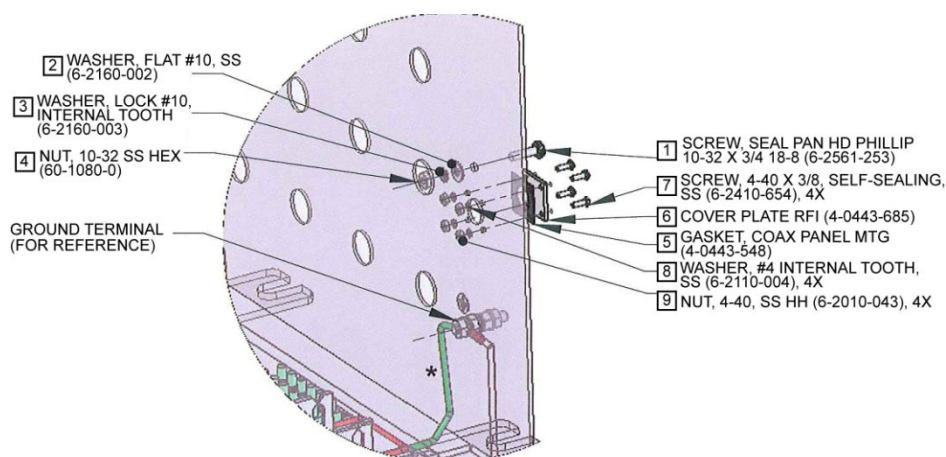


Figure 4-9. Installing the cover plate RFI

3. Mount the modem (item 10) onto the universal mounting bracket (item 13) using the standoffs and washers (items 11 and 12).

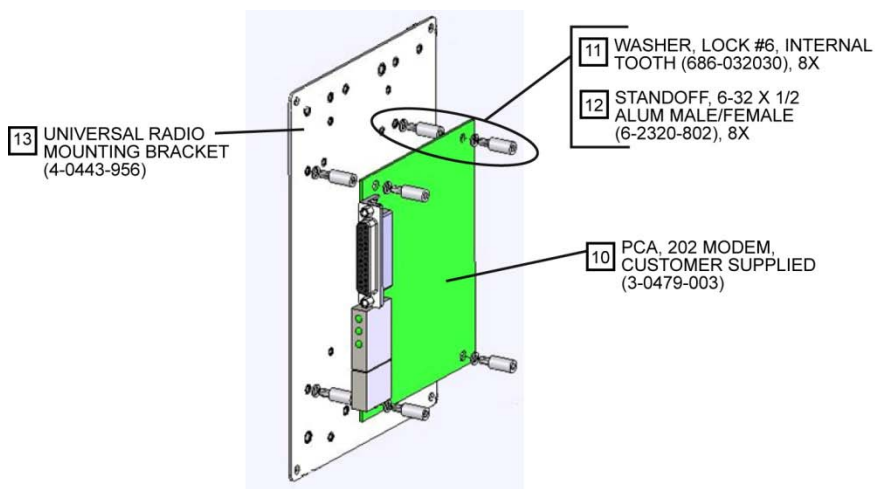


Figure 4-10. Mounting the modem onto the universal bracket

4. Mount the modem assembly in the enclosure using the screws and washers (items 11 and 14).

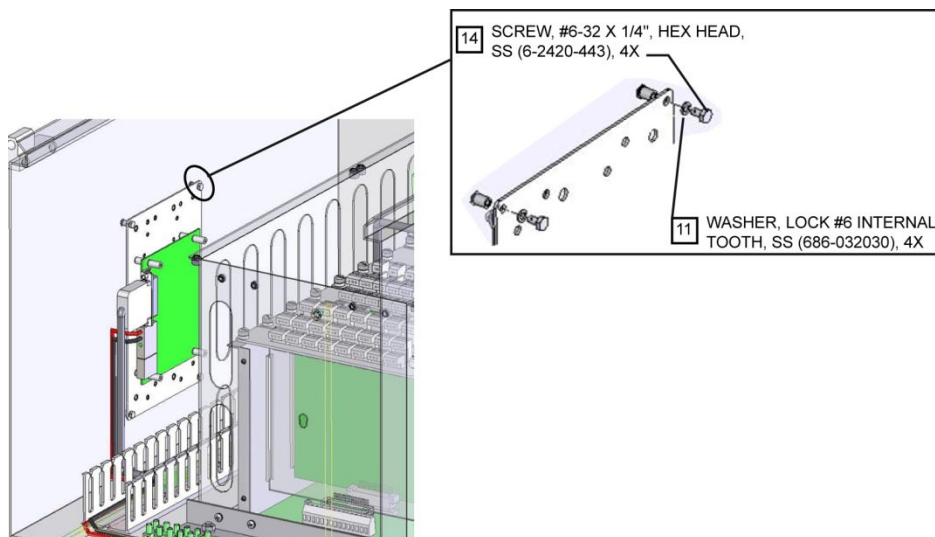


Figure 4-11. Mounting the modem assembly

5. Reference Figure 4-12 for the following steps.
 - a. Connect the modem power:
 - Crimp the red and black wires (items 14 and 15) with a ferrule (item 16). Attach and secure the wires to the connector J16 as shown in the figure.
 - Connect the red wire (item 14) to TB1 position 1-3 (POS) and the black wire (item 15) to TB1 position 4-6 (NEG).
 - b. Connect the communication cable (item 17):
 - Using the washers and screws (items 18 and 19) connect the cable (item 17) to the modem at J11.
 - Feed the remaining cable length through the wire duct in the direction shown in the figure.
 - Connect the other end of the cable to COMM 1 on the CPU.

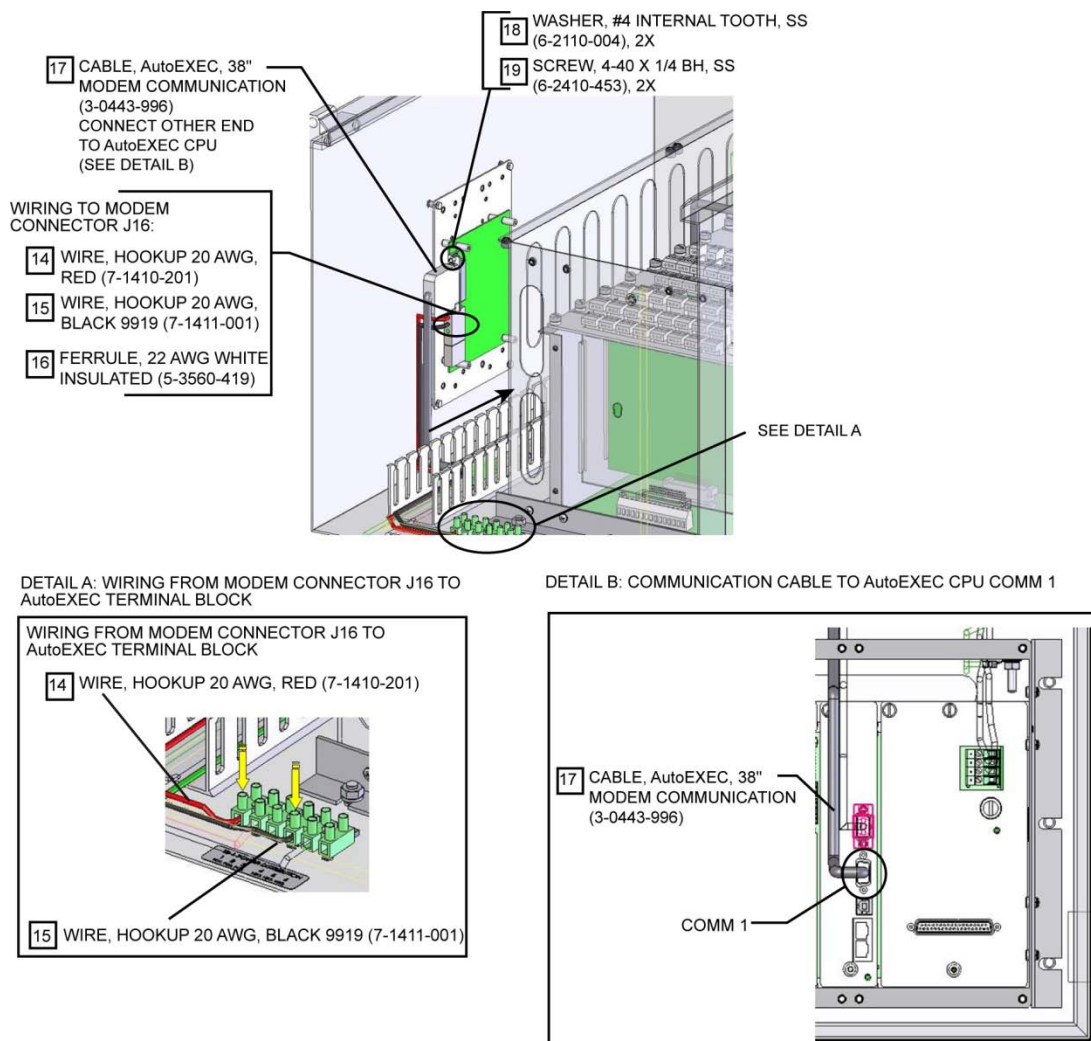


Figure 4-12. Modem connections

6. Secure wires and cabling with cable ties as necessary and replace the wire duct.
7. Shut the enclosure door.

An example of a complete installation and the 202 modem wiring diagram are shown below.

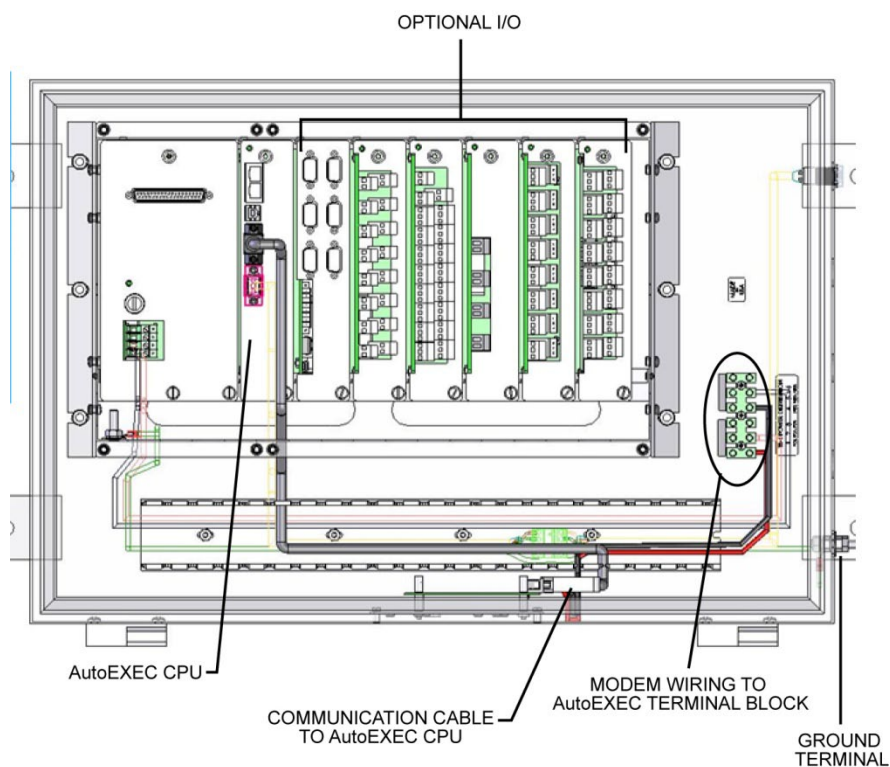


Figure 4-13. 202 modem installed in Type 4X enclosure

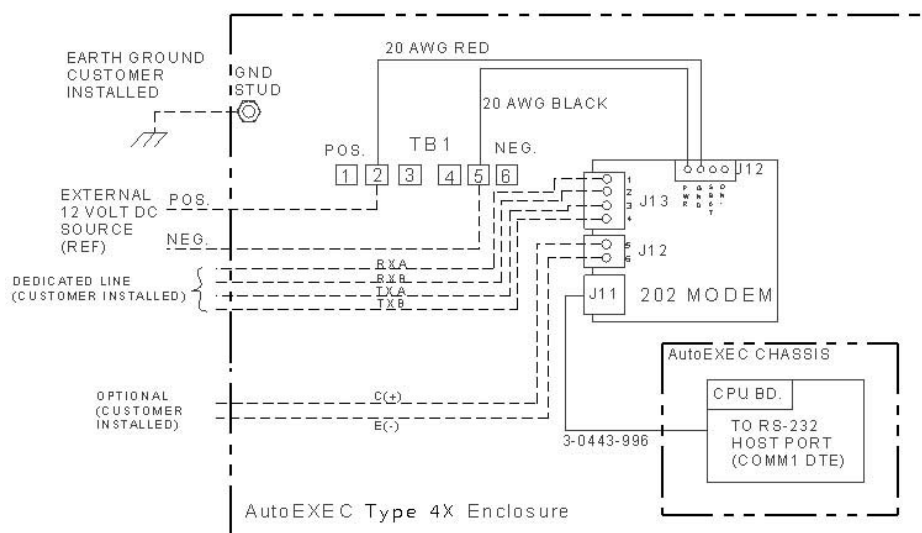


Figure 4-14. 202 modem wiring diagram

MDS XX10 Radio Installation

If you did not order a radio option, you can install one after receiving the instrument. The MDS XX10 radio ready kit number is 3-0443-1001-01.



Warning Only approved MDS radios may be installed. Installing any other model may create a potentially hazardous condition. ▲

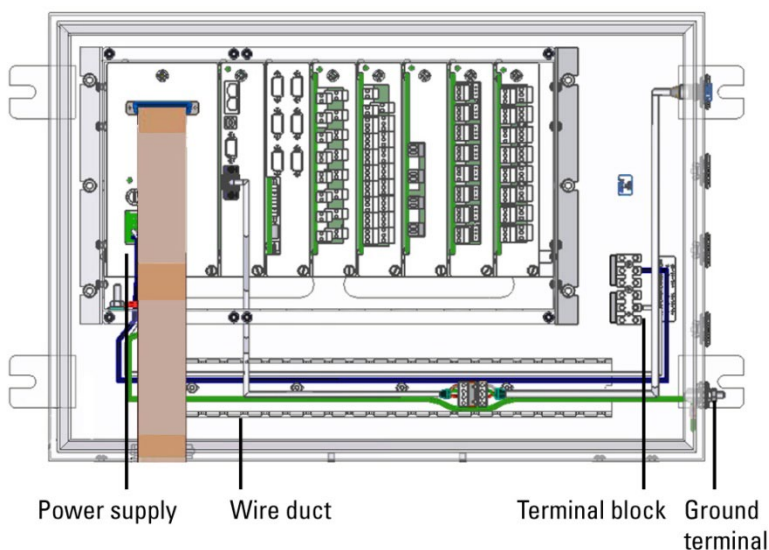


Warning Ensure power is off and the area is non-hazardous before making any connections. ▲



Warning Installation must be carried out in accordance with local site regulations and requirements. ▲

1. Open the enclosure door and remove the wire duct cover. An interior view of the enclosure is shown in Figure 4-15.



Bottom of enclosure (wires and cables outside the enclosure not shown)

Figure 4-15. Interior view of enclosure

2. It is recommended that you remove the flow computer chassis prior to installing the radio. To do this, remove the nuts that hold the chassis in place and pull the chassis out. Be careful of wiring when removing the chassis.

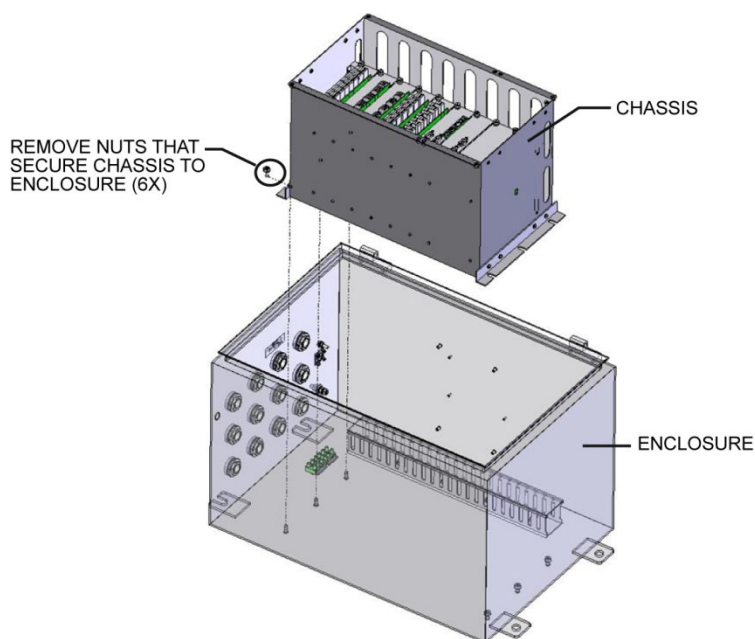


Figure 4–16. Removing the chassis

3. Reference the figure below for this series of steps.
 - a. Mount the radio (item 1) onto the universal mounting bracket (item 5) using the screws and washers (items 2, 3, and 4).
 - b. Mount the radio assembly in the enclosure with the washers and screws (items 6 and 7).

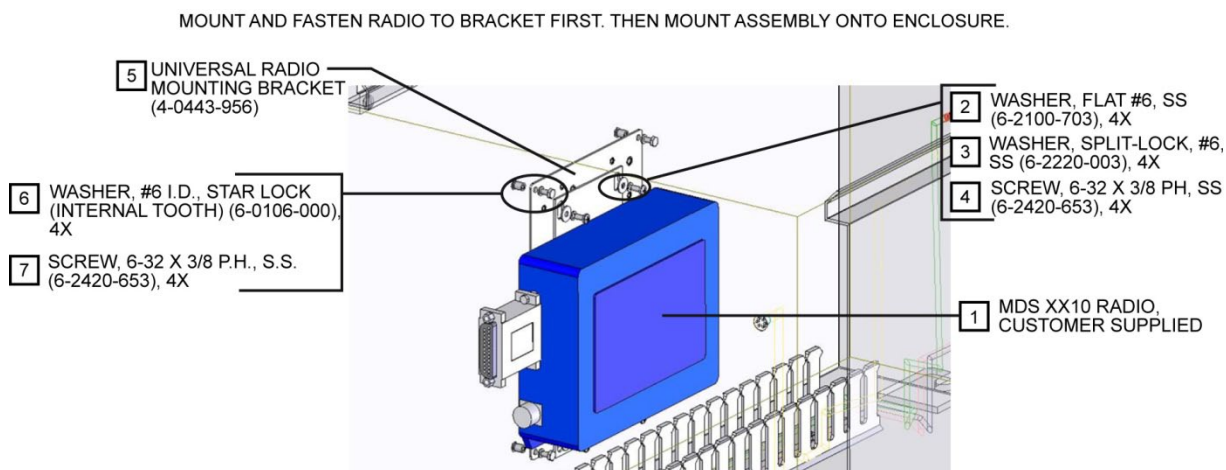


Figure 4–17. Mounting the radio assembly

4. Reference Figure 4-18 for the following steps.
 - a. Connect the communication cable (item 8):
 - Using the washers and screws (items 9 and 10), connect the cable (item 8) to the radio's DB25 connector.
 - Feed the remaining cable length through the wire duct in the direction shown in the figure.
 - Connect the other end of the cable to COMM 1 on the CPU.
 - b. Connect the radio power:
 - Install and secure the black and red wires to the radio (if necessary).
 - Crimp the other ends of the red and black wires with the ferrules (item 11).
 - Connect the RED wire to TB1 position 1–3 (POS) and the BLACK wire to TB1 position 4–6 (NEG).
 - c. Connect one end of the radio antenna cable (item 12) to the radio.
 - d. To connect the other end of the antenna cable (item 12):
 - Remove the nut from the stud of the coaxial protector (item 13) and place a gasket (item 14) over the stud.
 - Insert the coaxial protector (item 13) into the enclosure.
 - Place the second gasket (item 14) and the plate (item 15) over the stud from the outside of the enclosure.
 - Use the nut removed earlier to secure the coaxial protector to the enclosure, and cover that with the dust cap (item 23).
 - Connect the other end of the antenna cable (item 12) to the coaxial protector (item 13).
 - e. Connect the green wire (item 16):
 - Crimp both ends of the green wire (item 16) with the terminal lug ring and lug (items 17 and 18).
 - Fasten one end of the green wire (item 16) on top of the coaxial protector (item 13) with the screw, washers, and nut (items 19, 20, 21, 22).
 - Remove the nut and washer from the ground terminal on the enclosure, and use them to fasten the other end of the green wire (item 16).

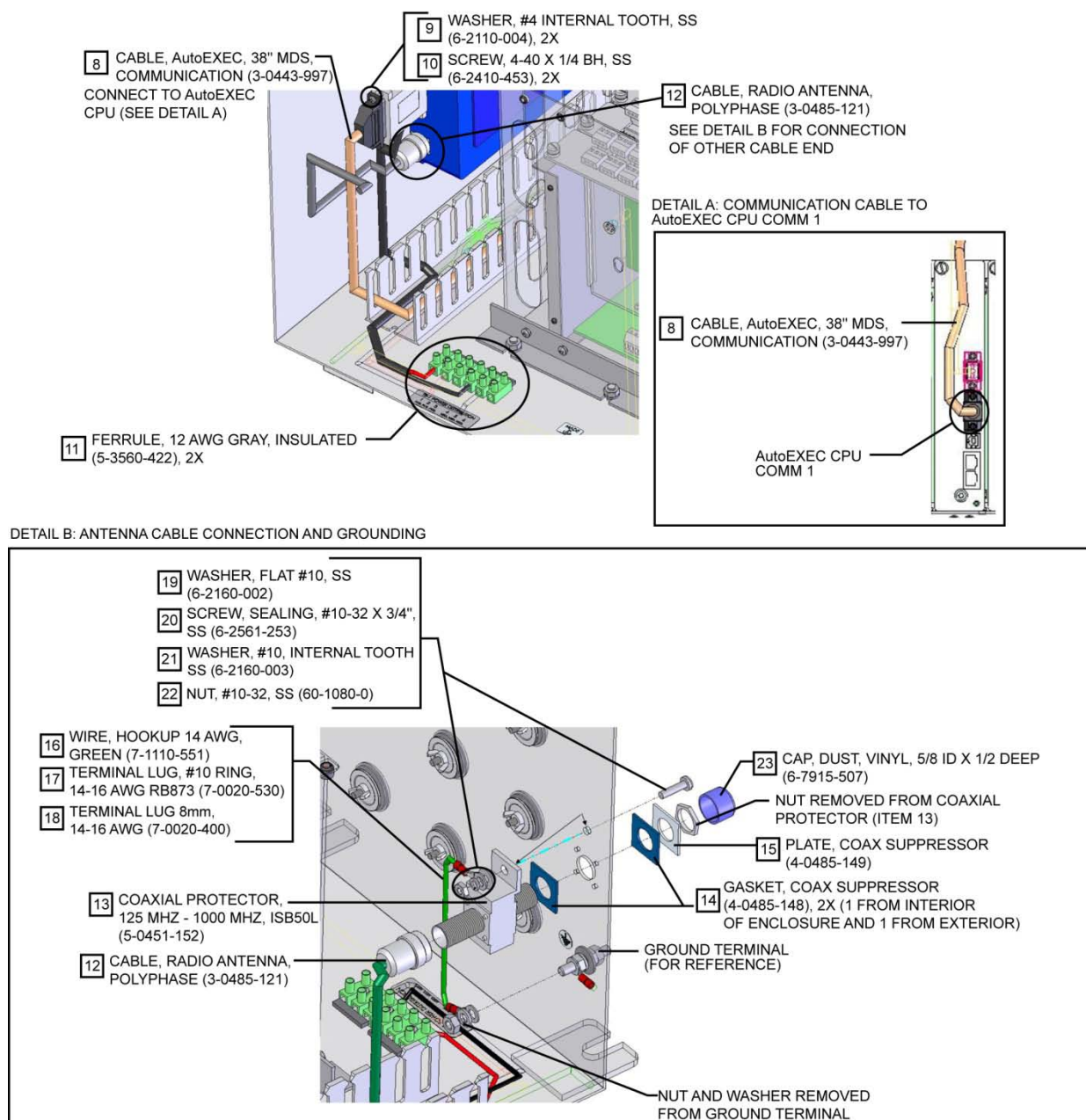


Figure 4-18. Radio connections

5. Align the flow computer chassis in the enclosure and secure it with the nuts that you removed earlier.
6. Secure wires and cabling with cable ties as necessary and replace the wire duct.
7. Shut the enclosure door.

An example of a complete installation and the MDS radio wiring diagram are shown below.

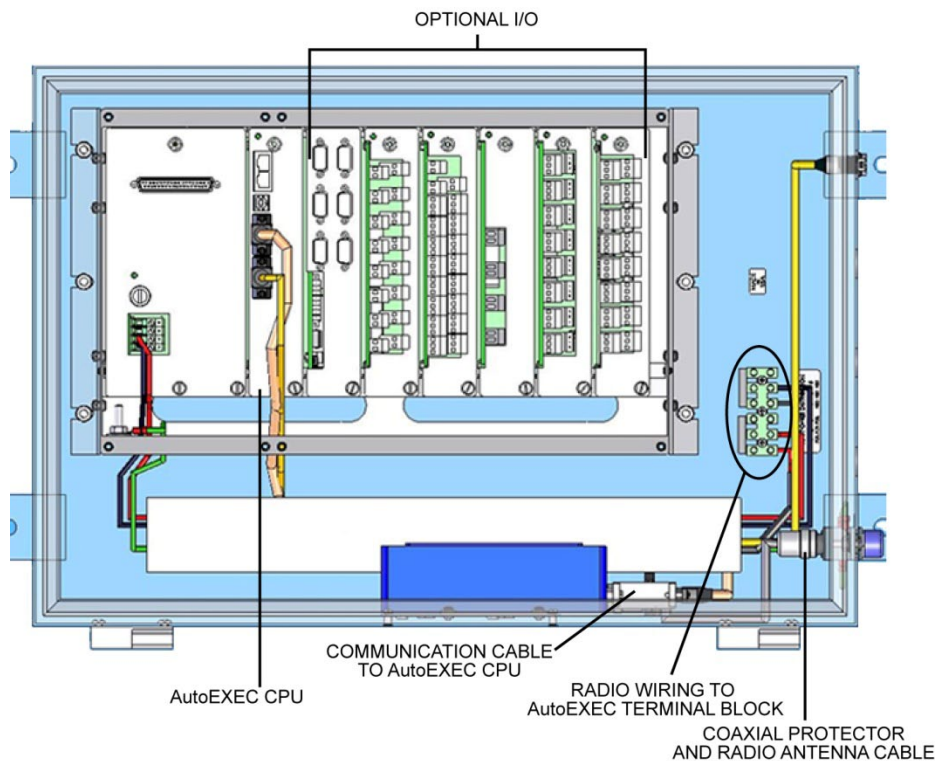


Figure 4-19. MDS XX10 radio installed in Type 4X enclosure

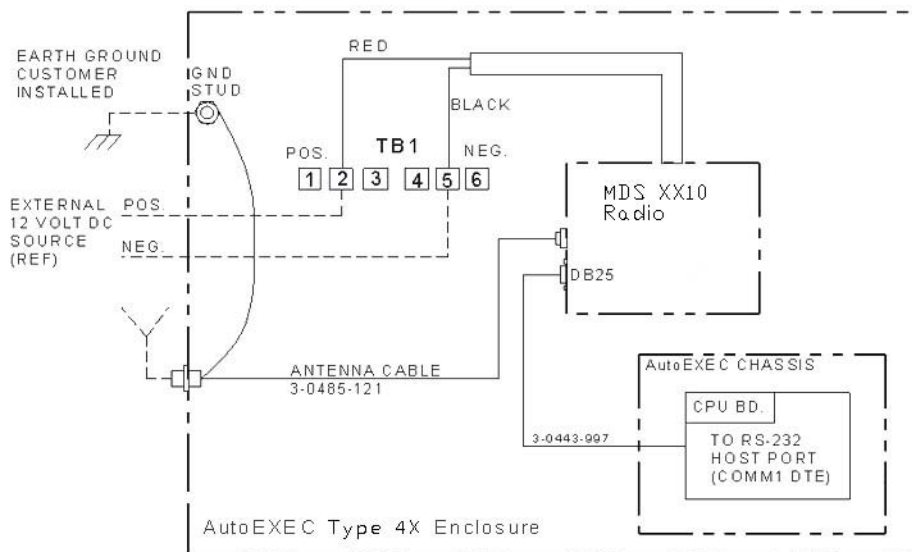


Figure 4-20. MDS XX10 wiring diagram

AutoWAVE Radio Installation

If you did not order a radio option, you can install one after receiving the instrument. The Thermo Scientific AutoWAVE radio ready kit number is 3-0443-1004-01.



Warning Only approved radios may be installed. Installing any other model may create a potentially hazardous condition. ▲

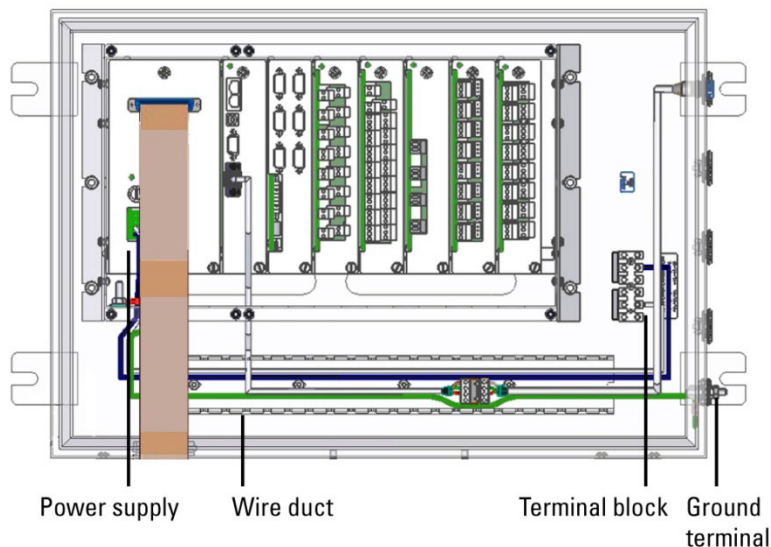


Warning Ensure power is off and the area is non-hazardous before making any connections. ▲



Warning Installation must be carried out in accordance with local site regulations and requirements. ▲

1. Open the enclosure door and remove the wire duct cover.



Bottom of enclosure (wires and cables outside the enclosure not shown)

Figure 4-21. Interior view of enclosure

2. Reference the figure below for this series of steps.
 - a. Mount the radio (item 1) onto the universal mounting bracket (item 5) using the standoffs, screws, and washers (items 2, 3, and 4).
 - b. Mount the radio assembly in the enclosure with the washers and screws (items 6 and 7).

MOUNT AND FASTEN RADIO TO BRACKET FIRST. THEN MOUNT ASSEMBLY ONTO ENCLOSURE.

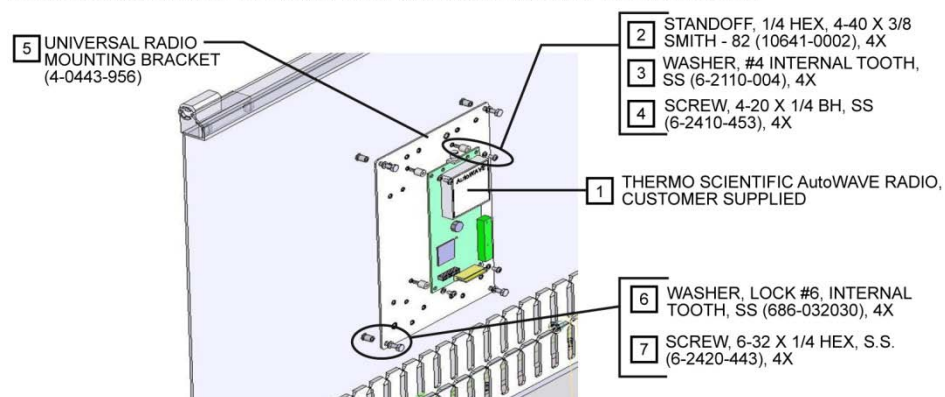


Figure 4-22. Mounting the radio assembly

3. Reference Figure 4-23 for the following steps.
 - a. Connect the power/communication cable (item 8):
 - Connect the cable to the radio.
 - Feed the remaining length of the DB9 cable through the wire duct in the direction shown in the figure.
 - Connect the DB9 end of the cable to COMM 1 on the CPU board.
 - Feed the BLACK and RED wires of the cable through the wire duct toward the terminal block.
 - Connect the RED wire to TB1 position 1–3 (POS) and the BLACK wire to TB1 position 4–6 (NEG).
 - b. Connect the radio antenna cable (item 9) to the radio, and feed the cable length through the wire duct as shown.

- c. To connect the other end of the antenna cable (item 9):
 - Remove the nut from the stud of the coaxial protector (item 10) and place a gasket (item 11) over the stud.
 - Insert the coaxial protector (item 10) into the enclosure.
 - Place the second gasket (item 11) and the plate (item 12) over the stud from the outside of the enclosure.
 - Use the nut removed earlier to secure the coaxial protector to the enclosure, and cover that with the plug (item 21).
 - Connect the other end of the antenna cable (item 9) to the coaxial protector (item 10).
- d. Connect the green wire (item 14):
 - Crimp both ends of the green wire (item 14) with the terminal lug ring and lug (items 15 and 16).
 - Fasten one end of the green wire (item 14) on top of the coaxial protector (item 10) with the screw, washers, and nut (items 17, 18, 19, 20).
 - Remove the nut and washer from the ground terminal on the enclosure, and use them to fasten the other end of the green wire (item 14).

Modem & Radio Options

AutoWAVE Radio Installation

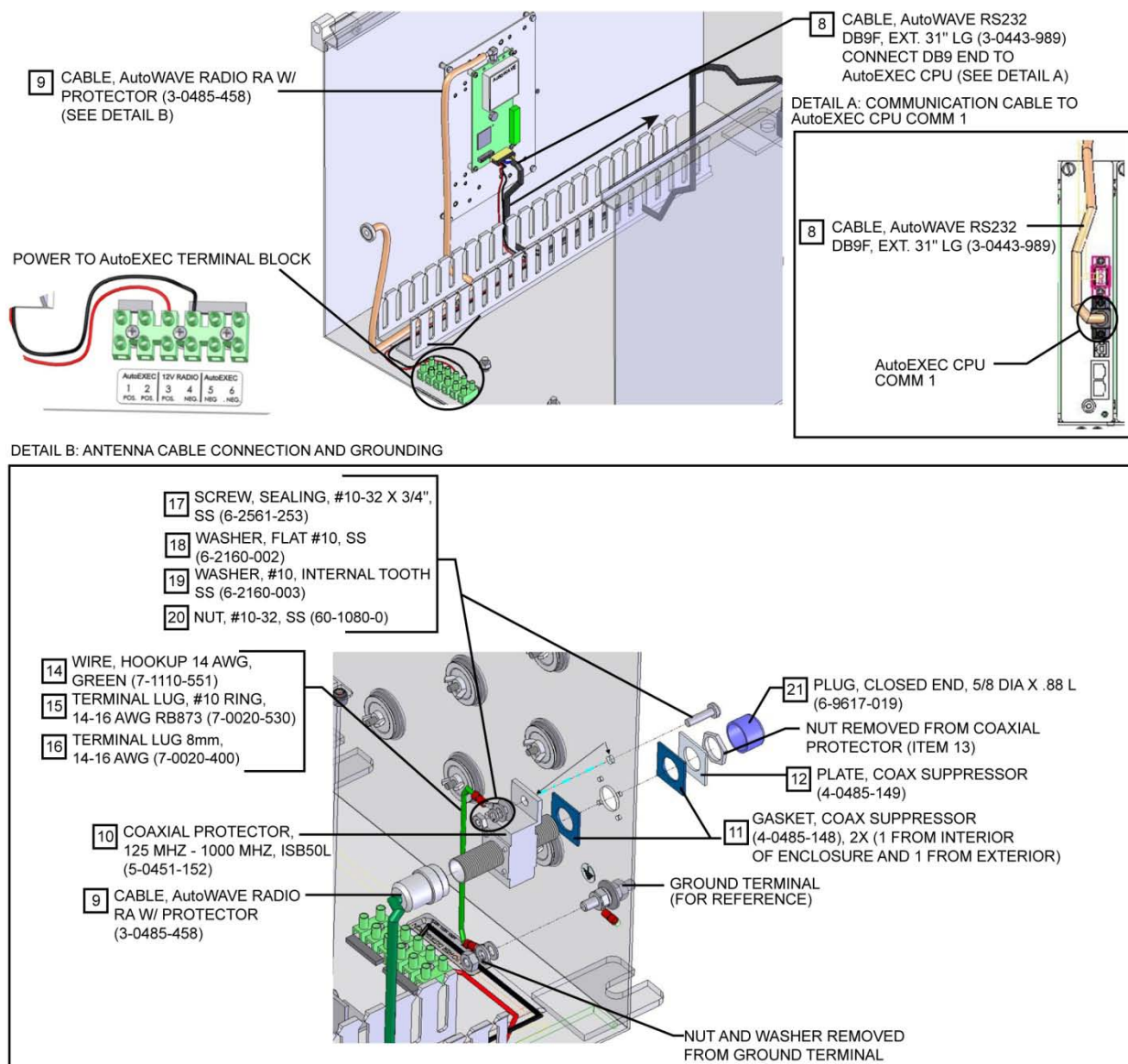


Figure 4-23. Radio connections

4. Secure wires and cabling with cable ties as necessary and replace the wire duct.
5. Shut the enclosure door.

The AutoWAVE radio wiring diagram is shown below.

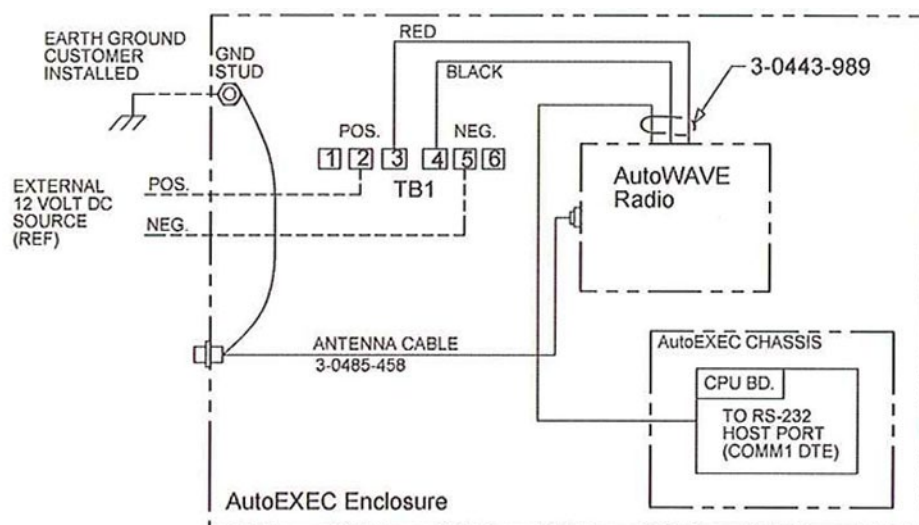


Figure 4-24. AutoWAVE radio wiring diagram

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Chapter 5

Front Panel Interface

You can interface with the instrument through the keypad and LCD on the front panel or through the AutoCONFIG software. This chapter covers the front panel interface. Instructions on getting started with the software are covered in the AutoCONFIG software startup guide (p/n 1-0485-068).

Using the Keypad

The flow computer features a 4 x 4 keypad. The table below describes how to use the keys to operate the instrument.

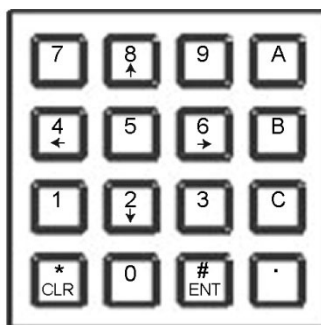


Figure 5–1.

Table 5–1.

Key	Description
Number keys (0–9)	Use to enter values.
Period	<p>Press to enter a decimal.</p> <p>In some cases, you can press the period to toggle the displayed item on and off. For example, go to FP Entry > FP Entry #1 > Current Status > IO Failed. To change the status to ON, press the period key.</p> <p>May also be pressed to pause a scrolling display.</p>
Up arrow	<p>Press to scroll up through a list of menu items or options.</p> <p>From the main display, you can also press the up arrow to increase the screen contrast.</p>
Down arrow	<p>Press to scroll down through a list of menu items or options.</p> <p>From the main display, you can also press the down arrow to decrease the screen contrast.</p>

Key	Description
Right and left arrows	No function.
A	No function.
B	Press to step back to the previous screen.
C	For items with multiple options, press C to move to the next option. For example, go to PID Calc > PID Mode . Press C to scroll through the Current Value options. When entering negative values, press C to toggle the minus sign on. Pressing C again toggle the minus sign off.
CLR	Press to clear the displayed value. When scrolling through multiple options, press CLR to return to the original selection.
ENT	Press to go to the next menu. For instance, to access PID Mode, scroll to PID Calc and press ENT . Once you have selected an option or entered a value, press ENT to save change.

Contrast Adjustment

If the display appears blank, you may need to adjust the contrast. Press **5** to enter the Contrast Adjustment screen. Press the **up arrow** to make the screen lighter and the down arrow to make it darker. Press **B** to exit the screen.

Getting Started

When you first apply power to the unit (or after a cold start), the flow computer displays three screens. The first two are the bootloader. The third screen displays "No Display List."

You will be prompted to enter your user ID and password.

The menus accessible through the keypad depends on if the unit has been configured keypad menu lists and on the user's level of security access. The base menus are listed below. Refer to the AutoCONFIG software help for specific details on the menus, information on the types of keypad menu lists, and instructions on how to add menus to or remove menus from the keypad lists.

Table 5–2.

Table #	Base Menu
1	FP Entry – Floating Point Value Table
2	Disc Entry – Discrete Value
3	Byte Entry – Byte Value
4	16Bit Entry – 16-Bit Word Table
16	AnalogIn – Physical Analog Input Table
17	Smart Input – Physical Smart Transducer Input Table
18	Honeywell DE – Physical Honeywell DE Input Table
19	Disc Input – Physical Discrete Input Table
20	Acc Input – Physical Accumulator Input Table
21	AnalogOut – Physical Analog Output Table
22	DiscOut – Physical Discrete Output Table
30	System Status – System Status Table
31	System Control – System Control Table
33	PID Entry – PID Calculation Entry
34	Proportional – Proportional Output Calculation
35	HILO Calc – Hi/Low Selection
36	AlmStatCalc – Alarm Status Calculation
37	PtConvCalc – Point Type Conversion Calculation
38	DP FlowCalc – DP Flow Calculation
39	AGA7 FlowCalc – AGA 7 Flow Calculation
40	AGA10 SoSCalc – AGA 10 Speed Of Sound Calculation
41	MeterStnCalc – Meter Station Calculation
42	RunSwitchCalc – Meter Run Switching Calculation
43	HistAvgCalc – Historical Average Calculation
44	FpScaleCalc – Floating Point Scaling Calculation
45	16BitScaleCalc – Word Scaling Calculation
46	LogicalOR – Discrete Logical OR
47	LogicalAND – Discrete Logical AND
48	FPSumCalc – Floating Point Summary
50	FPCopy – Floating Point Copy
51	Liquid Calc – Liquid Flow Calculation
52	Prover Calc – Prover Calculation

Table #	Base Menu
56	Density Calc – Density Calculation
60	Sampler/Acc – Sampler Accumulator
61	ScheduledCopy – Scheduled Copy Table
62	NominationCtl – Nomination Control Table
63	RemCtlValveRCV – Remote Control Valve
96	CommPortDef – Communication Port Definition
97	ModbusSlave – Modbus Slave Communication Block
98	ModbusMstr – Modbus Master Communication Block
100	Chromatograph – Chromatograph
101	TankGauge – Tank Gauge
128	GasQuality – Gas Components
129	Product Table – Product Table
192	LogAllocTable – Historical Data Log
193	AA_AllocTable – Audit/Alarm Data Log

Chapter 6

Functional Description

Flow Computer Tasks

This chapter provides a functional description of the instrument. For additional details, such as instructions on configuring calculations or performing calibrations, refer to the AutoCONFIG software help.

Meter Types

The AutoEXEC flow computer provides support for differential pressure meter and linear meter types. For differential pressure meters, the instrument supports orifice, V-Cone, annubar, and slotted DP installations. For linear meters, the instrument supports turbine and ultrasonic installations.

Equations

The following equations are used in combinations specified by the AGA.

Supercompressibility

Supercompressibility is run ten times per second for all meter runs. The following methods are supported for differential pressure and linear meters:

- AGA 8 Gross Method – 1992
- AGA 8 Detail Method – 1992
- AGA 8 Short Form – 1985
- NX-19
- NX-19 Analysis
- GERG

Differential Meters

The differential meter calculations are run at least ten times per second for all meter runs. Users may select from the following:

- AGA 3 / ASTM 2530-1992
- AGA 3-1985
- GOST
- V-Cone
- Annubar
- Slotted-DP

Linear Meters Linear meter calculations are run at least ten times per second for all meter runs. Per AGA 7 and 9, the equation is fixed at AGA 7 for both turbine and ultrasonic meter installations.

Energy The AGA 5 energy calculation is run at least ten times per second for all meter runs.

Diagnostic For diagnostic and alarming purposes specifically in ultrasonic applications, the AGA 10 – Speed of Sound equation is run ten times per second. The calculated value is compared to the measured value as retrieved from the ultrasonic device via a communication port. If the calculated value deviates from the measured value by a user configurable amount, an alarm is generated.

**Additional
Factors/Equations**

Fwv

The water vapor factor is a direct multiplier into the flow equation that compensates for any water vapor in the system. The number is a value close to the one derived from the following equation:

$$Fwv = 1 - [((lb. / mcf) / 21.0181) / 1000000]$$

Manual: Enter the Fwv directly (usually approximately .98).

Partial Calculation: Enter the pounds of water per million cubic feet of gas to enable the flow computer to calculate Fwv.

Full Calculation: This method assumes a fully saturated gas and uses the current pressure and temperature of the gas to calculate what the water content should be. The results of this calculation are then used as the input into the Fwv equation to obtain the Fwv factor.



Caution The water content equation used for the full calculation method is not an AGA sanctioned equation. Care should be taken in custody transfer applications. For custody transfer applications, the manual or partial calculation methods should be used using lab results or AGA test methods for determining water vapor content. ▲

Fws

A full well stream factor is provided for production applications that require compensation for well stream conditions. This value defaults to 1.0 and is a direct multiplier into the flow rate equation.

Turbine Meter Linearization

A 10-point break-pair table of K-Factor versus Frequency is utilized for the linearization of turbine meter K Factors. Individual tables are used for each meter run configured as a linear meter. Interpolation of the K-Factor between table points may be enabled and disabled on an individual meter run basis.

Averaging Techniques

Users may configure the flow computer to support one of the four averaging techniques as outlined in the API Ch 21.1.

1. Flow dependent time-weighted linear averaging
2. Flow dependent time-weighted formulaic averaging
3. Flow weighted linear averaging
4. Flow weighted formulaic averaging

For differential type meters, the square root of the measured differential pressure is used as the weight value in averaging techniques 3 and 4. For linear type meters, the Actual Flow Delta Volume is used as the weight value.

Calibration/As Found/As Left

A calibration routine is used for all analog inputs. The unit is capable of 2- or 3-point calibrations as well as a single point for re-zero. All calibration changes are logged in the audit trail with the old and new values for each of the calibration points.

The unit also allows for the verification of all analog inputs through an As Found / As Left procedure as outlined in the API Ch 21.1. Separate audit codes are used for As Found versus As Left audits.

Historical Data

The unit keeps historical logs for all meter run data as well as audit/alarm (event) logs for each meter run configured. For each meter run, the system defaults include:

- Hourly logs: storage for 840 hourly records (35 days)
- Daily logs: storage for 65 records
- Events: storage for the last 500 events

The data stored in these logs is configurable. Table #226 is reserved for DP flow calculations, and Table #227 is reserved for AGA 7 flow calculations. The structure for both tables is shown below.

Table 6–1. Structure of historical data log for DP and AGA 7 flow calculations

Field	Type	Description
1	Byte	History Log Item #1 Index
2	Byte	History Log Item #2 Index
3	Byte	History Log Item #3 Index
:	:	:
:	:	:
36	Byte	History Log Item #36 Index

History log index definitions for DP flow calculations are listed in the following table. Items with non-zero indices will be included in the log in the order specified.

Table 6–2. DP flow calculation history log index definitions

History Log Index	Definition
0	Undefined
1	Pipe Diameter (snapshot)
2	Orifice Diameter (snapshot)
3	Atmospheric Pressure (snapshot)
4	Pressure Base (snapshot)
5	Temperature Base (snapshot)
6	Average Differential Pressure
7	Average Static Pressure
8	Average Gas Temperature
9	Flow Status (snapshot)
10	Accumulated Volume (current log period)
11	Accumulated Energy (current log period)
12	Hourly Flow Rate (snapshot)
13	Daily Flow Rate (snapshot)
14	Hourly Energy Rate (snapshot)
15	Daily Energy Rate (snapshot)
16	Totalized Volume (snapshot, non-resettable accumulator)
17	Current Day Volume (snapshot)
18	Current Day Energy (snapshot)

History Log Index	Definition
19	Flow Time in Minutes (current log period)
20	Today Flow Time in Minutes (snapshot)
21	Average Square Root Extension
22	Average C' Prime
23	Average Fwv Water Content
24	Average Fwv Correction Factor
25	Average Full Well Stream Correction Factor
26	Average Fpwl Factor
27	Average BTU
28	Average Gravity
29	Average Methane Content
30	Average Nitrogen Content
31	Average Carbon Dioxide Content
32	Average Ethane Content
33	Average Propane Content
34	Average Water Content
35	Average Hydrogen Sulfide Content
36	Average Hydrogen Content
37	Average Carbon Monoxide Content
38	Average Oxygen Content
39	Average I-Butane Content
40	Average N-Butane Content
41	Average I-Pentane Content
42	Average N-Pentane Content
43	Average C6+ Content
44	Average N-Hexane Content
45	Average N-Heptane Content
46	Average N-Octane Content
47	Average N-Nonane Content
48	Average N-Decane Content
49	Average Helium Content
50	Average Argon Content
51	Average Air Content

History Log Index	Definition
52	Calculation ID
53–255	Undefined

History log index definitions for AGA 7 flow calculations are listed in the following table. Items with non-zero indices will be included in the log in the order specified.

Table 6–3. AGA 7 flow calculation history log index definitions

History Log Index	Definition
0	Undefined
1	Pipe Diameter (snapshot)
2	Average Meter Factor
3	Atmospheric Pressure (snapshot)
4	Pressure Base (snapshot)
5	Temperature Base (snapshot)
6	Accumulated Pulses
7	Average Static Pressure
8	Average Gas Temperature
9	Flow Status (snapshot)
10	Accumulated Volume (current log period)
11	Accumulated Energy (current log period)
12	Hourly Flow Rate (snapshot)
13	Daily Flow Rate (snapshot)
14	Hourly Energy Rate (snapshot)
15	Daily Energy Rate (snapshot)
16	Totalized Volume (snapshot, non-resettable accumulator)
17	Current Day Volume (snapshot)
18	Current Day Energy (snapshot)
19	Flow Time (current log period)
20	Today Flow Time (snapshot)
21	Actual Accumulated Volume (current log period)
22	Average Volume Correction Factor
23	Average Fwv Water Content

History Log Index	Definition
24	Average Fwv Correction Factor
25	Average Full Well Stream Correction Factor
26	Average Fpwl Factor
27	Average BTU
28	Average Gravity
29	Average Methane Content
30	Average Nitrogen Content
31	Average Carbon Dioxide Content
32	Average Ethane Content
33	Average Propane Content
34	Average Water Content
35	Average Hydrogen Sulfide Content
36	Average Hydrogen Content
37	Average Carbon Monoxide Content
38	Average Oxygen Content
39	Average I-Butane Content
40	Average N-Butane Content
41	Average I-Pentane Content
42	Average N-Pentane Content
43	Average C6+ Content
44	Average N-Hexane Content
45	Average N-Heptane Content
46	Average N-Octane Content
47	Average N-Nonane Content
48	Average N-Decane Content
49	Average Helium Content
50	Average Argon Content
51	Average Air Content
52	Average M Correction Factor
53	Main Rotor Pulses
54	Sensor Rotor Pulses
55	Average Delta A Deviation
56	Average Main Rotor Factor

History Log Index	Definition
57	Average Sensor Rotor Factor
58	Calculation ID
59–255	Undefined

Security

Table #213 is a table of passwords that allows you to configure user IDs, passwords, and security access levels. The four access levels are:

- Supervisor: The highest security access level. Allows for access to calibration data and modification of all configuration parameters, including passwords.
- Technician: Second highest level of security access. Identical to Supervisor, except cannot modify passwords.
- Control: Can access tables pertaining to control functions only, PID for example.
- Measurement: Can access tables pertaining to measurement functions only, DP flow calculation for example.

A valid user ID and password must be entered for all access levels. If an invalid entry is made, the instrument returns to scrolling through the display list. Refer to the AutoCONFIG software help for instructions on how to set user IDs, passwords, and security access levels. The help system also provides a list of the default security access levels.

When users log in, flow is not affected unless the unit is in maintenance mode. Before entering maintenance mode, the unit asks the user if the inputs should be frozen.

Communication Ports

The basic unit is equipped with the following dedicated communication ports:

- Two 10/100baseT Ethernet ports
- One USB 2.0
- One RS232 DTE host communication port
- One RS232 DCE local configuration port

The optional communication expansion board provides:

- Six RS232 DTE communication ports
- Two RS485 communication ports
- Two USB ports

Communication Functions

The AutoEXEC flow computer uses one communication port definition block per serial port. The block can be used to specify the port as a Master or slave.

When in Master mode, the communication block references contain pointers to any combination of the following types of Master blocks:

- Modbus Master Communication blocks – Read/Write Modbus Data
- Smart Transducer Communication blocks – Read Smart Transducer Data
- Chromatograph Communication blocks – Read Gas Quality Data
- Tank Gauge Communication blocks – Read Tank Gauge Data

When in slave mode, the communication block references contain pointers to a list of Modbus slave communication blocks and optionally an alarm callout block.

Table 6–4. Table #96: Communication port definition table entry

Field	Description
1	Communication Port Descriptor Text – Text Table Index (16-character ASCII string)
2	Communication Port Mode: 0 = Master Mode 1 = Slave Mode
3	Communication Port Enable: 0 = Port Disabled 1 = Port Enabled
4	Communication Port Baud Rate: 0 = 300 1 = 600 2 = 1200 3 = 2400 4 = 4800 5 = 9600 6 = 19200 7 = 38400 8 = 76800 9 = 115200
5	Communication Port Data Bits: 0 = 7 bits 1 = 8 bits

Field	Description
6	Communication Port Parity: 0 = None 1 = Even 2 = Odd 3 = Mark
7	Communication Port Stop Bits: 0 = 1 1 = 1.5 2 = 2
8	Communication Port RTS Delay (milliseconds) 10 msec. resolution
9	Communication Port Handshaking: 0 = None 1 = RTS/CTS
10	Master Mode Repeat Timer (seconds)
11	Slave Mode Communication Address
12	Slave Mode Write Enable: 0 = Write Disabled 1 = Write Enabled
13	Slave Mode Protocol Format: 0 = Modbus ASCII 1 = Modbus RTU
14	Slave Mode Communication Options (bit encoded)
15	Slave Mode Callout Block Index
16	Slave Mode Password #1 Modbus Register Number
17	Slave Mode Password #1 Value
18	Slave Mode Password #1 Security Access Mask: Bit 0 = Operator Access Bit 1 = Supervisor Access Bit 2 = Maintenance Access Bit 3 = Engineer Access Bits 4–7 = Undefined
19	Slave Mode Password #2 Modbus Register Number
20	Slave Mode Password #2 Value
21	Slave Mode Password #2 Security Access Mask
22	Slave Mode Password #3 Modbus Register Number
23	Slave Mode Password #3 Value

Field	Description
24	Slave Mode Password #3 Security Access Mask
25	Slave Mode Password #4 Modbus Register Number
26	Slave Mode Password #4 Value
27	Slave Mode Password #4 Security Access Mask
28	Slave Mode Password #5 Modbus Register Number
29	Slave Mode Password #5 Value
30	Slave Mode Password #5 Security Access Mask
31	Master/Slave Communication Block Reference #1
32	Master/Slave Communication Block Reference #2
33	Master/Slave Communication Block Reference #3
:	:
:	:
286	Master/Slave Communication Block Reference #256

Table 6–5. Table #97: Modbus slave communication block table entry

Field	Description
1	Modbus Slave Starting Register Number
2	Number of Registers (in this block)
3	Write Enable: 0 = Write Disabled 1 = Write Enabled (Does not apply for Historical Data Block Reference or Alarm/Audit Log Data Block Reference)
4	Register Format: 0 = Discrete 1 = 32-Bit Floating Point – 32-Bit Register 2 = 32-Bit Floating Point – 2 16-Bit Register 3 = 16-Bit Word 4 = Byte (Does not apply for Historical Data Block Reference or Alarm/Audit Log Data Block Reference)
5	Modbus Register Item #1 (Starting Register Number + 0)
6	Modbus Register Item #2 (Starting Register Number + 1)
7	Modbus Register Item #3 (Starting Register Number + 2)
:	:

Field	Description
:	:
104	Modbus Register Item #100 (Starting Register Number + 99)

Table 6-6. Table #98: Modbus Master communication block table entry

Field	Description
1	Modbus Master Communication Enable: 0 = Disabled 1 = Enabled
2	Modbus Master Communication Type: 0 = Read 1 = Write
3	Modbus Master Communication Address
4	Modbus Master Communication Status: 0 = Communication OK 1 = Illegal Function 2 = Illegal Data Address 3 = Illegal Data Value 4 = No Response 5 = Transmit Failure
5	Modbus Master Communication Options (Bit Encoded): 0 = 32-Bit Float 1 = 16-Bit Float #1 2 = 16-Bit Float #2 3 = AutoMITTER
6	Modbus Master Communication Protocol Format: 0 = Modbus ASCII 1 = Modbus RTU
7	Modbus Master Starting Register Number
8	Number of Registers (in this block)
9	Modbus Register Item #1 (Starting Register Number + 0)
10	Modbus Register Item #2 (Starting Register Number + 1)
11	Modbus Register Item #3 (Starting Register Number + 2)
:	:
:	:
58	Modbus Register Item #50 (Starting Register Number + 49)

Downloading Data

For standard enclosure, use the local RS232 DCE port on the CPU for downloading data from the flow computer to a PC (via the AutoCONFIG software). Use a straight-through DE9 extension cable (p/n 5-0580-002). See Figure 6-2.

For Type 4X enclosures, use a 6-pin circular connector cable (p/n 3-0446-090) to connect to the bottom of the enclosure. See [Figure 6-3](#).



Warning Ensure the area is non-hazardous before connecting to the bottom of the enclosure. ▲

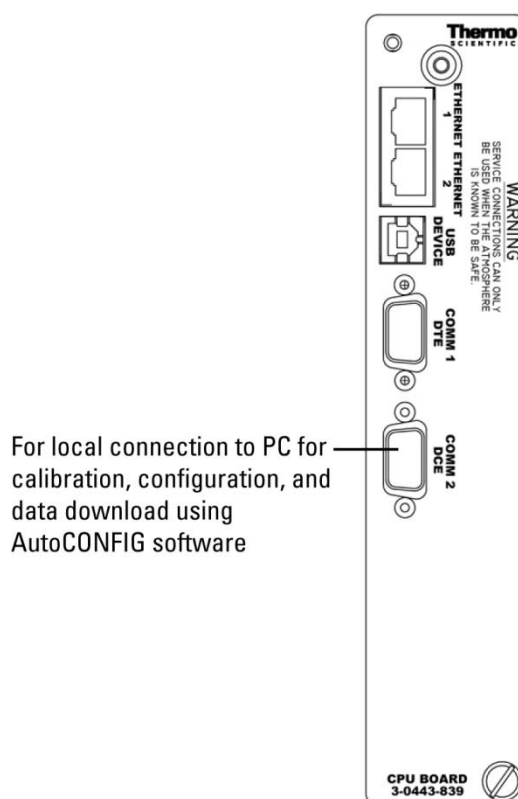
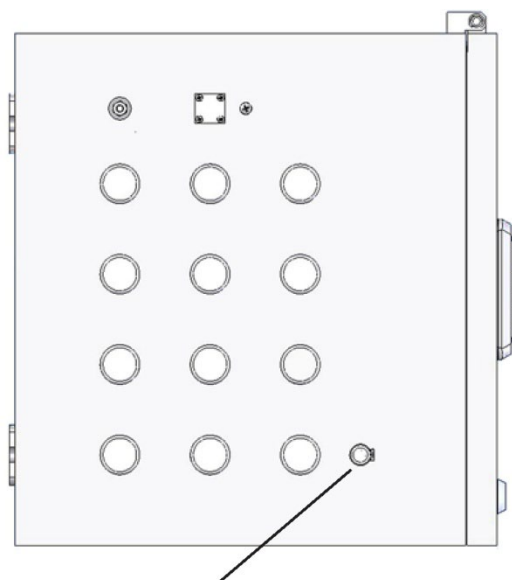


Figure 6–2. Local connection to a PC (rack or panel mounts)

Functional Description
Communication Ports



For local connection to PC for calibration,
configuration, & data download using AutoCONFIG

Figure 6–3. Local connection to a PC (bottom view of NEMA 4X enclosure, for pole mounts)

USB Host Port on the Communication Expansion Board



If you have the optional communication expansion board installed, you can connect a USB flash drive or a peripheral device, such as a printer, to the USB host port.

Warning Ensure the area is non-hazardous before connecting to the USB port on the communication expansion board. ▲

Using a USB flash drive, you can save the error log, upload or download a configuration file, or upload flow computer history. To do this from the front panel, enter your user ID and password. Select USB Menu and then select the action you want to perform (Save Error Log, Upload Config, Download Config, Upload History). To do this from the AutoCONFIG software, access the Files menu for configuration file upload/download or the Tools menu for log file upload.

You can also connect a printer to the USB host port. If you do this, you will need to set it in the AutoCONFIG software. Go to Miscellaneous > 31-System Control > Entry #1. Change the Target Printer parameter to USB and click Apply.

Inputs & Outputs

Optional I/O cards are available. See “[Optional I/O Boards](#)” in Chapter 2.

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Chapter 7

Maintenance



Warning For hazardous area installations: In the event of a fault condition, the AutoEXEC flow computer cannot be serviced by the customer. No repair to faulty assemblies should be attempted. Faulty assemblies must be replaced with identical replacements. All repairs or part replacements must be done by Thermo Fisher or its appointed repair agent. Contact Thermo Fisher for instructions. ▲

Replacing PCAs

Standard Enclosure

The following describes the procedure for replacing PCAs in the standard enclosure.



Warning Remove all power before adding or removing PCAs from the system. ▲

1. For the standard enclosure: Remove the left front cover if you are removing/replacing the power supply, or remove the right front cover for all other boards.

For a standard expansion enclosure: Remove the front cover.

2. Refer to [Figure 7-1](#) for a standard enclosure (basic) or [Figure 7-2](#) for a standard expansion enclosure. Locate the PCA you want to remove:

Power supply (p/n 3-0443-866): Slot 1 in basic or expansion

CPU (p/n 3-0443-839): Slot 2 in basic only

Optional communication expansion PCA (p/n 3-0443-842): Slot 3 or 4 in basic only

Other optional I/O PCAs: Slots 3–8 in basic; slots 2–8 in expansion

3. If replacing the PCA, remove the old one by loosening the thumbscrews and gently pulling the assembly out.

4. If replacing the power supply, disconnect the DB37 end of the cable connector.
5. Insert the replacement PCA into the card guides and press in until it is secured to the card cage. Tighten the thumbscrews.
6. Reconnect the DB37 end of the cable connector if necessary.
7. Replace the front cover.
8. Use the AutoCONFIG software to perform an I/O scan by going to Miscellaneous > 31–System Control. Select **Restart** for I/O Rescan and click Apply. The software will perform the scan and detect the board.

NOTES:

1. POWER SUPPLY (P/N 3-0443-866) MOUNTS IN SLOT 1.
2. CPU (P/N 3-0443-839) MOUNTS IN SLOT 2.
3. OPTIONAL COMM EXP BOARD (P/N 3-0443-842) MOUNTS IN SLOT 3 OR 4.
4. OTHER CARDS CAN BE MOUNTED IN ANY SLOT 3 THRU 8 (OPTIONAL).
5. ALL CARDS NEED TO BE SECURED TO THE CARD CAGE FOR GROUNDING PURPOSES.

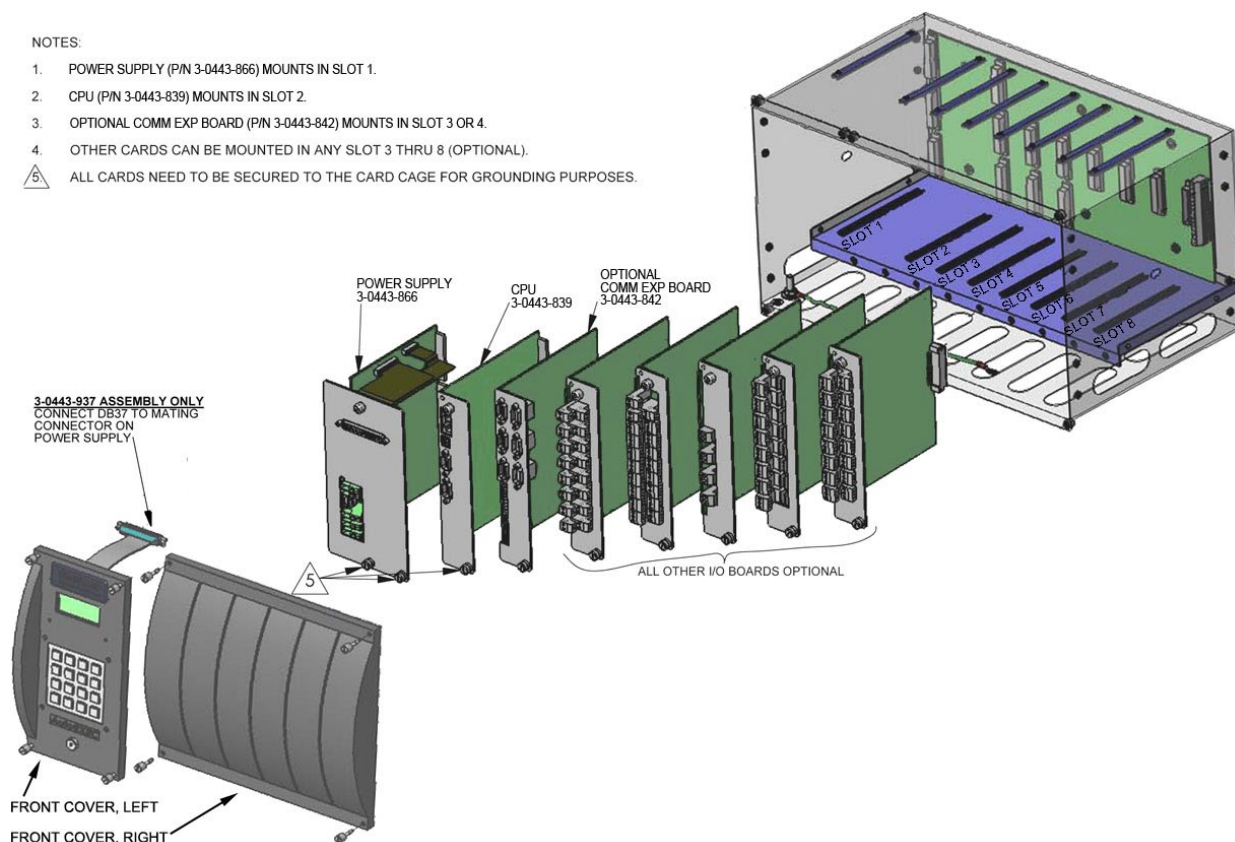


Figure 7–1. PCA locations in a standard enclosure (basic chassis)

NOTES:

1. POWER SUPPLY (P/N 3-0443-866) MOUNTS IN SLOT 1.
2. ALL OTHER I/O CARDS CAN BE MOUNTED IN SLOTS 2 THRU 8 (OPTIONAL).
3. ALL CARDS NEED TO BE SECURED TO THE CARD CAGE FOR GROUNDING PURPOSES.

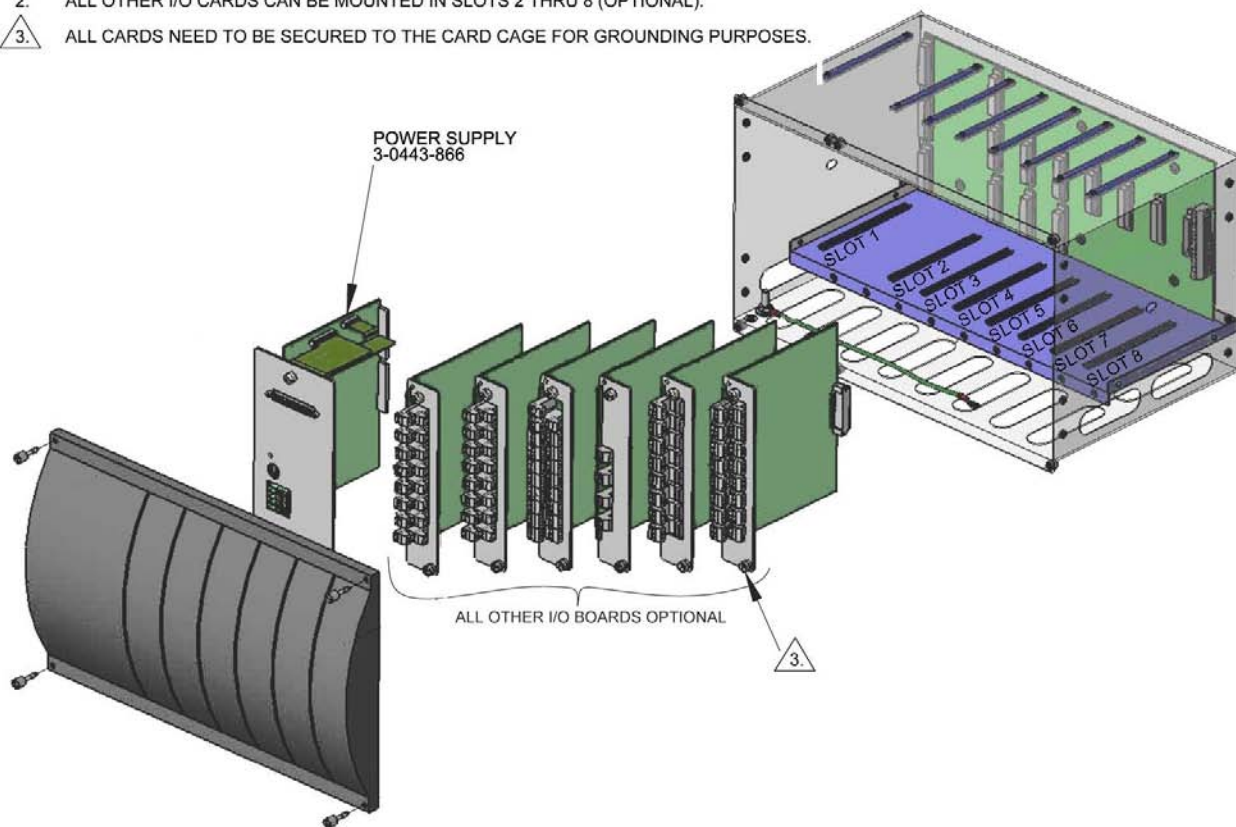


Figure 7–2. PCA locations in a standard expansion enclosure

Type 4X Enclosure

The following describes the procedure for replacing PCAs in an instrument with a Type 4X enclosure.



Warning Remove all power and ensure the area is non-hazardous before adding or removing PCAs from the system. ▲

1. Open the enclosure door.
2. Refer to [Figure 7-3](#) for a Type 4X basic enclosure or [Figure 7-4](#) for a Type 4X expansion enclosure.
 - Power supply (p/n 3-0443-866): Slot 1 in basic or expansion
 - CPU (p/n 3-0443-839): Slot 2 in basic; no CPU in expansion
 - Optional communication expansion PCA (p/n 3-0443-842): Slot 3 or 4 in basic; slot 2, 3, or 4 in expansion
 - Other optional I/O PCAs: Slots 3–8 in basic; slots 2–8 in expansion
3. Remove the old PCA by loosening the thumbscrews and gently pulling it out of its slot.
4. If you are removing the power supply, disconnect the DB37 end of the cable connector.
5. Insert the replacement assembly into the card guides and press in until it is secured to the card cage. Tighten the thumbscrews.
6. If installing the power supply, connect the DB37 end of the cable connector to it.
7. Shut the enclosure door securely.
8. Use the AutoCONFIG software to perform an I/O scan by going to Miscellaneous > 31–System Control. Select **Restart** for I/O Rescan and click Apply. The software will perform the scan and detect the board.

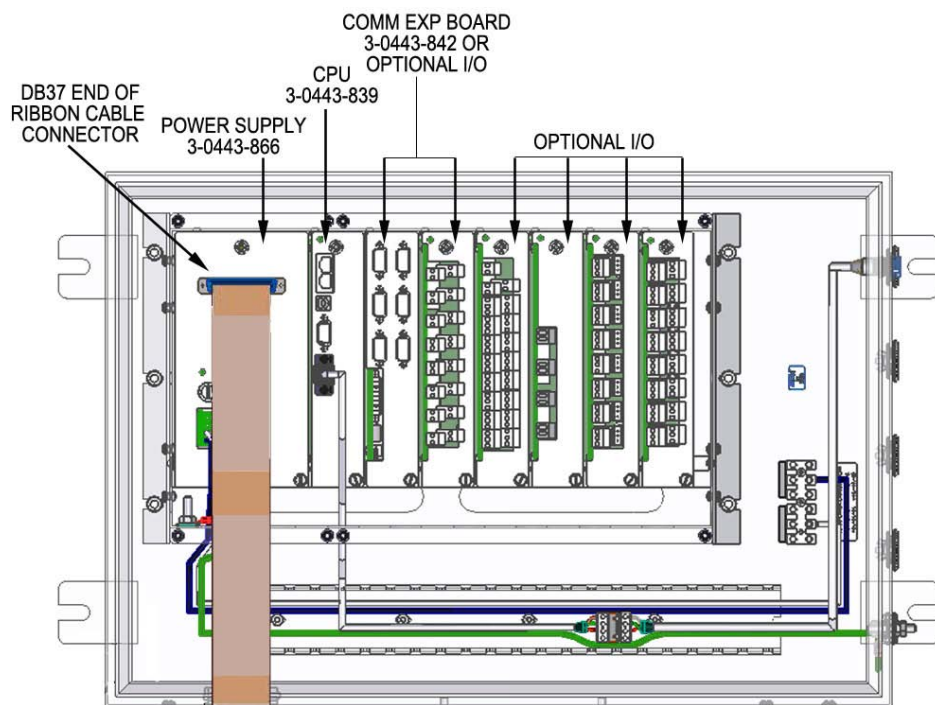


Figure 7–3. PCA locations in Type 4X basic enclosure

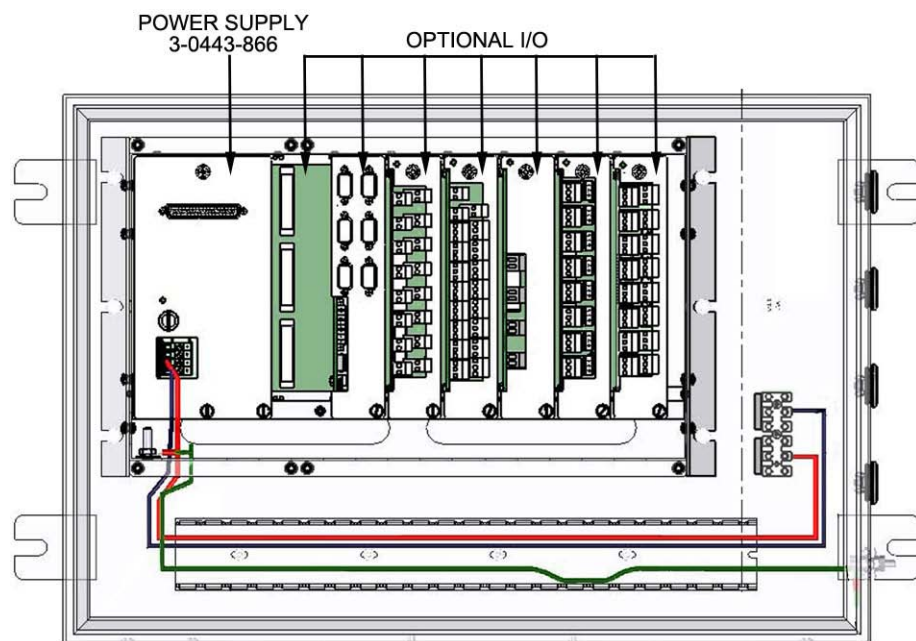


Figure 7–4. PCA locations in Type 4X expansion enclosure

Replacing the Fuse Standard Enclosure

The fuse for the power supply is accessible on the front of the power supply faceplate. To replace the fuse, you will need a flat head screwdriver.

1. Remove the left front cover (or the front cover for expansion enclosure) and locate the power supply (p/n 3-0443-866).
2. If necessary, disconnect the DB37 end of the cable connector.
3. Locate the fuse holder (see Figure 7-5 below). Insert the screwdriver into the fuse cap slot, and push the cap inward while turning counterclockwise until the holder pops out.
4. Remove the fuse. Insert the replacement; it should be one of the same rating: Fuse, 4A 5 x 20 mm, p/n 153-0566-001.
5. Press the holder in with the screwdriver and turn clockwise until it locks in place.
6. Reconnect the cable connector, if necessary.
7. Replace the cover.

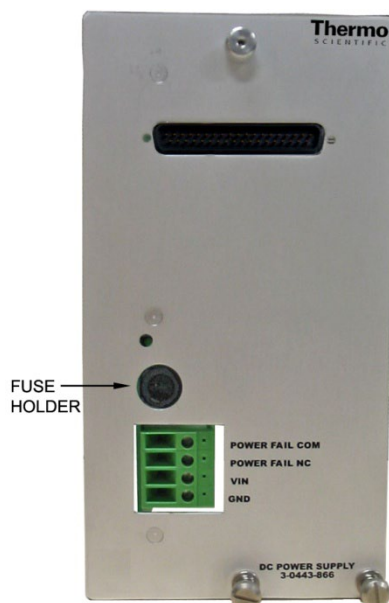


Figure 7–5. Location of fuse holder

Type 4X Enclosure

The fuse for the power supply is accessible on the front of the power supply faceplate. To replace the fuse, you will need a flat head screwdriver.

1. Open the enclosure door and locate the power supply board (p/n 3-0443-866).
2. If necessary, disconnect the DB37 end of the ribbon cable connector.
3. Locate the fuse holder (see [Figure 7-5](#)). Insert the screwdriver into the fuse cap slot, and push the cap inward while turning counterclockwise until the holder pops out.
4. Remove the fuse. Insert the replacement; it should be one of the same rating: Fuse, 4A 5 x 20 mm, p/n 153-0566-001.
5. Press the holder in with the screwdriver and turn clockwise until it locks in place.
6. Reconnect the cable connector, if necessary.
7. Shut the enclosure door securely.

Replacing the Battery Backup

A 3 V coin type Lithium battery is installed on the CPU as a backup for RTC and SRAM memory in the event of a power failure.



Warning Remove all power and ensure the area is non-hazardous prior to removing or adding a PCA to the system. ▲

Standard Enclosure

Follow the steps below to replace the Lithium battery on a CPU board in a standard enclosure.

1. Remove the right front cover and locate the CPU (p/n 3-0443-839).
2. Remove the CPU by loosening the thumbscrews and pulling it out of its slot.
3. Locate the Lithium battery (see [Figure 2-4](#)). Slide a small, flat bladed screwdriver in the slot and gently push up on the battery until it slides out from underneath the holder.
4. Insert the replacement battery (p/n 7-0131-285).
5. Slide the CPU back into its slot and secure it to the card cage.
6. Replace the right front cover.

Type 4X Enclosure

Follow the steps below to replace the Lithium battery on a CPU board in a Type 4X enclosure.

1. Open the enclosure door and locate the CPU (p/n 3-0443-839).
2. Remove the CPU by loosening the thumbscrews and pulling it out of its slot.
3. Locate the Lithium battery (see [Figure 2-4](#)). Slide a small, flat bladed screwdriver in the slot and gently push up on the battery until it slides out from underneath the holder.
4. Insert the replacement battery (p/n 7-0131-285).
5. Slide the CPU back into its slot and secure it to the card cage.
6. Shut the enclosure door securely.

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Chapter 8

Troubleshooting & Support

General Troubleshooting

This section provides troubleshooting steps to several problems.

1. **Symptom:** Power is connected but the LCD is not on and no LEDs are lit.

Possible solution: The green LED on the front panel of the power supply indicates whether the power supply is generating 12 Vdc output. If it is not on and the power supply has a fuse, check it. Measure the incoming voltage at the screws of the terminal blocks on the front panel of the power supply.

2. **Symptom:** The green LED on the power supply faceplate is lit but the LCD is blank.

Possible solution: Press **5** on the keypad and use the up and down arrows to adjust the contrast. If this does not solve the problem, check the 37-pin connector on the faceplate of the power supply to make sure it is secure. Remove any cables connected to the CPU. Press the CPU in to ensure it is well seated. To reset the CPU, remove power, let it sit for 10 seconds, then reapply power.

3. **Symptom:** The LCD on the front panel is displaying valid information but one or more of the LEDs on the I/O boards is not flashing slowly (once per second).

Possible solution: This may indicate a communication problem on the RS485 backplane. First, use the AutoCONFIG software to perform a warm restart (Tools > Warm Restart) and see if that resolves the problem. If not, ensure the load resistor on the expansion chassis farthest away from the CPU is properly installed. If there is only one expansion chassis, remove the I/O card farthest to the right and look down into the chassis at the backplane. Verify that both switches on the backplane are set to CLOSED. If you have several chassis that are daisy chained, the switches on the middle racks should be OPEN and the switches on the end chassis should be CLOSED. Also, check if a unique address is assigned to the board. You cannot assign the same address to any type of I/O card in a backplane or series of backplanes.

4. **Symptom:** The time and date have been set up in the configuration program but when the power is removed and reapplied, the time and date are displayed incorrectly.

Possible solution: The memory backup battery may be depleted. Remove the power, and remove the CPU. Slide the battery out of its holder and replace it with a new one. If the chassis is plugged in, the battery should last virtually forever. Without power applied to the CPU, the battery should be good for more than 5 years.

5. **Symptom:** The system has been set up and either the digital input board or the DE communication board does not operate properly.

Possible solution: The digital input and DE communication boards need to have a transducer that is isolated from ground. To determine if this is the problem, bring a transducer in from the field (or use a backup transducer of the same type) and connect it close to the I/O board with the transducer lying on some insulating material (like newspaper).

6. **Symptom:** The system is working but one channel (or more) is noisy.

Possible solution: For differential signals like RS485 and isolated signals like the digital input board and DE communication, it is best to use twisted pair cabling. If noise is still present, use a shielded twisted pair cable and ground the shield on one end. Experiment to determine which end works the best, but do not ground both ends. The ground should be an earth ground like a metal water pipe or ground rod. If steel conduit is available, routing the signals through it may help, but do not route the signal cables close to any power cables. Grounded conduit is also good for reducing the effects that electrical storms may have on a unit's operation.

Contact Information

If you have completed the troubleshooting steps in the previous section and the unit still is not performing satisfactorily, the local representative is your first contact for support and is well equipped to answer questions and provide application assistance. You can also contact Thermo Fisher directly at any of the locations below.

1410 Gillingham Lane Sugar Land, TX 77478 USA +1 (800) 437-7979 +1 (713) 272-0404 direct +1 (713) 4573 fax	14 Gormley Industrial Avenue Gormley, Ontario L0H 1G0 CANADA +1 (905) 888-8808 +1 (905) 888-8828 fax	Unit 702-715, 7/F Tower West Yonghe Plaza No. 28 Andingmen East Street, Beijing 100007 CHINA +86 (10) 8419-3588 +86 (10) 8419-3580 fax
A-101, 1CC Trade Tower Senapati Bapat Road Pune 411 016 Maharashtra, INDIA +91 (20) 6626 7000 +91 (20) 6626 7001 fax	Ion Path, Road Three Winsford, Cheshire CW7 3GA UNITED KINGDOM +44 (0) 1606 548700 +44 (0) 1606 548711 fax	
www.thermoscientific.com		

For returns, contact Thermo Fisher for specific instructions.

Warranty

Thermo Scientific products are warranted to be free from defects in material and workmanship at the time of shipment and for one year thereafter. Any claimed defects in Thermo Scientific products must be reported within the warranty period. Thermo Fisher Scientific shall have the right to inspect such products at Buyer's plant or to require Buyer to return such products to Thermo Fisher plant.

In the event Thermo Fisher requests return of its products, Buyer shall ship with transportation charges paid by the Buyer to Thermo Fisher plant. Shipment of repaired or replacement goods from Thermo Fisher plant shall be F.O.B. Thermo Fisher plant. A quotation of proposed work will be sent to the customer. Thermo Fisher shall be liable only to replace or repair, at its option, free of charge, products which are found by Thermo Fisher to be defective in material or workmanship, and which are reported to Thermo Fisher within the warranty period as provided above. This right to replacement shall be Buyer's exclusive remedy against Thermo Fisher.

Thermo Fisher shall not be liable for labor charges or other losses or damages of any kind or description, including but not limited to, incidental, special or consequential damages caused by defective products. This warranty shall be void if recommendations provided by Thermo Fisher or its Sales Representatives are not followed concerning methods of operation, usage and storage or exposure to harsh conditions.

Materials and/or products furnished to Thermo Fisher by other suppliers shall carry no warranty except such suppliers' warranties as to materials and workmanship. Thermo Fisher disclaims all warranties, expressed or implied, with respect to such products.

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Appendix A

Parts Lists

Replacement Part Numbers

Table A–1. Power

Part Number	Description
3-0443-866	PCA, DC power supply
153-0566-001	Fuse, 4A 5x20mm

Table A–2. CPU

Part Number	Description
3-0443-839	AutoEXEC CPU
7-0131-285	Lithium battery backup
10436-3013	Jumper, Mini Test

Kits

Table A–3. Type 4X ATEX PCA options

P/N	Description
3-0443-842	Kit, communication expansion board
3-0443-851	Kit, digital output board
3-0443-854	Kit, analog input board
3-0443-857	Kit, digital input board
3-0443-863	Kit, analog output board
3-0443-869	Kit, Honeywell DE communication board
3-0443-872	Kit, pulse input board
3-0443-921	Kit, liquid flow board
8-0443-1025	Kit, AutoMITTER Safety Interface, ATEX and Brazilian certified version

Table A–4. Type 4X UL & cUL additional options¹

P/N	Description
3-0443-999-01	Kit, 212A/202 modem ready
3-0443-1001-01	Kit, MDS XX10 radio ready
3-0443-1004-01	Kit, AutoWAVE radio ready
8-0443-1024	Kit, AutoMITTER Safety Interface, CSA version
Consult Thermo Fisher	Kit, AutoMITTER

¹All kits listed in Table A–4 except 8-0443-1025 also available for this configuration.

Table A–5. Standard enclosure PCA options

P/N	Description
3-0443-842	Kit, communication expansion board
3-0443-851	Kit, digital output board
3-0443-854	Kit, analog input board
3-0443-857	Kit, digital input board
3-0443-860	Kit, prover board
3-0443-863	Kit, analog output board
3-0443-869	Kit, Honeywell DE communication board
3-0443-872	Kit, pulse input board
3-0443-921	Kit, liquid flow board

Appendix B

Specifications

Results may vary under different operating conditions.

Table B–1. General Specifications

Processor	32-bit Freescale™ ColdFire®, operates at 200 MHz, processes at 300 million instructions per second (MIPS)
Memory	Program operation: 32 MB Program memory: 16 MB Flash Data storage: 2 MB battery backed RAM plus 4 MB non-volatile serial Flash
Communication Ports	CPU: Two RS232, two Ethernet, one “device” type USB Optional communication expansion board: Six RS232, two RS485, one USB Host, one USB OTG
Power	Input power: 9–30 Vdc Output power: 12 Vdc on analog input board
Security	Valid user ID and password necessary for access. Four levels of security: <ul style="list-style-type: none"> - Supervisor: The highest security access level. Allows for access to calibration data and modification of all configuration parameters, including passwords. - Technician: Second highest level of security access. Identical to Supervisor, except cannot modify passwords. - Control: Can access tables pertaining to control functions only, PID for example. - Measurement: Can access tables pertaining to measurement functions only, DP flow calculation for example.
Historical Data Storage	65 days of daily, 35 days of hourly
Audit Trails	200 alarm events, 100 different types of alarms
Alarm Log Storage	200 alarm events, 23 different types of alarms
Dimensions: Standard Enclosure	Cover, W x H: 17.25” x 10.50” (438.15 x 266.70 mm) Card Cage, W x H x D: 17.00” x 9.50” x 10.68” (431.80 x 241.30 x 271.27 mm) Overall, W x H x D: 17.25” x 9.50” x 12.57” (438.15 x 266.70 x 319.18 mm)
Dimensions: Type 4X Enclosure	Overall, W x H x D: 17.00” x 28.00” x 16.16” in (431.80 x 711.20 x 410.44 mm)

Specifications

Keypad	4 x 4 (16-key) input, metal keypad button, calculator configuration
Display	4-line x 16-character LCD

Table B–2. Environmental Specifications

Operating Temperature	-40°C to +85°C (-40°F to +185°F)
Operating Humidity	0%–95% RH, non-condensing
Approvals	CSA C/US Listed for use in Class I, Div. 2, Groups C & D, T4 hazardous locations CE – EMC CE – ATEX [EPSILON 07 ATEX 2143] II 3 G Ex nA nL IIB T4 Brazil (INMETRO) – Ex nA nL IIB T4 Gc IP65
Enclosure Rating	IP65 for optional Type 4X industrial control enclosure in aluminum or stainless steel

Table B–3. Natural Gas Calculations

Supercompressibility (Fpv)	AGA 8 Gross-1992, AGA 8 Detail-1992, AGA 8 Short-1985, NX-19, NX-19 Analysis, GERG
Differential Meters (DP, Orifice)	AGA 3/ASTM 2530–1992, AGA 3–1985, GOST, V-Cone, Annubar, Slotted-DP
Linear Meters (Turbine)	AGA 7, AGA 9
Energy	AGA 5
Diagnostic	AGA 10-SOS
Additional Factors/Equations	Fwv (manual), Fwv (partial), Fwv (full), Fws
Turbine Meter Linearization	10-Point Frq/K-Factor Table

Table B–4. Liquid Calculations

API Tables	Table A (generalized crude oils); Table B (generalized products); Table C (thermal expansion properties); Old Table (NGL, LPG SG range .425 to .650); Table 23/24 E (NGL, LPG); VCF (CH 11.1 2004); propylene (CH 11.3.3.2); ethylene (API 2565/CH 11.3.2.1); ethylene (NBS 1045)
Volume Correction Factor (VCF)	Consistent with API 2540/ASTM D1250-80/IP 200; 5/6 A/B; 23/24 A/B; 53/54 A/B; 6/24/54 C; CH 11.1 2004; Note: natural gas liquids (NGL) and liquefied petroleum gases (LPG): OLD 23/24, OLD 53/54; Table E is new standard to replace Old 23/24.
CPL	Ch 11.2.1/Ch 11.2.2; Ch 11.2.1M/Ch 11.2.2M (compressibility factors for hydrocarbons), equilibrium pressure
Propylene Density Calculation	API Ch 11.3.3.2
Ethylene Density Calculation	API 2565 (Ch 11.3.2.1); ethylene NBS 1045
Live Density Input	Sarasota, Solartron, UGC, 4-20 mA

Table B–5. Configurations & Options

IP65 – ATEX (Europe)	I/O expansion chassis: Up to 7 expansion chassis can be daisy chained, allowing for installation of 49 additional I/O boards (7 I/O boards per expansion chassis). See Kits in Appendix A for kit part numbers and descriptions.
IP65 – Brazil	I/O expansion chassis: Up to 7 expansion chassis can be daisy chained, allowing for installation of 49 additional I/O boards (7 I/O boards per expansion chassis). See Kits in Appendix A for kit part numbers and descriptions.
Type 4X – CSA C/US (North America)	I/O expansion chassis: Up to 7 expansion chassis can be daisy chained, allowing for installation of 49 additional I/O boards (7 I/O boards per expansion chassis). Additional options are available. See Kits in Appendix A for kit part numbers and descriptions.
Standard enclosure	I/O expansion: Up to 7 expansion chassis can be daisy chained, allowing for installation of 49 additional I/O boards (7 I/O boards per expansion chassis). See Kits in Appendix A for kit part numbers and descriptions.

Table B–6. Optional I/O

Analog Input Board	<p>16 inputs with 14-bit resolution, 0–5 V.</p> <p>Current input 4–20 mA can be converted to voltage input by an external 250-ohm resistor.</p> <p>Full scale $\pm 0.1\%$ over operating temperature range.</p> <p>Acceptable overrange $\pm 10\%$ as -0.5 to 5.5 V, overvoltage protection up to +24 V.</p> <p>Power output: 12 V/160 mA and 24 V/100 mA.</p> <p>1500-volt isolation.</p> <p>Inputs protected against 6000 volt/3000 amp transients.</p>
Analog Output Board	<p>Provides four 4–20 mA current loop outputs.</p> <p>Features 12-bit resolution onboard auto-calibration circuit.</p> <p>Accuracy:</p> <ul style="list-style-type: none"> 0.1% of full scale at 25°C 0.3% typical from -40°C to +85°C <p>Inputs protected against 6000 volt/3000 amp transients.</p>
AutoMITTER Safety Interface Board (SIB)	<p>Provides an optional connection for up to four remote mounted Thermo Scientific AutoMITTER / AutoMITTER PRO transmitters.</p> <p>Each transmitter provides temperature, differential pressure, and static pressure measurements.</p>
Combo Board	<p>Combination board with:</p> <ul style="list-style-type: none"> - Four analog inputs, 0–5 V/4–20 mA with external 250-ohm resistor. - One analog 4–20 mA analog output. - Four digital inputs rated for 0–12 V. - Four digital outputs, opto-coupled solid state switches rated for 50 V at 2 A. - Four pulse inputs rated for 0–5 V. <p>Inputs protected against 6000 volt/3000 amp transients.</p>
Communication Expansion Board	<p>Adds six RS232 compatible serial ports, two RS485 full duplex ports, and two USB ports (one host, one on-the-go).</p>
DE Communication Board	<p>Each board supports 8 Honeywell transducers using DE protocol. The transducer operates in the digital mode as a current loop. DE Comm programs translate the data and process it the same way the analog input board processes data.</p> <p>Inputs protected against 6000 volt/3000 amp transients.</p>
Digital Input Board	<p>Provides the field interface for 16 digital (off/on) inputs.</p> <p>Pull-up resistor provides wetting current for dry contact inputs.</p> <p>Inputs can range from 0–5 to 0–12 V.</p> <p>Inputs protected against 6000 volt/3000 amp transients.</p>
Digital Output Board	<p>Provides 16 isolated, dry, normally open and normally closed contacts (from each of 16 magnetically latched, sealed relays).</p> <p>Inputs protected against 6000 volt/3000 amp transients.</p>

Liquid Combo Board	<p>Combination board with:</p> <ul style="list-style-type: none"> - Four 24V outputs, maximum 40 mA/CH, total 120 mA from -20°C to +70°C. - Four analog inputs, current 4–20 mA/voltage 0–5 V inputs by onboard jumper selection with accuracy $\pm 0.1\%$ or 5 mV. - Two analog outputs, 4–20 mA, 0.1% of full scale at 25°C. - Two digital inputs, optional 12 V pull-up for contact closure input. - Two digital outputs, solid state relays 1 A, externally powered. - Four pulse/density inputs, current 4–20 mA or differential voltage 0–5 V pulse up to 10 kHz by onboard jumper selection. Optional 5 V pull-up for open-collector input. Accumulator and density information provided, density frequency accuracy 0.01 Hz. Prover function supported with prover board (p/n 3-0443-860). Dual pulse security supported. - Two RTD inputs with 3-wire or 4-wire configuration and process temperature range of -200°C to +200°C. - Four pulse/density inputs, current pulse or differential voltage pulse selectable by onboard jumpers. <p>Surge protection up to 6000 volt/3000 amp transients.</p>
Liquid Flow Board	<p>Accepts six pulse/frequency inputs from magnetic inputs, contact closures, or slot sensors. Normally, turbines will be the input sensors.</p> <p>Provides accumulator and density information.</p> <p>Can be used with prover board to provide proving function.</p> <p>Frequency range: 10 Hz–10 kHz; signals <10 Hz also supported with slower density update rate.</p> <p>Accuracy: 0.01 Hz or 0.00001%, over temperature range of -40°C to +185°C.</p> <p>Inputs protected against 6000 volt/3000 amp transients.</p>
Pulse Input Board	<p>Can process four pulse count inputs, normally from turbine type meters. A variety of dry contact and magnetic inputs are supported.</p> <p>Inputs protected against 6000 volt/3000 amp transients.</p>
Prover Board	<p>Used in conjunction with liquid flow boards to provide proving function. The start and stop switches for a proving run are connected to this board.</p> <p>Inputs protected against 6000 volt/3000 amp transients.</p>

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Appendix C

AutoMITTER SIB Installation for CSA Certified Systems

Part Identification

This section provides an overview of the components in the CSA certified version of the AutoMITTER safety interface (SI) system.

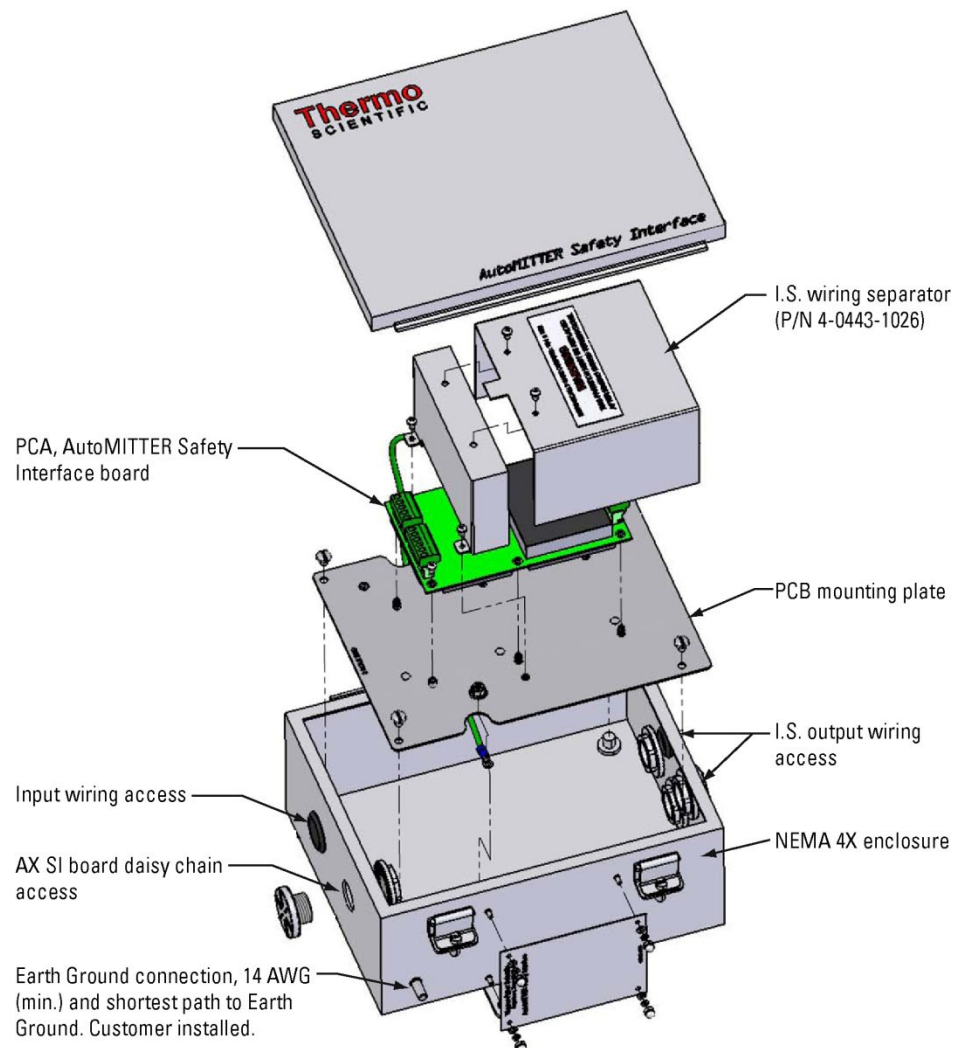


Figure C–1. Exploded view of AutoMITTER SI system, CSA

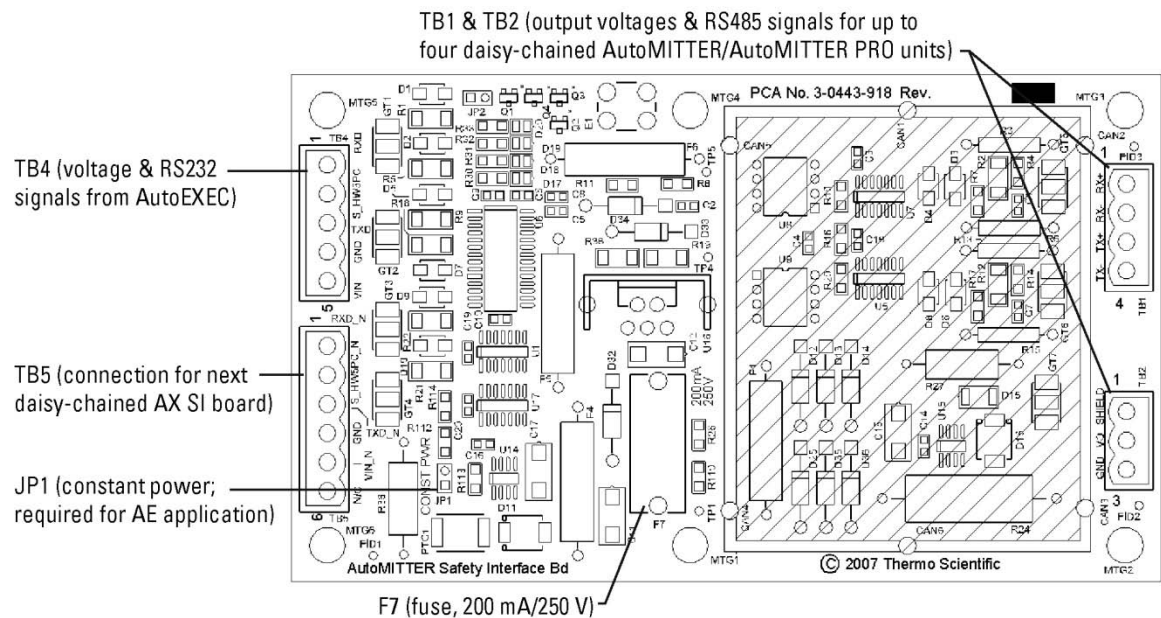


Figure C–2. AutoMITTER safety interface board (SIB), CSA (p/n 3-0443-918)

Mounting Reference the following figure for mounting instructions. Use kit p/n 3-0459-107.

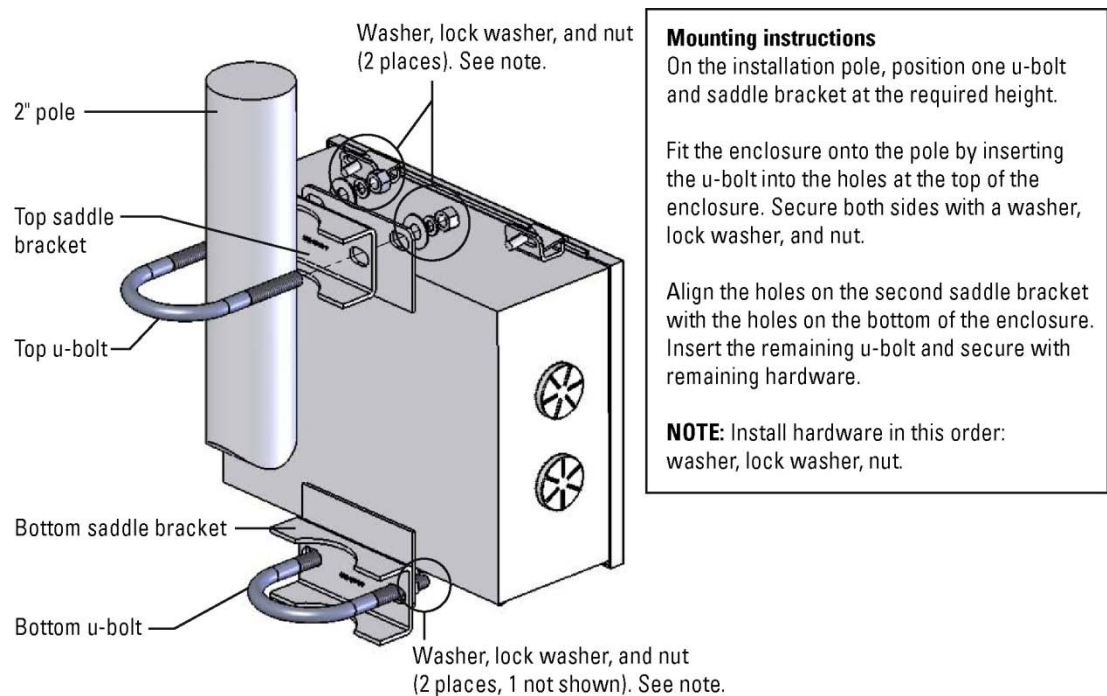


Figure C–3. Mounting the enclosure, CSA

Wiring

The CSA certified version of the AutoMITTER SI system has the following ratings:

- Electrical: 12 Vdc nominal at 250 mA maximum
- CSA Enclosure Type 4X
- Class I, Div. 2, Groups C & D; hazardous area
- Temperature Code T4 (135°C)
- Ambient temperature range: -40°C to +85°C

The AutoMITTER SI system may accept the following connections:

- Power source from flow computer, 12 Vdc nominal at 5 A maximum.
- RS232 signal from flow computer.
- Up to four AutoMITTER SI units, with each supporting up to four AutoMITTER / AutoMITTER PRO transmitters.
- One Honeywell Smart Multivariable transducer for each AutoMITTER / AutoMITTER PRO transmitter. Transducer option can be from the SMV3000 or SMV2000 series. Maximum pressure rating for selected transducer model is 4500 psi.

Preparation

Read the following warnings before making any connections.



Warning Do not install the system in any hazardous area, except in those for which the system has been approved. ▲



Warning Do not make any connections unless the area is known to be non-hazardous. Once connections are made, do not disconnect unless power has been removed and the area is known to be non-hazardous. ▲



Warning Do not connect power to TB4 until all other connections are made. ▲



Warning Substitution of components may impair suitability for Class I, Div. 2. ▲



Warning Use wires suitable for at least 90°C. ▲



Warning Service connections can only be used in safe atmospheres. ▲

When you are ready to begin, ensure the area is non-hazardous, and note the following:

- Access the I.S. output terminals on the AutoMITTER SIB by removing the wiring separator (shown in [Figure C-1](#)).
- All wiring to the AutoMITTER SIB is 18 AWG or less, except for the Earth Ground, which is 14 AWG (min.) and is customer provided.

Refer to the wiring diagrams below.

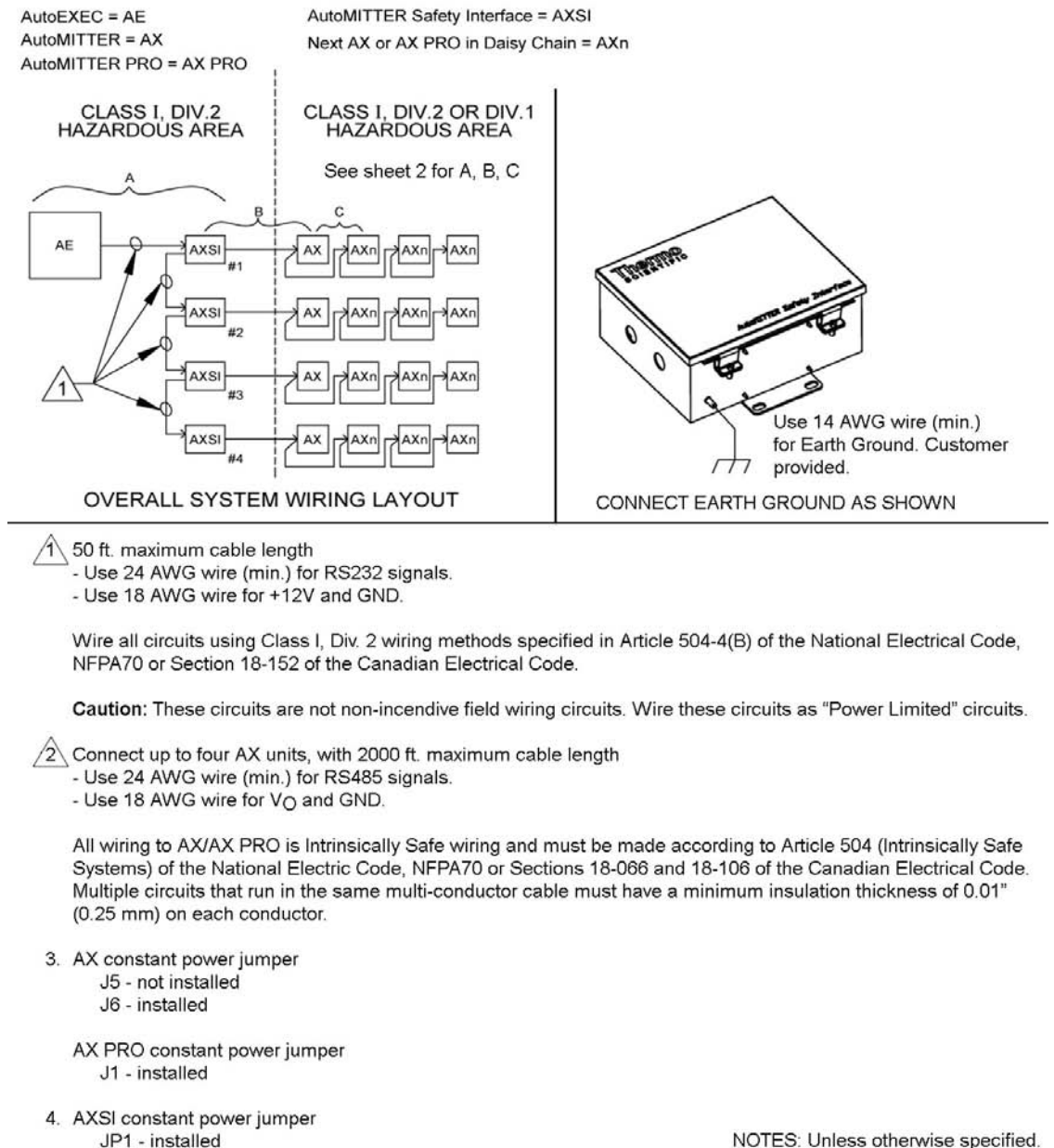


Figure C-4. AutoMITTER SI system wiring diagram, CSA (sheet 1 of 2)

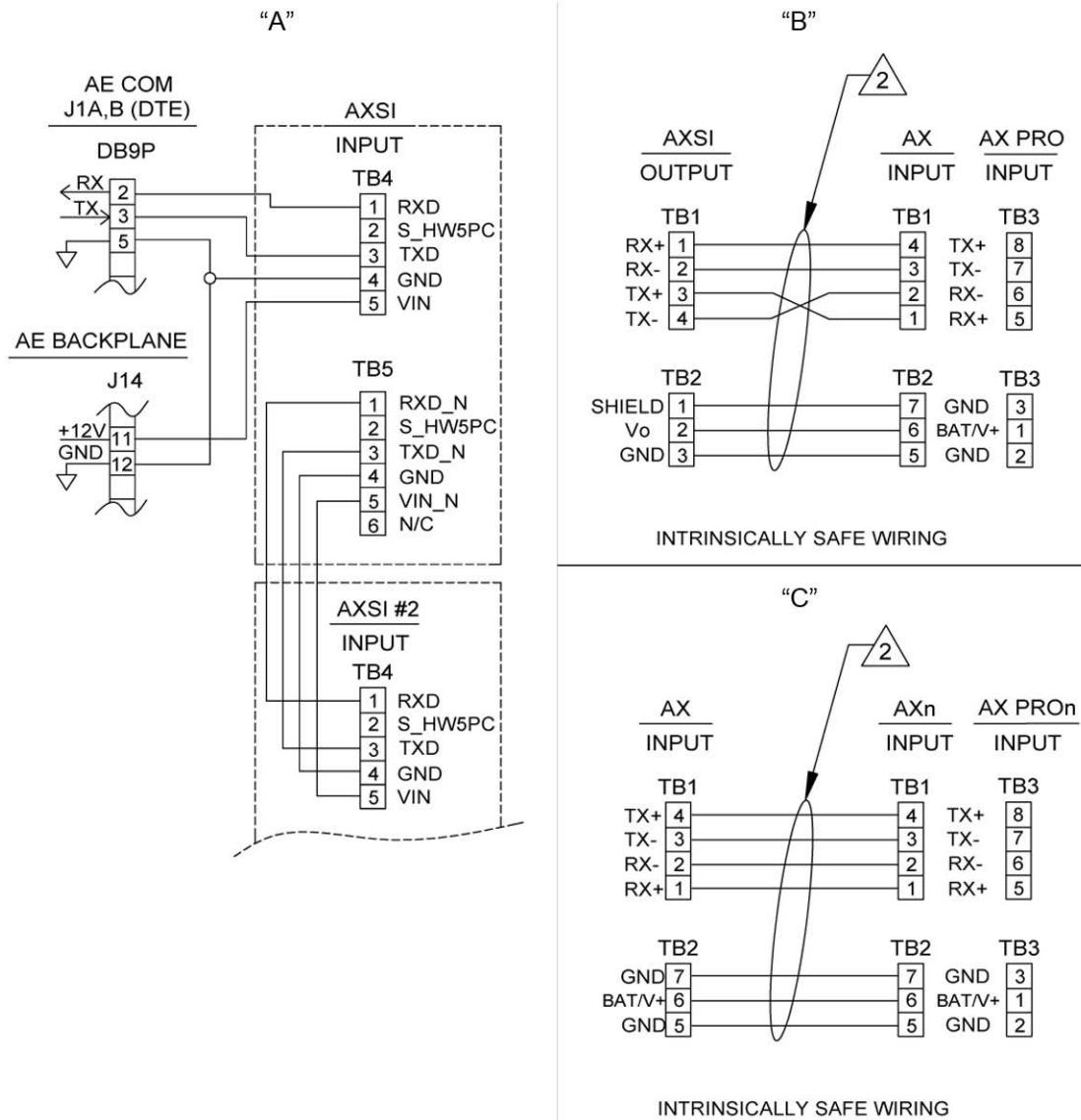


Figure C-5. AutoMITTER SI system wiring diagram, CSA (sheet 2 of 2)

Jumper Settings

JP1 (shown in [Figure C-2](#)) must be installed for AutoEXEC flow computer applications.

Replacing the Fuse



The fuse (p/n 5-0470-056, see [Figure C-2](#)) is rated for 200 mA/250 V.

Warning Ensure the area is safe or non-hazardous. ▲

1. Remove power from the PCA by disconnecting connector TB4.
2. Pull the fuse cover straight up.
3. The fuse cartridge is latched to the cover. Replace the cartridge.
4. Replace the fuse cover.

Replacement Part Numbers

Table C-1.

P/N	Description
5-0470-056	Fuse, 200 mA/250 V
4-0443-1026	Wiring separator
6-9617-020	Type 4X hole plug

Appendix D

AutoMITTER SIB Installation for ATEX and Brazilian Certified Systems

Hazardous Area Installations

The following instructions are specific to AutoMITTER safety interface systems (SI) installed in hazardous areas. For European installations, reference European ATEX Directive 94/9/EC, Annex II, 1.0.6. For Brazilian installations, reference Inmetro Administrative Rule no. 179 (May 18, 2010)).

Note The material in this appendix applies to European and Brazilian hazardous area installations. ▲

1. The equipment is rated for Zone 0 with intrinsically safe outputs to the AutoMITTER PRO transmitter and may be only used with flammable gases and vapors with apparatus Group IIB and with temperature class T4.
2. The equipment is only certified for use in ambient temperatures in the range -40°C to +80°C. It should not be used outside this range.
3. The certificate marking is detailed in [Figure D-1](#) for Europe and [Figure D-2](#) for Brazil.
4. Repair of this equipment shall be carried out by the manufacturer or in accordance with the applicable code of practice.
5. The certification of this equipment relies on the following materials used in its construction:

Stainless steel.

If the equipment is likely to come into contact with aggressive substances, then it is the responsibility of the user to take suitable precautions that prevent it from being adversely affected, thus ensuring that the type of protection is not compromised.

Aggressive substances: e.g. solvents that may affect polymeric materials

Suitable precautions: e.g. regular checks as part of routine inspections or establishing from the material's data sheet that it is resistant to specific chemicals.

6. Earth bonding: The enclosure must be earth bonded back to the source of the power supply using a 4 mm² cross-sectional area conductor using the earth lug provided on the enclosure.



Figure D–1. AutoMITTER SI certificate marking for European installations



Figure D–2. AutoMITTER SI certificate marking for Brazilian installations

Part Identification

This section provides an overview of the components in the ATEX and Brazilian certified version of an AutoMITTER SI system.

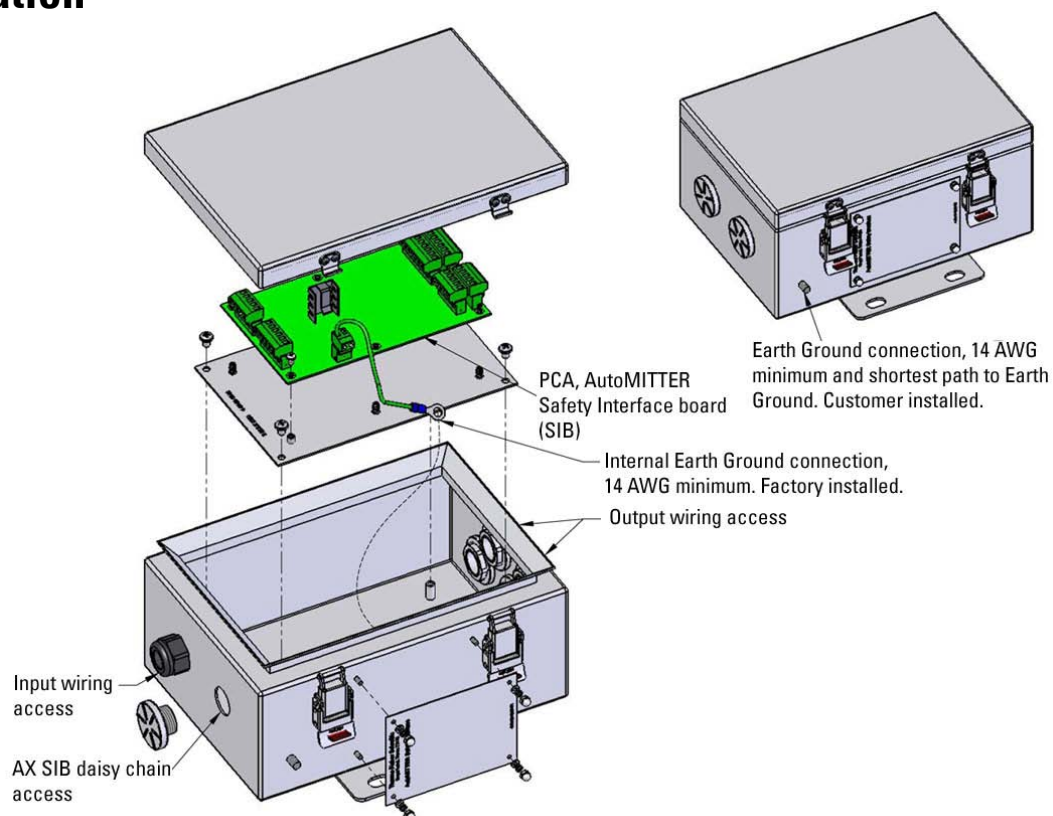


Figure D-3. Exploded view of AutoMITTER SI system, ATEX/Brazilian installations

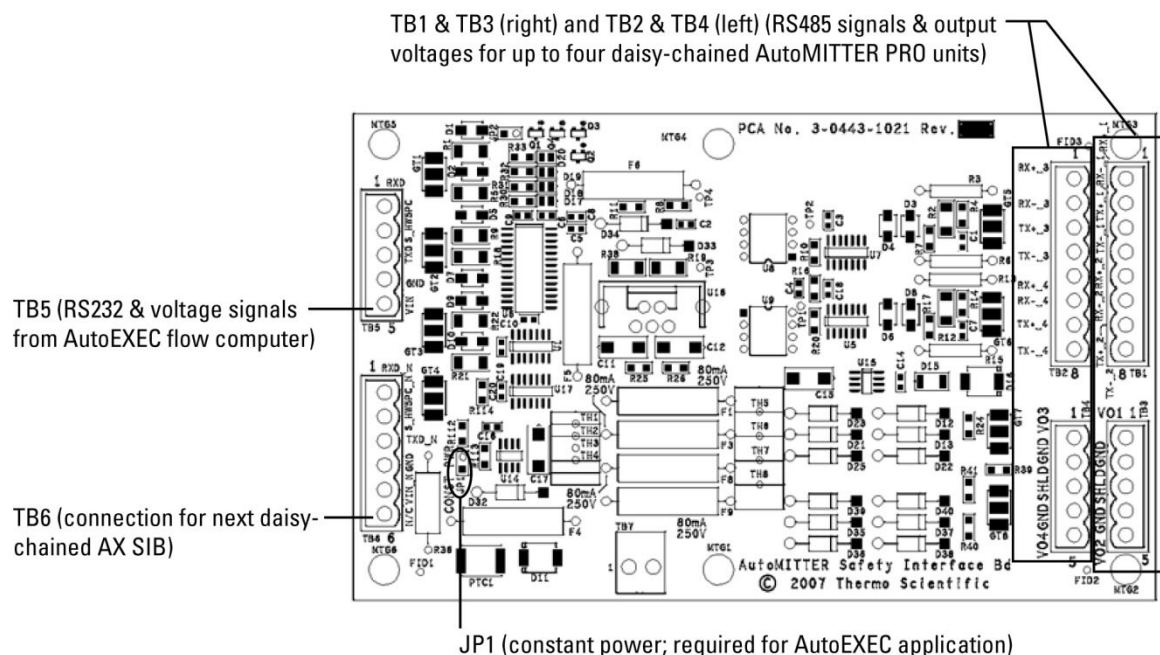
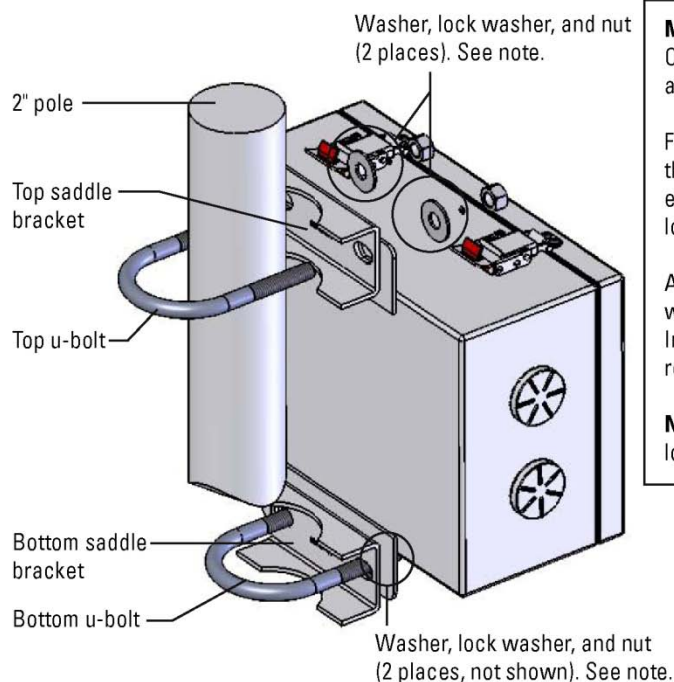


Figure D-4. AutoMITTER safety interface board (SIB), ATEX/Brazilian installations (p/n 3-0443-1021)

Mounting

Reference the following figure for mounting instructions. Use kit p/n 3-0459-107.



Mounting instructions

On the installation pole, position one u-bolt and saddle bracket at the required height.

Fit the enclosure onto the pole by inserting the u-bolt into the holes at the top of the enclosure. Secure both sides with a washer, lock washer, and nut.

Align the holes on the second saddle bracket with the holes on the bottom of the enclosure. Insert the remaining u-bolt and secure with remaining hardware.

NOTE: Install hardware in this order: washer, lock washer, nut.

Figure D-5. Mounting the enclosure, ATEX/Brazilian installations

Wiring

The ATEX and Brazilian certified version of the AutoMITTER SI system has the following ratings:

- Electrical: 12 Vdc nominal at 250 mA maximum
- Enclosure type: IP65
- Zone 0, Group IIB
- Temperature Code T4 (135°C)
- Ambient temperature range: -40°C to +80°C

The AutoMITTER SI system may accept the following connections:

- Power source from flow computer, 12 Vdc nominal.
- RS232 signal from flow computer.
- Up to four AutoMITTER SI units, with each supporting up to four AutoMITTER PRO transmitters.
- One Honeywell Smart Multivariable transducer for each AutoMITTER PRO transmitter. Transducer option can be from the SMV3000 or SMV2000 series. Maximum pressure rating for selected transducer model is 4500 psi.

Cable entries into the enclosure may be sealed with an IP65 rated conduit seal certified by an ATEX/Brazilian notified body used in accordance with the manufacturer's instructions.

Preparation

Read the following warnings before making any connections.



Warning Do not install the system in any hazardous area, except in those for which the system has been approved. ▲



Warning Do not make any connections unless power has been removed and the area is known to be non-hazardous. Once connections are made, do not disconnect unless power has been removed and the area is known to be non-hazardous. ▲



Warning Substitution of components may impair the intrinsic safety of the product. ▲

When you are ready to begin, ensure the area is non-hazardous before making any connections and note the following:

- All wiring to the AutoMITTER SIB is 18 AWG or less, except for the Earth Ground, which is 14 AWG (min.) and is customer provided.
- I.S. parameters for each separate channel from TB3 and TB4:

$$U_o = 7.14 \text{ V}$$

$$I_o = 2.404 \text{ A transient}$$

$$P_o = 0.92 \text{ W}$$

$$I_o = 136 \text{ mA continuous}$$

$$C_i = 0$$

$$L_i = 0$$

$$C_o = 240 \text{ } \mu\text{F}$$

$$L_o = 24.6 \text{ } \mu\text{H}$$

$$L_o/R_o = 33 \text{ } \mu\text{H/ohm}$$

Wiring diagrams are provided on the following pages.

AutoMITTER Safety Interface = AXSI

Next AXP in parallel = AXP_n

OVERALL SYSTEM WIRING LAYOUT

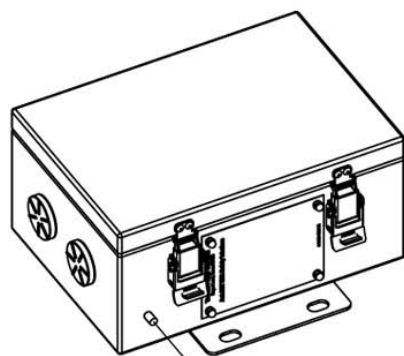


Figure D–6. AutoMITTER SI system wiring diagram, ATEX/Brazilian installations (sheet 1 of 2)

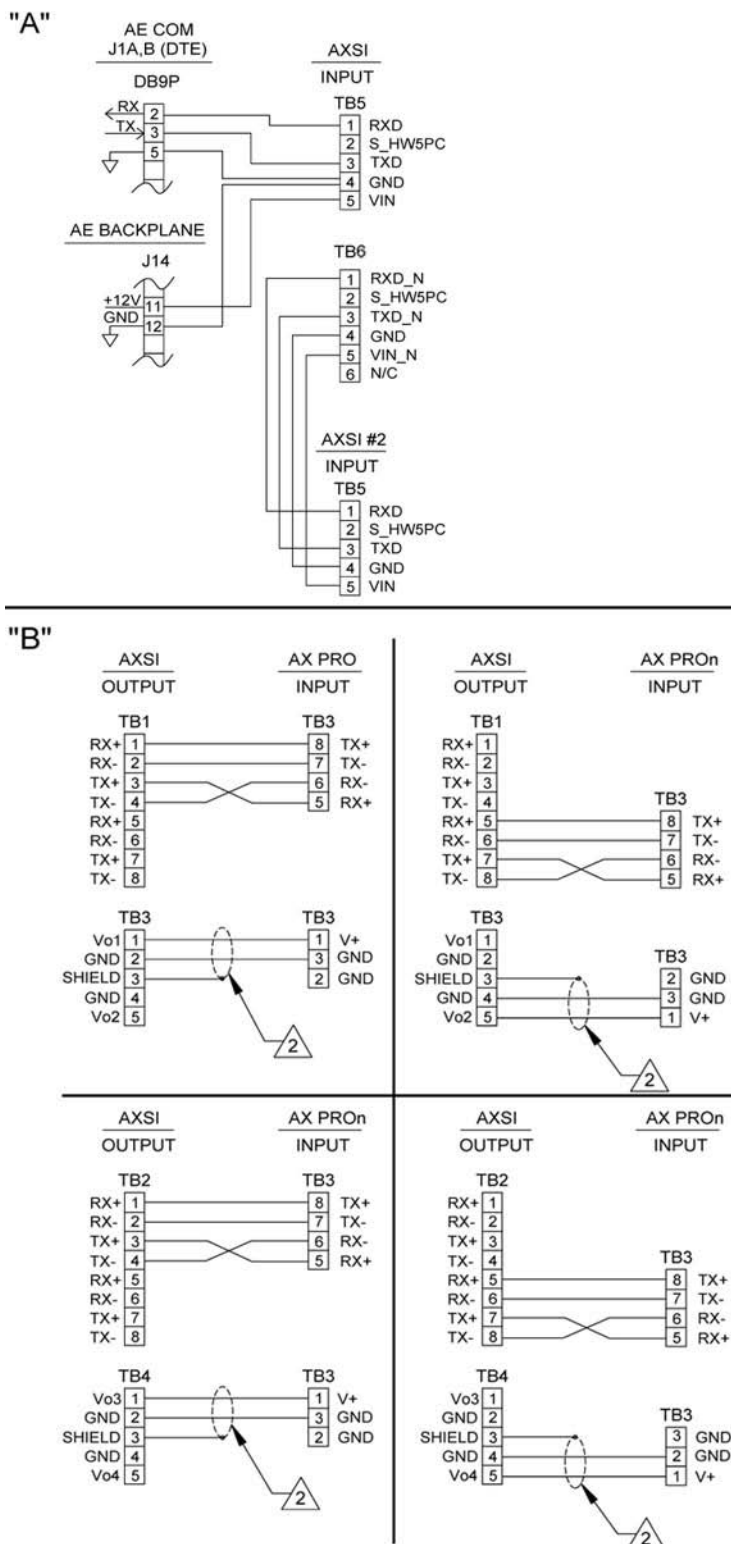


Figure D-7. AutoMITTER SI system wiring diagram, ATEX/Brazilian installations (sheet 2 of 2)

Jumper Settings

JP1 (shown in [Figure D-4](#)) must be installed for AutoEXEC flow computer applications.

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Appendix E

Wiring Quick Start

Note Information presented in this chapter has been regenerated from original drawings. Every effort is made to maintain document accuracy. However, in order to enhance legibility, the documents may have been restructured, and some information may have been intentionally excluded. Therefore, the drawings within this guide may not be exact duplicates of the original drawings. ▲

Note Drawings in this manual are included for reference only and may not be the current version. Contact the factory if you need a copy of the latest revision. ▲

Table E–1. Enclosure dimensional and mounting drawings

Drawing #	Rev.	Description	Page
--	--	Dimensional drawing: Standard enclosure (wall, panel, and rack mount configurations)	E-4
--	--	Dimensional drawing: Type 4X enclosure (pole mount configuration)	E-5
3-0443-939-01	A	Wall mount configuration	E-6
3-0443-939-02	A	Rack mount configuration	E-7
3-0443-939-03	A	Panel mount configuration	E-8
3-0443-995	B	Pole mount configuration	E-9

Table E–2. PCA locations

Drawing #	Rev.	Description	Page
0-0443-965	C	PCA locations in standard enclosure (basic chassis)	E-10
0-0443-966	C	PCA locations in standard expansion enclosure	E-11
0-0443-967	E	PCA locations in Type 4X enclosure	E-12
0-0443-968	E	PCA locations in Type 4X expansion enclosure	E-13

Table E–3. Wiring diagrams

Drawing #	Rev.	Description	Page
0-0443-967	E	Wiring diagram for Type 4X enclosure	E-13
0-0443-968	E	Wiring diagram for Type 4X expansion enclosure	E-14

Table E–4. Power supply and CPU

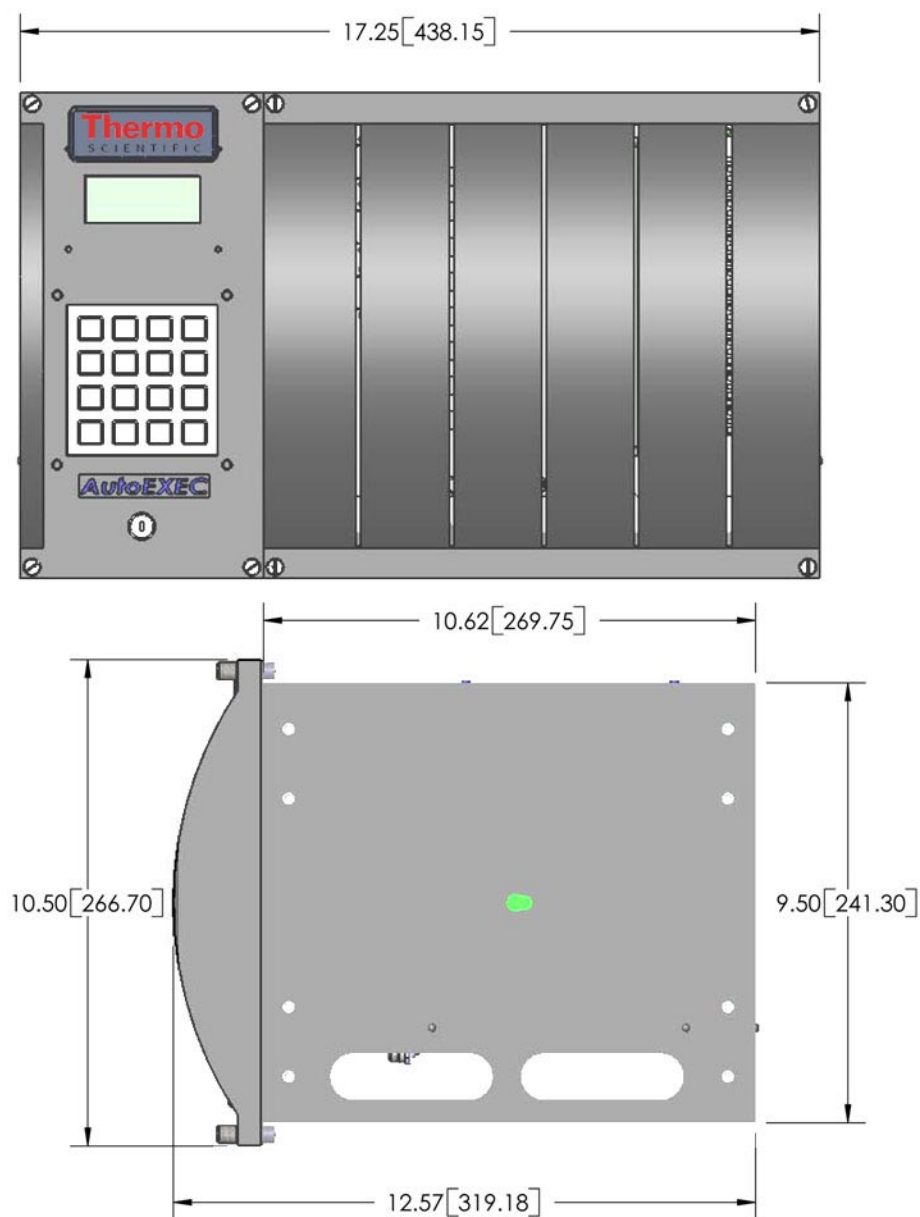
Drawing #	Rev.	Description	Page
3-0443-866	B	Power supply connections	E-15
4-0443-839	F	CPU connections and jumper settings	E-15

Table E–5. Optional I/O & connections

Drawing #	Rev.	Description	Page
3-0443-854	C	Analog input board	E-16
--	-	Analog input field wiring diagram	E-16
3-0443-863	A	Analog output board	E-17
3-0443-842	J	Communication expansion board	E-18
3-0443-1017	A	Combo board	E-19
--	-	Combo board connections	E-20
3-0443-869	D	DE communication board	E-21
3-0443-857	B	Digital input board	E-21
3-0443-851	D	Digital output board	E-22
3-0443-1051		Liquid combo board	E-22
--	-	Liquid combo board connections	E-23
3-0443-921	B	Liquid flow board	E-24
--	-	Pulse input field wiring for liquid flow board	E-24
3-0443-860	E	Prover board	E-25
3-0443-872	B	Pulse input board	E-26
--	-	Field wiring for pulse input board	E-26

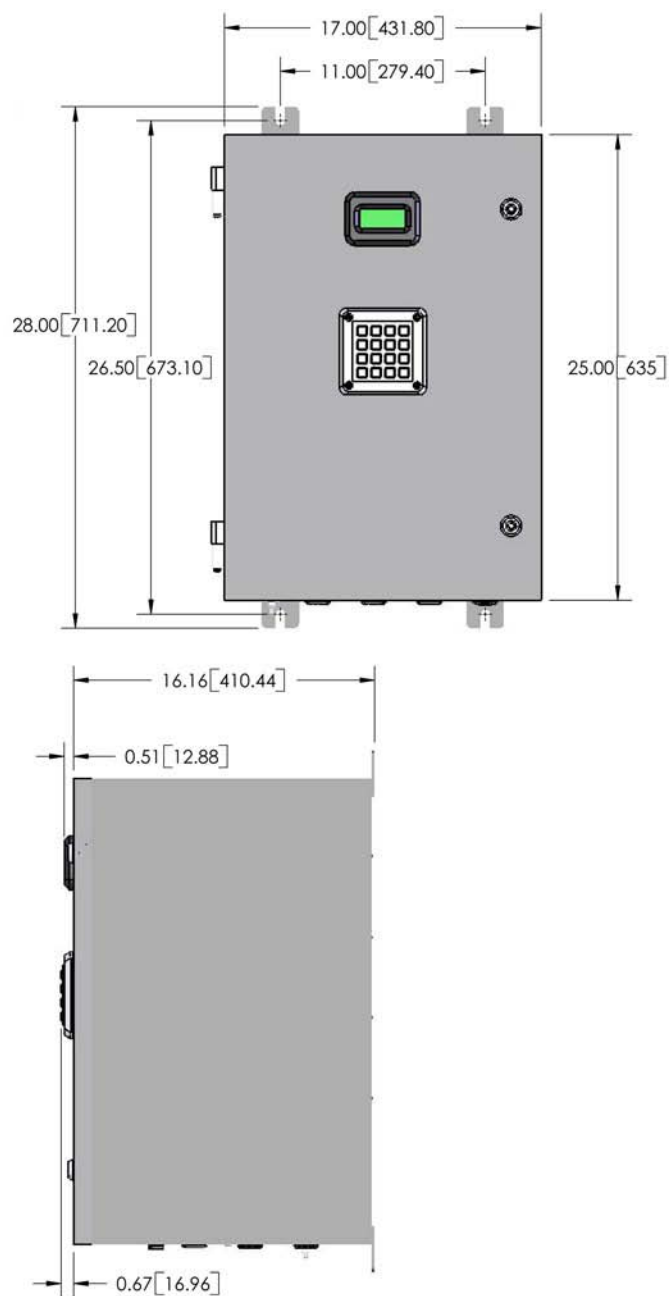
Table E-6. AutoMITTER Safety Interface Board (SIB)

Drawing #	Rev.	Description	Page
0-0443-1035	A	Exploded view of AutoMITTER SI system, CSA	E-27
3-0443-918	C	AutoMITTER SIB, CSA	E-28
--	-	Enclosure mounting, CSA	E-28
0-0443-1035	A	AutoMITTER SI system wiring diagram, CSA	E-29
0-0443-1036	A	Exploded view of AutoMITTER SI system, ATEX/Brazilian installations	E-31
3-0443-1021	A	AutoMITTER SIB PCA, ATEX/Brazilian installations	E-32
--	-	Enclosure mounting, ATEX/Brazilian installations	E-32
0-0443-1036	A	AutoMITTER SI system wiring diagram, ATEX/Brazilian installations	E-33



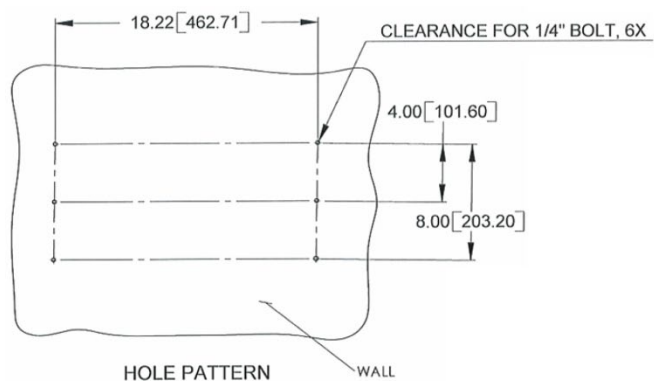
Dimensions are in inches[millimeters].

Figure E-1. Dimensional drawing: Standard enclosure (wall, panel, and rack mount configurations)



Dimensions are in inches[millimeters].

Figure E-2. Dimensional drawing: Type 4X enclosure (pole mount configuration)



Item	P/N	Description
1	3-0443-939	Assembly, enclosure & mounting brackets
2	4-0443-883	Card cage mounting brackets
3	6-2430-543	Screw, 8-32 x 5/16, BH, SS
4	6-2130-003	Washer, #8, int. tooth

- NOTES: UNLESS OTHERWISE SPECIFIED.
1. USE SUPPLIED HARDWARE TO SECURE MOUNTING BRACKETS TO CHASSIS.
 2. USE BOM 3-0443-939-01 FOR WALL MOUNT ASSEMBLY.

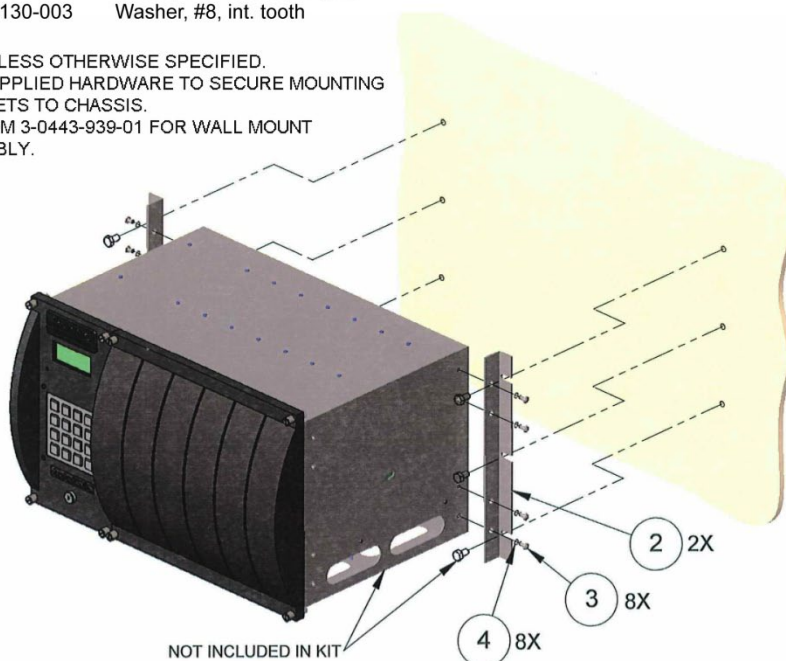


Figure E-3. 3-0443-939-01: Wall mount configuration

Item	P/N	Description
1	3-0443-939	Assembly, enclosure & mounting brackets
2	4-0443-883	Bracket, enclosure mounting
3	6-2430-543	Screw, #8-32 x 5/16", pan hd., Phil, SS
4	6-2130-003	Washer, lock, #8, int. tooth

NOTES: UNLESS OTHERWISE SPECIFIED.

1. USE SUPPLIED HARDWARE TO SECURE MOUNTING BRACKETS TO CHASSIS.
2. USE BOM 3-0443-939-02 FOR RACK MOUNT ASSEMBLY.

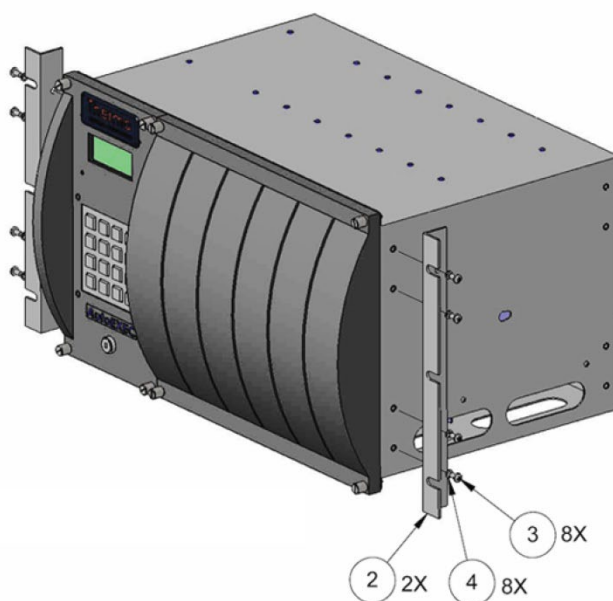
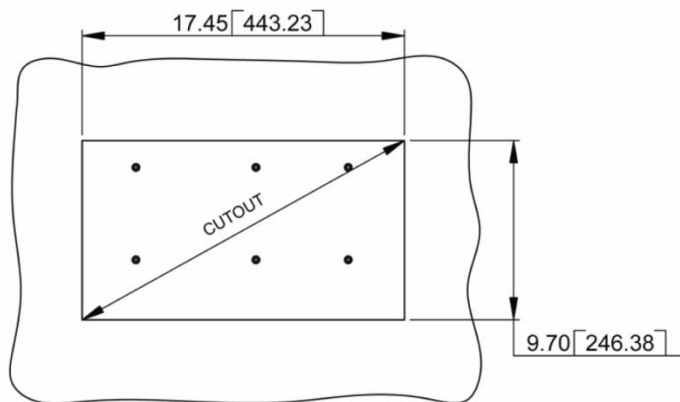


Figure E-4. 3-0443-939-02: Rack mount configuration



Dimensions are in inches[millimeters].

Item	P/N	Description
1	3-0443-939	Assembly, enclosure & mounting brackets
2	KT100313-02	Kit, panel mount jackscrew

NOTES: UNLESS OTHERWISE SPECIFIED.

1. INSTALL THE AutoEXEC UNIT INTO THE PANEL CUTOUT FROM THE FRONT SIDE OF THE PANEL.
2. SECURE THE TAB ON THE JACKSCREW INTO MATING SLOT IN THE CHASSIS.
3. USING A SCREW DRIVER, TIGHTEN SCREW UNTIL THE AutoEXEC CHASSIS IS SECURED FLUSH AGAINST THE PANEL.
4. USE BOM 3-0443-939-03 FOR PANEL MOUNT ASSEMBLY.

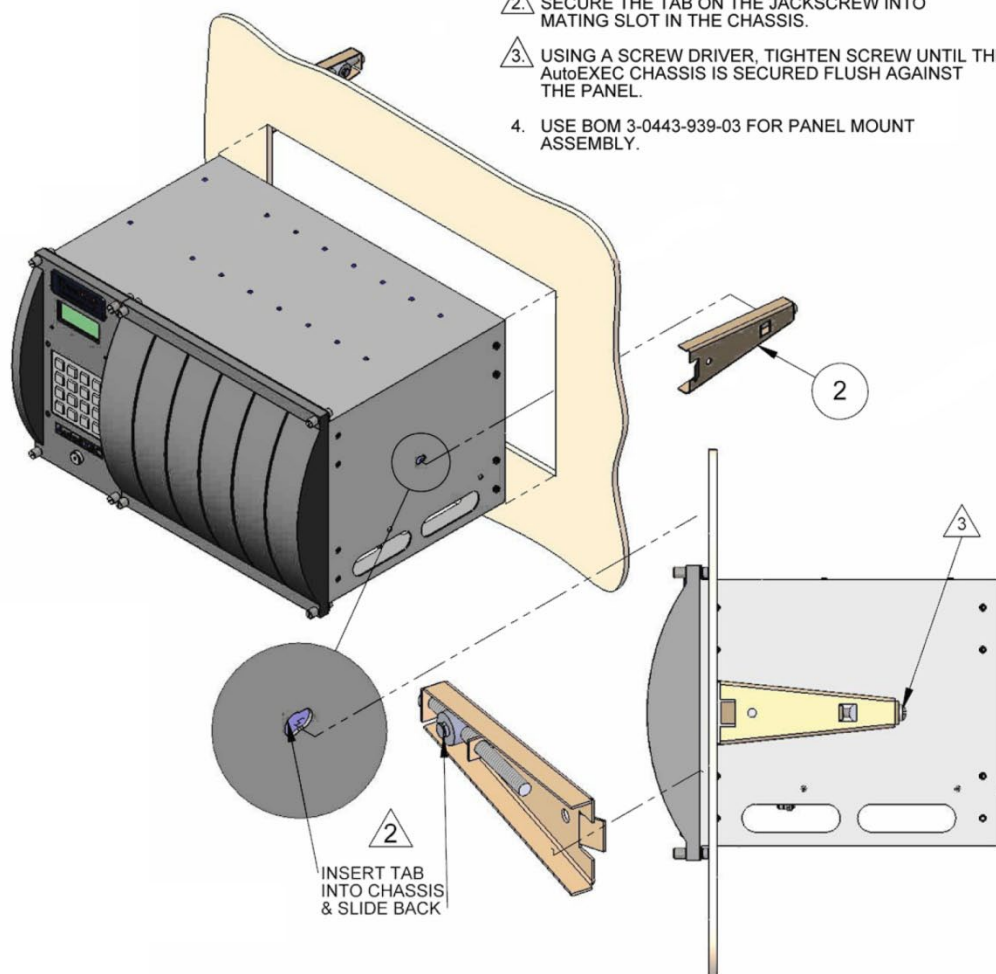


Figure E-5. 3-0443-939-03: Panel mount configuration

Item	P/N	Description
1	49-1009-0	2" pipe clamp (pole mount)
2	6-2082-609	1/4"-20 spring nut
3	4-0443-994	Channel, 1.625, SS, (B-Line B22ss4)
4	6-2481-243	1/4-20 X 3/4" cap screw
5	6-2080-043	1/4-20 nut
6	61-1002-0	1/4" flat washer
7	6-2280-403	1/4" lock washer
8	412-5081-106	3/8-16 X 1" lg. cap screw
9	60-1013-0	3/8-16 nut
10	6-2140-003	3/8" flat washer
11	6-2290-603	3/8" lock washer

NOTES: UNLESS OTHERWISE SPECIFIED.

1. USE SUPPLIED HARDWARE TO SECURE CHANNELS AND PIPE CLAMPS TO UNIT & POLE.
2. NOTE- VIEWS SHOW ONLY THE TOP BRACKET ASSEMBLY. REPEAT ASSEMBLY STEPS FOR BOTTOM BRACKET INSTALLATION.

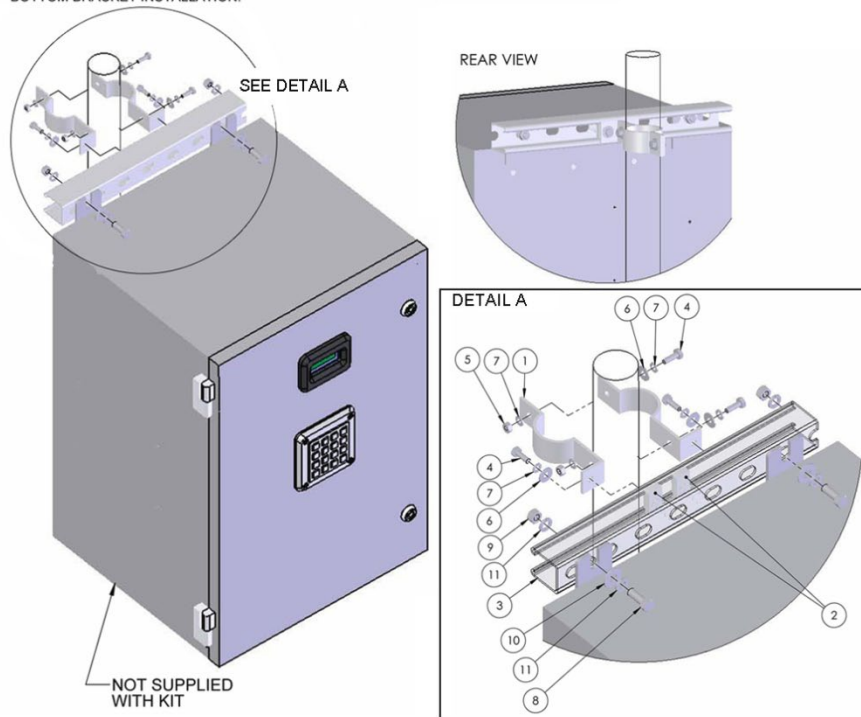


Figure E-6. 3-0443-995: Pole mount configuration

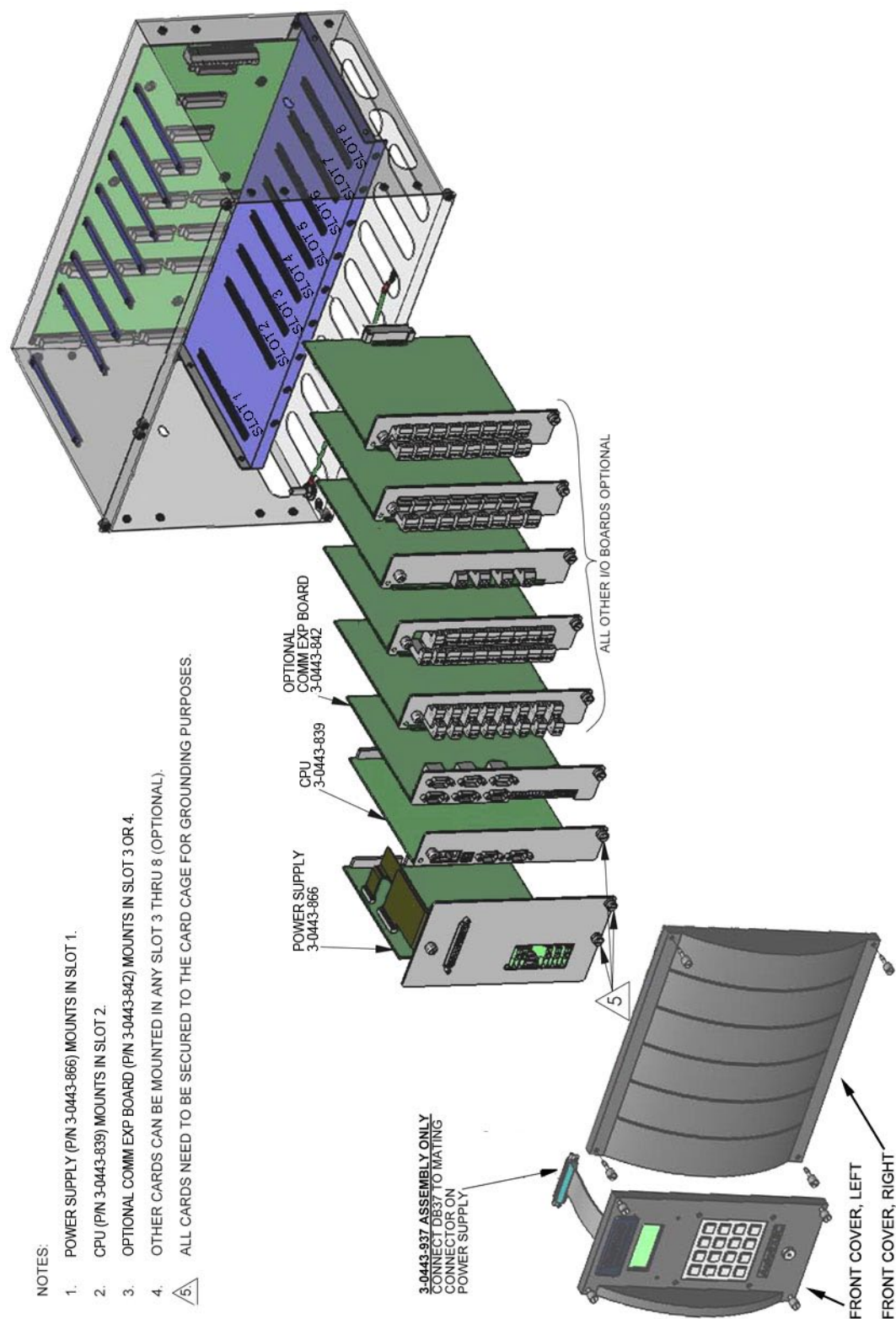


Figure E-7. 0-0443-965: PCA locations in standard enclosure (basic)

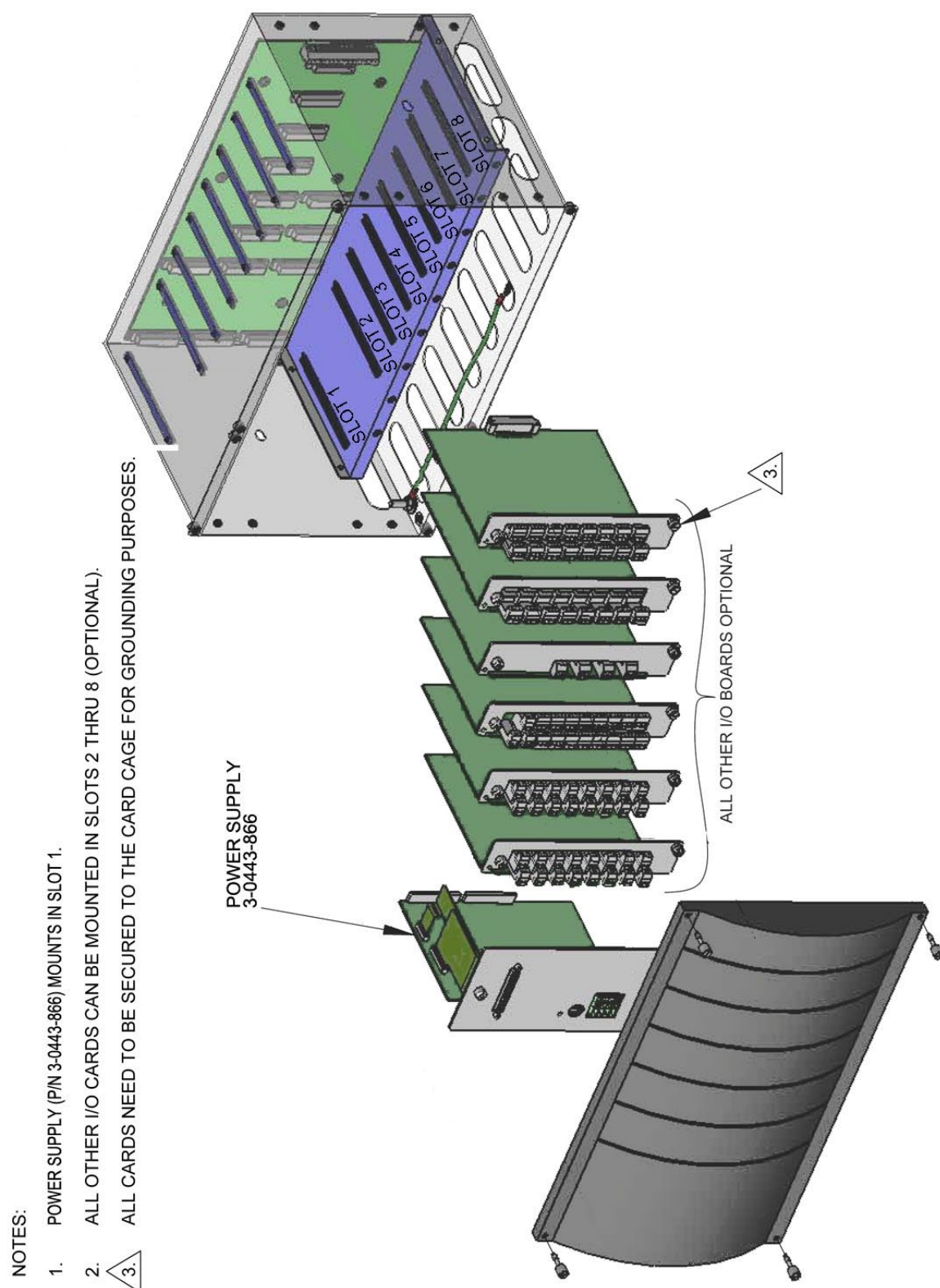


Figure E-8. 0-0443-966: PCA locations in standard expansion enclosure

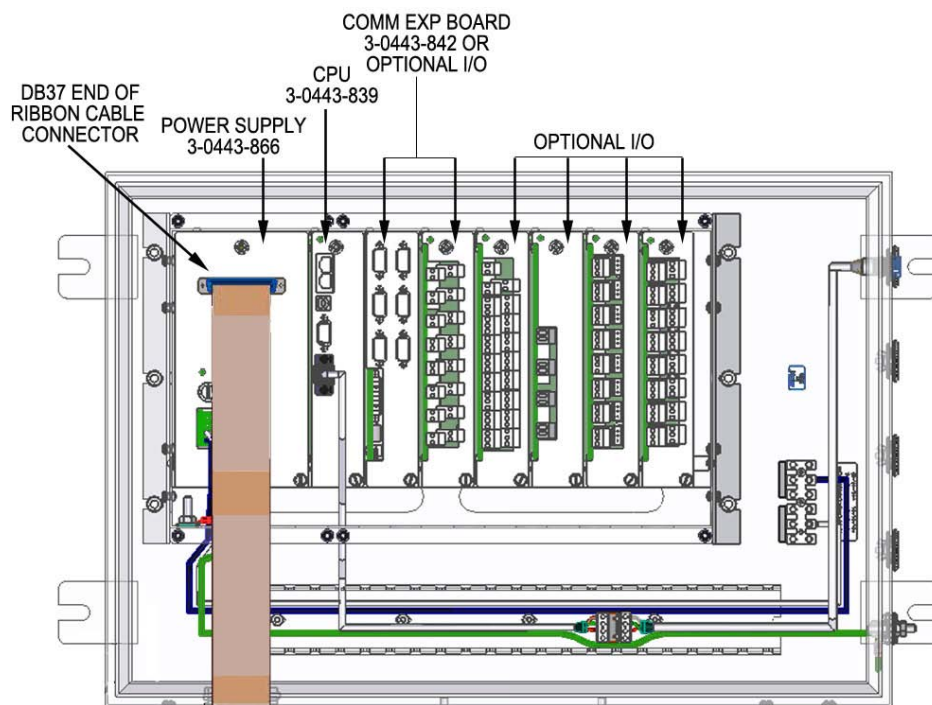


Figure E-9. 0-0443-967: PCA locations in Type 4X enclosure

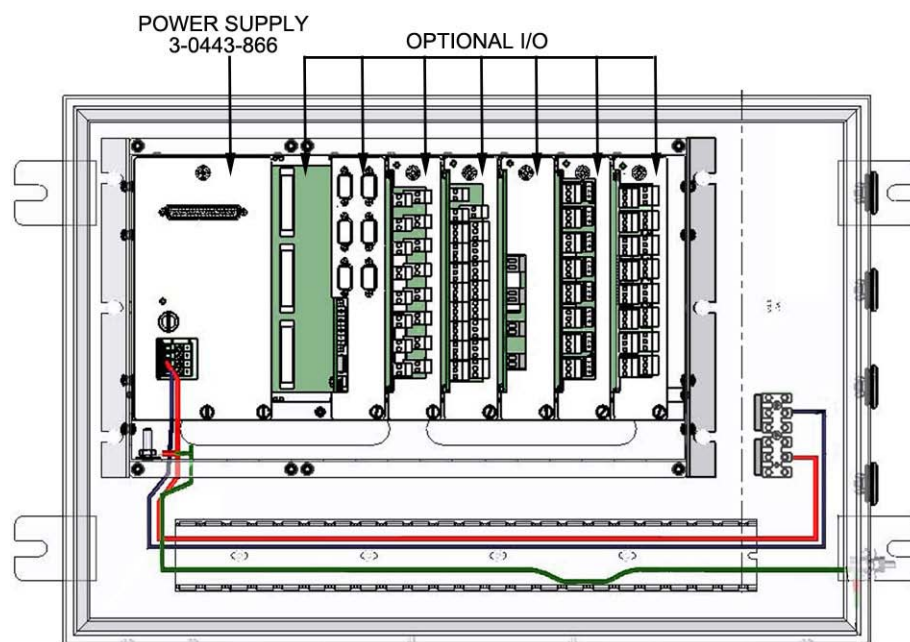


Figure E-10. 0-0443-968: PCA locations in Type 4X expansion enclosure

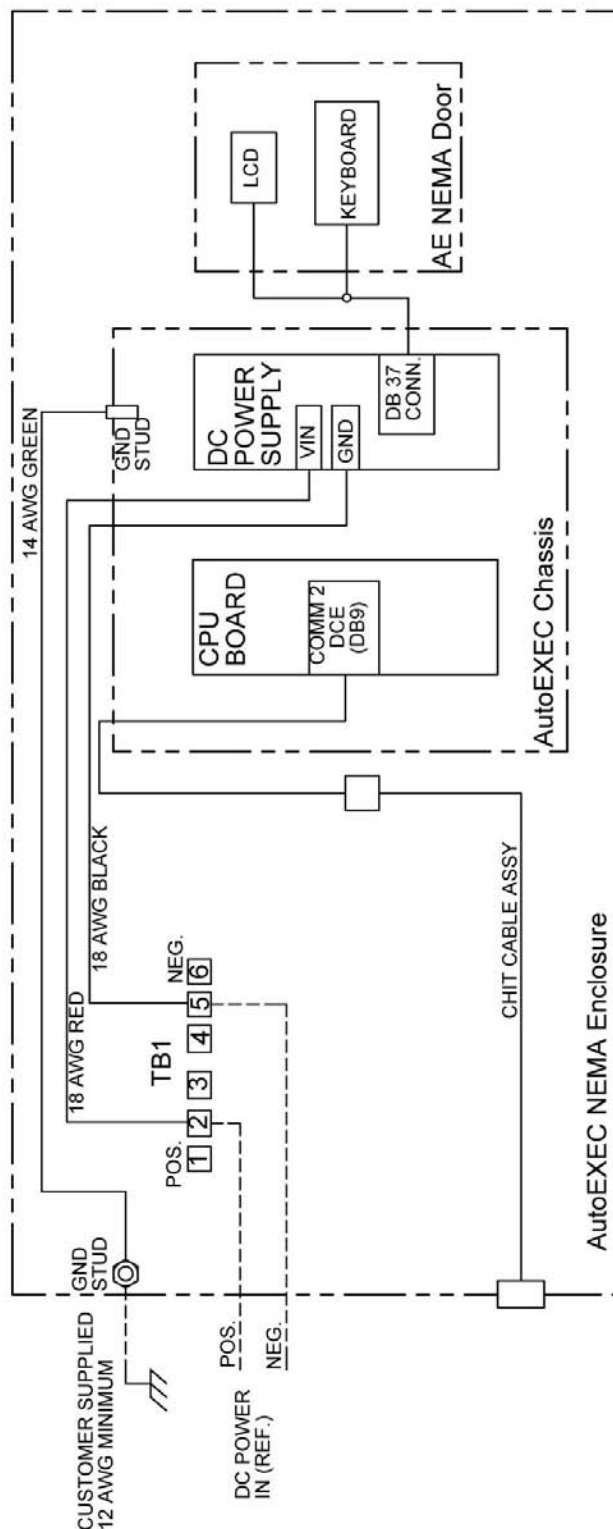


Figure E-11. 0-0443-967: Wiring diagram for Type 4X enclosure

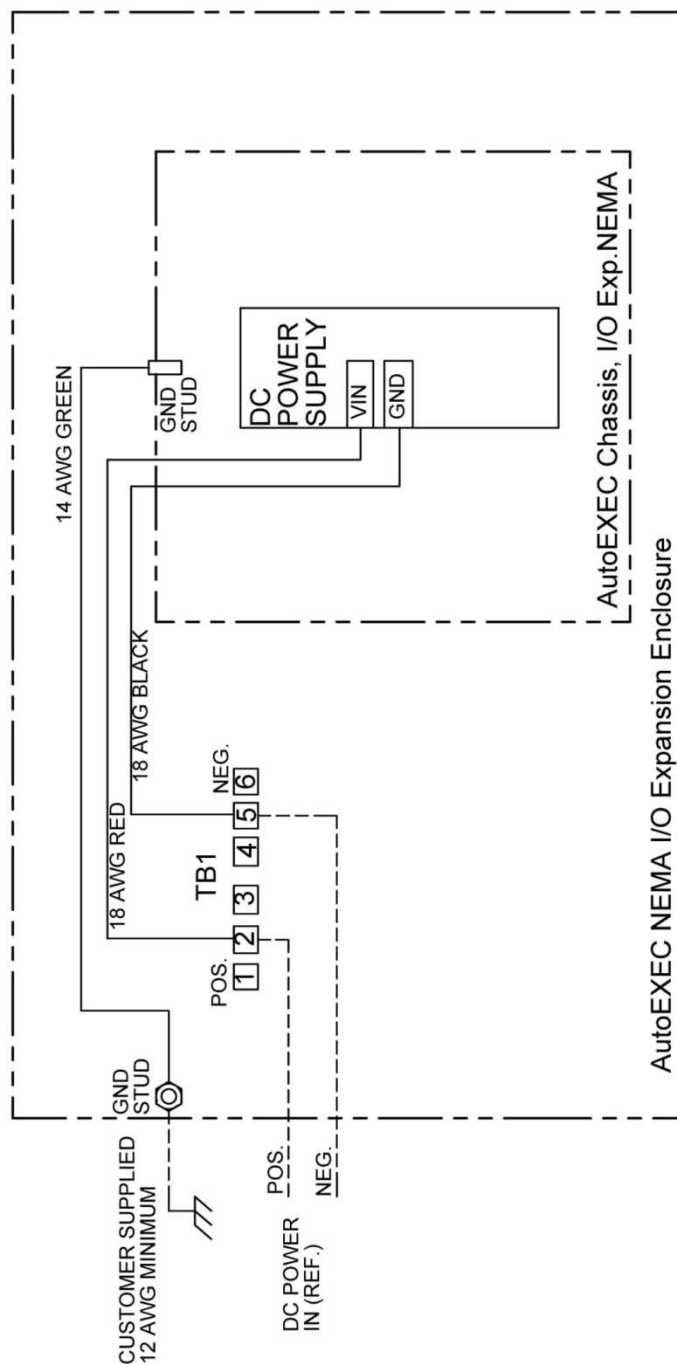


Figure E-12. 0-0443-968: Wiring diagram for Type 4X expansion enclosure

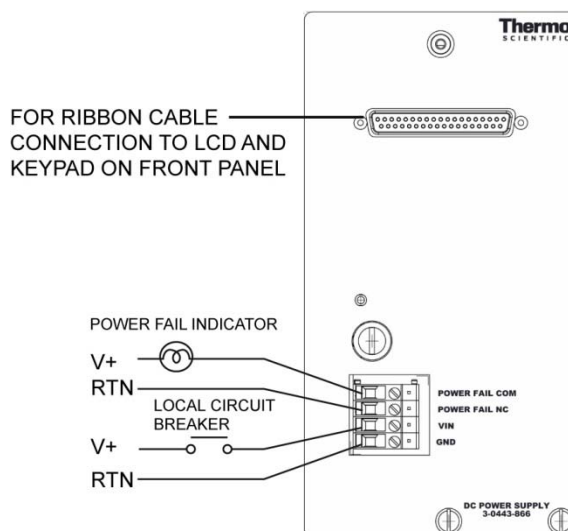


Figure E-13. 3-0443-866: Power supply connections

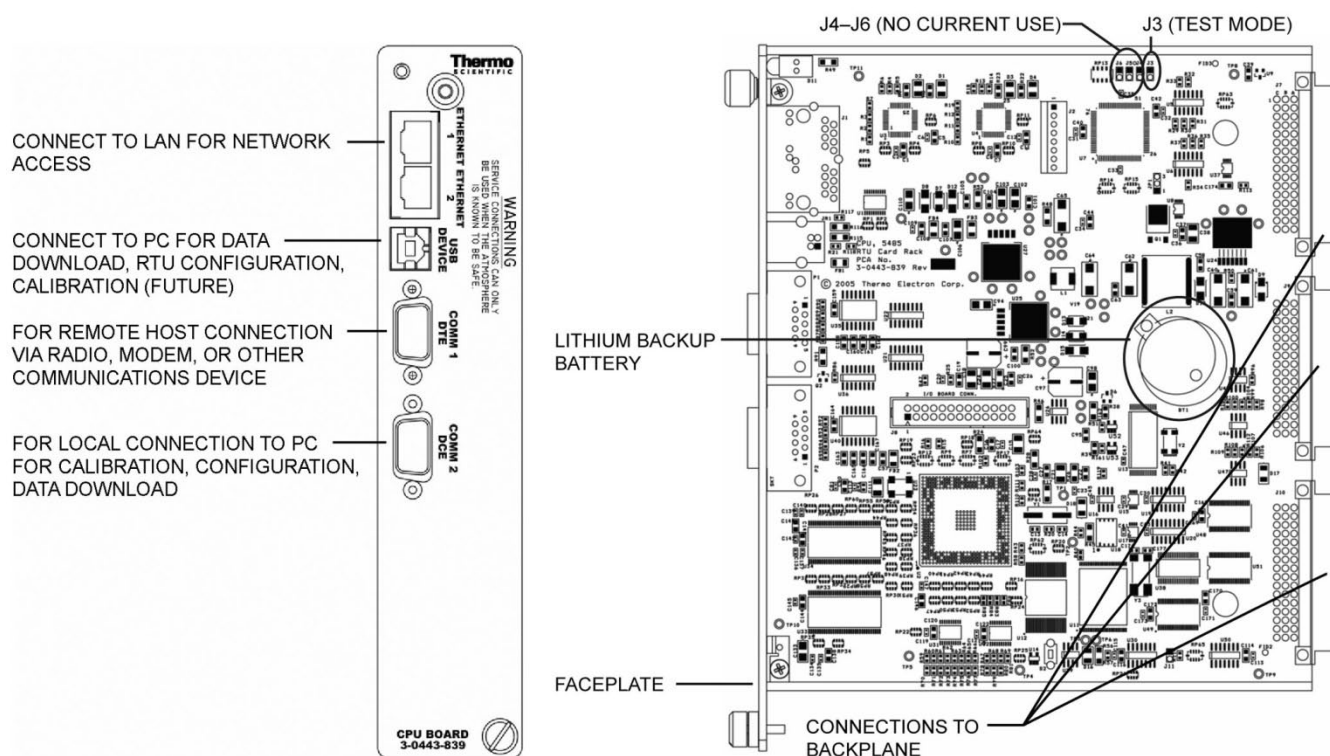


Figure E-14. 4-0443-839: CPU connections and jumper settings

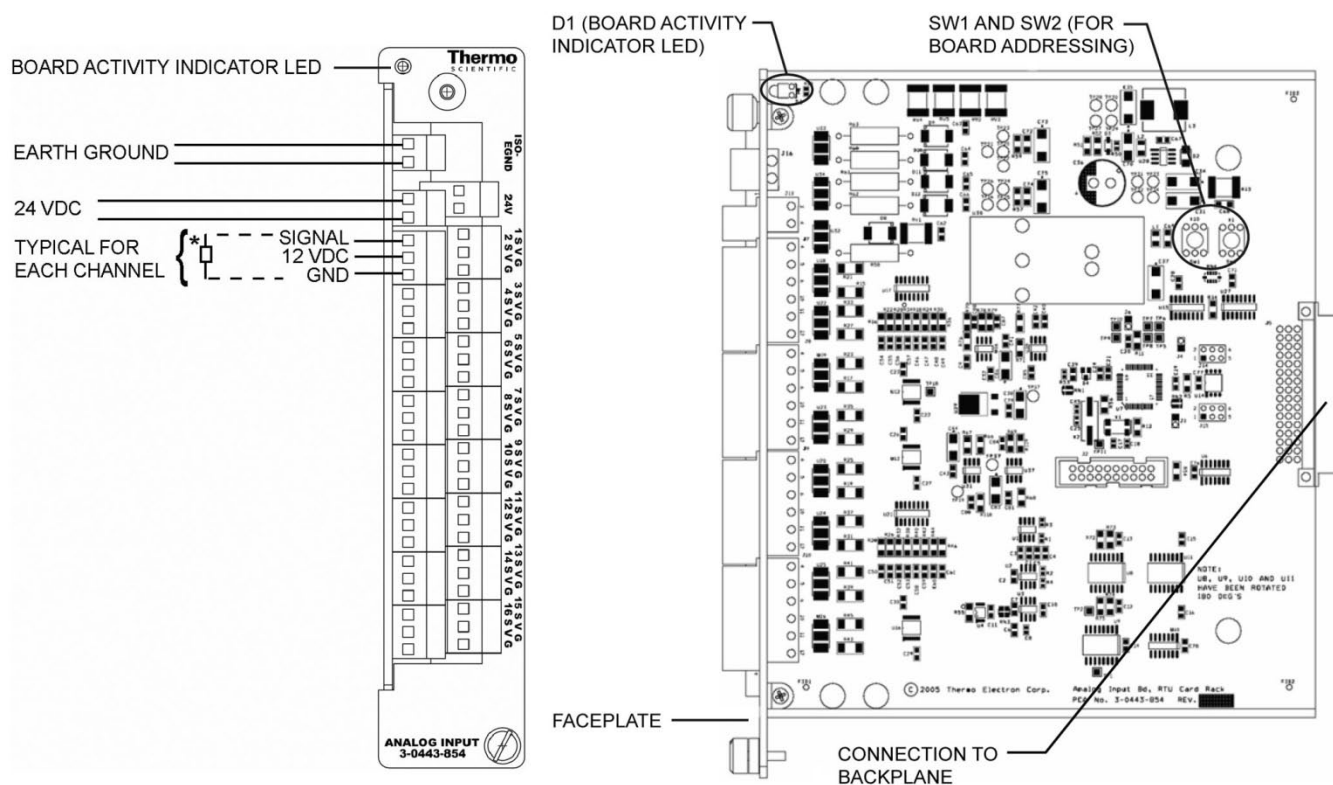


Figure E-15. 3-0443-854: Analog input board

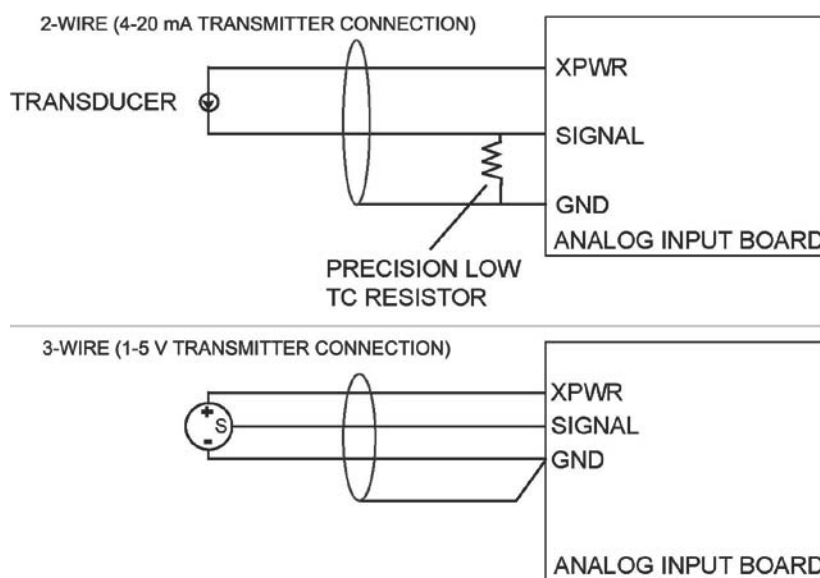


Figure E-16. Analog input field wiring diagram: 2-wire and 3-wire connections

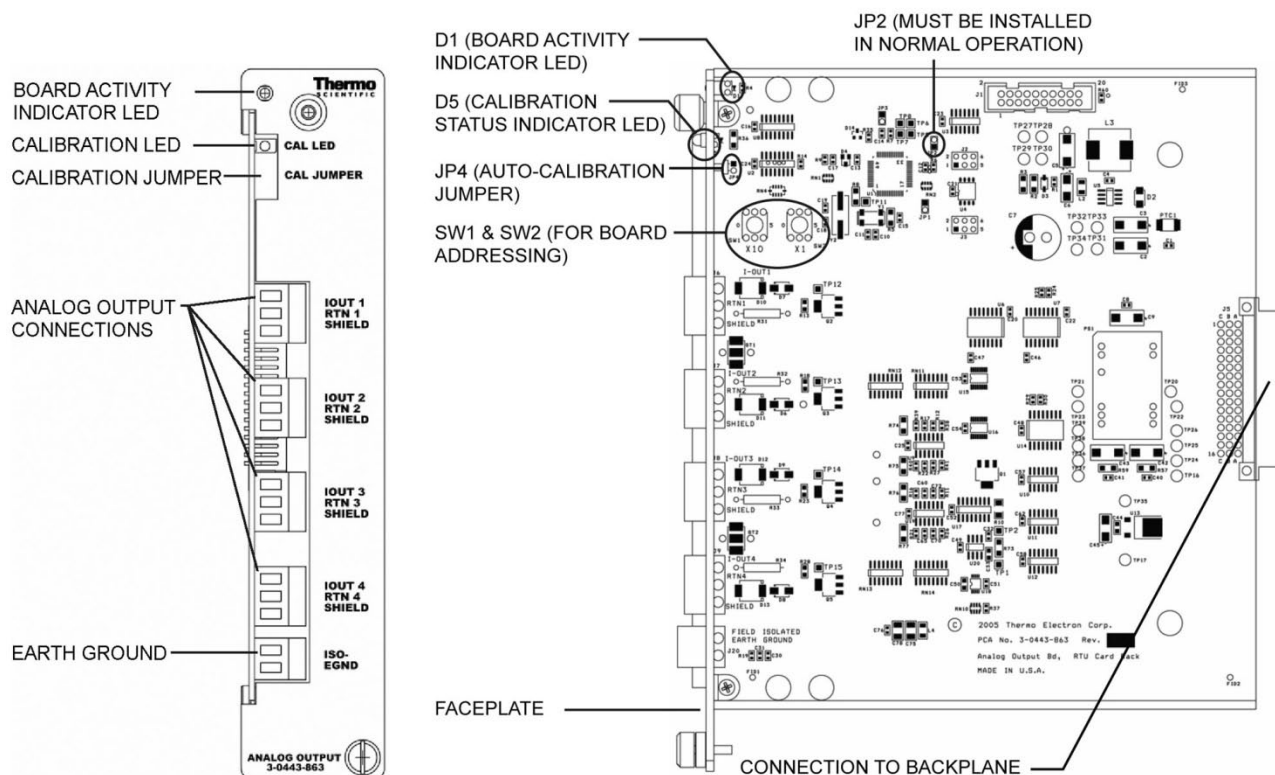


Figure E-17. 3-0443-863: Analog output board

DB9 CABLE TO REMOTE DEVICE SUCH
AS A CHROMATOGRAPH OR AutoMITTER

FOR FULL DUPLEX, 4-WIRE RS485
CONNECTIONS, USE TWO TWISTED
PAIRS AND CONNECT THE SHIELDS

CONNECTION TO USB FLASH DRIVE
FOR HISTORICAL DATA DOWNLOAD OR TO
PERIPHERAL DEVICE SUCH AS A PRINTER

FUTURE

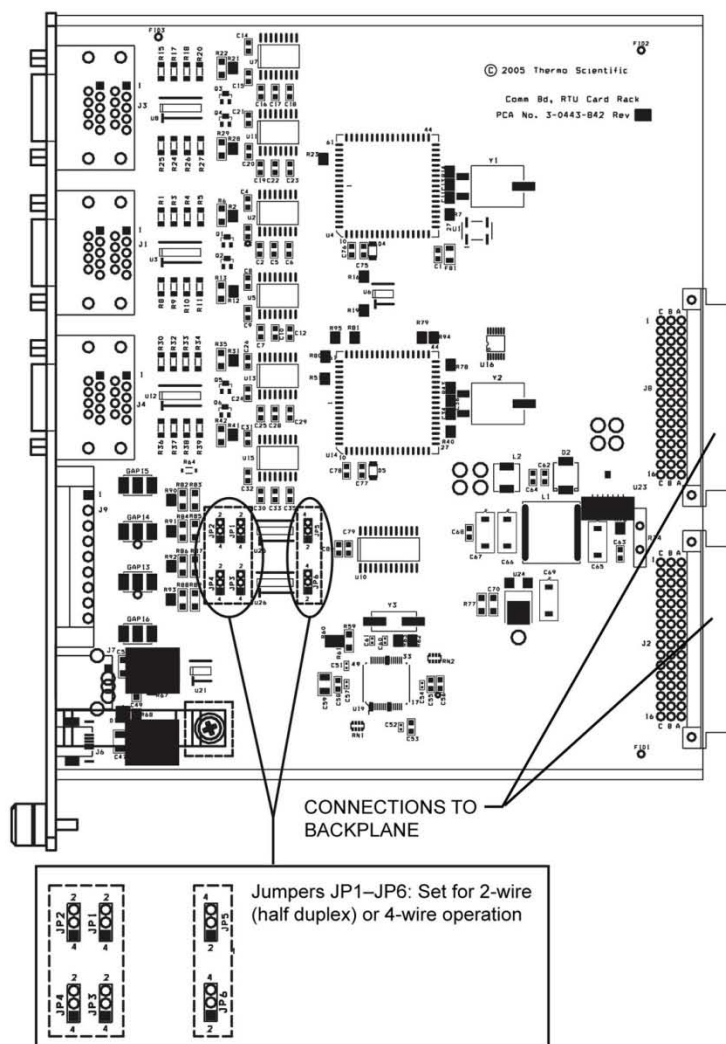
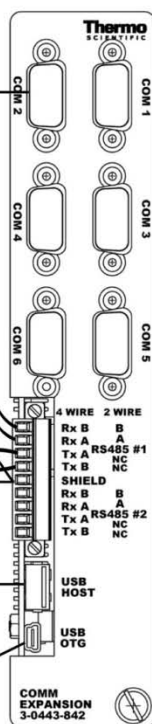


Figure E-18. 3-0443-842: Communication expansion board

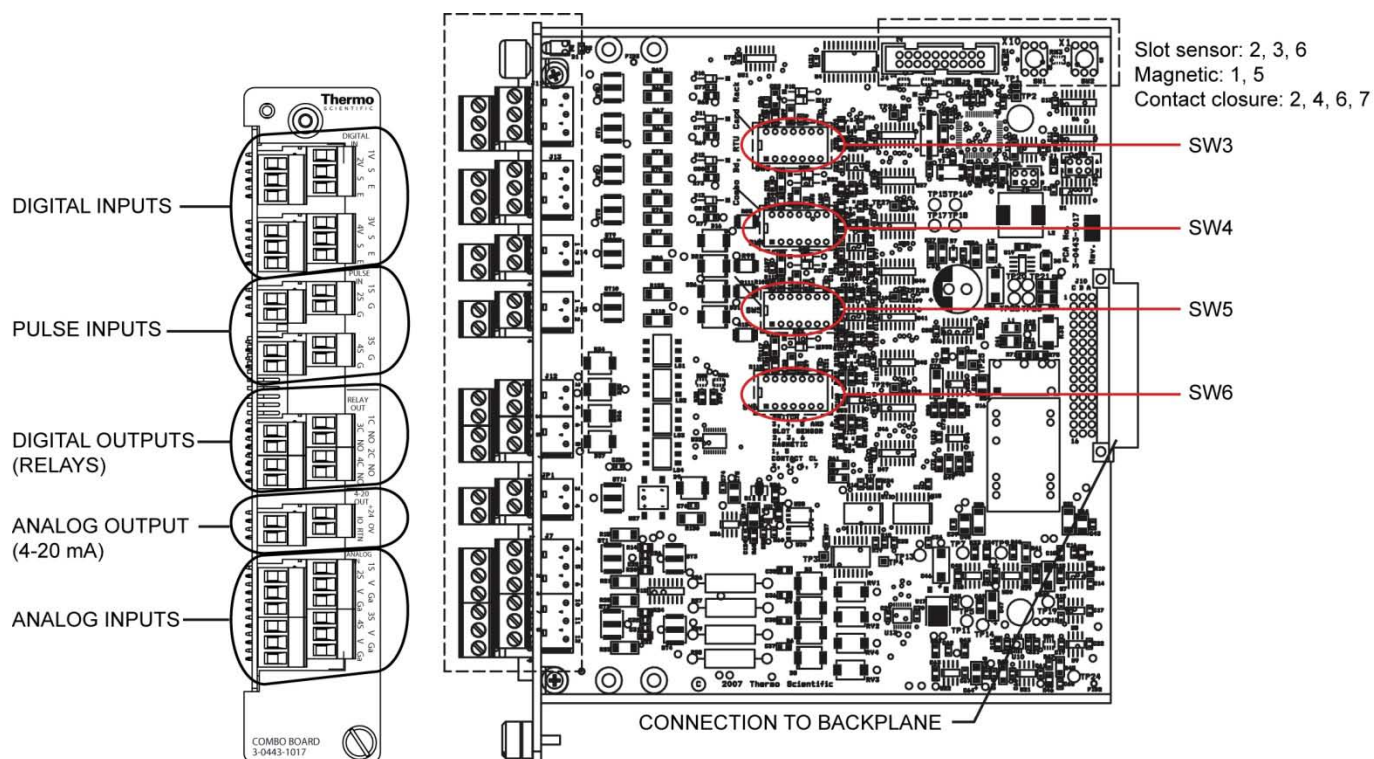


Figure E–19. 3-0443-1017: Combo board

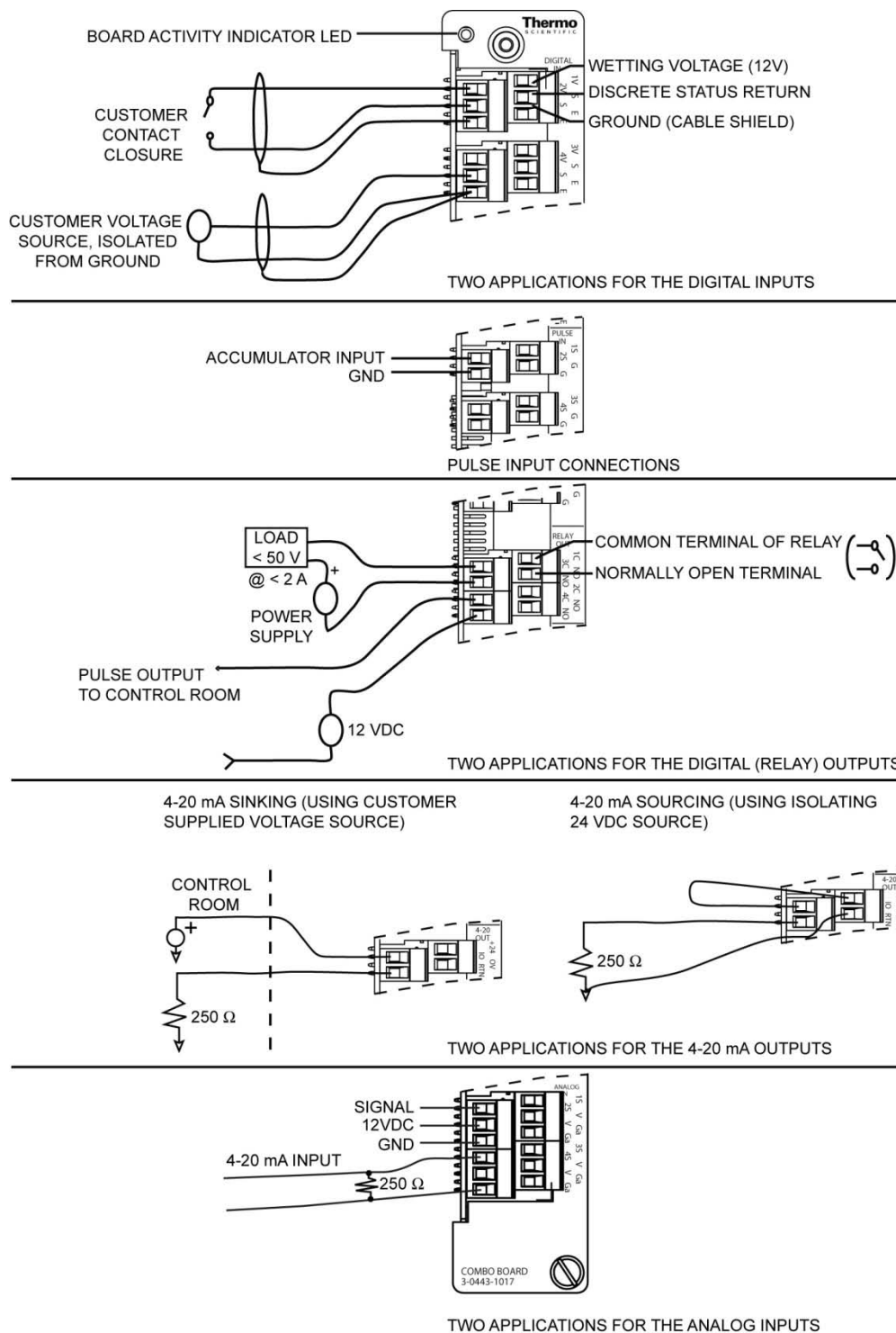


Figure E-20. Combo board connections

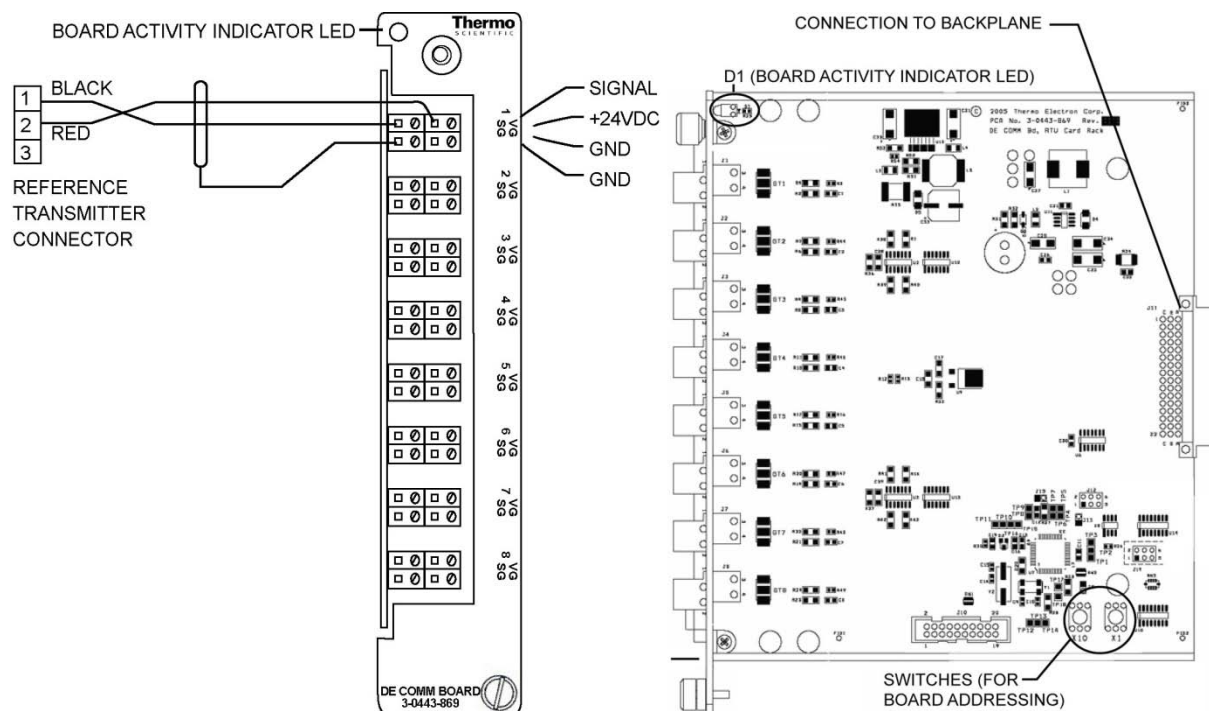


Figure E-21. 3-0443-869: DE communication board

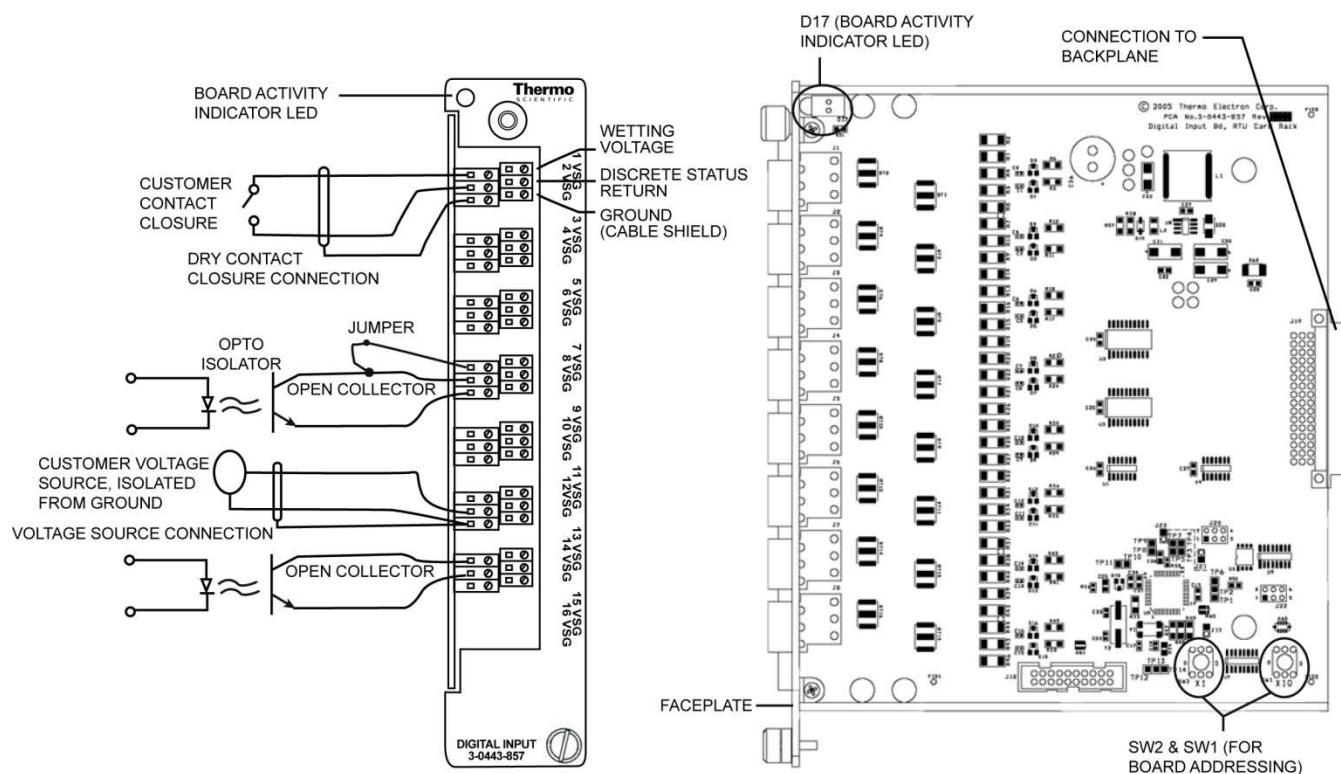


Figure E-22. 3-0443-857: Digital input board

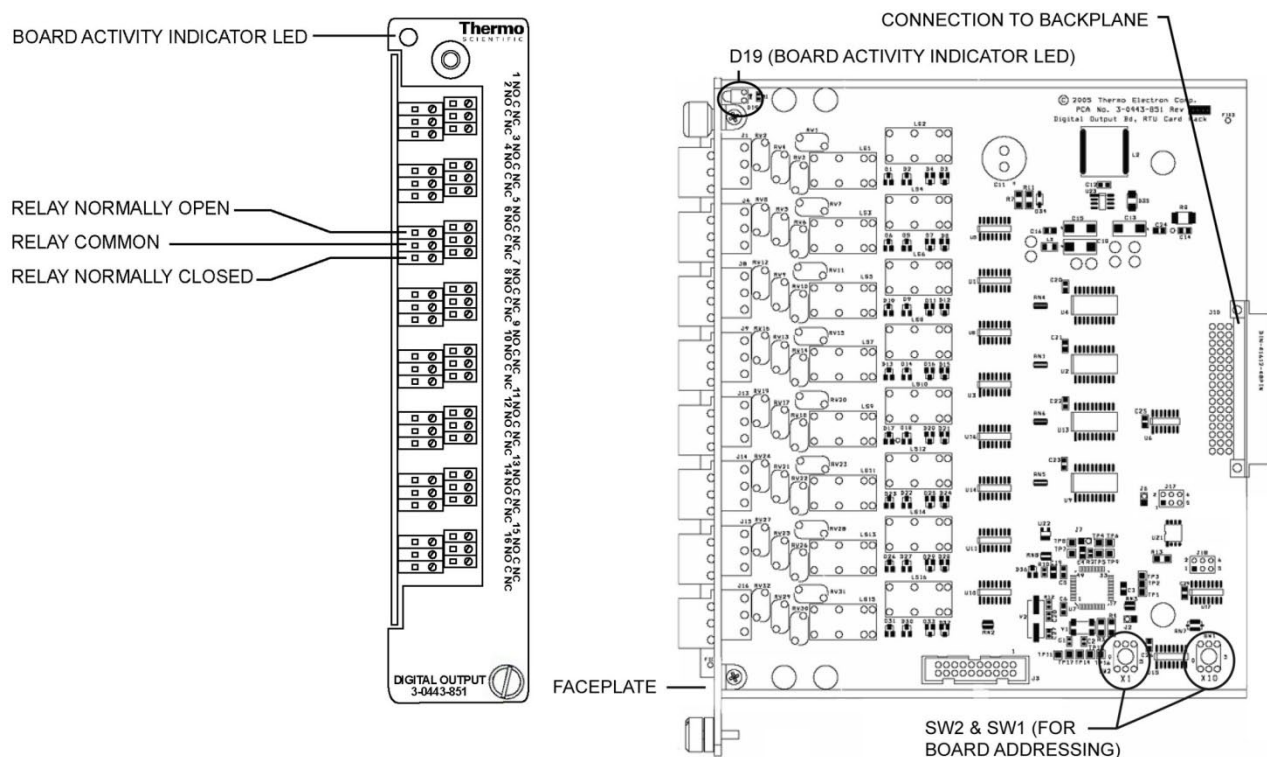


Figure E-23. 3-0443-851: Digital output board

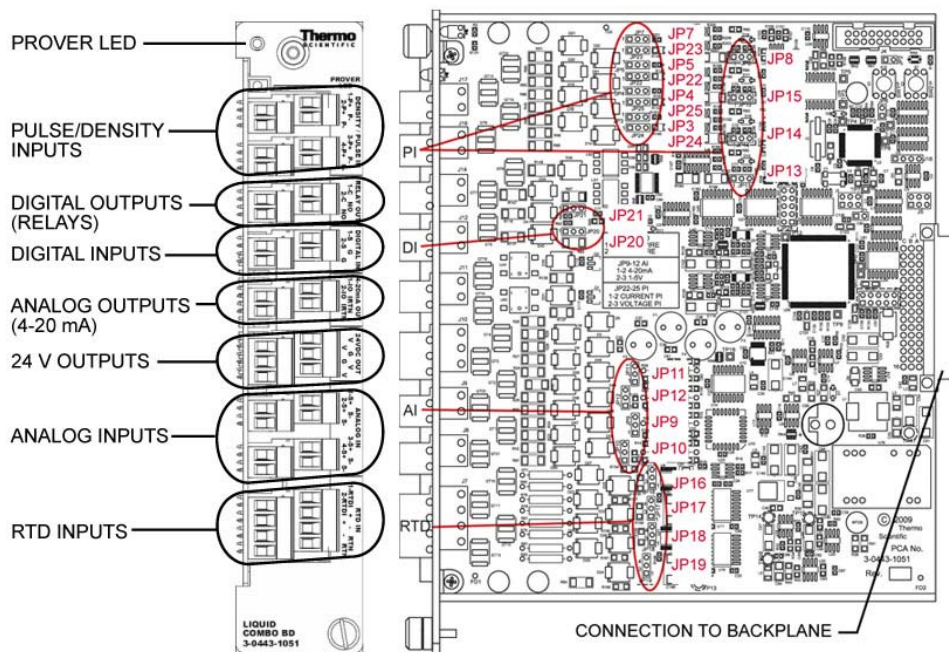


Figure E-24. 3-0443-1051: Liquid combo board

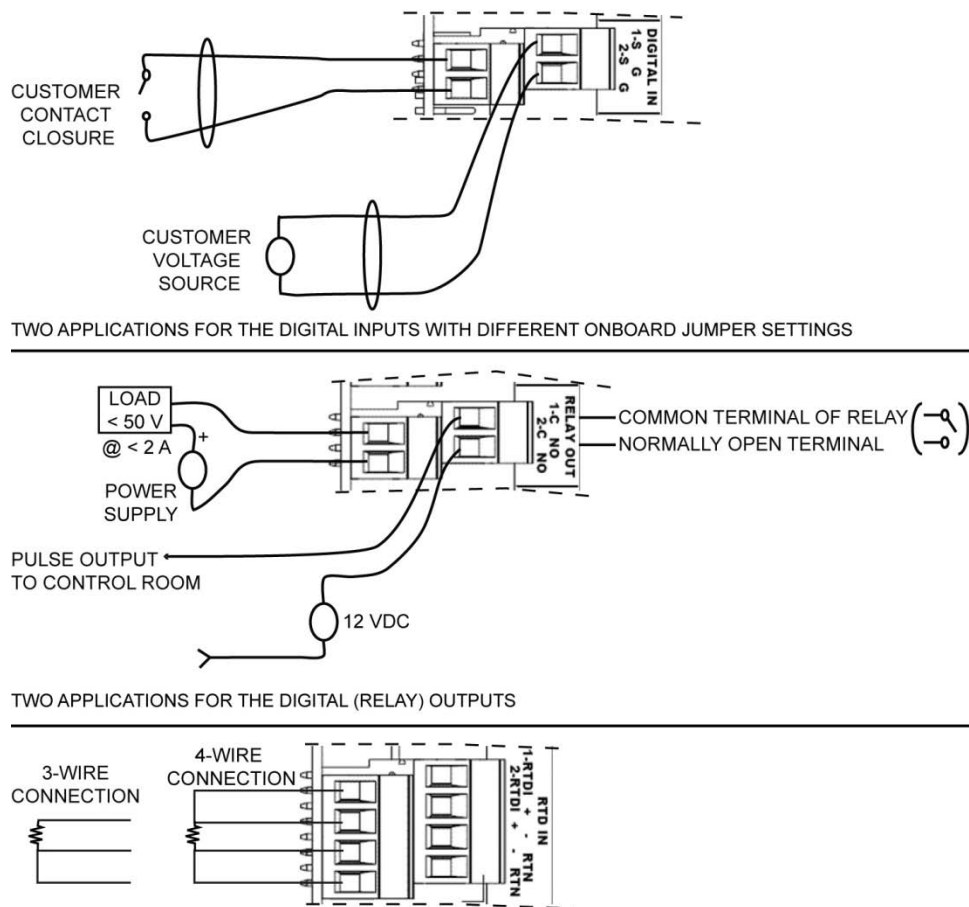


Figure E-25. Liquid combo board connections

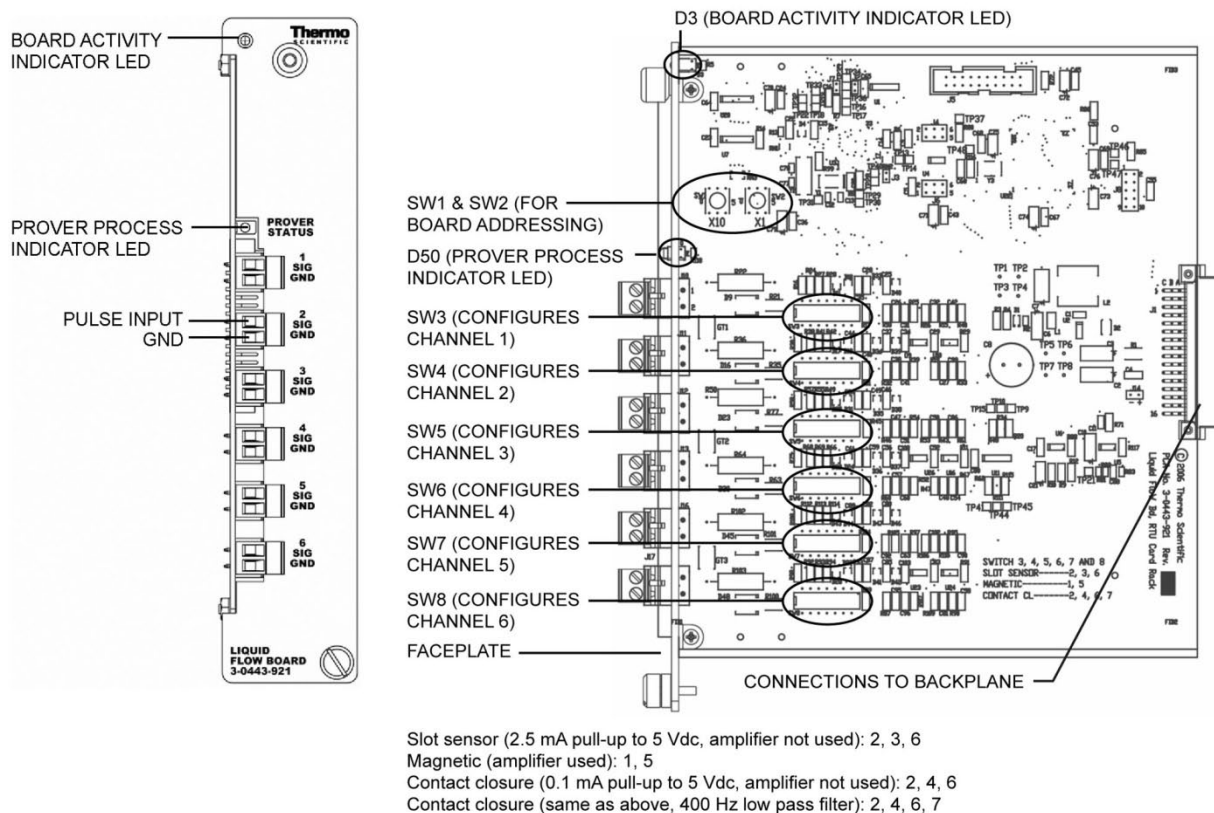


Figure E-26. 3-0443-921: Liquid flow board

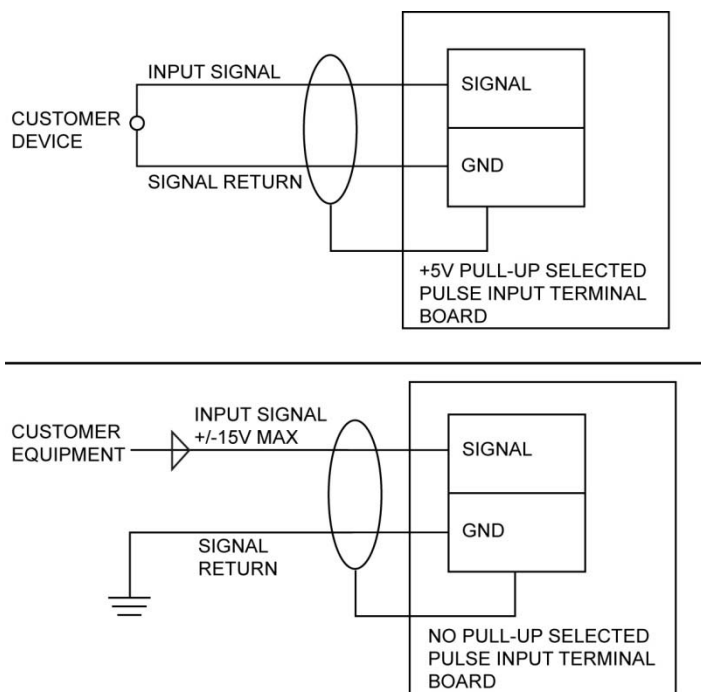


Figure E-27. Pulse input field wiring for liquid flow board

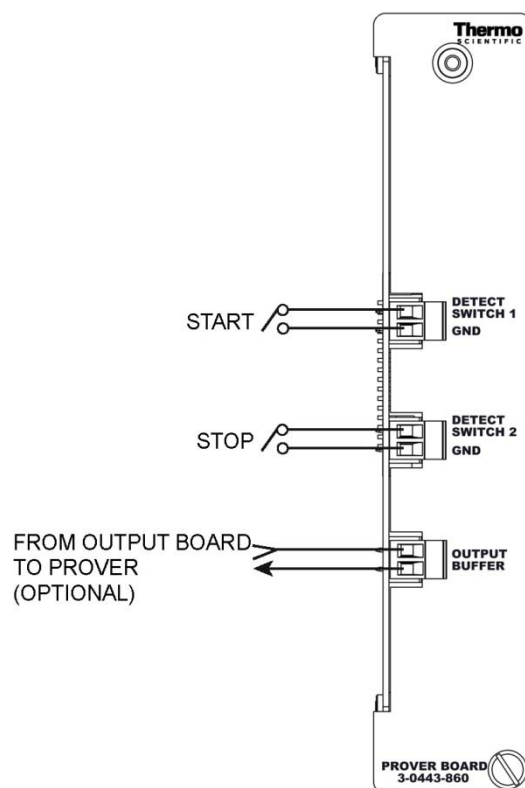


Figure E–28. 3-0443-860: Prover board

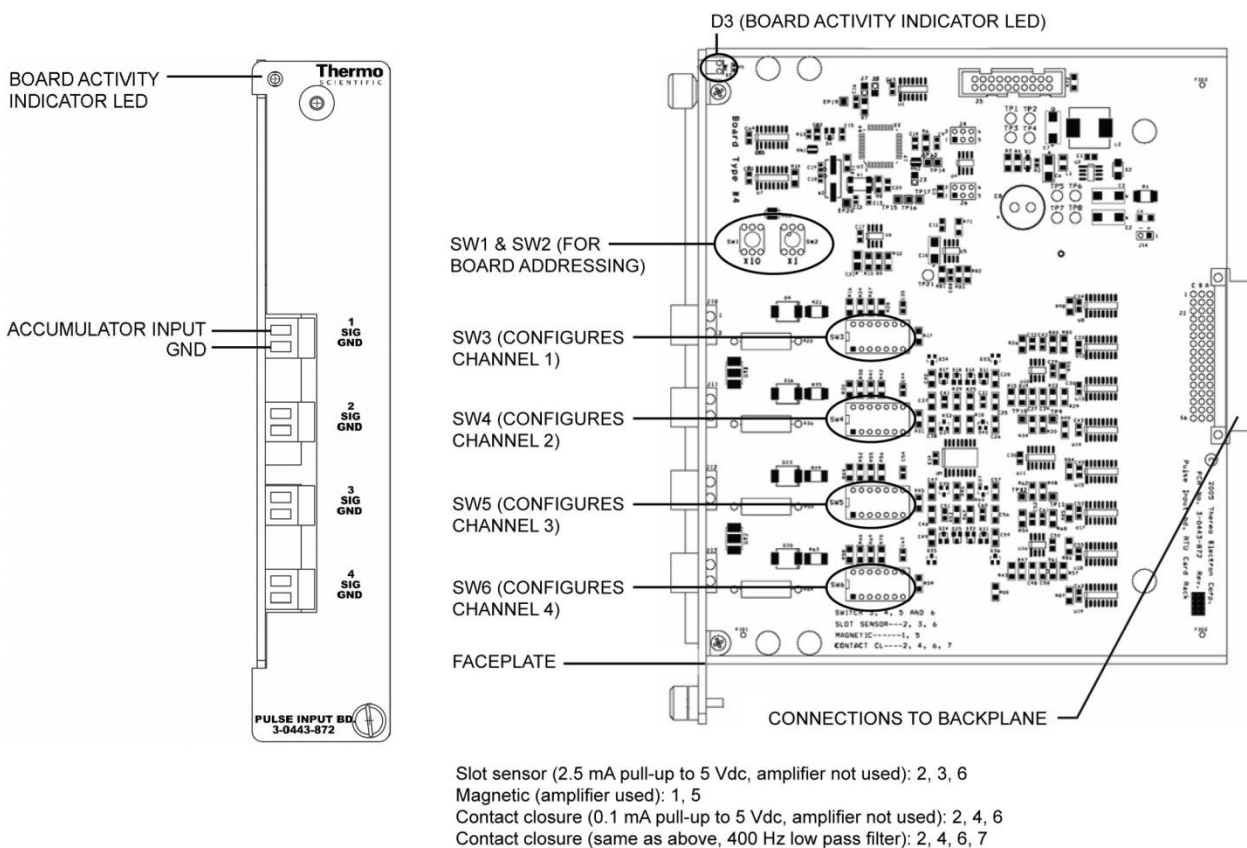


Figure E-29. 3-0443-872: Pulse input board

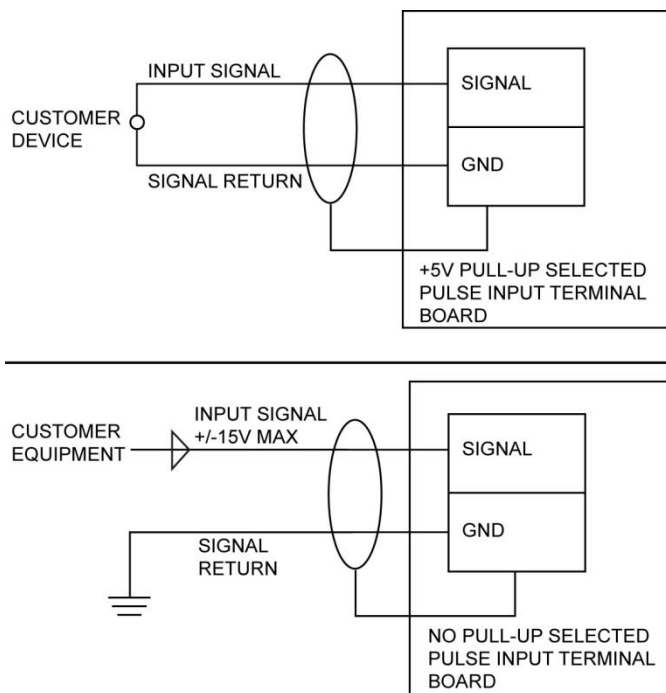


Figure E-30. Field wiring for pulse input board

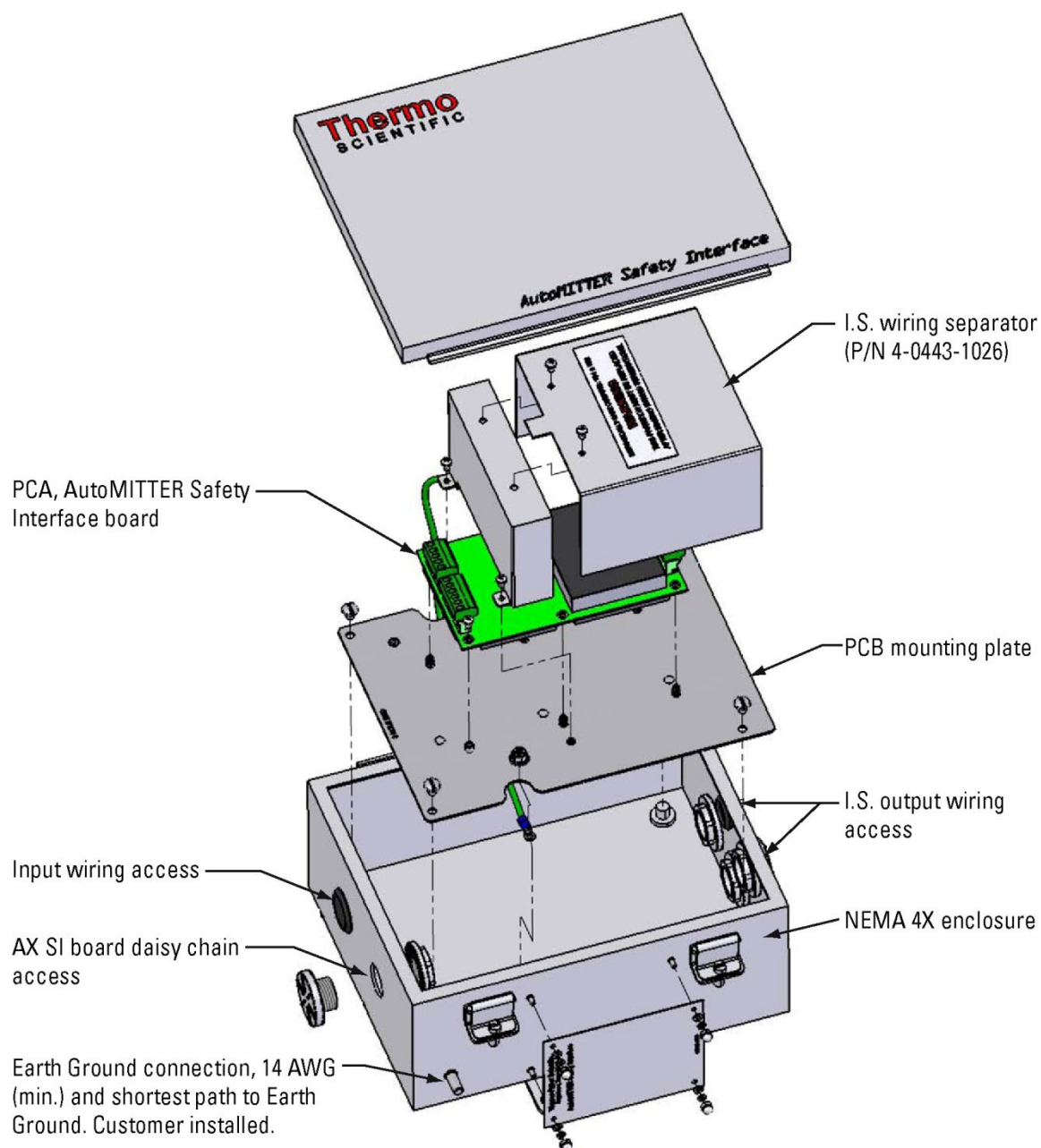


Figure E-31. 0-0443-1035: Exploded view of AutoMITTER SI system, CSA

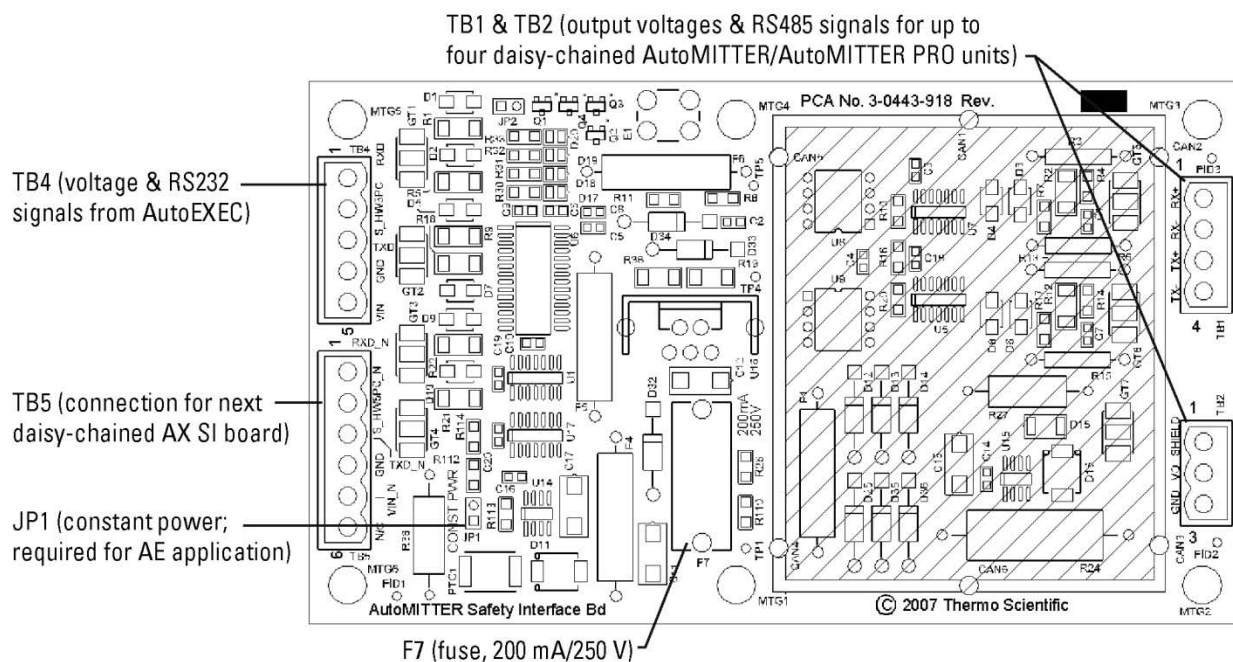
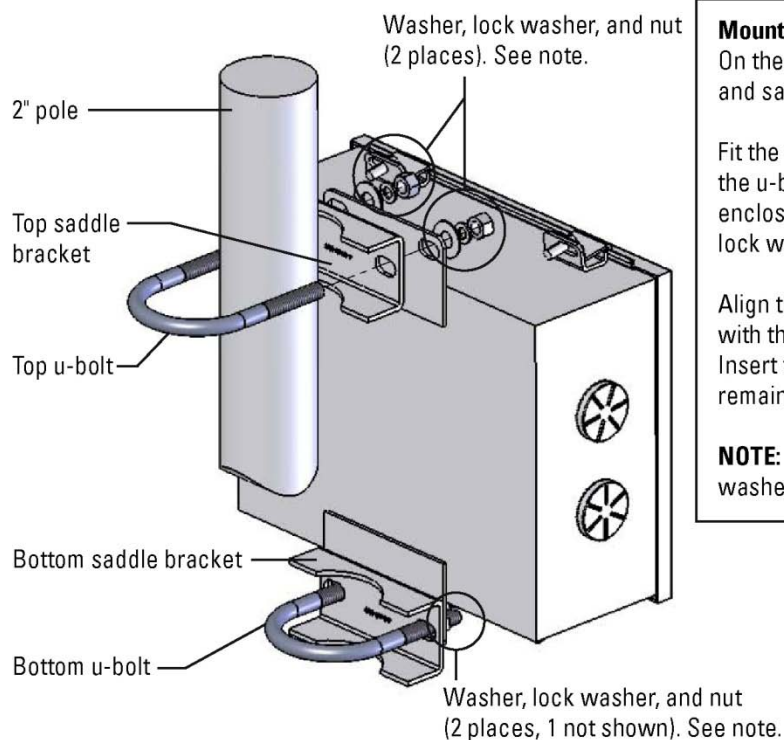


Figure E-32. 3-0443-918: AutoMITTER SIB, CSA



Mounting instructions

On the installation pole, position one u-bolt and saddle bracket at the required height.

Fit the enclosure onto the pole by inserting the u-bolt into the holes at the top of the enclosure. Secure both sides with a washer, lock washer, and nut.

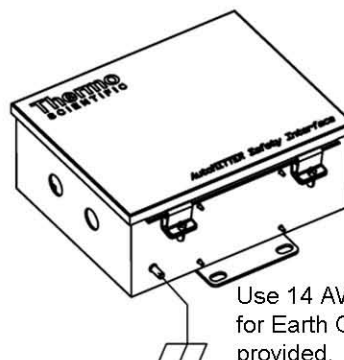
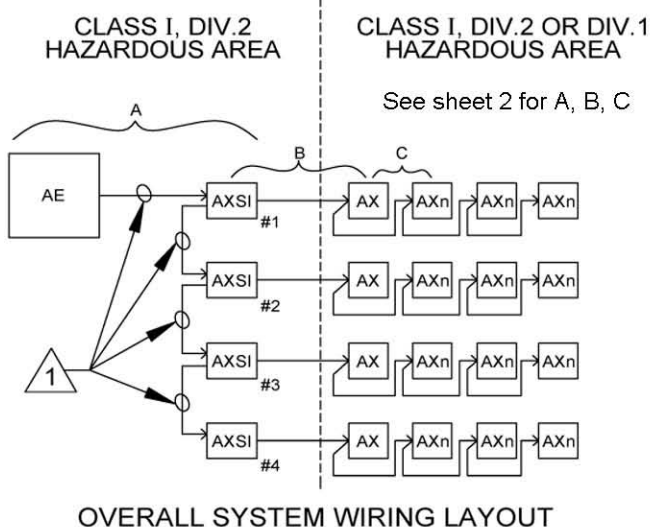
Align the holes on the second saddle bracket with the holes on the bottom of the enclosure. Insert the remaining u-bolt and secure with remaining hardware.

NOTE: Install hardware in this order: washer, lock washer, nut.

Figure E-33. AutoMITTER SI system enclosure mounting, CSA

AutoEXEC = AE
 AutoMITTER = AX
 AutoMITTER PRO = AX PRO

AutoMITTER Safety Interface = AXSI
 Next AX or AX PRO in Daisy Chain = AXn



CONNECT EARTH GROUND AS SHOWN

- 1 50 ft. maximum cable length
- Use 24 AWG wire (min.) for RS232 signals.
 - Use 18 AWG wire for +12V and GND.

Wire all circuits using Class I, Div. 2 wiring methods specified in Article 504-4(B) of the National Electrical Code, NFPA70 or Section 18-152 of the Canadian Electrical Code.

Caution: These circuits are not non-incendive field wiring circuits. Wire these circuits as "Power Limited" circuits.

- 2 Connect up to four AX units, with 2000 ft. maximum cable length
- Use 24 AWG wire (min.) for RS485 signals.
 - Use 18 AWG wire for V_O and GND.

All wiring to AX/AX PRO is Intrinsically Safe wiring and must be made according to Article 504 (Intrinsically Safe Systems) of the National Electric Code, NFPA70 or Sections 18-066 and 18-106 of the Canadian Electrical Code. Multiple circuits that run in the same multi-conductor cable must have a minimum insulation thickness of 0.01" (0.25 mm) on each conductor.

3. AX constant power jumper
- J5 - not installed
 - J6 - installed

AX PRO constant power jumper

- J1 - installed

4. AXSI constant power jumper
- JP1 - installed

NOTES: Unless otherwise specified.

Figure E-34. 0-0443-1035: AutoMITTER SI system wiring diagram, CSA (1 of 2)

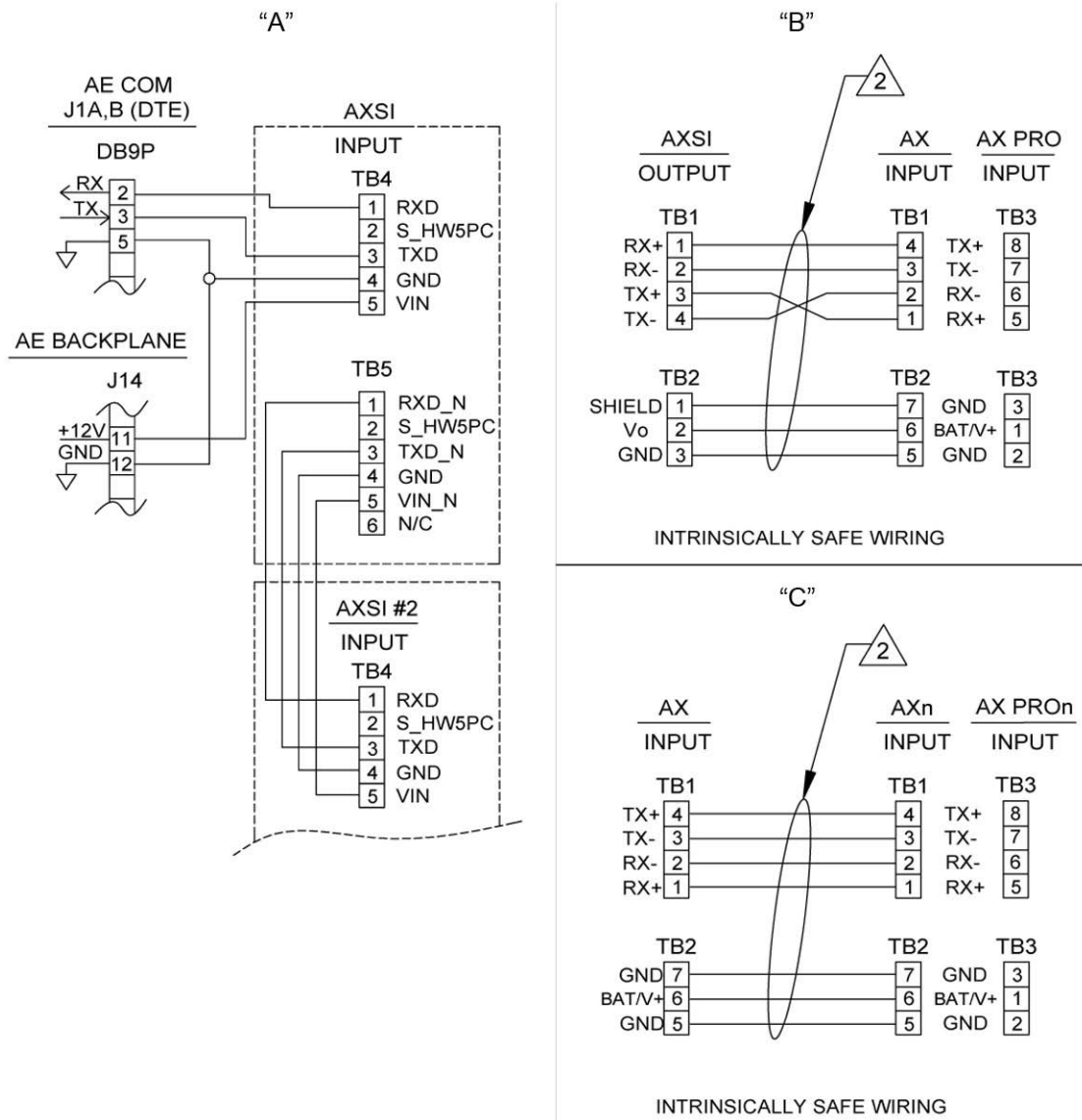


Figure E-35. 0-0443-1035: AutoMITTER SI system wiring diagram, CSA (2 of 2)

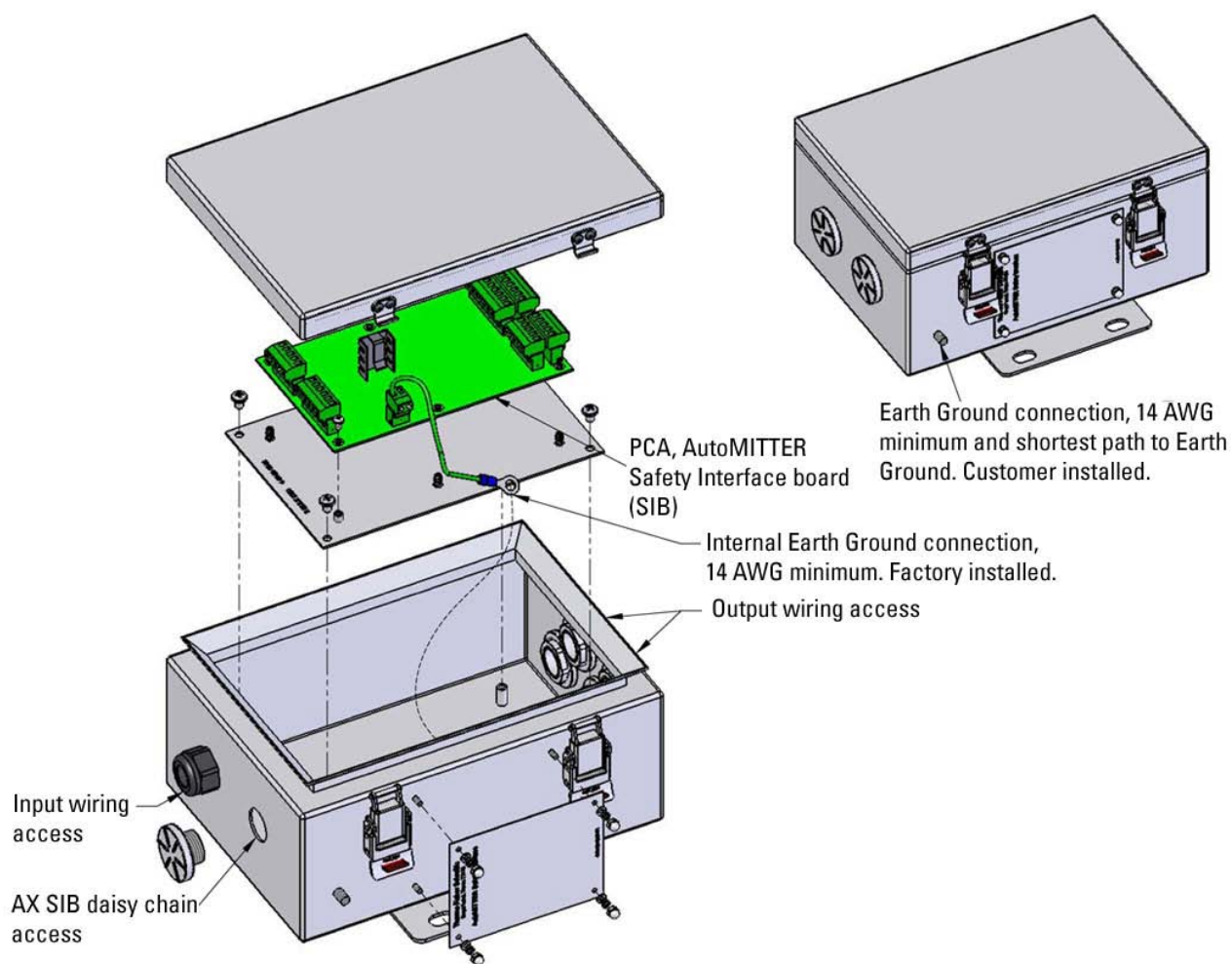


Figure E-36. 0-0443-1036: Exploded view of AutoMITTER SI system, ATEX/Brazilian installations

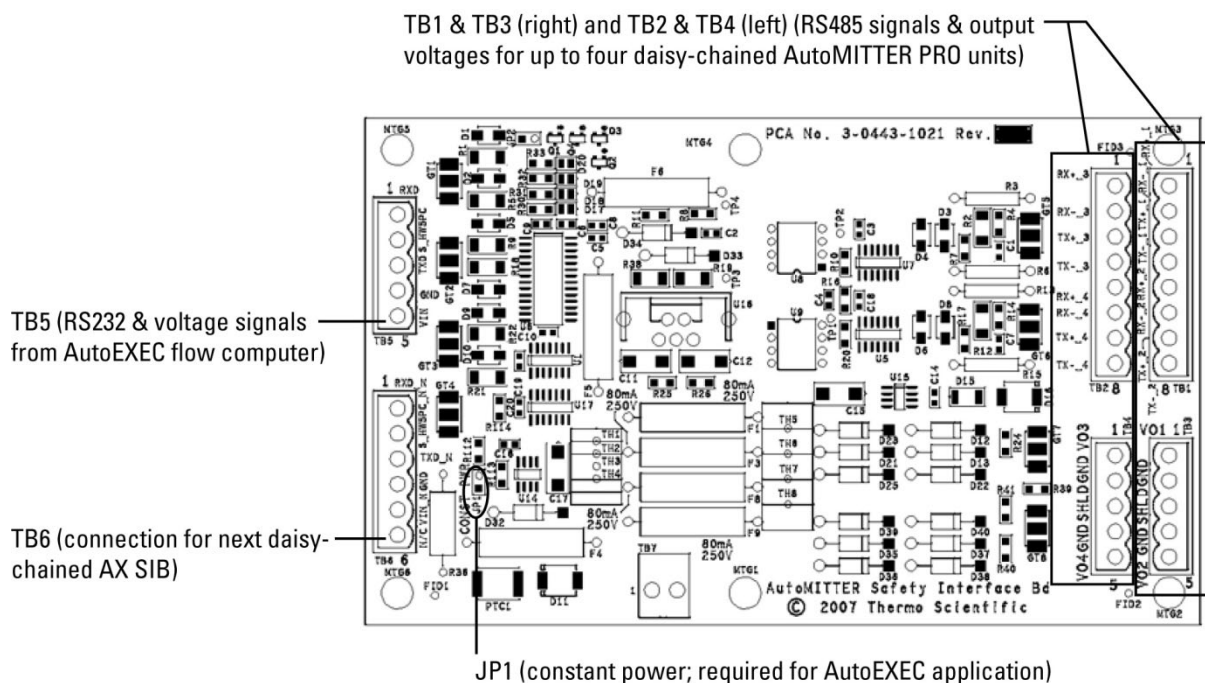
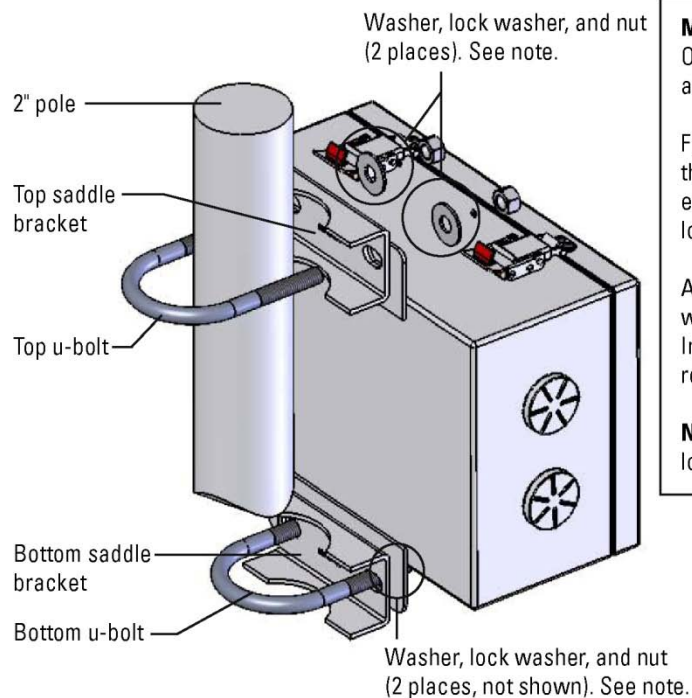


Figure E-37. 3-0443-1021: AutoMITTER SIB PCA, ATEX/Brazilian installations



Mounting instructions

On the installation pole, position one u-bolt and saddle bracket at the required height.

Fit the enclosure onto the pole by inserting the u-bolt into the holes at the top of the enclosure. Secure both sides with a washer, lock washer, and nut.

Align the holes on the second saddle bracket with the holes on the bottom of the enclosure. Insert the remaining u-bolt and secure with remaining hardware.

NOTE: Install hardware in this order: washer, lock washer, nut.

Figure E-38. AutoMITTER SI enclosure mounting, ATEX/Brazilian installations

AutoEXEC = AE

AutoMITTER Safety Interface = AXSI

AutoMITTER PRO = AXP

Next AXP in parallel = AXPr

OVERALL SYSTEM WIRING LAYOUT

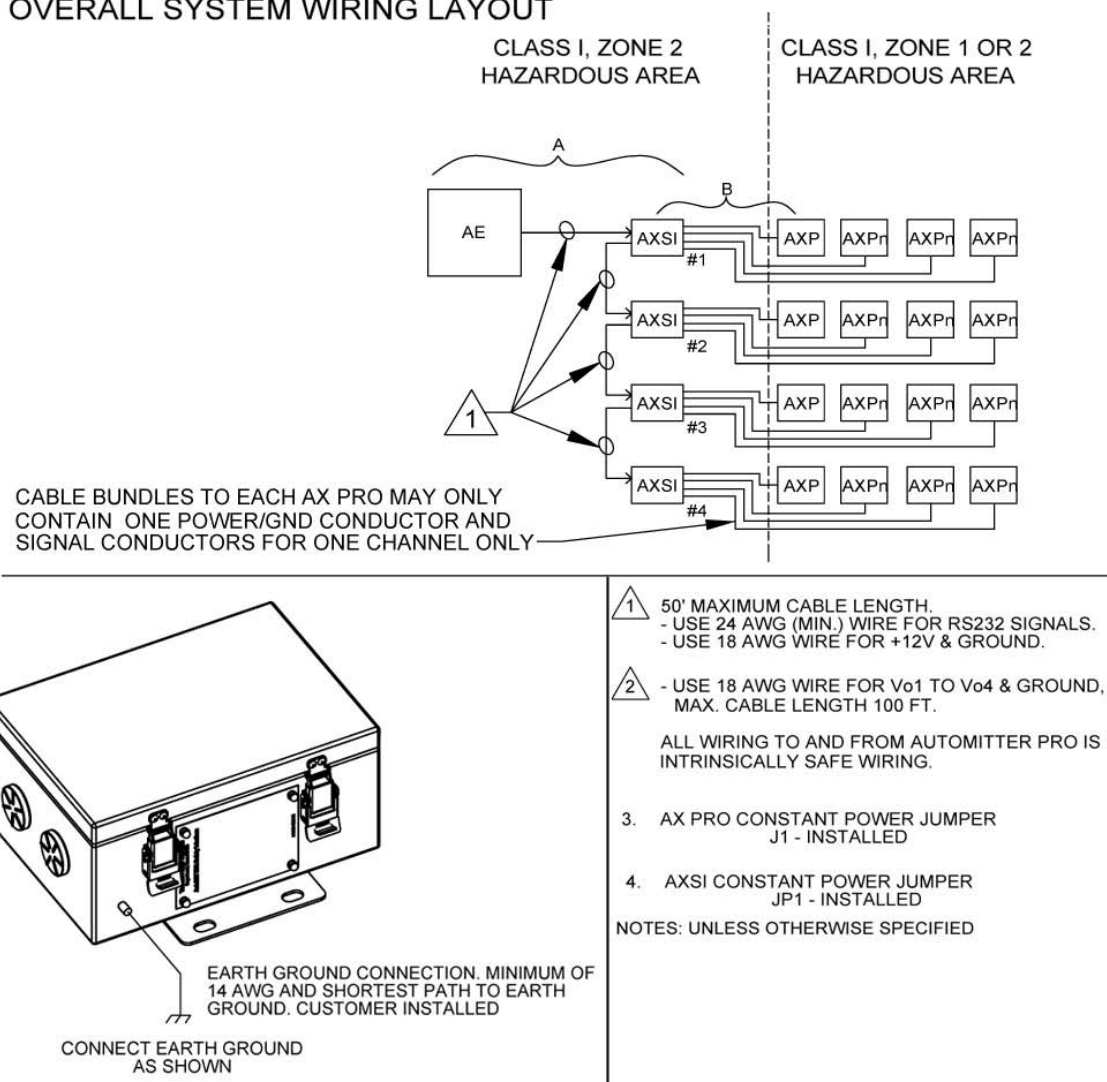


Figure E-39. 0-0443-1036: AutoMITTER SI system wiring diagram, ATEX/Brazilian installations (1 of 2)

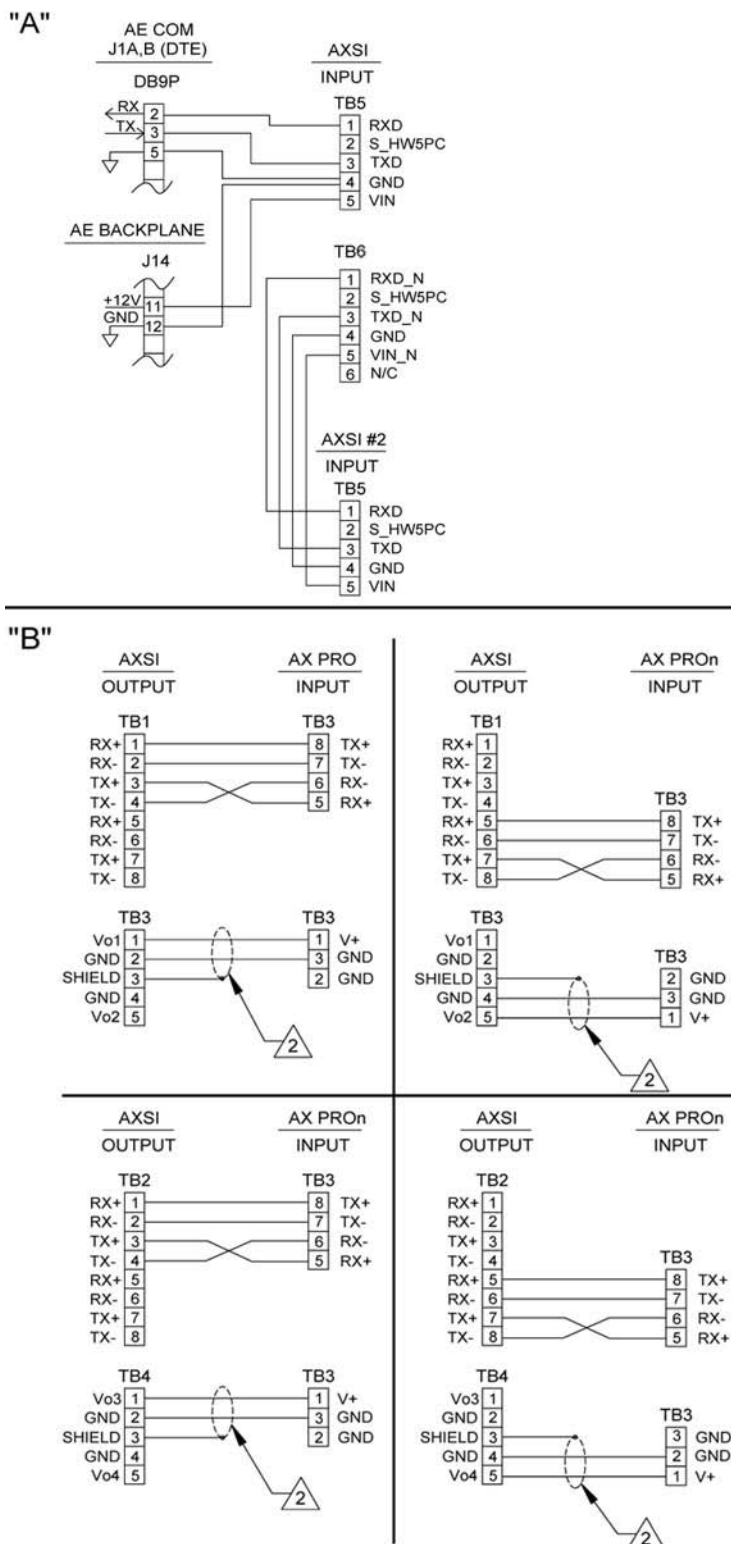


Figure E-40. 0-0443-1036: AutoMITTER SI system wiring diagram, ATEX/Brazilian installations (2 of 2)

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