FB2200 Flow Computer Instruction Manual



Energy and Transportation Solutions

EMERSON

Application & Device Safety Considerations

- ## Reading these Instructions
  Before operating a device or application, read these instructions carefully and understand their safety implications. In some situations, improper use may result in damage or injury. Keep this manual in a convenient location for future reference. Note that these instructions may not cover all details or variations in equipment or cover every possible situation regarding installation, operation, or maintenance. Should problems arise that are not covered sufficiently in the text, immediately contact Energy and Transportation Solutions (ETS) Customer Support for further information.

- ## Protecting Operating Processes
  The failure of a device or application – for whatever reason – may leave an operating process without appropriate protection and could result in possible damage to property or injury to persons. To protect against this, review the need for additional backup equipment or provide alternate means of protection (such as alarm devices, output limiting, fail-safe valves, relief valves, emergency shutoffs, emergency switches, etc.). Contact ETS for additional information.

- ## Using Qualified Personnel
  Installation, configuration, and any subsequent modifications to a device or application should only be performed by qualified, suitably trained personnel information.

- ## System Training
  A well-trained workforce is critical to the success of your operation. Knowing how to correctly install, configure, program, calibrate, and troubleshoot your Emerson equipment provides your engineers and technicians with the skills and confidence to optimize your investment. ETS offers a variety of ways for your personnel to acquire essential system expertise. Our full-time professional instructors can conduct classroom training at several of our corporate offices, at your site, or even at your regional Emerson office. You can also receive the same quality training via our live, interactive Emerson Virtual Classroom and save on travel costs. For our complete schedule and further information, contact the ETS Training Department at 800-338-8158 or email us at *education@emerson.com*.

- ## Grounding Equipment
  Ground metal enclosures and exposed metal parts of electrical instruments in accordance with relevant safety standards. For the USA, refer to OSHA rules and regulations as specified in *Design Safety Standards for Electrical Systems*, 29 CFR, Part 1910, Subpart S, dated: May 16, 1981 (OSHA rulings are in agreement with the National Electrical Code). For international locations, refer to IEC 60364-4-41: PROTECTION AGAINST ELECTRIC SHOCK. You must also ground mechanical or pneumatic instruments that include electrically operated devices such as lights, switches, relays, alarms, or chart drives. The chassis (or earth ground) lug provides a safe connection point to a customer-designated ground location for ESD and transient voltage suppression. Do not use the chassis ground lug for signal, common, or return connections. **Do not connect the chassis ground lug directly to a lightning arrestor/lightning rod.** Do not run signal wiring in conduit or open trays with power wiring or near heavy electrical equipment. If shielded wiring is used, ground the shield of the signal wiring at any one point of the signal loop.

  Important: Complying with the codes and regulations of authorities having jurisdiction is essential to ensuring personnel safety. The guidelines and recommendations in this manual are intended to meet or exceed applicable codes and regulations. If differences occur between this manual and the codes and regulations of authorities having jurisdiction, those codes and regulations must take precedence.

- ## Protecting from Electrostatic Discharge (ESD)
  Any device contains sensitive electronic components which can be damaged by exposure to an ESD voltage. Depending on the magnitude and duration of the ESD, it can result in erratic operation or complete failure of the equipment. Ensure that you correctly care for and handle ESD-sensitive components.

- ## Ethernet Connectivity
  This automation device is intended to be used in an Ethernet network which **does not** have public access. The inclusion of this device in a publicly accessible Ethernet-based network is **not recommended**.

- ## Returning Equipment
  If you need to return any equipment to ETS, it is your responsibility to ensure that the equipment has been cleaned to safe levels, as defined and/or determined by applicable federal, state and/or local law regulations or codes. You also agree to indemnify ETS and hold ETS harmless from any liability or damage which ETS may incur or suffer due to your failure to ensure device cleanliness.

Important
This controlled document includes **Underwriters Laboratories (UL)** safety instructions for use/installation of the Emerson FB2200 Flow Computer in hazardous locations.

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Special Instructions for Class I Division 2 Locations UL-2

ATEX/UKEx Increased Safety Zone 2 Certifications UL-6

Special Instructions for Class I Division 2 Locations

1. The Emerson FB2200 Flow Computer is listed by Underwriters Laboratories (UL) as non-incendive and is suitable for use in Class I, Division 2, Groups A, B, C and D hazardous locations or nonhazardous locations. Read this document carefully before installing a non-incendive Emerson FB2200 Flow Computer. Refer to the *Emerson FB2200 Flow Computer Instruction Manual (D301784X012)* for general information. In the event of a conflict between D301784X012 and this document, always follow the instructions in this document.
2. The Emerson FB2200 Flow Computer includes both non-incendive and unrated field circuits. Unless a circuit is specifically identified in this document as non-incendive, the circuit is unrated. Unrated circuits must be wired using wiring methods as specified in *Article 501-4(b)* of the *National Electrical Code (NEC), NFPA 70* for installations in the United States, or as specified in *Section 18-152* of the *Canadian Electrical Code* for installation in Canada.
3. All communication ports terminate on the terminal plate within the enclosure. Wiring to the connectors is unrated. No connections may be made to communication ports unless the user ensures that the area is known to be nonhazardous. Connections to the "Local Port" are temporary and must be short in duration to ensure that flammable concentrations do not accumulate while it is in use.
4. An RTD may be supplied with the Emerson FB2200 Flow Computer. Connection to the RTD is approved as a non-incendive circuit so that Division 2 wiring methods are not required.
5. I/O connections are unrated and must be wired using Division 2 wiring methods.

⚠ DANGER

EXPLOSION HAZARD: Do not connect or disconnect equipment unless power has been removed or the area is known to be non-hazardous.

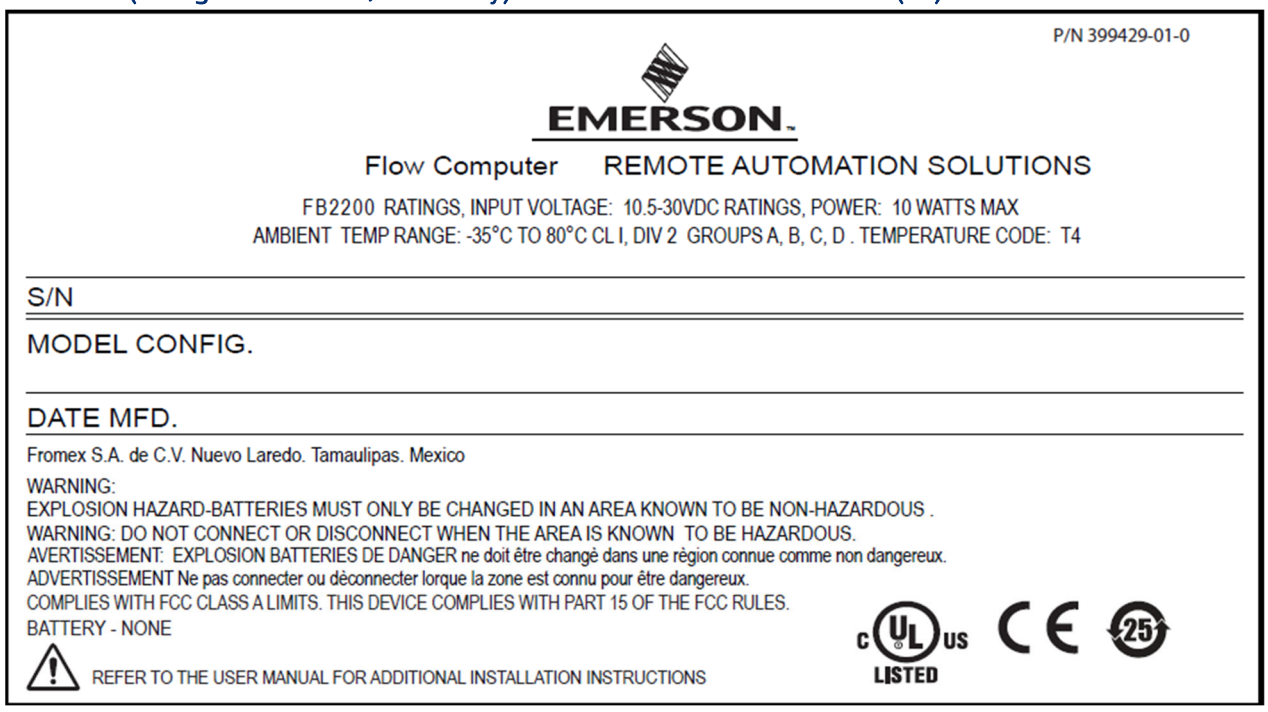
⚠ DANGER

EXPLOSION HAZARD: Substitution of any components may impair suitability for Class I, Division 2.

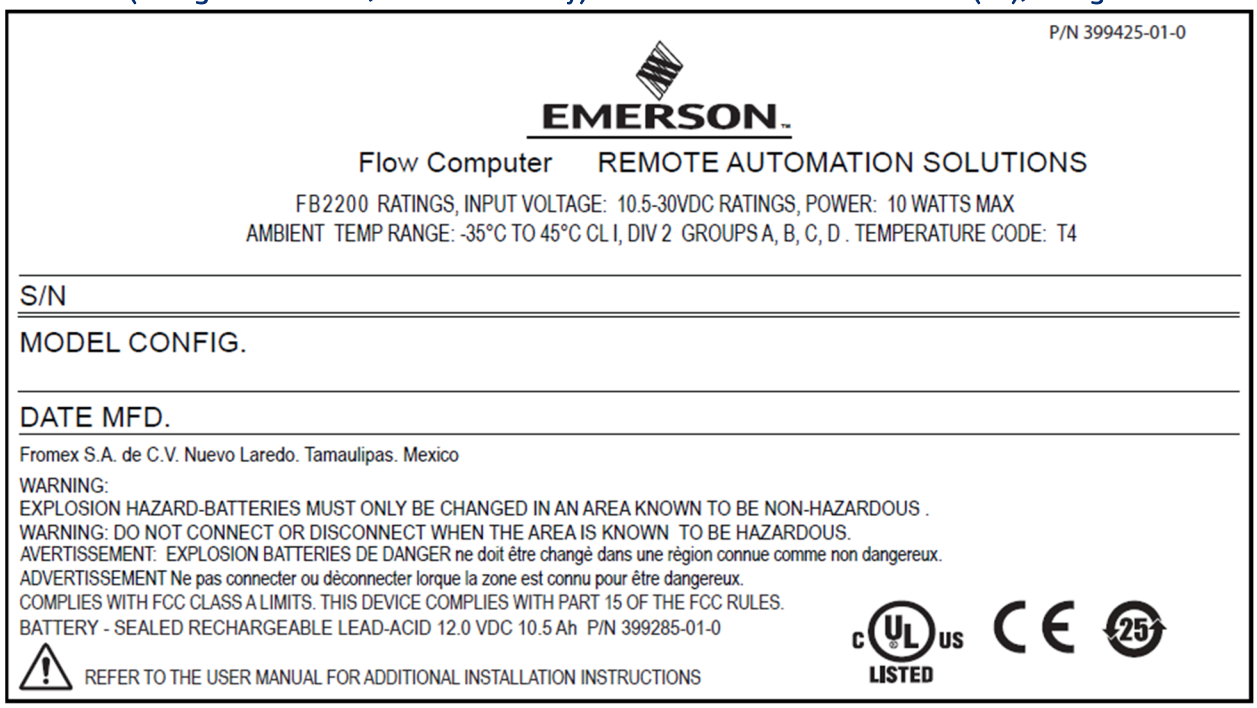
⚠ DANGER

EXPLOSION HAZARD: Do not replace batteries unless power has been switched off or the area is known to be non-hazardous. Batteries must only be changed in an area known to be non-hazardous.

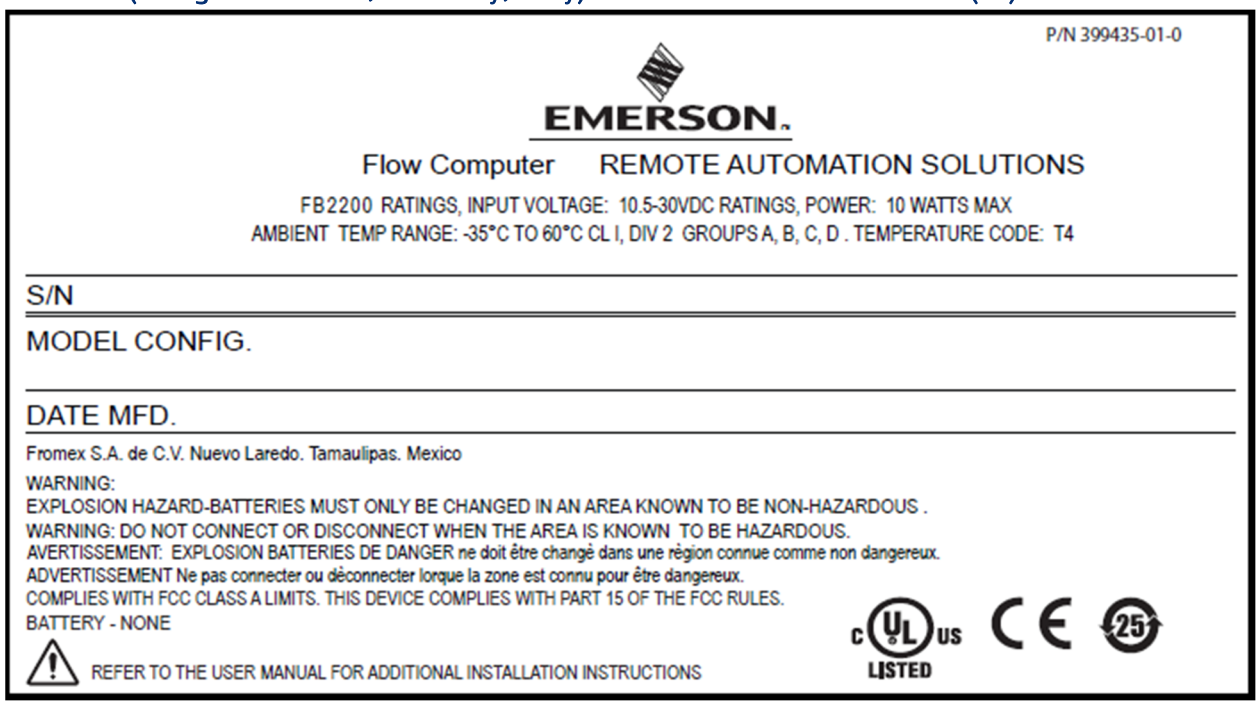
Data Plate (Fiberglass Enclosure, No Battery) - Class I Division 2 Non-incendive (UL)



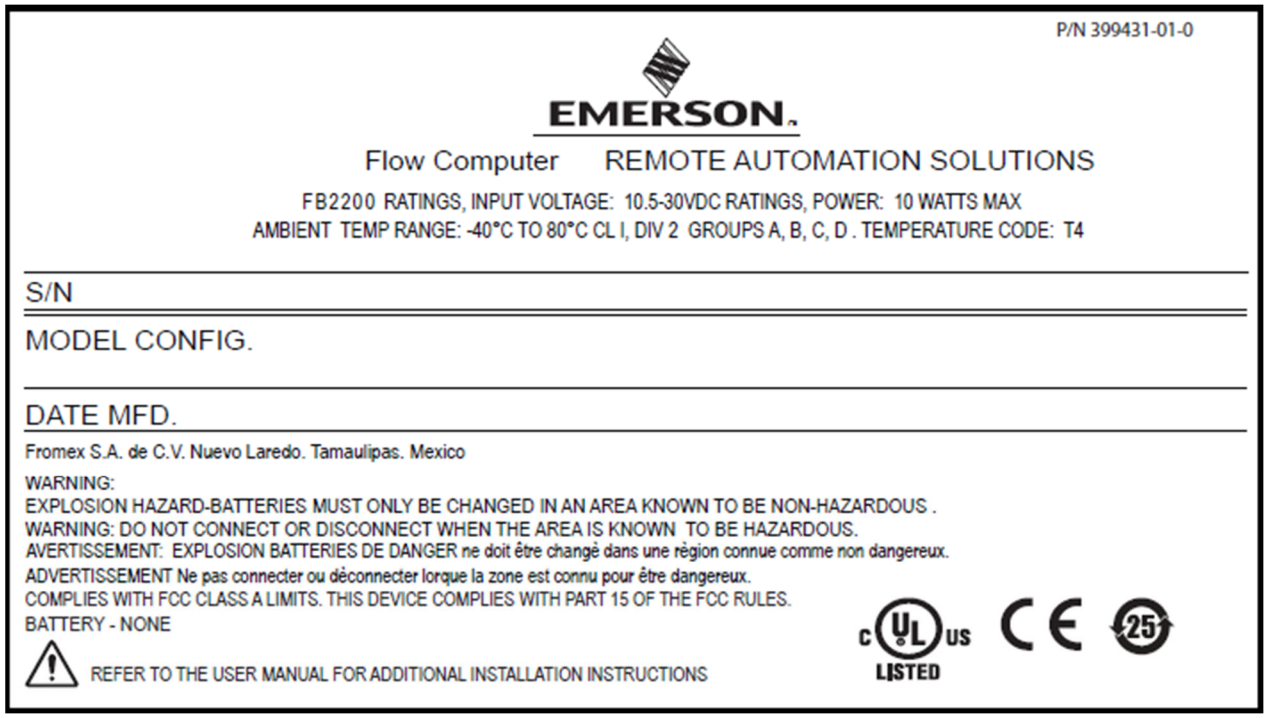
Data Plate (Fiberglass Enclosure, Lead Acid Battery) - Class I Division 2 Non-incendive (UL), Fiberglass Enclosure



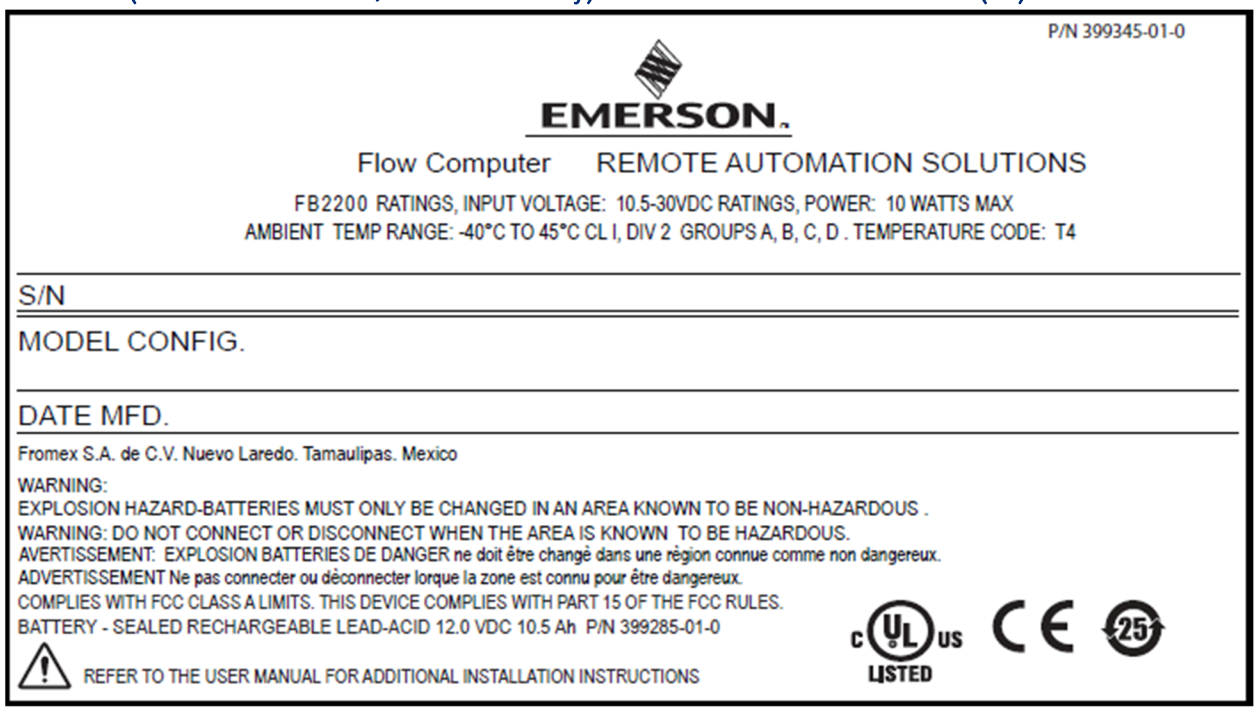
Data Plate (Fiberglass Enclosure, No Battery, Relay) - Class I Division 2 Non-incendive (UL)



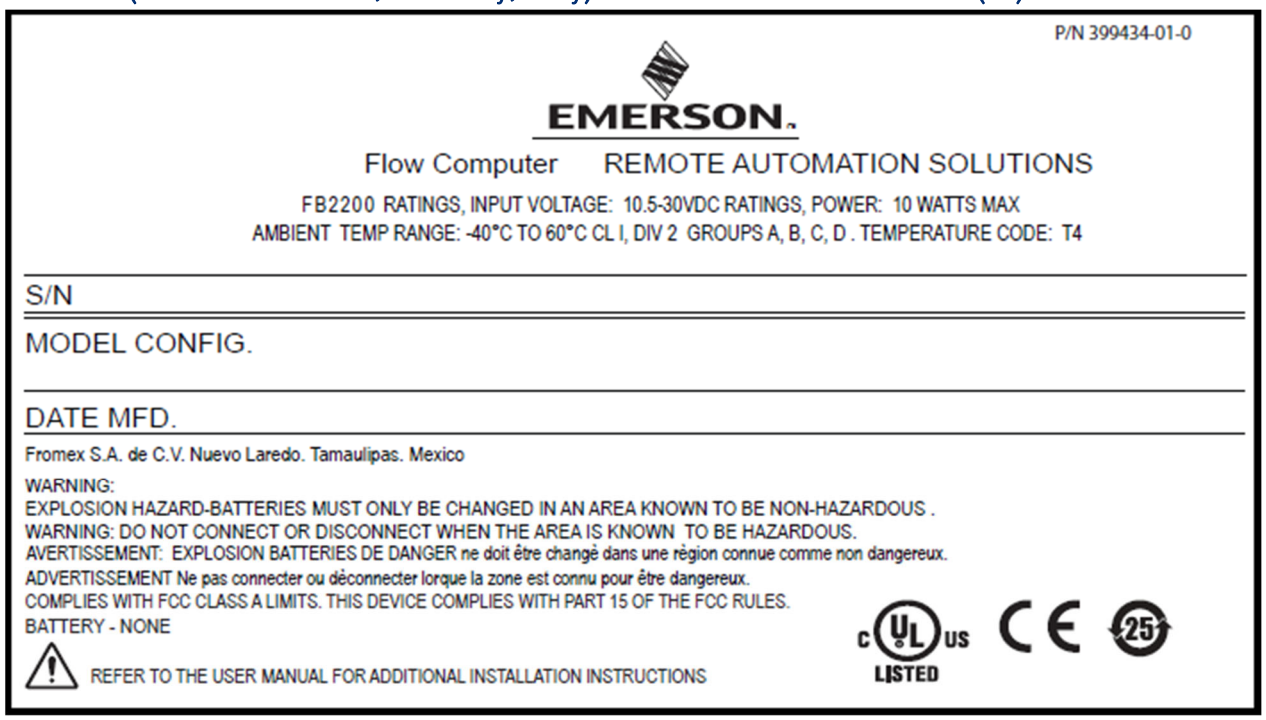
Data Plate (Aluminum Enclosure, No Battery) - Class I Division 2 Non-incendive (UL)



Data Plate (Aluminum Enclosure, Lead Acid Battery) - Class I Division 2 Non-incendive (UL)



Data Plate (Aluminum Enclosure, No Battery, Relay) - Class I Division 2 Non-incendive (UL)



ATEX/UKEx Increased Safety Zone 2 Certifications

This document includes notes on ATEX/UKEx certifications. For full details, please refer to the *Emerson FB2200 Flow Computer Safe Use Instructions* (D301801X012).

Special Conditions of Use:

- Use equipment in an area of not more than pollution degree 2.
- Make provisions to ensure, in the event of transient disturbances, that the rated voltage does not exceed 140 percent of the peak rated voltage.
- Lead acid battery and solar power options are not for use in ATEX/UKEx applications.
- Impact tests on the display were conducted based on Group II values for the low risk of mechanical danger, in accordance with *Table 15* of both *EN IEC 60079-0:2018* and *IEC 60079-0 7th Edition*. Install flow computers with displays in areas where the risk of impact is low.
- For Zone 2 installations, ensure that the flow computer is installed and used in such a way to prevent the danger of electrostatic charges.
- The FB2200 enclosure must require a tool to permit access.
- Refer to field replacement guides for replacement of the following parts:

Replacement Part	Kit Number	Field Replacement Guide document number:
8-Channel Expansion I/O Module	400217010-KIT	D301804X012
6-Channel Expansion I/O Module	400215010-KIT	D301803X012
HMI Module Display Assembly	399379-01-0, 621627011-KIT, 399380-01-0, 621627020-KIT	D301822X012
I/O Termination Board	400210010-KIT, 358807010-KIT	D301805X012
CPU Enclosure and Electronics	621673-01-0, 621674-01-0, 621675-01-0, 621676-01-0, 621678-01-0, 400209010-KIT, 399260-	D301803X012
Sensor	Variable Kit Number	D301843X012
Door Accessories	399291-01-0, 399267-01-0, 399266-01-0, 621661010-KIT, 399394-00-0	D301825X012
Relay	395828-01-0	D301847X012
Coin Cell Battery	395620-03-1	D301855X012

This device was evaluated according to the following standards:

- *IEC 60079-0 7th Edition*
- *IEC 60079-7, Edition 5.1*
- *EN IEC 60079-0 :2018*
- *EN 60079-7:2015 + A1:2018*

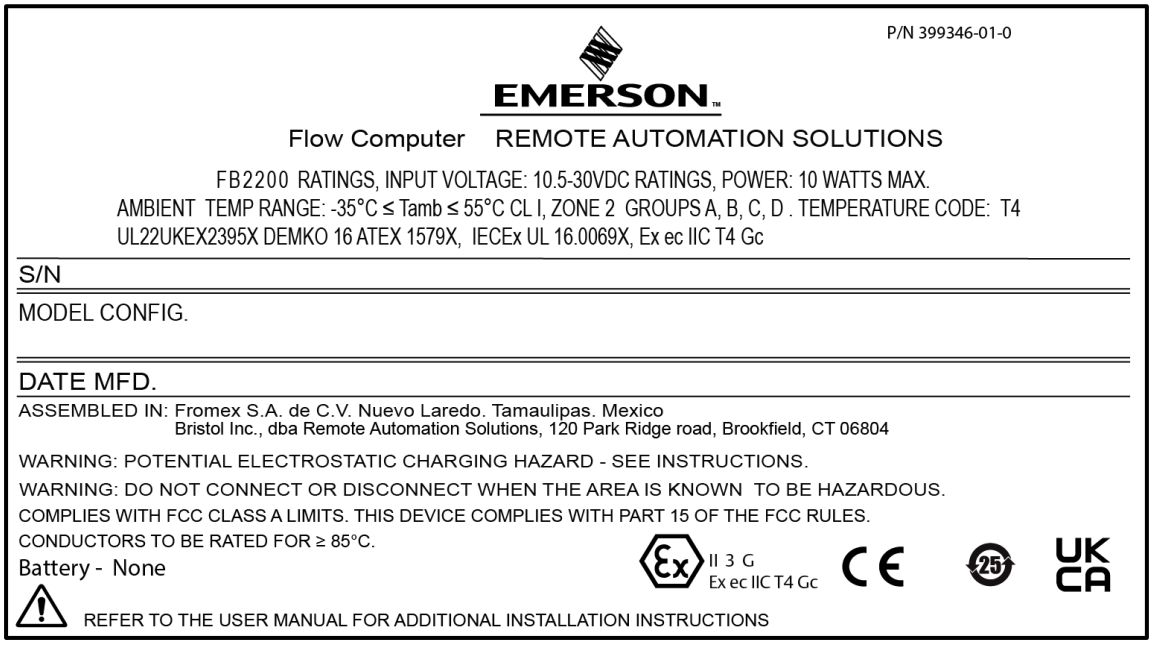
Enclosure Rating: IP54

Terminal blocks for the FB2200 have the following characteristics:

- Terminal blocks can accommodate two conductors per channel.
- Stranded or solid wire allowed.
- Torque values: NM 0.5-0.6
- Wire size: 28-12 AWG (0.08 – 3.3 mm^2); (0.32 – 2.05 mm)

Bristol Inc.
120 Park Ridge Road
Brookfield, CT 06804 U.S.A.

Data Plate (Fiberglass Enclosure, No Battery) – ATEX ec/UKEx Increased Safety



This confirms compliance with the European ATEX Directive 2014/34/EU as well as the United Kingdom UKEx regulation UKSI 2016/1107 (as amended by UKSI 2019:696).

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Chapter 1: Introduction

This chapter covers the following topics:

- Safety Labels
- Features
- FB2200 Flow Computer Models
- Central Processing Unit (CPU)
- Inputs & Outputs (I/O)
- Power Options
- Communications
- Human-Machine Interface (HMI) Module
- FBxWifi™ Communications
- Software Tools
- RoHS2 Compliance
- Physical Security
- Secure Gateway

The Emerson FB2200 Flow Computer measures pressure, differential pressure, and temperature for one or two meter runs of natural gas. It works with both differential pressure-based meters measuring static pressure (SP), differential pressure (DP), and temperature (T), and linear meters measuring pulse or analog inputs, SP, and T.

This manual describes how to install and configure the Emerson FB2200 flow computer hardware.

For information on using the FBxConnect™ configuration software, see the online help that accompanies FBxConnect.

Figure 1-1. FB2200 Flow Computer



1 HMI module
2 Front cover
3 Data plate
4 Enclosure
5 Sensor module

1.1 Safety Labels



This product may display safety label(s) to identify potential hazards. The same types of notices appear within the documentation. Whenever you see an exclamation point (!) enclosed within a triangle (shown to the left), consult the documentation for additional safety information about the hazard and how to avoid it. The labels used are:

⚠ DANGER

MAY CAUSE DEATH

Observe all precautionary signs posted on the equipment.

Failure to do so may result in death or serious injury to personnel.

⚠ WARNING

DANGER TO PERSONNEL AND EQUIPMENT

Observe all precautionary signs posted on the equipment.

Failure to do so may result in injury to personnel or cause damage to the equipment.

⚠ CAUTION

MAY CAUSE INJURY TO PERSONNEL OR DAMAGE EQUIPMENT

Observe all precautionary signs posted on the equipment.

Failure to do so may result in injury to personnel or cause damage to the equipment.

⚠ SAFETY FIRST

General instructions and safety reminders.

1.2 Features

The FB2200 flow computer includes the following key features:

- Enclosure suitable for use in Class I Division 2 non-incendive and Ex ec Zone 2 non-sparking environments. Enclosure available in either aluminum or compression-molded fiberglass
- Optional Integral multi-variable sensor for measurement of Pressure (P) and Differential Pressure (DP)

- Optional static pressure sensor, typically used with linear meters
- Connections for customer-supplied resistance temperature detector (RTD) for measurement of temperature (T)
- Base I/O consists of two on-board channels you can individually configure as digital input (DI), digital output (DO), or pulse input (PI) and two on-board I/O channels you can individually configure as either analog input (AI) or analog output (AO). Optional expansion I/O modules are available.
- Power from a DC power supply or an optional lead acid battery/solar panel combination
- Serial communication options for RS-232, RS-485 (4-wire), and RS-485 (2-wire)
- Optional 10/100 Base T-Ethernet port
- HMI module with optional display and back light for local operator interaction
- Optional Wi-Fi® transceiver (802.11 b/g) enabling a field technician to access the flow computer from a laptop without physical cable connection
- Application software supports AGA3, AGA8, ISO 5167, ISO 6976, and API 21.1 calculations in either U.S., metric, or other natural gas standard units

1.3 FB2200 Flow Computer Models

You can purchase two basic models of the FB2200 flow computer. In addition, each model is available in either an aluminum enclosure or a compression-molded fiberglass enclosure.

Either model includes two ¾ in NPT pipe-threaded conduit ports on the bottom of the enclosure to permit entry of field conduit for I/O and communication wiring.

1.3.1 FB2200 Flow Computer – With Sensor

This version includes either a multi-variable (MV) sensor module (*Figure 1-2*) or a static pressure sensor module (not shown).

Figure 1-2. FB2200 Flow Computer – Multivariable Sensor Version



1.3.2 FB2200 Flow Computer – No Integral Sensor

The no integral sensor version includes no sensor module. In this case the process variable data used in flow computer calculations comes from external devices and enters the device through the serial ports or I/O channels.

Figure 1-3. FB2200 Flow Computer – No Integral Sensor Version



1.4 Central Processing Unit (CPU)

The flow computer's CPU is a NXP® Kinetis® K61 series CPU with an ARM® Cortex® M4 processor that operates at 4 to 60 MHz depending on the power mode. The CPU runs the Micrium operating system.

1.4.1 Memory

The flow computer includes both static and flash memory.

Table 1-1: Memory

Memory	Usage
8 MB SRAM	Holds in-use configuration, current state of all variables
128 MB Flash	Holds firmware image, historical logs, configuration backup (if saved to flash), and the executing program

1.5 Inputs & Outputs (I/O)

The flow computer comes with base I/O from both the CPU and the built-in multi-variable (MV) sensor.

Base I/O consists of:

- Pressure (P) input from the MV sensor, differential pressure (DP) input from the MV sensor, connections for temperature (T) input from a customer-supplied RTD/PRT - *or* – a single Static Pressure Sensor with RTD/PRT connections. Alternatively, you can purchase the flow computer without an integral sensor.
- Two on-board I/O channels that you can individually configure as digital input (DI), digital output (DO), or pulse input (PI)
- Two on-board I/O channels that you can individually configure as either analog input (AI) or analog output (AO)

An optional 8-channel expansion I/O board includes:

- Four I/O channels that you can individually configure as digital inputs (DI), digital outputs (DO), or pulse inputs (PI)
- Four I/O channels that you can individually configure as either analog inputs (AI) or analog outputs (AO)

If the optional 8-channel expansion I/O board is present, the device can optionally support an additional 6-channel expansion I/O board which includes:

- Four I/O channels that you can individually configure as digital inputs (DI), digital outputs (DO), or pulse inputs (PI)
- Two I/O channels that you can individually configure as either analog inputs (AI) or analog outputs (AO)

Table 1-2. FB2200 I/O Configurations

FB2200 Base Unit	FB2200 purchased with 8-channel Expansion I/O Module	FB2200 purchased with 8-channel Expansion I/O Module and 6-channel Expansion I/O Module
▪ MV Sensor (P, DP) or Static Pressure (SP) Sensor ▪ Connections for customer-supplied 2-, 3-, or 4-wire RTD/PRT	▪ MV Sensor (P, DP) or Static Pressure (SP) Sensor ▪ Connections for customer-supplied 2-, 3-, or 4-wire RTD/PRT	▪ MV Sensor (P, DP) or Static Pressure (SP) Sensor ▪ Connection for customer-supplied 2-, 3-, or 4-wire RTD/PRT
2 DI/DO/PI channels	6 DI/DO/PI channels (4 residing on the 8-channel expansion I/O module).	10 DI/DO/PI channels (4 residing on the 8-channel expansion I/O module and 4 residing on the 6-channel expansion I/O module)
2 AI/AO channels	6 AI/AO channels (4 residing on the 8-channel expansion I/O module).	8 DI/DO channels (4 residing on the 8-channel expansion I/O module and 2 residing on the 6-channel expansion I/O module)

1.6 Power Options

You can power the flow computer using an external DC input, or an internal rechargeable battery connected to a solar panel.

Important

Use **only** batteries supplied with the flow computer or sold by Emerson Remote Automation Solutions as spare parts for this flow computer. If you substitute a battery you obtain elsewhere you will void your certification unless it is the identical part from the same manufacturer as that supplied with the flow computer from Emerson.

Table 1-3. Power Options

Option	Usage
External DC Power Supply	10.5 Vdc to 30 Vdc external supply (Max power at 10 watts)
Lead Acid Battery Pack	▪ 12 Vdc ▪ 10.5 Ah ▪ Not suitable with ATEX or IECEx applications ▪ Optional solar panel and charge controller to charge battery (supplied separately)

1.7 Communications

The flow computer includes three serial communication ports and one Ethernet port. The serial ports allow communication using DNP3, Modbus, BSAP, and ROC protocols. The Ethernet port is an RJ-45 connector; the FB2200 supports a maximum of six concurrent TCP connections (sockets) through this port.

Table 1-4. Serial Ports

Port	Type	Use
COM 1	▪ Serial communications ▪ Software-selectable for RS-232, RS-485/422 (4-wire), or RS-485 (2-wire) operation ▪ 4-wire	RS-232, RS-485 (4-wire), or RS-485 (2-wire) communication to host or other devices. 4-wire used with external radio. **Note:** Under older standards RS-485 (4-wire) is identified as RS-422.
COM 2	▪ Serial communications ▪ Software-selectable for RS-232 or RS-485 (2-wire) operation ▪ 2-wire	RS-232 or RS-485 (2-wire) communication to host or other devices.
COM 3	▪ Serial communications ▪ Software-selectable for RS-232 or RS-485 (2-wire) operation ▪ 2-wire	RS-232 or RS-485 (2-wire) communication to host or other devices.

1.8 Human-Machine Interface (HMI) Module

The flow computer includes an HMI module with an optional liquid crystal display (LCD) for local operator access to the device. The LCD, if present, shows a series of menus that

sequentially displays the current values of particular process variables. A configuration parameter in FBxConnect determines whether you must first log in to view the menus. If required, you log in by selecting alphanumeric characters by scrolling through a list until you select the correct character.

The HMI module includes four LEDs to provide status information. Units with the display include four infrared (IR) buttons for operator interaction.

To conserve power the HMI module enters sleep mode after a period of inactivity. Sleep mode disables FBxWifi communication. In FBxConnect, you can configure the number of minutes of inactivity triggering sleep mode through the LCD Sleep Time parameter. Setting this parameter to 0 disables sleep mode which keeps the HMI module on but uses significantly more power.

Figure 1-4. HMI Module with LCD



Figure 1-5. HMI Module without LCD



Note

If your flow computer does not include the LCD option (shown in *Figure 1-4*), you still have the status LEDs and a single IR button for waking up the device (shown in *Figure 1-5*).

1.9 FBxWifi™ Communications

The flow computer has an optional Wi-Fi® transceiver (FBxWifi) that enables you to connect via a laptop or tablet from a distance. The distance supported varies depending on the laptop/tablet type and environmental conditions but is typically 70 to 100 feet from the front of the flow computer and 40 to 60 feet from the side and rear of the flow computer.

This capability allows an operator to potentially remain outside the hazardous location and still communicate with the flow computer. The operator's laptop must have Wi-Fi capability, line-of-sight access to the HMI module, and must be loaded with FBxConnect configuration software. Once connected, the operator can view process values, edit configuration parameters, and collect logs.

Note

The FBxWifi electronics reside inside the HMI module. The HMI module must be awake to use FBxWifi communications You can wake it up manually by holding a finger against the front cover glass over the Hold to Wake button (the left-most button) for typically from five to ten seconds.

1.10 Software Tools

The FBxConnect configuration software provides a series of wizards that allow you to perform configuration activities for the flow computer. You connect a PC running the FBxConnect configuration software to the flow computer using one of the communication ports or through a wireless connection. You can then:

- Set parameters within your application
- Configure I/O channels
- Specify the serial communication method for a port (RS-232 to RS-485) as needed
- View or collect audit trail information such as alarm, event, or historical logs
- Update system firmware

1.11 RoHS2 Compliance

Device without Integral MVS or SP Sensor:

RoHS (2) EU Directive 2011/65/EU

Device with Integral MVS or SP Sensor:

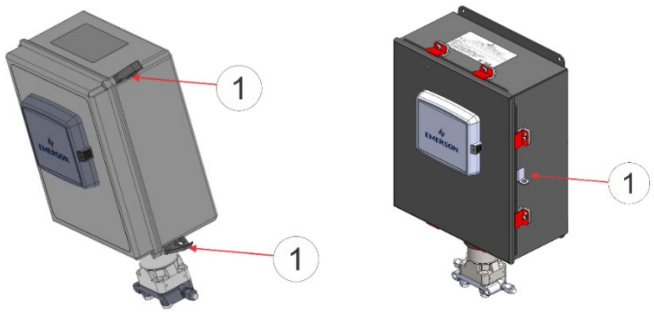
RoHS (2) EU Directive 2011/65/EU: This product may be considered out-of-scope when used for the intended design purpose in a Large Scale Fixed Installation (LSFI).

Consult *https://www.emerson.com/compliance* for up-to-date product information.

1.12 Physical Security

The flow computer enclosure enables you padlock the door shut. The fiberglass enclosure supports two padlocks (left in *Figure 1-6*); the aluminum enclosure supports one padlock (right in *Figure 1-6*).

Figure 1-6. Possible Padlock Locations

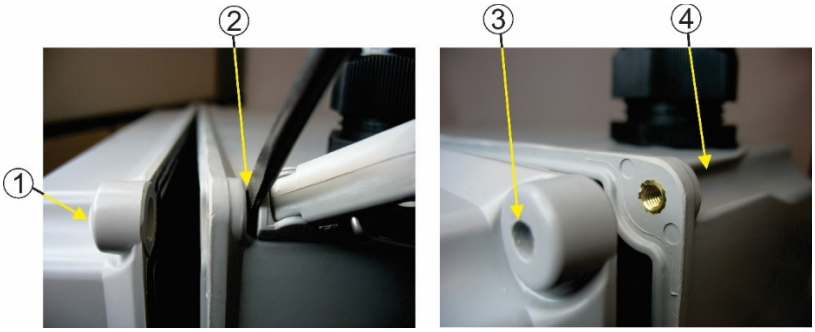


1 Location where customer-supplied padlocks can be used to lock the door

Holes in the door latches of the fiberglass enclosure allow you to attach a wire seal.

Alternatively, you can use a pan head screw (#10-32 X 0.81 316 SS or Monel alloy 400) with an O-ring (0.15 ID, 0.07 W) in place of one or both door latches to screw the door shut. In this case, you pry off the latch with a flat head screwdriver and pop out the mating cap to free up the holes for the screw.

Figure 1-7. Removing Cap and Latch from Fiberglass Enclosure

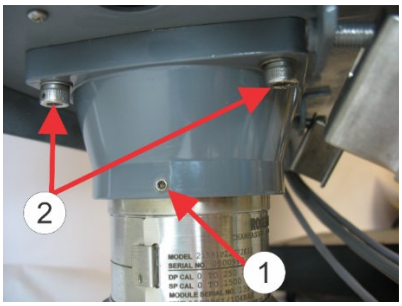


1 Cap
2 Prying off the latch
3 Cap removed
4 Latch removed

For ATEX/IEC-compliant installations with the fiberglass enclosure, you must use one of these three choices (padlock, wire seal, or screw).

For either enclosure type, you may apply tamper-evident tape to the four sensor coupling screws and two rotation set screws to provide evidence of unauthorized sensor adjustments. The four coupling screws also include holes through which you could attach a wire seal.

Figure 1-8. Potential Locations for Tamper-evident Tape



1 Rotation Set Screws (2) – One shown
2 Coupling Screws (4) – Two shown

1.13 Secure Gateway

For enhanced data security when using an IP/Ethernet connection or a serial connection into an IP terminal server, Emerson Remote Automation Solutions recommends adding an industrial router with VPN and firewall security. Recommended solutions include the MOXA EDR-810, the Hirschman Eagle One, or the Phoenix mGuard rs4000 (or equivalents). An example of how to install one of these devices to the RTU can be found in the Emerson Remote Automation Solutions MOXA® Industrial Secure Router Installation Guide (part number D301766X012). For further information, contact your Emerson Impact Partner or the individual vendor's website.

Chapter 2: Installation

This chapter covers the following topics:

- Hazardous Locations
- Environmental Specifications
- Required Tools
- Site Considerations
- General Wiring Guidelines
- Grounding
- Opening/Closing the Enclosure
- Mounting the Enclosure
- Power Modes
- Connecting Power
- Installing the Optional 30W Solar Panel
- Adjusting the Optional Solar Panel
- Connecting Communications Ports
- Door Contact Terminal

The flow computer ships from the factory fully assembled, except for the optional solar panel assembly.

2.1 Hazardous Locations

For North America the FB2200 has certifications for Class I Division 2 (Groups A, B, C, & D) non-incendive, and non-hazardous locations only. *Appendix A* contains special information for Class I Division 2 installations.

For other world areas the FB2200 has ATEX and IEC Ex certifications for Ex ec Zone 2 non-sparking installations and non-hazardous locations only. See *Appendix B* for more information.

All certifications are listed on the data plate located on the top of the device.

2.2 Environmental Specifications

This section summarizes the environmental specifications for the device. For full details, refer to the product data sheet *FB2200 Flow Computer* (D301792X012).

Table 2-1. Environmental Specifications

		Range	
Specification	**Configuration**	**Aluminum Enclosure**	**Fiberglass Enclosure**
Ambient Temperature	No battery, C1D2	–40 °C to +80 °C (-40 °F to +176 °F)	–35 °C to 80 °C (–31 °F to 176 °F)
	No Battery, C1D2, Relay installed	–40 °C to 60 °C (–40 °F to 140 °F)	–35 °C to 60 °C (–31 °F to 140 °F)
	Lead Acid Battery, C1D2	–40 °C to 45 °C (–40 °F to 113 °F)	–35 °C to 45 °C (–31 °F to 113 °F)
	ATEX/IEC Ex ec No Battery	–25 °C to 55 °C (–13 °F to 131 °F)	–25 °C to 55 °C (–13 °F to 131 °F)
Humidity		5% to 95% non-condensing	
Vibration		2g over 10 to 150 Hz; 1g over 150 to 200 Hz	

2.3 Required Tools

Certain tools and equipment are required for installing and servicing the flow computer.

Table 2-2. Required Tools

Tool	Use
Torque wrench	For bolting/mounting the flow computer
2.5 mm hexagonal wrench	For manipulating rotation set screw
#1 Phillips-head screwdriver	For screws on HMI module
#2 Phillips-head screwdriver	For screws on other modules and boards
#3 Phillips-head screwdriver	For optional aluminum enclosure clamps
1/8 inch flat-head screwdriver	For 5.08 mm pitch terminal block connections
7/32 inch flat-head screwdriver	For installing external solar controller
Utility knife	For installing external solar controller
Wire cutters	For installing external solar controller
Wire strippers	For installing external solar controller
Laptop PC running Field Tools with FBxConnect configuration software	For configuring

2.4 Site Considerations

The flow computer must reside in an accessible location for configuration and service. Refer to the dimensional drawings for information on the space required.

- Ensure the installation location provides easy access to the HMI module.
- If your unit includes the optional solar panel, ensure the installation location provides sufficient space to mount the solar panel and adequate sunlight to charge the battery.
- If your unit includes the optional FBxWifi ensure the installation location provides line-of-sight access to the transceiver.

Figure 2-1. Dimensions – Multivariable Sensor Version - Fiberglass Enclosure

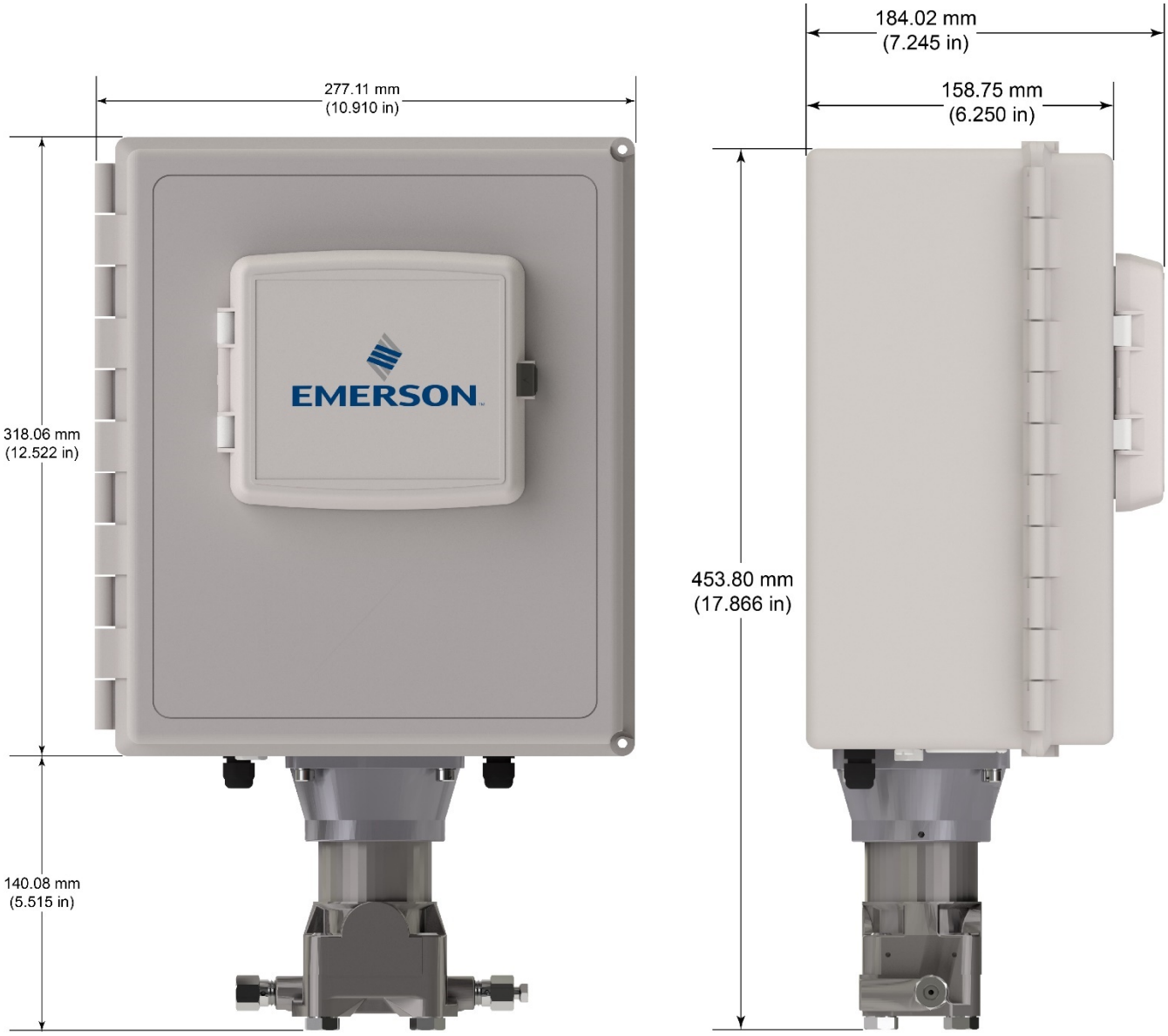


Figure 2-2. Dimensions – Multivariable Sensor Version - Aluminum Enclosure

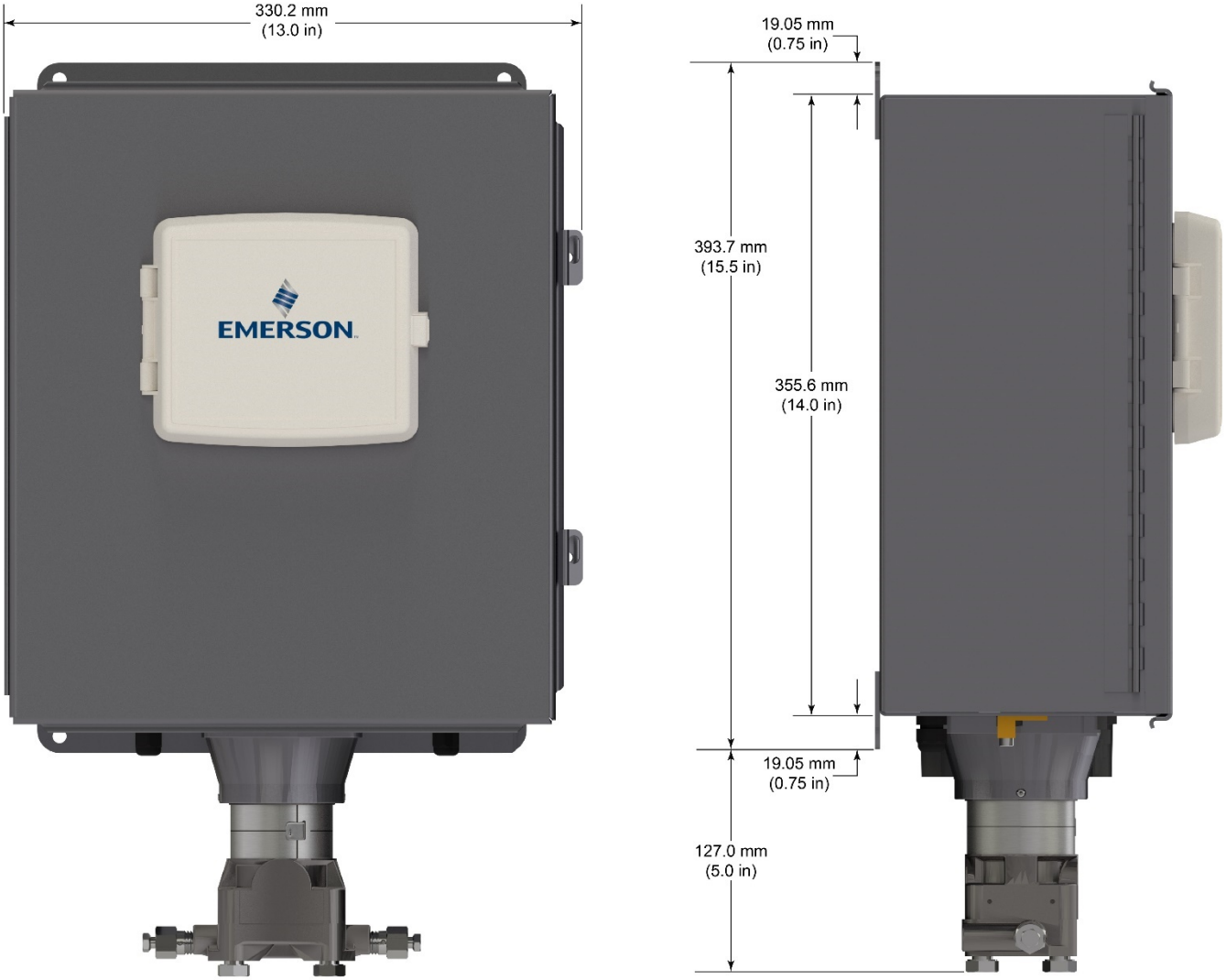


Figure 2-3. Dimensions – No Integral Sensor Version – Fiberglass Enclosure



Figure 2-4. Dimensions – No Integral Sensor Version – Aluminum Enclosure

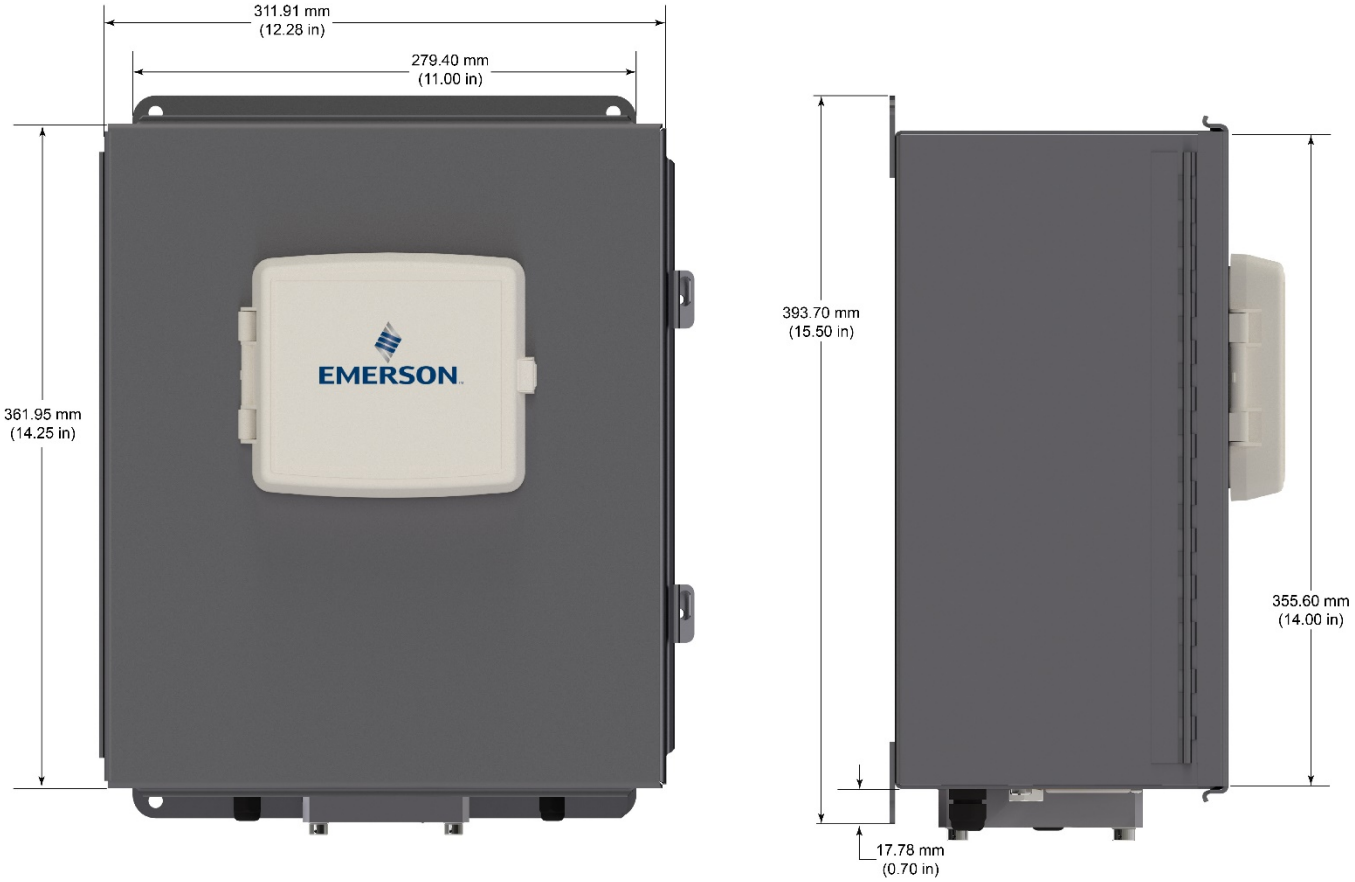


Figure 2-5. Dimensions – Static Pressure Sensor Version – Fiberglass Enclosure

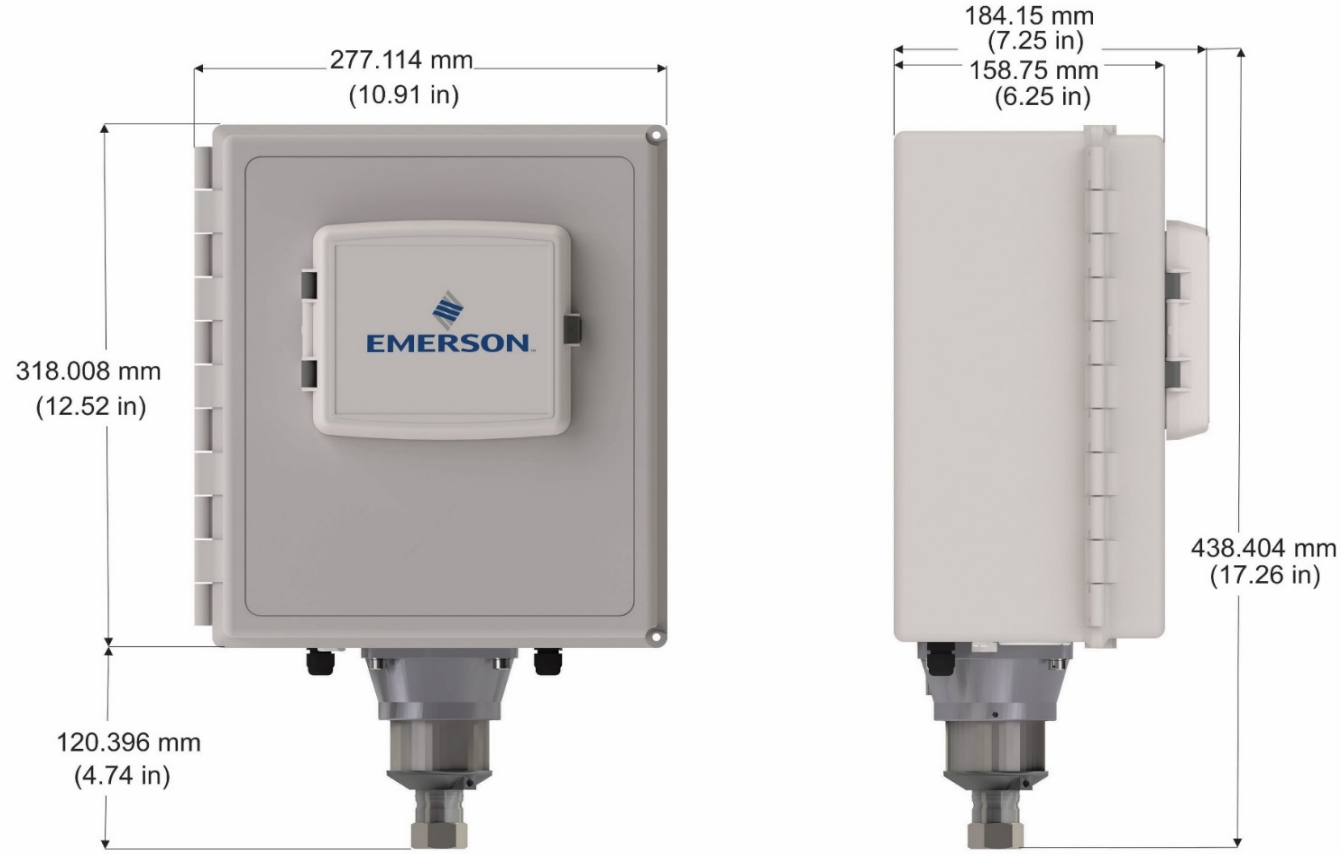
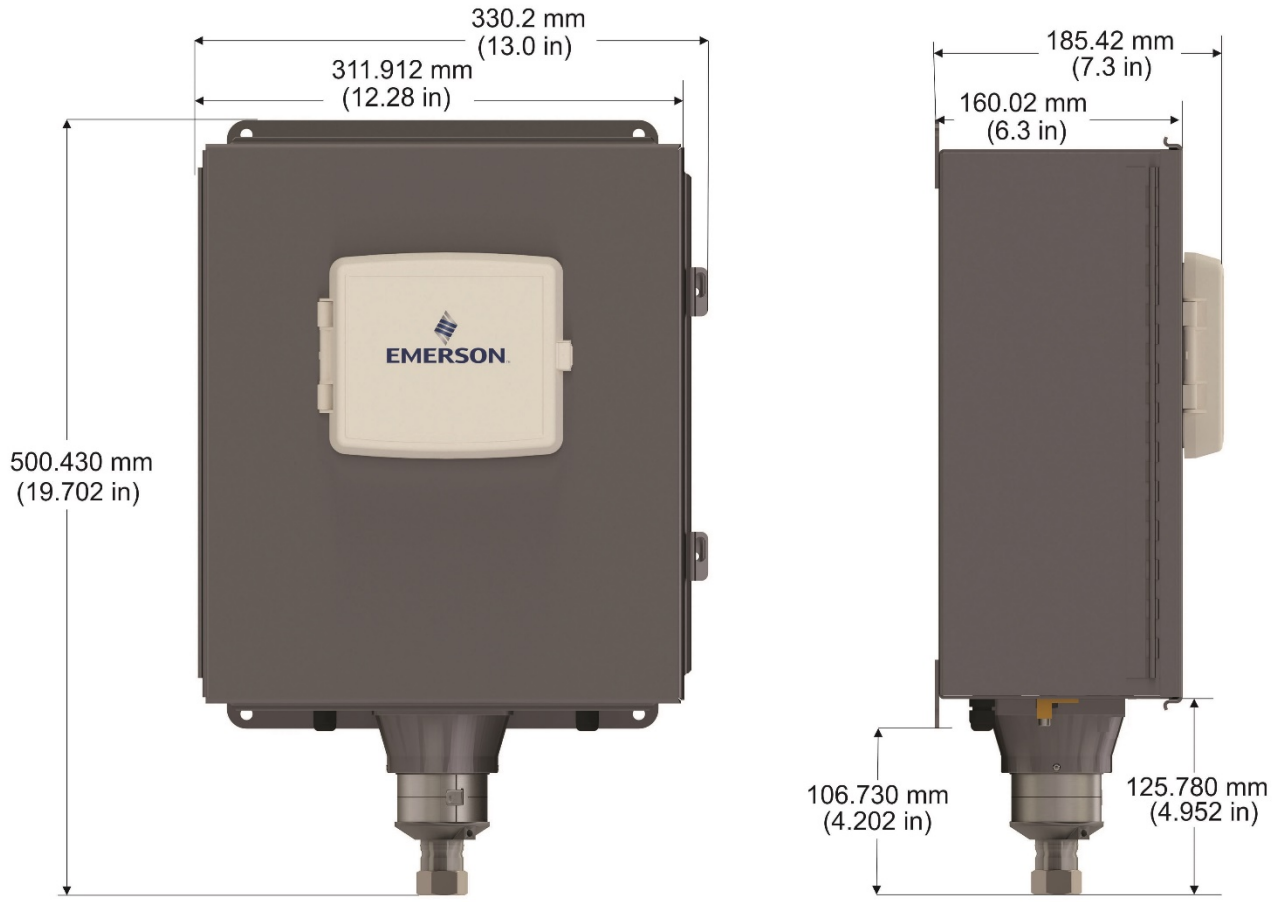


Figure 2-6. Dimensions – Static Pressure Sensor Version – Aluminum Enclosure



2.5 General Wiring Guidelines

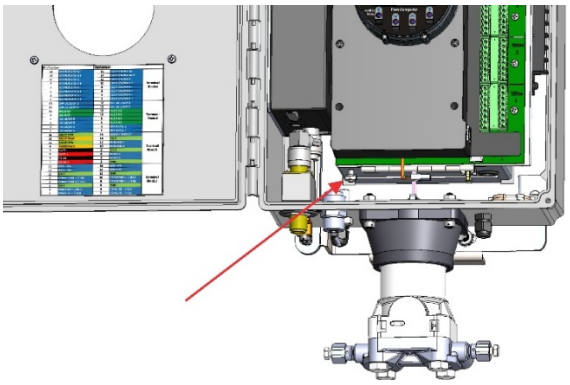
The flow computer's pluggable terminal blocks use compression-type terminals that accommodate wire between 28 and 12 AWG.

- When making a connection, insert the bare end of the wire (approx. 1/4" max) into the clamp adjacent to the screw and secure the screw.
- To prevent shorts, ensure that no bare wire is exposed.
- Allow some slack in the wire while making terminal connections. Slack makes the wires more manageable and helps minimize mechanical strain on the terminal blocks.
- Use twisted pair, shielded and insulated cable for communication and I/O wiring to minimize signal errors caused by electromagnetic interference (EMI), radio frequency interference (RFI) and transients. When using shielded cable, ground all shields at only one point in the appropriate system. This prevents circulating ground current loops that can cause signal errors.

2.6 Grounding

The flow computer includes a ground stud on the bottom of the battery compartment

Figure 2-7. Ground Stud



- Once you have installed the unit, run a ground wire between the ground stud on the bottom of the battery compartment and a known good earth ground. You route the ground wire through one of the conduit fittings.
- Use stranded copper wire to earth ground and keep the length as short as possible.
- Clamp or braze the ground wire to the ground bed conductor (typically a stranded copper AWG 0000 cable installed vertically or horizontally).
- Run the ground wire so that any routing bend in the cable has a minimum radius of 30.48 cm (12 inches) below ground and 20.32 cm (8 inches) above ground.

For more information on grounding or if your installation uses cathodic protection, refer to *Site Considerations for Equipment Installation, Grounding, and Wiring* (D301452X012).

2.7 Opening/Closing the Enclosure

The enclosure opens/closes differently depending upon whether you have the fiberglass enclosure or the aluminum enclosure.

⚠ DANGER

EXPLOSION HAZARD: Never open the enclosure in a hazardous location. Opening the enclosure in a hazardous location could result in an explosion.

- Fiberglass Enclosure

  The enclosure includes two fasteners at the top and bottom of the door. To open the door, lift the clasp to loosen the latch and pull it free of the post, then repeat for the

other fastener and open the door. To fasten the door, place the latch on the post and press down the clasp; repeat for the other fastener.

Figure 2-8. Fiberglass Enclosure Fasteners



- Aluminum Enclosure

  The enclosure includes six clamps along the edge of the door (two at the top, two on the bottom, two at the side). To open the door, use a Phillips-head screwdriver to loosen (but not remove) the screws enough so you can then pop the clamp free of the lip of the door, then repeat for the other clamps and open the door. To fasten the door, place the clamp over the door lip then tighten the screw torqueing to 20 in-lbs (2.3 N m); repeat for the other clamps.

Figure 2-9. Aluminum Enclosure Clamps



2.8 Mounting the Enclosure

You can mount the flow computer directly to a pole. You can also mount it on a wall or panel.

2.8.1 Bolting Considerations

If the flow computer installation requires assembly of a process flange, manifold, or flange adapters, follow these assembly guidelines to ensure a tight seal for optimal performance characteristics of the flow computer.

Only use bolts supplied with the flow computer or sold by Emerson Remote Automation Solutions as spare parts. Refer to the figure for common flow computer assemblies with the bolt length required for proper flow computer installation.

⚠ DANGER

EXPLOSION HAZARD: Ensure the area in which you perform this operation is non-hazardous. Performing this operation in a hazardous area could result in an explosion.

Note

For all other manifolds, contact your local Emerson Sales office or Emerson Impact Partner.

Bolts are typically carbon steel or stainless steel. Confirm the material by viewing the markings on the head of the bolt and referencing the figure. If bolt material is not shown in the figure, contact your local Emerson Remote Automation Solutions representative for more information.

Figure 2-10. Transmitter with Coplanar Flange

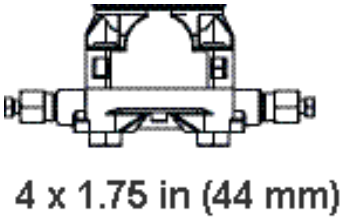


Figure 2-11. Transmitter with Coplanar Flange and Optional Flange Adapters

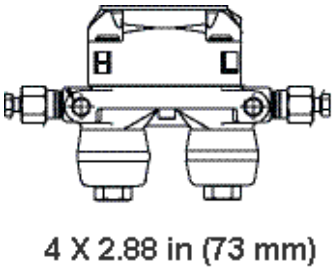
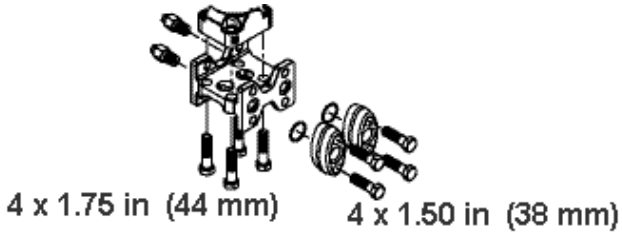


Figure 2-12. Transmitter with Traditional Flange and Optional Flange Adapters



Use the following bolt installation procedure:

1. Carbon steel bolts do not require lubrication. Stainless steel bolts are factory-coated with a lubricant to ease installation. Do not apply any additional lubricant when installing either type of bolt.
2. Finger-tighten the bolts.
3. Torque the bolts to the initial torque value using a crossing pattern. See *Table 2-3* for initial torque value.
4. Torque the bolts to the final torque value using the same crossing pattern. See *Table 2-3* for final torque value.
5. Verify that the flange bolts protrude through the sensor module before applying pressure.

Table 2-3. Torque Values for the Flange and Flange Adapter Bolts

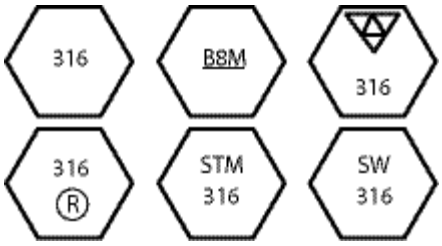
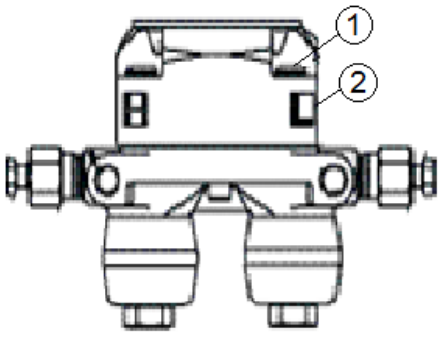
Bolt Material	Head markings	Initial Torque	Final Torque
Carbon Steel (CS)		300 in. -lbs. (33.9 N m)	650 in. -lbs. (73.4 N m)
Stainless Steel (SST)		150 in. -lbs. (16.9 N m)	300 in. -lbs. (33.9 N m

Figure 2-13. Proper Bolt Installation



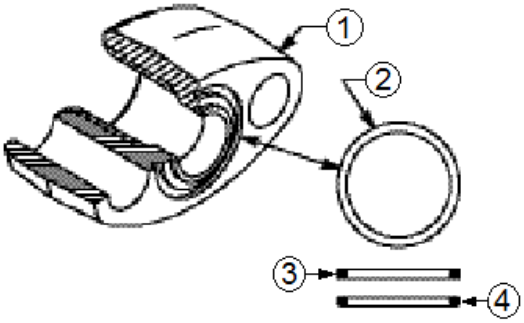
1 Bolt
2 Sensor module

2.8.2 O-rings with Flange Adapters

⚠ DANGER

Failure to install proper flange adapter O-rings may cause process leaks, which can result in death or serious injury. Only use the O-ring that is designed for its specific flange adapter.

Figure 2-14. O-rings with Flange Adapters



1 Flange
2 O-ring
3 Square PTFE-based profile
4 Round Elastomer profile

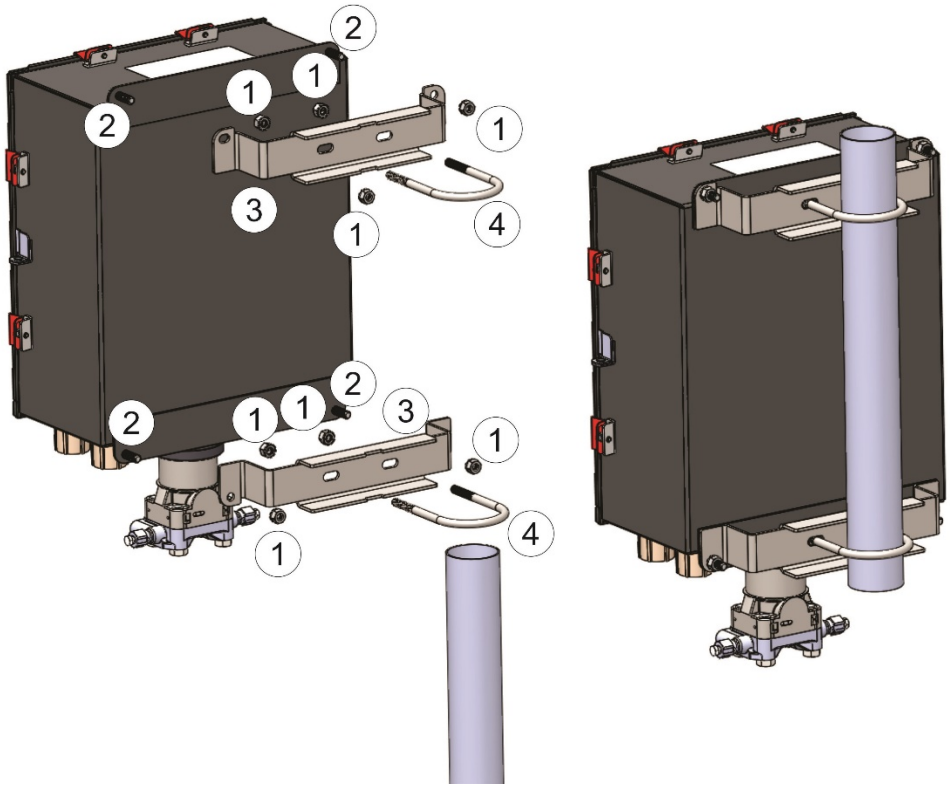
1. Whenever the flange or adapters are removed, visually inspect the O-rings.
2. Replace the O-rings if there are any signs of damage, such as nicks or cuts.
3. If the O-rings are replaced, re-torque the flange bolts and alignment screws after installation to compensate for seating of the O-rings.

2.8.3 Pole Mounting – Aluminum Enclosure

Refer to *Figure 2-15* during the mounting procedure.

1. Apply Loctite® 222 Low Strength Purple Threadlocker sparingly to threads of head cap screws (Item 2).
2. Attach pole mounting brackets (Item3) to enclosure using head cap screws (Item 2) and hex nuts (Item 1). Torque hex nuts to 30 in-lbs (3.4 N m).
3. Apply Loctite 222 Threadlocker sparingly to threads of U-bolts (Item 4).
4. Use U-bolts (Item 4) to mount enclosure to pole using hex nuts (Item 1). Torque hex nuts to 30 in-lbs (3.4 N m).

Figure 2-15. Aluminum Enclosure Pole Mounting



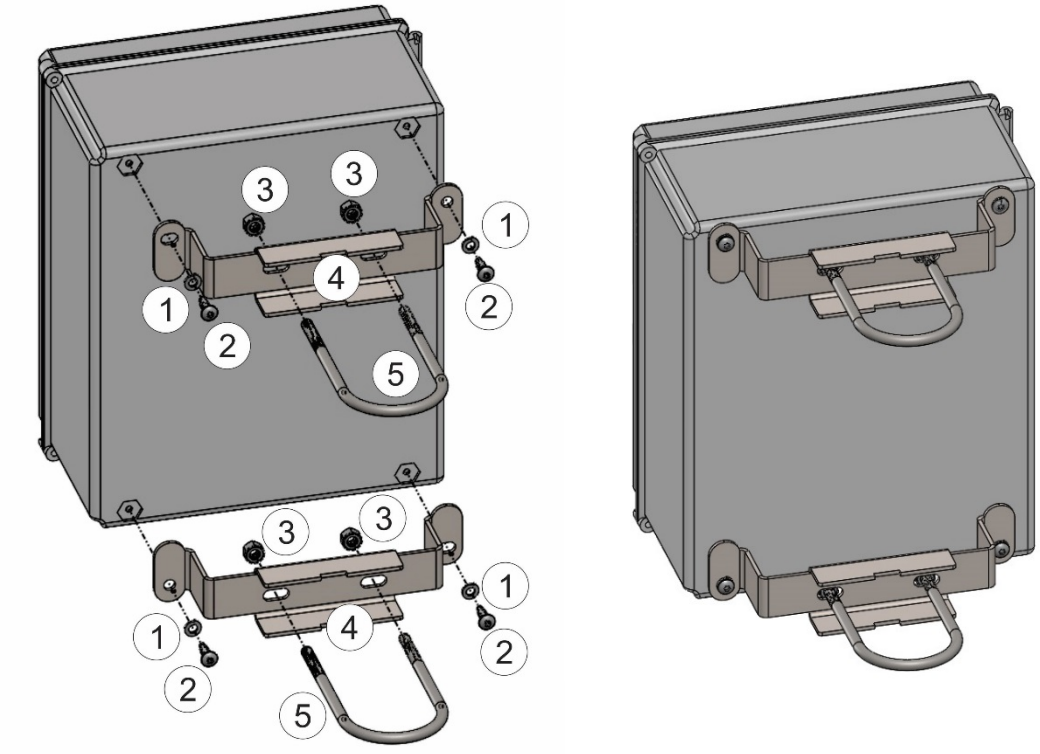
1 5/16-18 keps stainless steel hex nut
2 5/16-18 x 1.0 LG wire-lockable socket head cap screw
3 Pole mounting bracket
4 2-inch diameter 5/16-18 x 4.0LG U-bolt

2.8.4 Pole Mounting – Fiberglass Enclosure

Refer to *Figure 2-16* during the mounting procedure.

1. Attach plastic pole mounting brackets (Item4) to enclosure using split lock stainless steel washers (Item 1) and torx head screws (Item 2).
2. Apply Loctite 222 Low Strength Purple Threadlocker adhesive sparingly to threads of U-bolts (Item 5).
3. Use U-bolts (Item 5) to mount enclosure to pole using hex nuts (Item 3). Torque hex nuts to 30 in-lbs (3.4 N m).

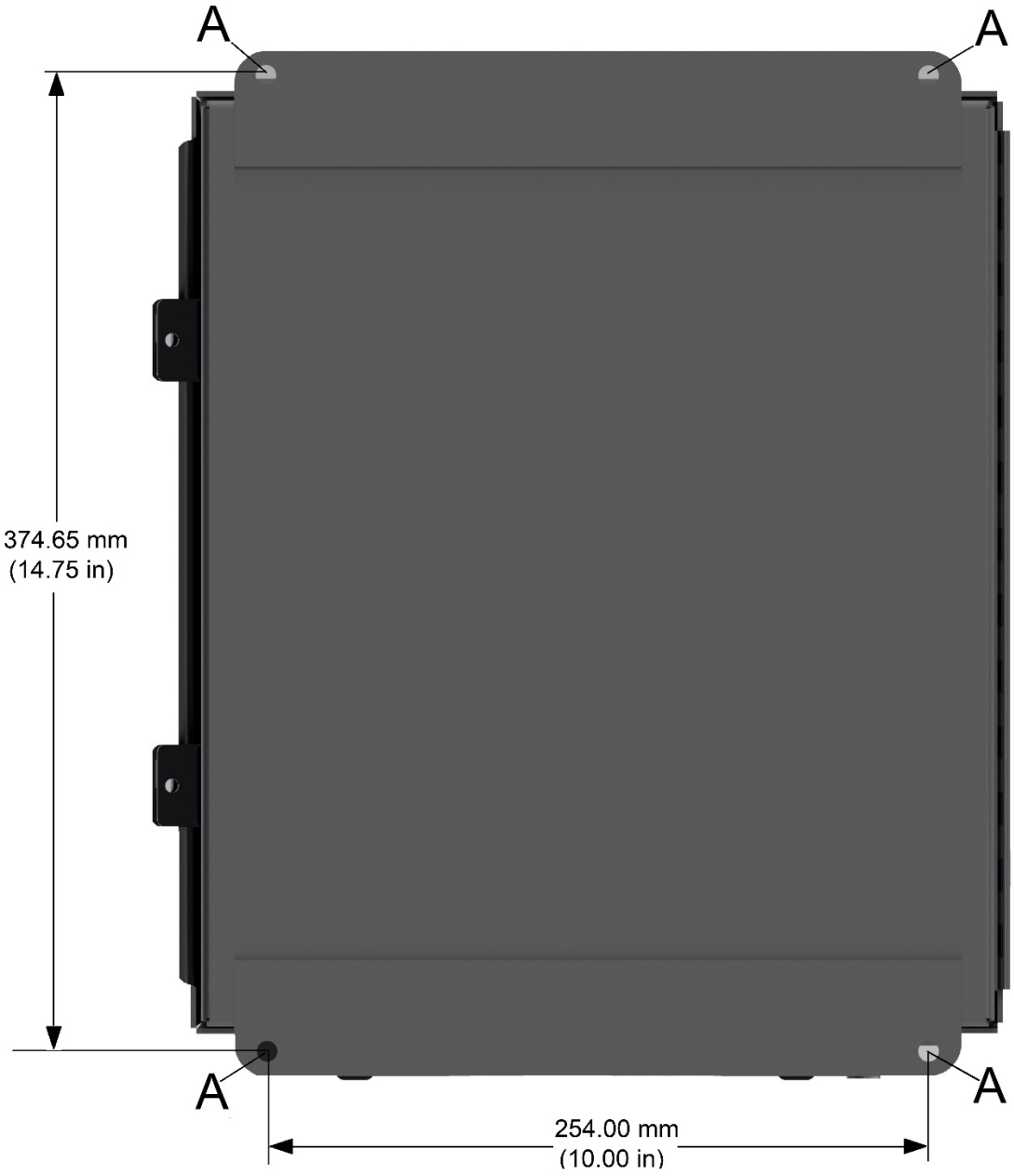
Figure 2-16. Fiberglass Enclosure Pole Mounting



1 ¼ inch screw split lock stainless steel washer
2 ¼-10 x .75LG thread forming torx head screw
3 5/16-18 keps stainless steel hex nut
4 Pole mounting bracket
5 2 inch diameter 5/16-18 x 4.0LG U-bolt

2.8.5 Panel/Wall Mounting Dimensions – Aluminum Enclosure

Figure 2-17. Aluminum Enclosure Panel/Wall Mounting



A Mounting holes are 7.92 mm (0.312 in) diameter

2.8.6 Panel/Wall Mounting Dimensions – Fiberglass Enclosure

Prior to mounting, attach mounting tabs to enclosure:

Figure 2-18. Attaching mounting tabs

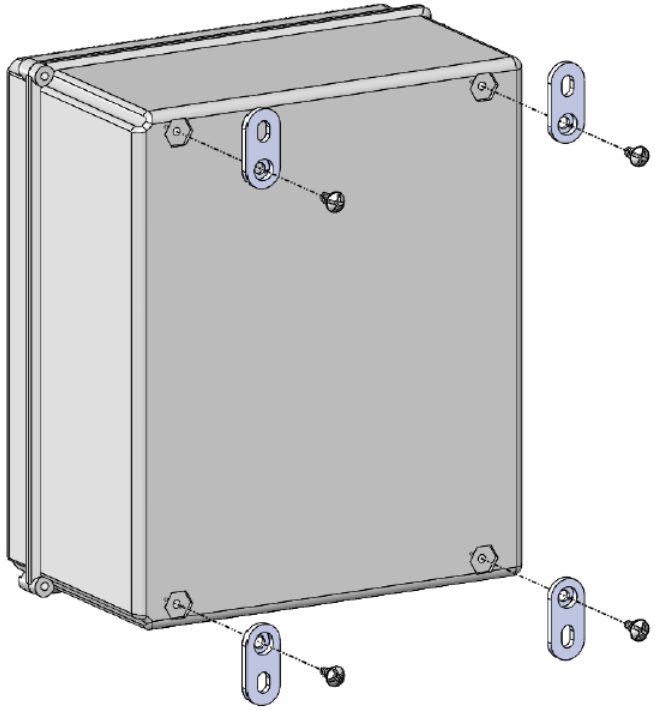
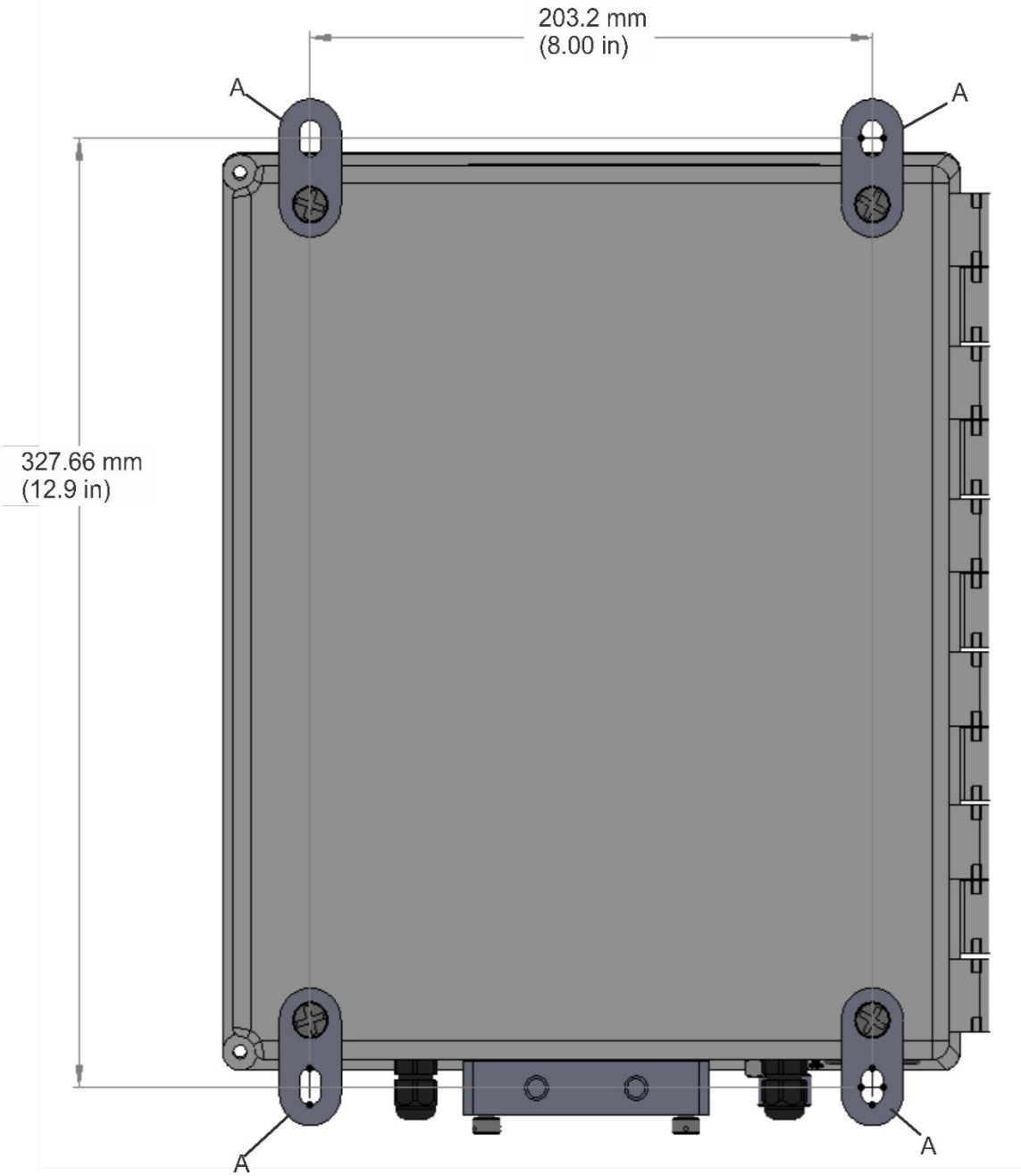


Figure 2-19. Fiberglass Enclosure Panel/Wall Mounting



A Mounting holes are 7.9 mm (0.31 in) wide

2.8.7 Rotating the Housing

To improve accessibility to the HMI module or to ease wiring, you can optionally rotate the housing.

Important

Never rotate the housing **more than** 180 degrees from its original (as-shipped) position. Over-rotation can break electronics within the unit.

Figure 2-20. Housing Rotation Set Screw (1 each side)



1 Set Screw (one each side)

DANGER

EXPLOSION HAZARD: Ensure the area in which you perform this operation is non-hazardous. Performing this operation in a hazardous area could result in an explosion.

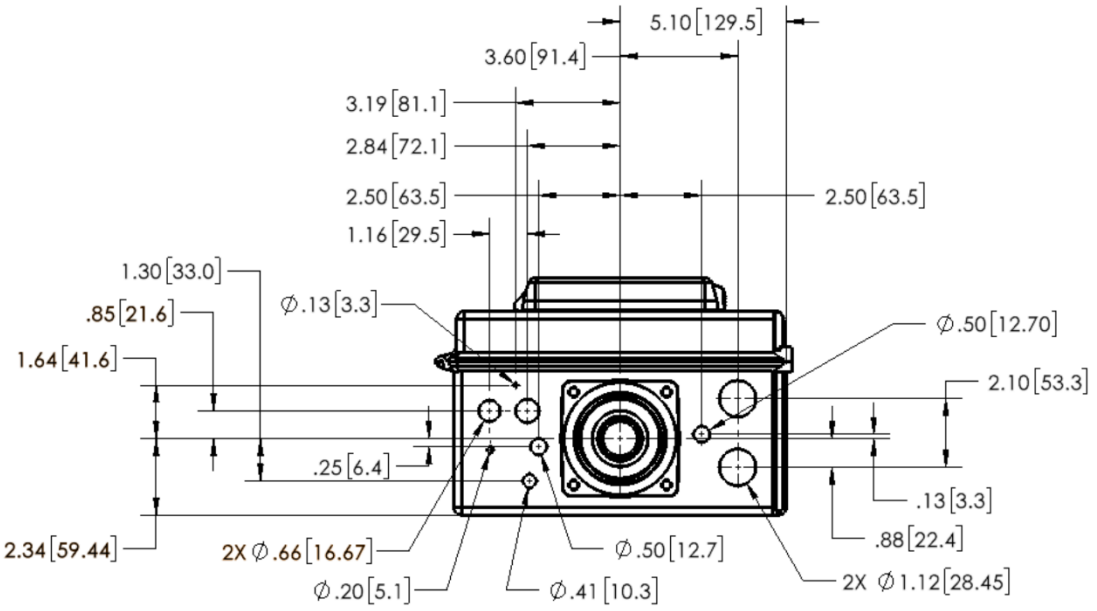
1. Loosen the two housing rotation set screws.
2. Rotate the housing **no more than** 180 degrees from its original (as-shipped) position.
3. Re-tighten the two housing rotation set screws. Torque to 6 in-lbs. (0.7 N m).

2.8.8 Enclosure Conduit Entry

⚠ DANGER

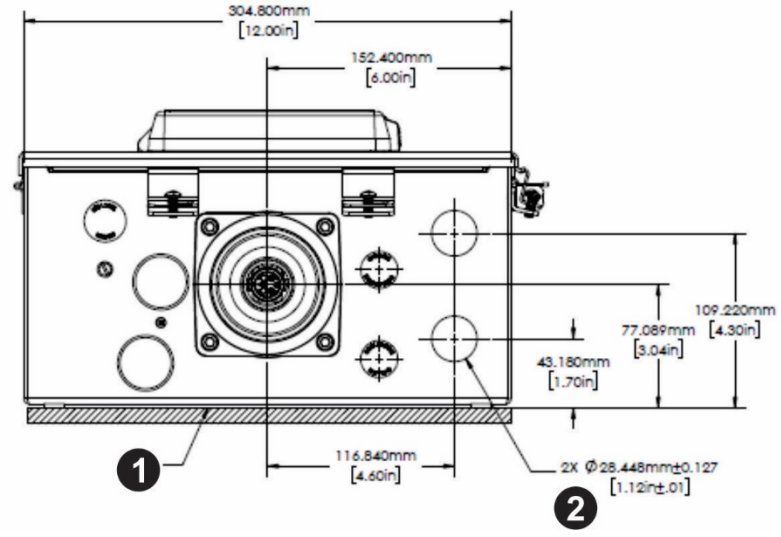
EXPLOSION HAZARD: Refer to UL safety instructions and applicable standards. All conduit entries must be suitable for the location where you install the flow computer.

Figure 2-21. Conduit Entry Points – Fiberglass Enclosure



First dimension shown in inches, second dimension [ ] in millimeters.

Figure 2-22. Conduit Entry Points – Aluminum Enclosure



1 Mounting surface

2 Hole plugs not shown for clarity

2.9 Power Modes

To keep power consumption to a minimum, especially for remote sites, the FB2200 can run in two different power modes – Low Power Mode (4 MHz or 8 CPU MHz clock speed) or Standard Power Mode (60 MHz CPU clock speed).

2.9.1 Low Power Mode

The FB2200 normally runs in low power mode for typical metering applications. The radio Power Control function (configurable in FBxConnect) switches the flow computer into standard power mode at specific times when serial communications are required, then it reverts to low power mode when the communication period is over. A serial connection to a remote 4088B MVT can occur in low power mode.

The local display (HMI module) with FBxWifi uses additional power. You can configure it in FBxConnect to shut down after a period of inactivity.



Important
You must **disable** the Ethernet port (using a jumper) to run in low power mode. See *Section 2.13.3.*

Table 2-4. Typical Power Usage – Low Power Mode at Room Temperature

Description	Power Usage (mW) at 12Vdc
Base flow computer with integral multivariable DP and pressure sensor and temperature measurement, single DO available, for a single meter run. Historical configuration supports maximum of: ▪ 4 averages ▪ 12 Station 1 history points (Group 4) ▪ 10 User Periodic history points (Group 1)	55
Base flow computer with integral multivariable DP and pressure sensor and temperature measurement, 2 digital and 2 analog channels available for a single meter run Historical configuration supports maximum of: ▪ 4 averages ▪ 12 Station 1 history points (Group 4) ▪ 10 User Periodic history points (Group 1)	67

Table 2-4. Typical Power Usage – Low Power Mode at Room Temperature (continued)

Description	Power Usage (mW) at 12Vdc
Additional Load Options:	
Display and backlight active	340
FBxWifi active	379
FBxWifi and display active	398
DO active (1 Hz, 50:50 duty cycle, no load)	12
PI active (10 KHz, 50:50 duty cycle, square wave)	12

Important
If you increase the number of history points/averages beyond any of the maximum limits in *Table 2-4*, the flow computer **cannot** operate in low power mode and automatically runs in standard power mode.

2.9.2 Standard Power Mode

When serial communication is active (other than to a remote 4088B MVT) the FB2200 operates in standard power mode. The unit also uses standard power mode when:

- The HMI module display is ON
- FBxWifi is active
- Ethernet port is enabled in the flow computer
- Modbus Master communication is active
- PID, Math/logic Blocks, Action Blocks, and Effect Blocks are enabled
- Power control zone is enabled

Table 2-5. Typical Power Usage – Standard Power Mode at room temperature

Description	Power Usage (mW) at 12Vdc	Power Usage (mW) at 24Vdc
Base flow computer with integral multivariable DP and pressure sensor and temperature measurement for a single meter run	240	290

Table 2-5. (Continued)

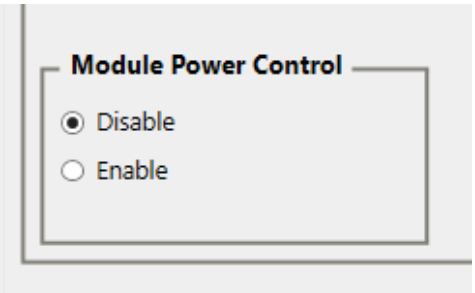
Description	Power Usage (mW) at 12Vdc	Power Usage (mW) at 24Vdc
Base flow computer with temperature measurement (no integral sensor) communicating to remote 4088B (externally powered) for a single meter run	220	268
Base flow computer with integral multivariable DP and pressure sensor and temperature measurement, 2 digital and 2 analog channels available for a single meter run	260	313
Base flow computer with temperature measurement, integral static pressure sensor and pulsed input for a single meter run	276	330
Base flow computer with integral multivariable DP and pressure sensor and temperature measurement, communicating to remote 4088B (externally powered) for a dual meter run	250	300
Additional Load Options:		
Display and backlight active	159	188
FBxWifi active	191	199
FBxWifi and display active	233	245
DO active (1 Hz, 50:50 duty cycle, no load)	20	23
PI active (10 KHz, 50:50 duty cycle, square wave)	14	15
8-channel expansion I/O module installed (isolated)	228	280
Additional 6-channel expansion I/O module installed (isolated)	68	66
Ethernet enabled 100 Mbit	430	466
Ethernet active 100 Mbit	640	650
Loop power supply	310	393

2.9.3 Notes on Battery Life

Battery life varies based on numerous factors including temperature, communication usage, and various load options. To achieve the maximum battery life noted in the product data sheet requires that you:

- Limit use of the display, backlight, and FBxWifi options.
- Limit communication activity.
- Disable power to all I/O (except for the MV or static pressure sensor, or RTD). To do this, click **Configure > I/O Setup > I/O Configuration > Properties** and select **Disable** for each I/O module.

Figure 2-23. Module Power Control



2.10 Connecting Power

Power can come from an external DC supply or a lead acid battery pack with a solar panel.

2.10.1 Connecting DC Power

⚠ DANGER

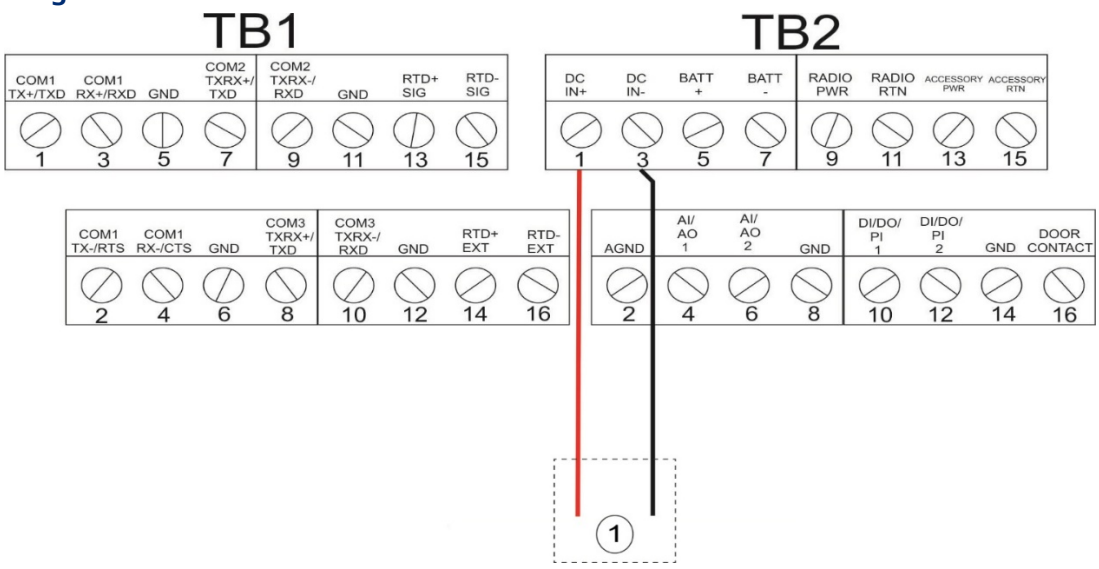
EXPLOSION HAZARD: Ensure the area in which you perform this operation is non-hazardous. Performing this operation in a hazardous area could result in an explosion.

When power comes from an external DC supply, connect using the +DCIN and –DCIN terminals. Use standard copper wire (#18 AWG minimum). The device supports both 12V and 24V power supplies. It accepts DC voltage from 10.5 to 30V; the amount of power required varies depending upon the options used.

Important

If your installation uses DC power for main power, **do not** wire battery power as a secondary (back up) power source. Certification only allows a ***single*** main power source; wiring both sources **will void your certification**.

Figure 2-24. DC Power Connections



1	To external DC power supply

Note

If your flow computer does not power on, check that the polarity of the DC input voltage wiring connections match *Figure 2-24*. If you accidentally reversed the polarity of the connectors, it triggers a polyfuse (positive coefficient temperature thermistor) to protect the device from damage. Once the polarity is corrected, the polyfuse resets automatically to allow for proper operation.

2.10.2 Connecting Battery Power

⚠ DANGER

EXPLOSION HAZARD: Ensure the area in which you perform this operation is non-hazardous Performing this operation in a hazardous area could result in an explosion.

Important

If you purchased this device with the rechargeable lead acid battery pack, be aware that the lead acid battery pack must always be stored in a charged state. If you do not intend to install the flow computer immediately, make provisions to “top-off” the lead acid battery at six-month intervals. Failure to do so could sharply reduce battery life or result in a dead battery. **Note**: Battery options for main power are **not** allowed in ATEX installations.

When power comes from an internal battery pack, the battery pack plugs into one of two pairs of connectors.

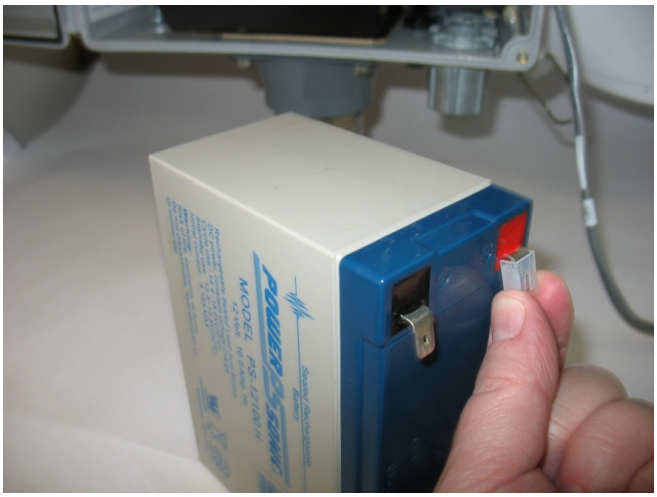
2.10.2.1 Installing the Main Battery Pack

If you purchased one of the battery/solar panel options, you need to install the main battery pack before you place the device in service.

The device provides a battery cable with two pairs of battery connectors, enabling you to hot-swap the battery pack in a non-hazardous location. You can use either pair of connectors when you install the battery.

1. Remove the battery pack from its packaging.
2. Remove the plastic tabs covering the connectors on the battery pack.

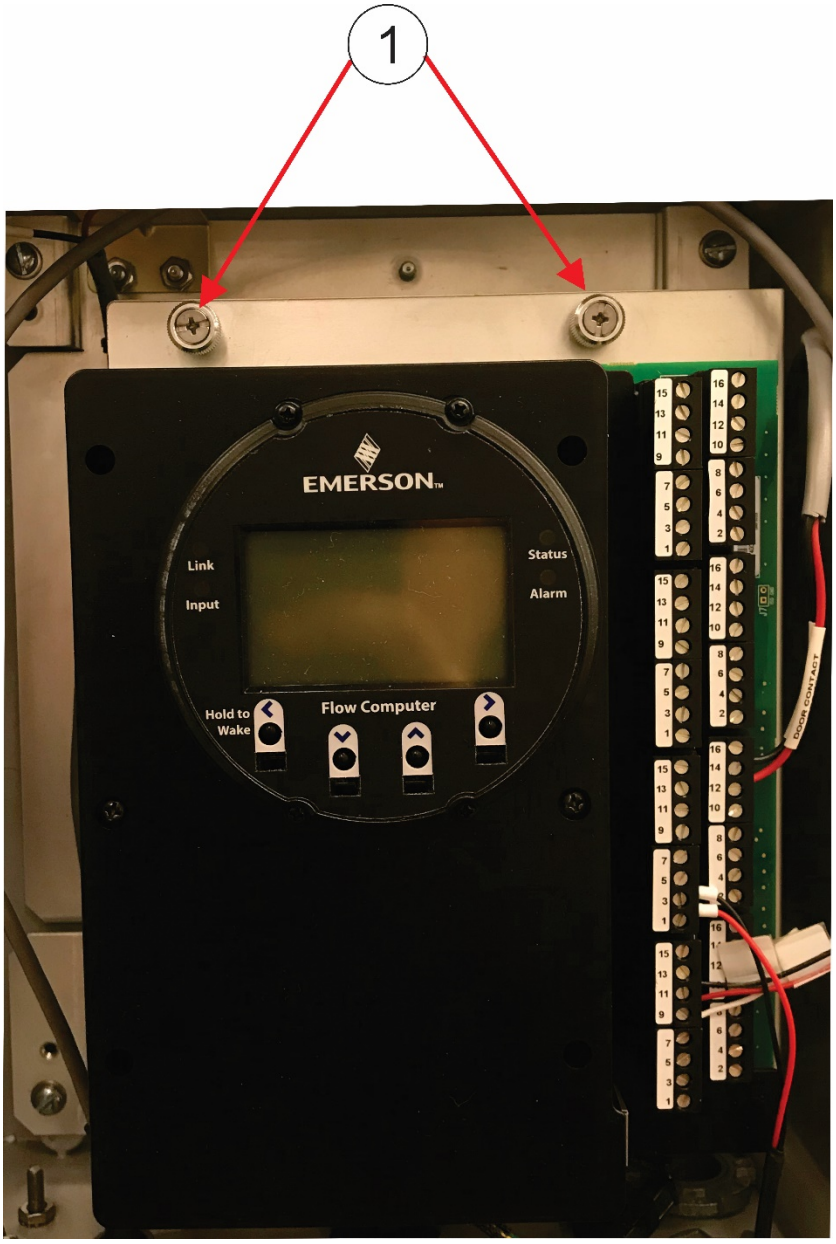
Figure 2-25. Removing Plastic Tabs from Battery Pack



3. Open the enclosure.

4. Loosen the two captive fastening screws at the top of the of the battery compartment, while holding onto the battery compartment door. Carefully rotate the electronics assembly towards you to reveal the inside of the battery compartment. A strap prevents the front of the compartment from rotating too far forward.

Figure 2-26. Captive Fastening Screws



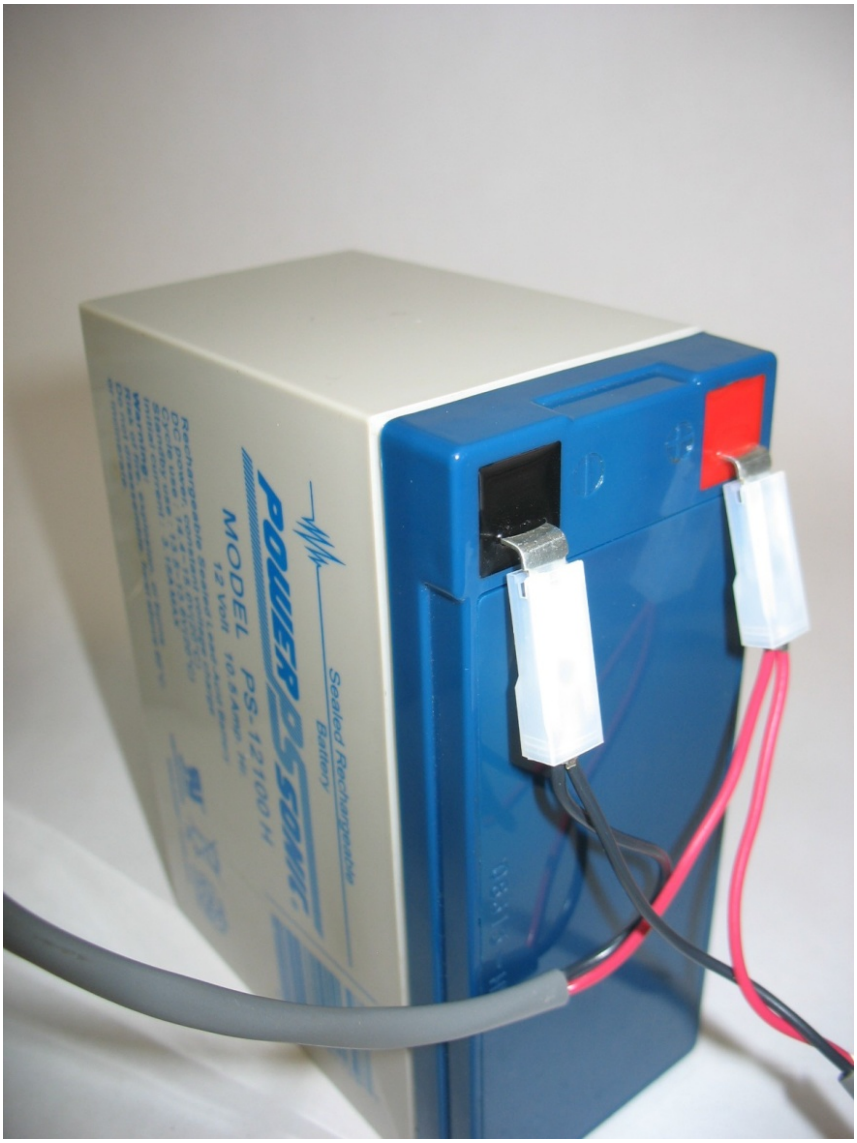
1 Captive Fastening Screws

Figure 2-27. Rotate Assembly Forward



5. The battery cable inside the battery compartment is divided into two branches, each with its own pair of connectors. Take either pair of connectors and connect them to the battery; the red (positive) wire connector attaches to the red connection point on the battery and the black (negative) wire connector attaches to the black connection point on the battery.

Figure 2-28. Connect the Battery



6. Now you must secure the battery in the battery compartment so that it doesn't move around. How you do this depends on which battery compartment configuration you have. If the battery compartment includes a strap for holding the battery, see *Section 2.10.2.1 – Securing the Battery with a Strap*; if the battery compartment includes an adhesive pad, see *Section 2.10.2.2 – Securing the Battery to the Pad*.

2.10.2.2 Securing the Battery with a Strap

This type of battery compartment allows for certain accessories to be installed such as a relay or internal solar regulator.

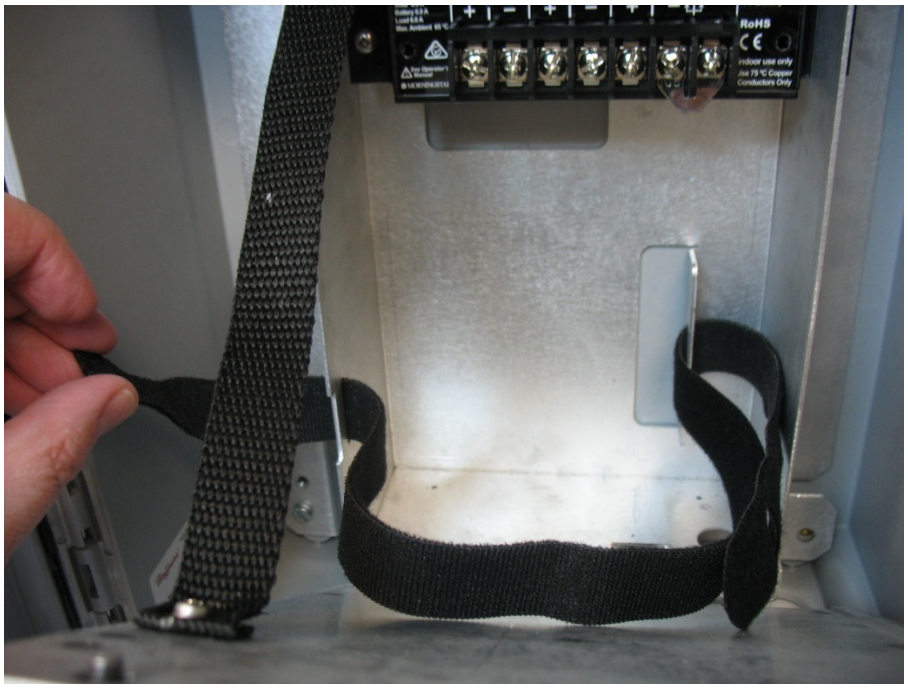
1. If you have an internal solar regulator installed in the battery compartment, you must remove its termination cover in order to fit the battery inside. Remove the two screws (left and right) that fasten the termination cover to the solar regulator, and then set the termination cover aside. (If you don't have an internal solar regulator, skip to Step 2.)

Figure 2-29. Removing Termination Cover of Internal Solar Regulator



2. The battery strap must already be threaded through the holes of the battery compartment.

Figure 2-30. Battery Strap



3. Pick up the battery and carefully ease it into the battery compartment with the writing on the battery facing out and the connectors on the upper right-hand side. Nothing (including the strap) can be **behind** the battery.

Figure 2-31. Easing Battery Pack into Compartment



4. Carefully push the battery under the solar regulator (if present) and against the back of the compartment, now strap it in tightly by pulling the ends of the strap.

Figure 2-32. Battery Pack Attached to Compartment



5. The strap includes a narrow opening into which you can slide the other end of the strap to help you tighten it.

Figure 2-33. Battery Pack Attached to Compartment



6. Route the extra portion of the strap as well as the wires of the free portion of the battery cable so that they sit in an open area of the battery compartment.
7. If you had to remove the termination cover of an internal solar regulator (Step 1), re-attach the termination cover.
8. Rotate the electronics assembly up against the battery compartment and tighten the captive fastening screws with a torque value of 2 to 4 in-lbs. (0.2 to 0.5 N m) to close the compartment.

2.10.2.3 Securing the Battery to the Pad

For this type of battery compartment, a hook-and-loop adhesive pad on the back of the battery secures it to the back of the battery compartment.

1. Pick up the battery and align it with the lower left edge of the battery compartment. Press it against the back of the compartment so the pad on the back of the battery secures to the back of the battery compartment.

Figure 2-34. Battery Pack Attached to Compartment



2. Route the wires of the free portion of the battery cable so that they sit completely inside the open area at the top of the battery compartment.
3. Rotate the electronics assembly up against the battery compartment and tighten the captive fastening screws with a torque value of 2 to 4 in-lbs (0.2 to 0.5 N m) to close the compartment.
4. Close the enclosure.

2.10.3 Connecting Solar Power

⚠ DANGER

EXPLOSION HAZARD: Ensure the area in which you perform this operation is non-hazardous. Performing this operation in a hazardous area could result in an explosion.

Restriction

The solar panel and lead acid battery combination cannot be used with ATEX/IECEx applications.

When power comes from a solar panel/lead acid battery combination, connect using the BATT+ and BATT– terminals and standard copper wire (#18 AWG minimum).

Important

- Only use batteries supplied with the flow computer or sold by Emerson as spare parts for this flow computer. If you substitute a battery you obtain elsewhere **you will void your certification unless it is the identical part from the same manufacturer** as that supplied with the flow computer from Emerson.
- If you purchase a solar panel/external solar regulator combination other than the Emerson-approved option, it **must** meet the specifications listed in *Tables 2-6* and *2-7*.

2.10.3.1 Wiring the 30W Solar Panel

For the 30W solar panel option with an external solar controller (charger/regulator) purchased through Emerson (Emerson-approved option) connect the external solar controller to the flow computer battery using the instructions in this section.

If you are using your own external solar controller/30W solar panel not purchased through Emersion, you can use this section as an example of a typical installation. You should also consult the manufacturer's instructions for your solar panel/solar regulator.

In either situation, you must use the battery, cables, and fuses supplied by Emerson for your connections to the solar controller/solar panel.

Note

When making connections to the junction box or the solar regulator, you will need a suitable cable gland/grommet to prevent water ingress to the junction box.

See *Figure 2-39* for wiring instructions if you ordered the internal solar regulator.

Table 2-6. Solar Panel Electrical Characteristics

Characteristic	Value/Range
Peak Power	30W ± 10%
Voltage (@peak power)	17.9V
Current (@peak power)	1.68A
Open Circuit Voltage	22.1V
Short Circuit Current	1.74A

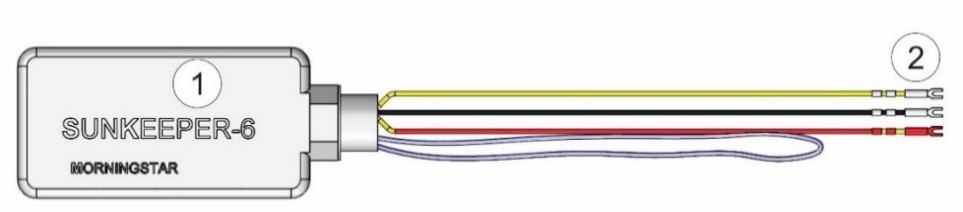
Table 2-7. Solar Regulator Electrical Characteristics

Characteristic	Value/Range
Rated Solar Input	6A
Nominal System Voltage	12V
Maximum Solar Voltage	30V
3 stage charging	Bulk, PWM, and float
Regulation Voltage	14.1V
Float Voltage	13.7V
Temperature Compensation	30 mV / °C
Operating Temperature	40 °C to 70 °C
Humidity	100%
Short Circuit Current	▪ reverse polarity ▪ lightning and transient surges ▪ short circuit ▪ high temperature ▪ overcurrent ▪ reverse current at night

1. The solar controller comes with plastic mounting feet used only for surface mounting applications. Remove the mounting feet but save the lock nut.

2. The solar controller also comes with fork connectors.

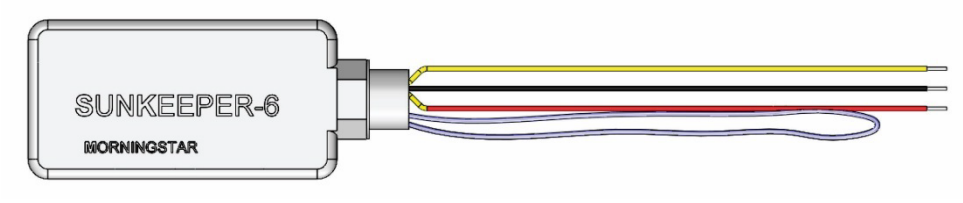
Figure 2-35. Solar Controller



1 Solar controller
2 Fork connectors

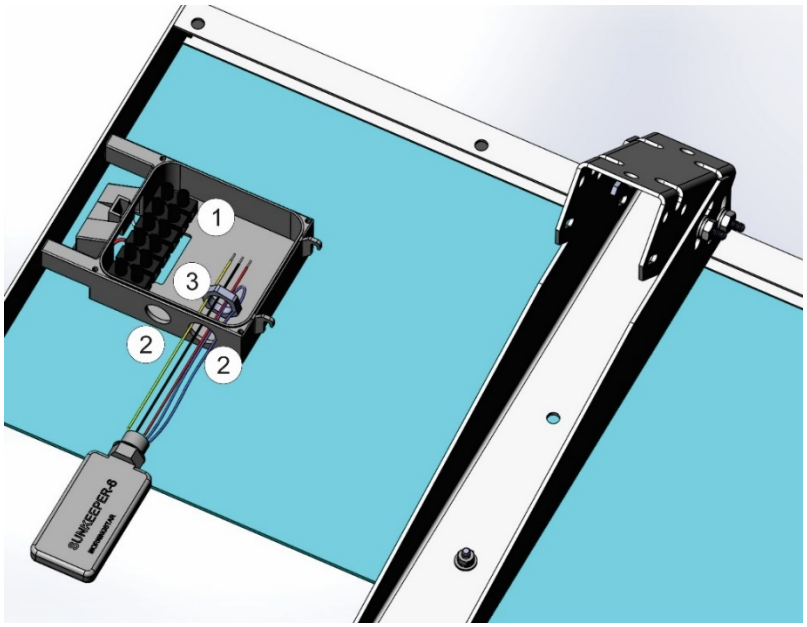
3. Remove the fork connectors and trim back the insulation on the wires ¼ inch.

Figure 2-36. Removing Fork Connectors



4. Remove the junction box cover. Use a utility knife to remove the knock-outs (Item 2) in the junction box (Item 1) and feed the wires from the solar controller into the junction box, and through the solar controller lock nut (Item 3).

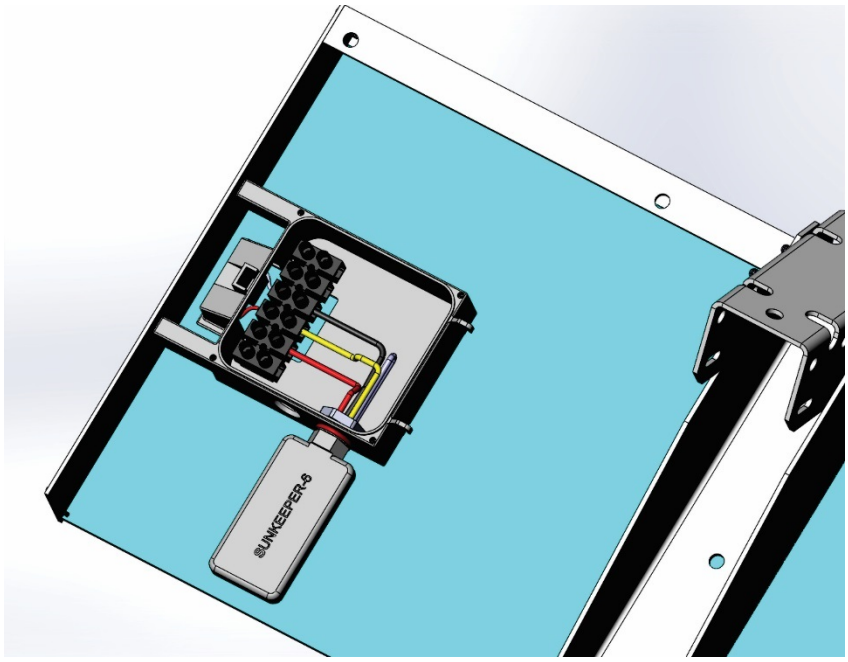
Figure 2-37.Wiring Solar Power – External Regulator



1 Junction box
2 Knock-outs
3 Lock nut

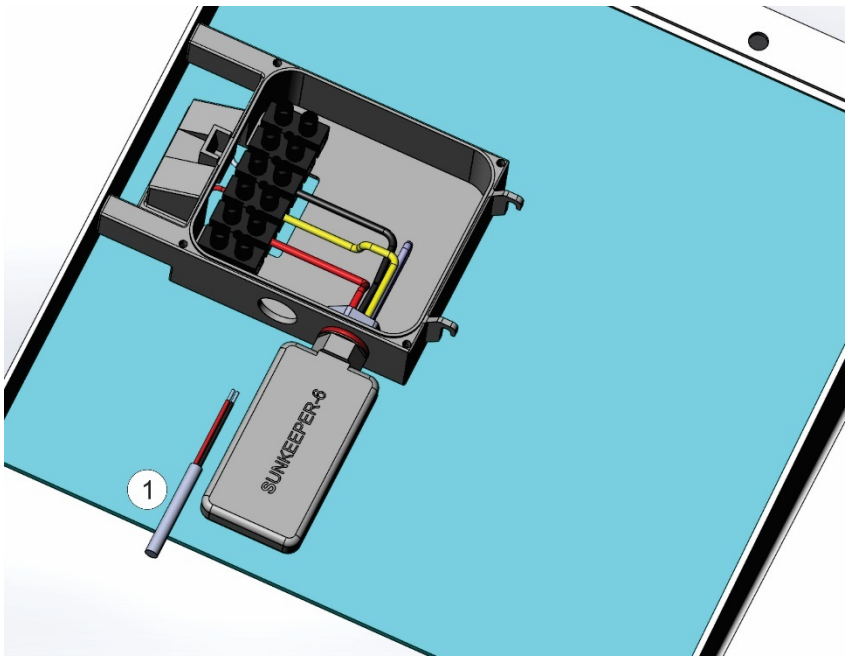
5. Use the solar controller lock nut to attach the solar controller to the junction box and use a 7/32” flat head screwdriver to attach the wires from the controller to the junction box connectors as shown.

Figure 2-38. Wiring Solar Power – External Regulator



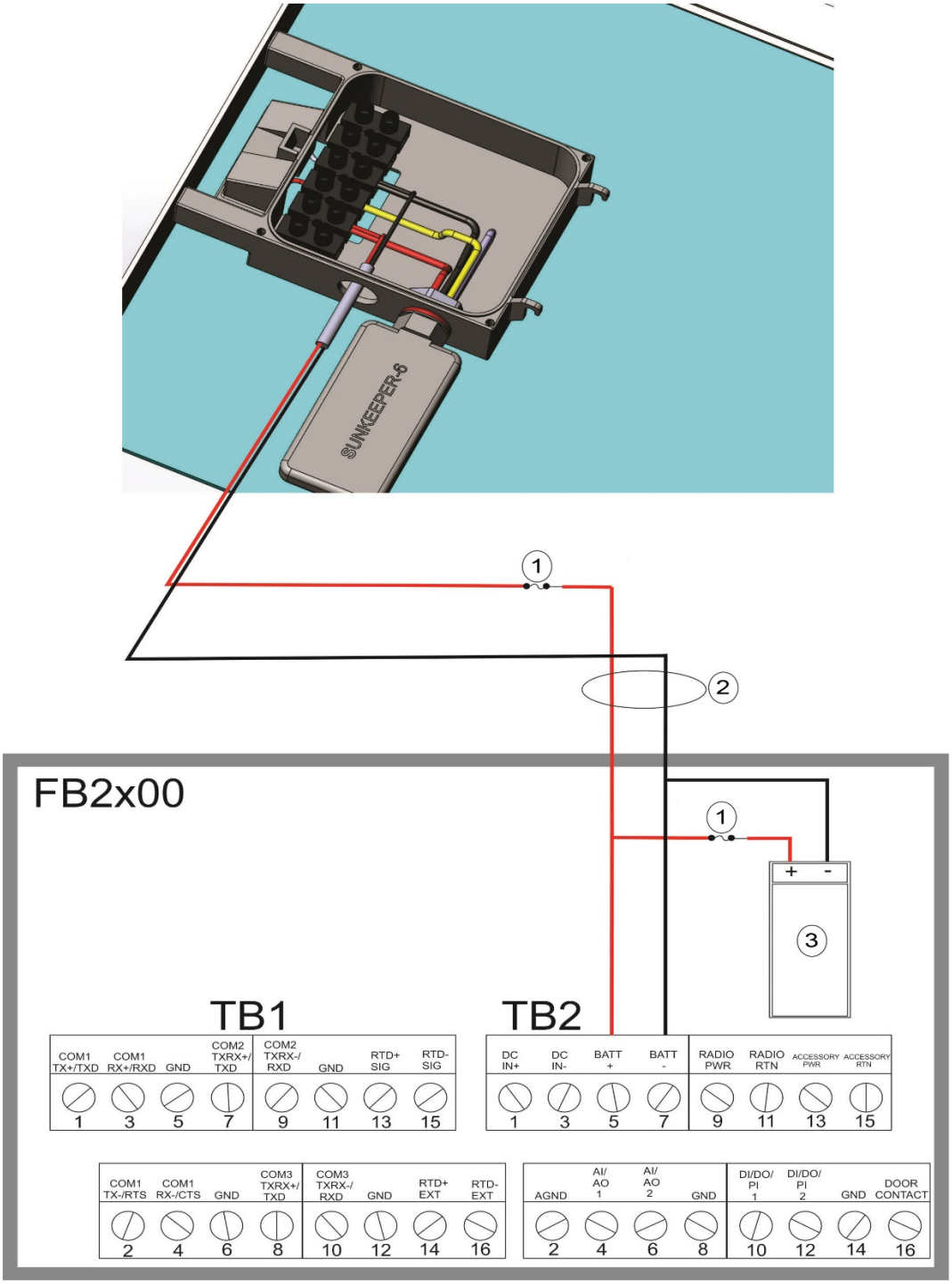
6. Route the BATT+ and BATT– wires from the flow computer into the junction box.

Figure 2-39. Routing Battery Wires



7. Connect the wires as shown. Replace the junction box cover.

Figure 2-40. Wiring Solar Power – External Regulator



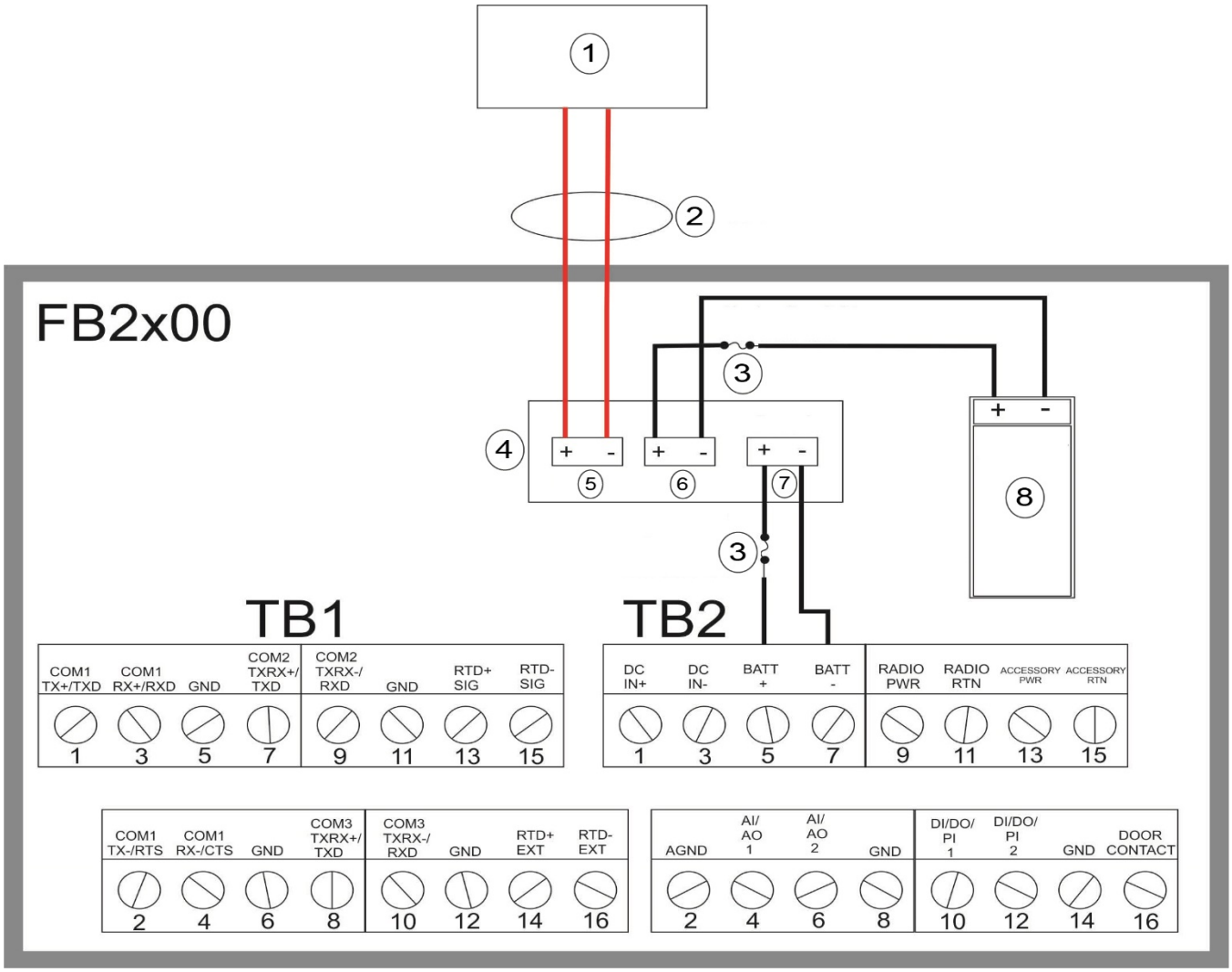
1 Fast-acting 6.3A one-time fuse

2 Conduit

3 Battery

If you ordered the flow computer with an internal solar regulator for the 30W solar panel, wire it according to *Figure 2-41*.

Figure 2-41. Wiring Solar Power – Internal Regulator



1 Solar Panel
2 Conduit
3 Fast acting 6.3A one time fuse
4 Solar Regulator
5 Solar
6 Battery
7 Load
8 Battery

2.11 Installing the Optional 30W Solar Panel

If you purchased the lead acid battery/30W solar panel kit for main power, you need to install the supplied solar panel. Refer to *Figure 2-42* during this procedure.

⚠ DANGER

EXPLOSION HAZARD: Ensure the area in which you perform this operation is non-hazardous. Performing this operation in a hazardous area could result in an explosion.

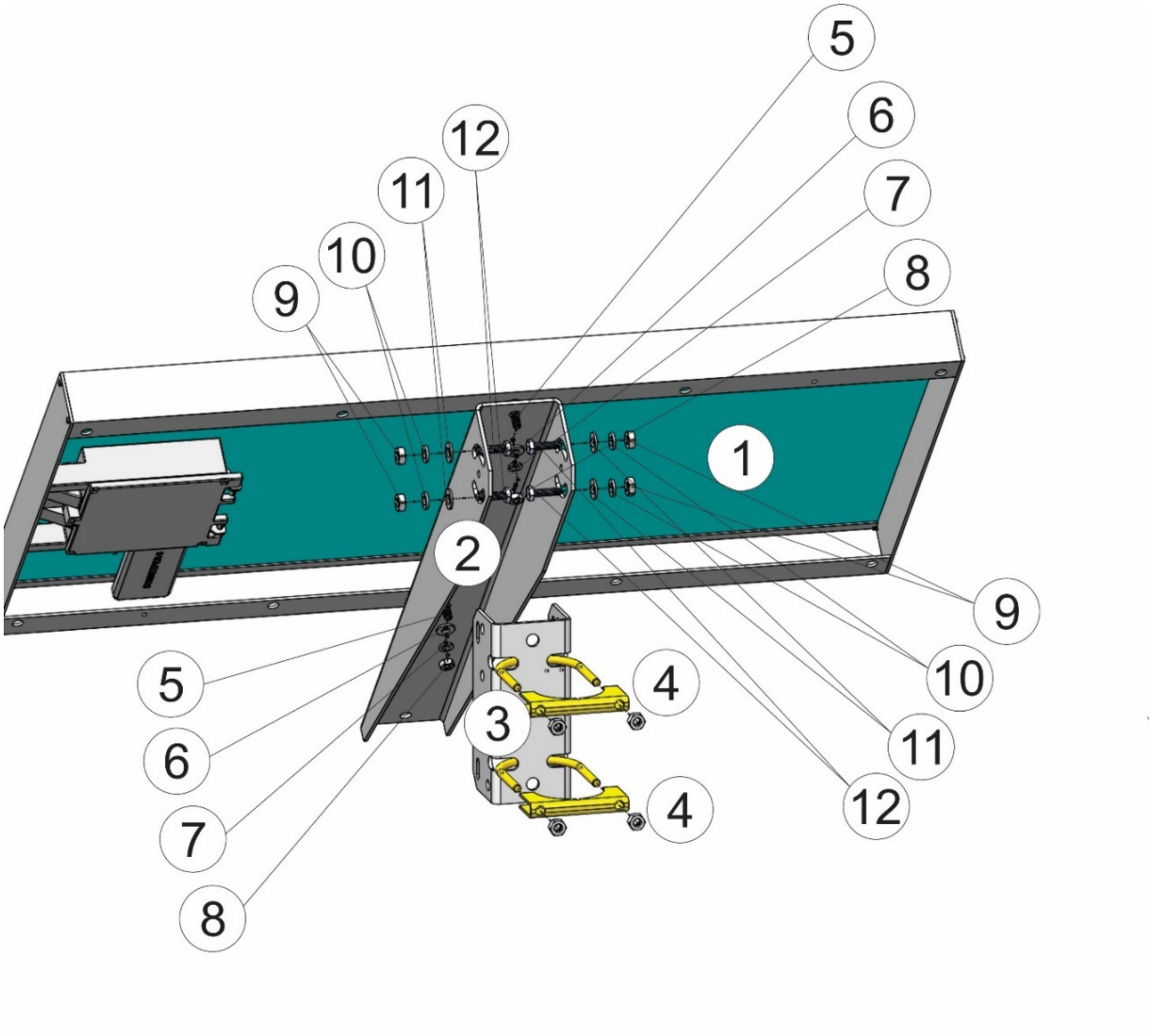
Solar panel installation involves:

- Mounting the solar panel on a pole
- Wiring power to the solar panel. (See *Section 2.10.3*)
- Setting the tilt angle of the panel for maximum solar exposure. (See *Section 2.13*)

Install the solar panel as follows:

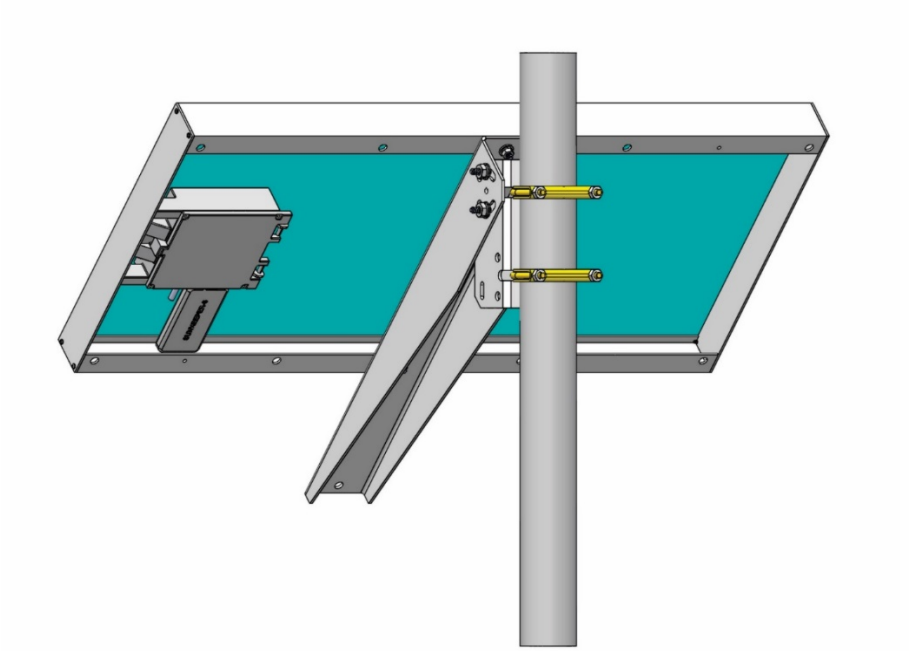
1. Attach the adjustable angle bracket (Item 2 in *Figure 2-42*) to the solar panel (Item 1) using the hex screws (Item 5), flat washers (Item 6), lock washers (Item 7), and hex nuts (Item 8).
2. Torque hex nuts (Item 8) to 60 in-lbs (6.8 N m).
3. Apply Loctite® 222MS™ Purple Threadlocker Low Strength sparingly to hex nut threads (Item 8) after torqueing.
4. Attach pole mounting bracket (Item 3) to angle bracket (Item 2) using hex screws (Item 12), flat washers (Item11), lock washers (Item 10) and hex nuts (Item 9).
5. Torque hex nuts (Item 9) to 108 in-lbs (12.2 N m).
6. Apply Loctite 222MS Threadlocker sparingly to hex nut threads (Item 9) after torqueing.
7. Attach entire solar panel assembly to pole by attaching pole mounting bracket (Item 3) to U-bolt assembly (Item 4). Torque nuts in U-bolt assembly to 60 in-lbs (6.8 N m).
8. Apply Loctite 222MS Threadlocker sparingly to hex nut threads (Item 8) after torqueing.
9. Attach a ground wire at the back of the solar panel. For more information on grounding, refer to *Site Considerations for Equipment Installation, Grounding, and Wiring Manual* (D301452X012).

Figure 2-42. Installing 30W Solar Panel



1	30W solar panel
2	Adjustable angle bracket
3	Pole mounting bracket
4	U-bolt assembly (2)
5	¼ x 20 x .75LG Hex head cap screw (2)
6	¼ flat washer (2)
7	¼ lock washer (2)
8	¼-20 hex nut (2)
9	5/16-18 hex nut (4)
10	5/16 lock washer (4)
11	5/16 flat washer (4)
12	5/16-18 x 0.75 LG Hex head cap screw (4)

Figure 2-43. 30W Solar Panel Installed



2.12 Adjusting the Optional Solar Panel

⚠ DANGER

EXPLOSION HAZARD: Ensure the area in which you perform this operation is non-hazardous. Performing this operation in a hazardous area could result in an explosion.

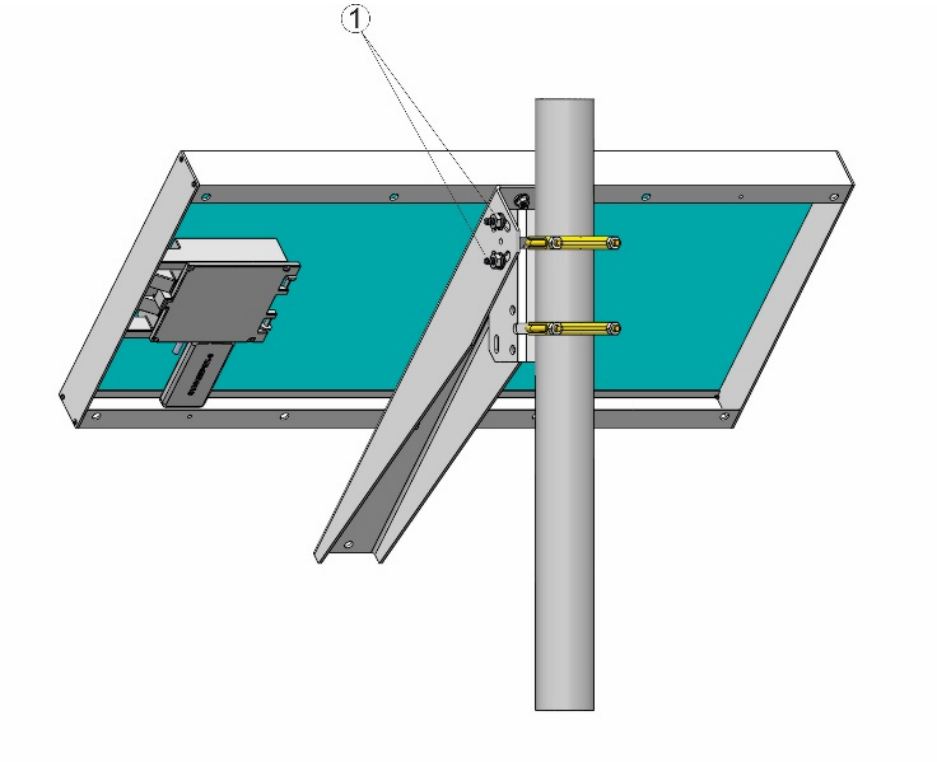
- Point the solar panel surface due south (in the northern hemisphere) or due north (in the southern hemisphere) at an angle determined by the latitude of the site. *Table 2-8* shows the angle (from horizontal) at which you should install the solar panel to maximize annual energy output. At most latitudes, you can improve performance by reducing the angle during the summer and increasing the angle during the winter. If no seasonal adjustments in panel direction are needed, then adjust the position for the worst-case December-March angle.
- Solar insolation is the amount of solar energy in hours received each day by an optimally tilted panel during the worst month of the year. An insolation rating of one hour means that the site, on average, would receive one hour of solar energy at the panel's rated power level (1000W/m^2 per day). This rating varies from less than one hour in northern Canada to more than six hours in the Sahara Desert.

Table 2-8. Solar Panel Tilt Angle

Latitude	Installation Angle
0 to 4°	10° from horizontal
5 to 20°	Add 5° to the local latitude
21 to 45°	Add 10° to the local latitude
46 to 65°	Add 15° to the local latitude
66 to 75°	80° from horizontal

To adjust the tilt angle on the 30W solar panel, loosen the four (4) nuts in the adjustable angle bracket and move the panel to the desired tilt angle. When in the proper position, torque the nuts to 108 in-lbs (12.2 N m) and apply Loctite® 222MS Threadlocker sparingly to hex nut threads after torqueing.

Figure 2-44. Adjusting the 30W Solar Panel Tilt Angle



1 Tilt angle adjustment (2 of 4 shown)

The mounting brackets allow you to adjust the solar panel for maximum solar exposure.

2.13 Connecting Communication Ports

⚠ DANGER

EXPLOSION HAZARD: Ensure the area in which you perform this operation is non-hazardous. Performing this operation in a hazardous area could result in an explosion.

The communication ports allow you either to connect to a PC or laptop running FBxConnect software or to other devices.

Open the enclosure door to access the terminal blocks for the three serial communication ports and the Ethernet port.

You route communication cables through the conduit fittings and connect the cables to the terminal blocks.

Note

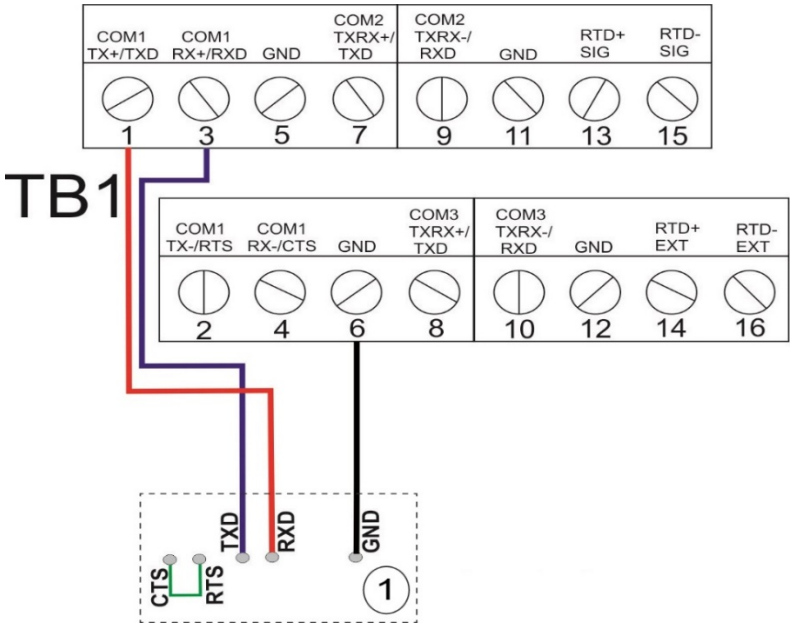
The optional local serial port connector on the base of the enclosure is hard-wired to COM2.

2.13.1 Connecting to COM1

COM1 can be configured for RS-232, RS-485 (2-wire), or RS-485 (4-wire) communications.

When connecting COM1 to another device using **RS-232**, use a cable with configurations as shown in *Figure 2-45*:

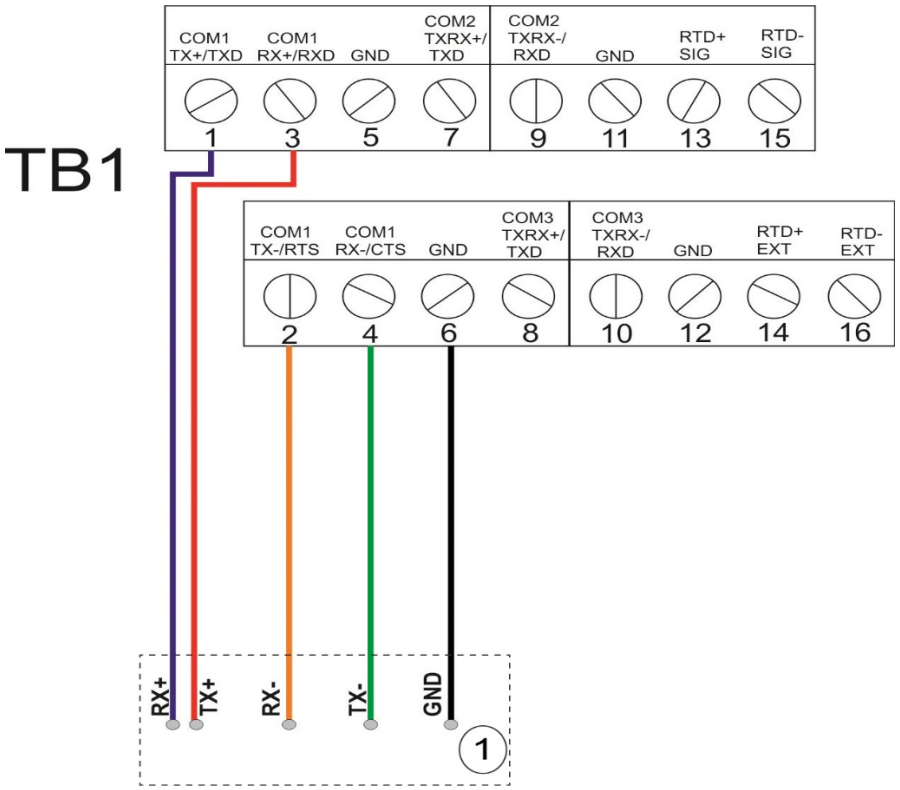
Figure 2-45. Connecting a Device to COM1 Using RS-232



1 RS-232 Port on other device

When connecting COM1 to another device using **RS-485 (4-wire)**, use a cable with configurations as shown in *Figure 2-46*:

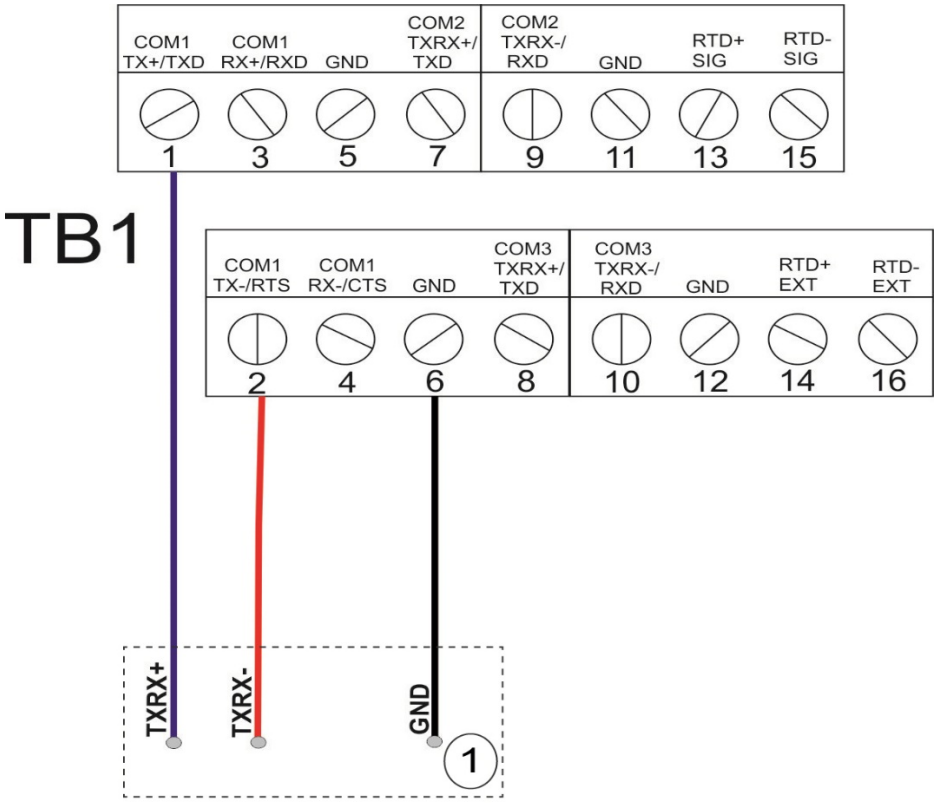
Figure 2-46. Connecting a Device to COM1 Using RS-485 (4-wire)



1 RS-485 (4-wire) Port on other device

When connecting COM1 to another device using **RS-485 (2-wire)**, use a cable with configurations as shown in *Figure 2-47*:

Figure 2-47. Connecting a Device to COM1 Using RS-485 (2-wire)



1 RS-485 (2-wire) Port on other device

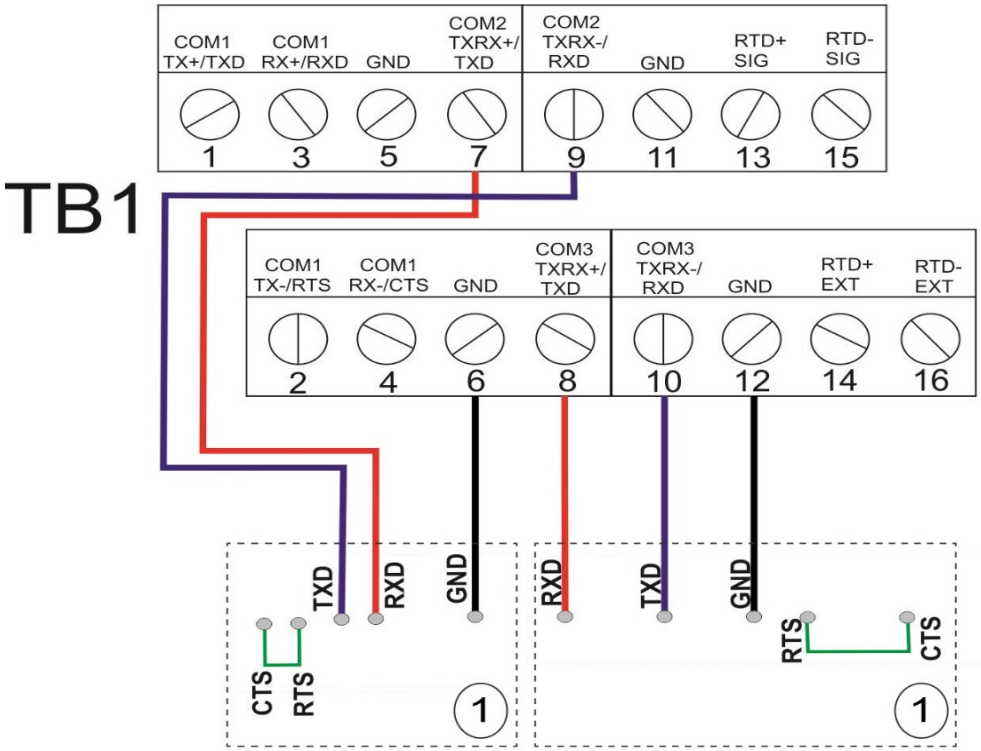
Regardless of the interface standard (RS-232, RS-485 [2-wire], or RS-485 [4-wire]) you must use FBxConnect to configure the port for proper usage.

2.13.2 Connecting to COM2 and COM3

COM2 and COM3 operate identically. Each can be configured for either RS-232 or RS-485 (2-wire) communication.

When connecting COM2 or COM3 to an **RS-232** port on another device (a PC or another controller/flow computer) use a cable with configurations as shown in *Figure 2-48*:

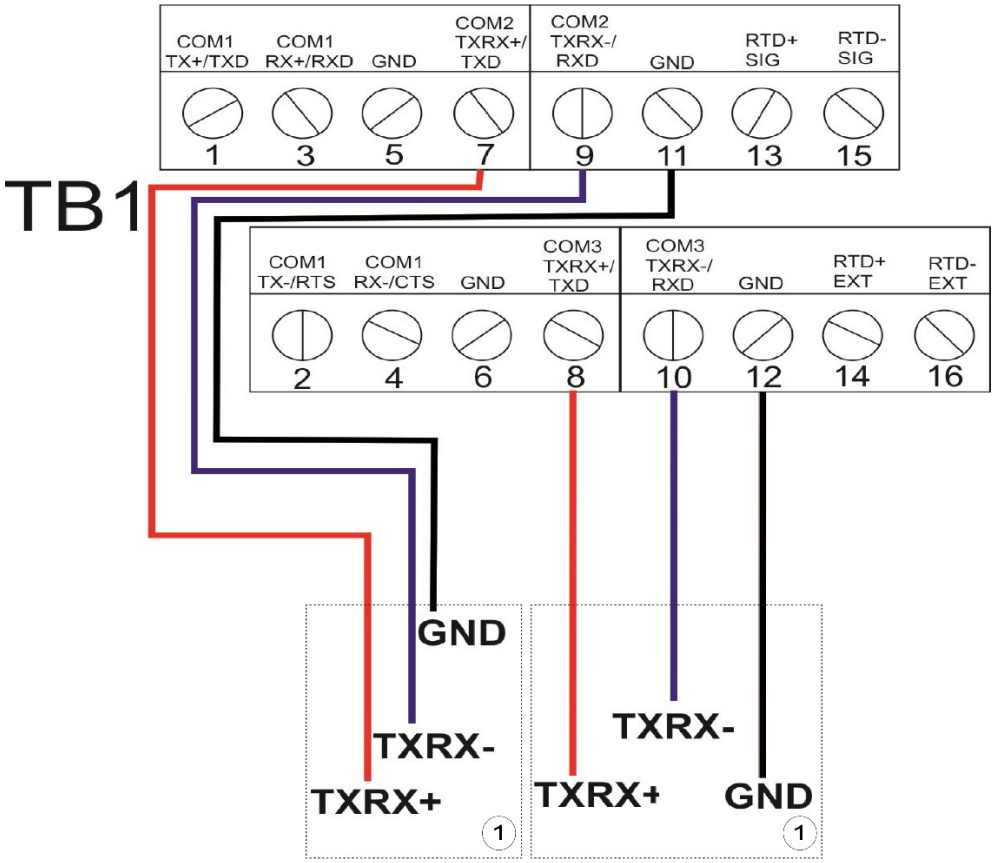
Figure 2-48. Connecting a Device to COM2 or COM3 Using RS-232



1 RS-232 Port on other device

When connecting COM2 or COM3 to an **RS-485 (2-wire)** port on another device (for example, a transmitter), use a cable with configurations as shown in *Figure 2-49*:

Figure 2-49. Connecting a Device to COM2 or COM3 Using RS-485 (2-wire)



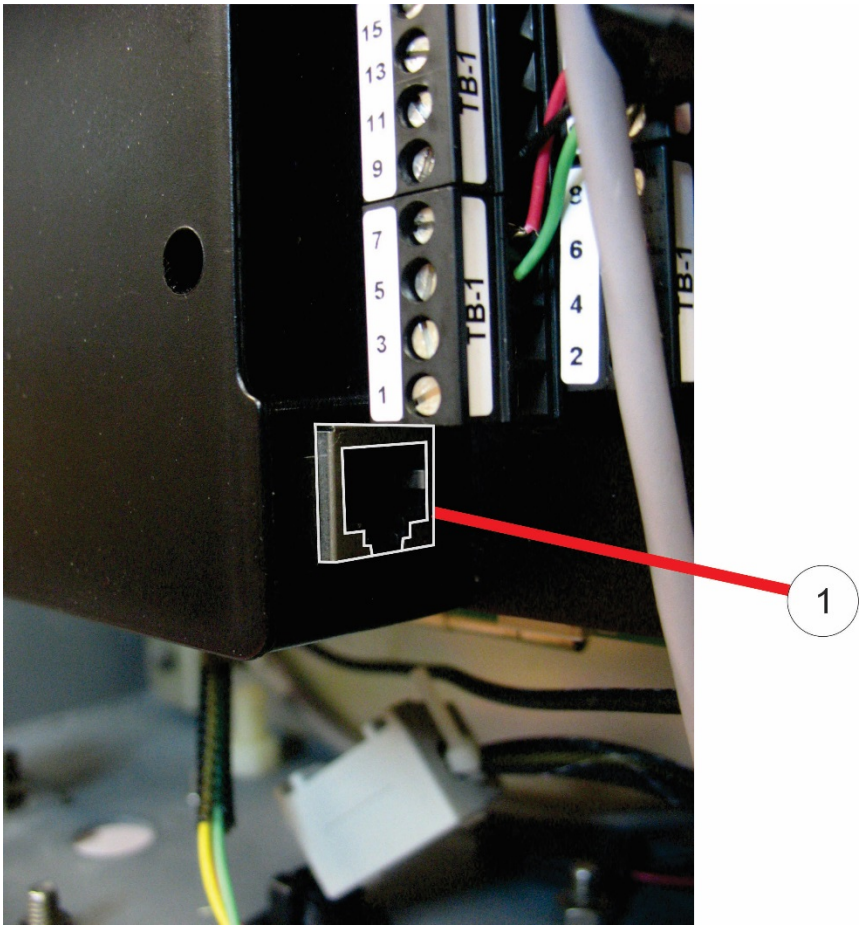
1 RS-485 (2-wire) Port on other device

Regardless of the interface standard (RS-232 or RS-485 2-wire), you must use FBxConnect to configure the port for proper usage.

2.13.3 Connecting to Ethernet

The Ethernet port is a standard 8-pin 10/100 Base T RJ-45 modular connector located on the bottom right side of the CPU enclosure.

Figure 2-50.Connecting to Ethernet



1 Ethernet Port

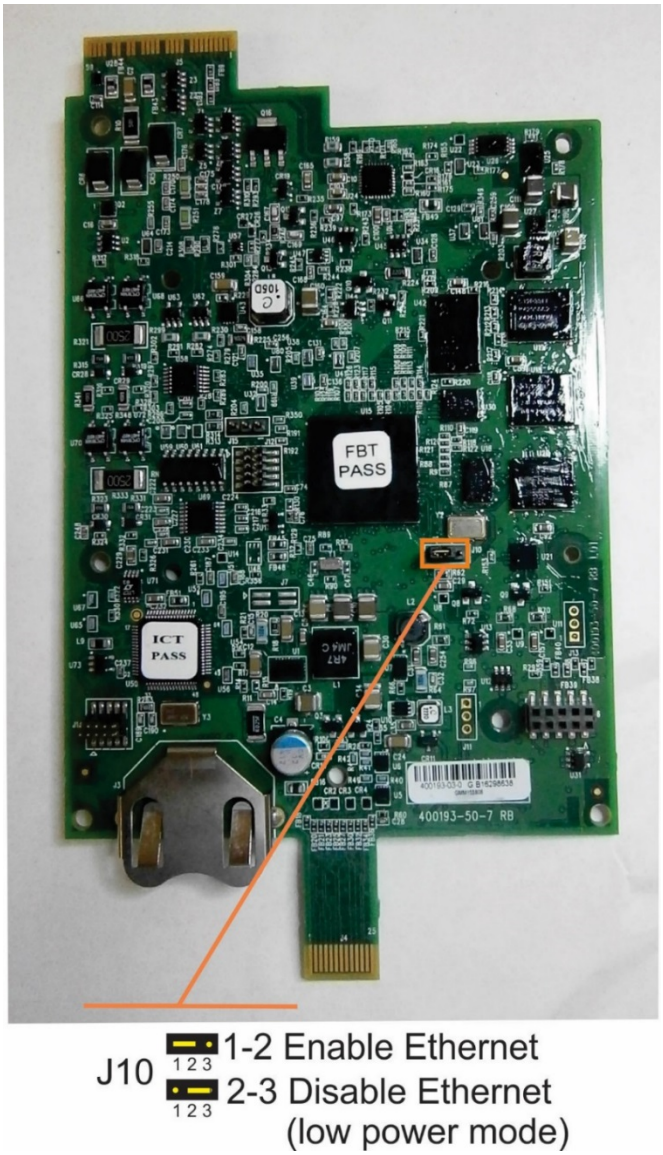
Connect to an Ethernet switch using the appropriate Category 5 shielded patch cable.

Note

The default Ethernet IP address is **192.168.1.10**; the default port is **20000**.

If you ordered Ethernet, the unit ships with Ethernet enabled. If you need to operate the device in lower power mode, you **must disable** Ethernet. Jumper J10 on the CPU module (see *Figure 2-49*) determines whether Ethernet is enabled or disabled. Refer to the *CPU Enclosure and Electronics Field Replacement Guide* (D301803X012) for information on how to open the unit to gain access to the CPU module.

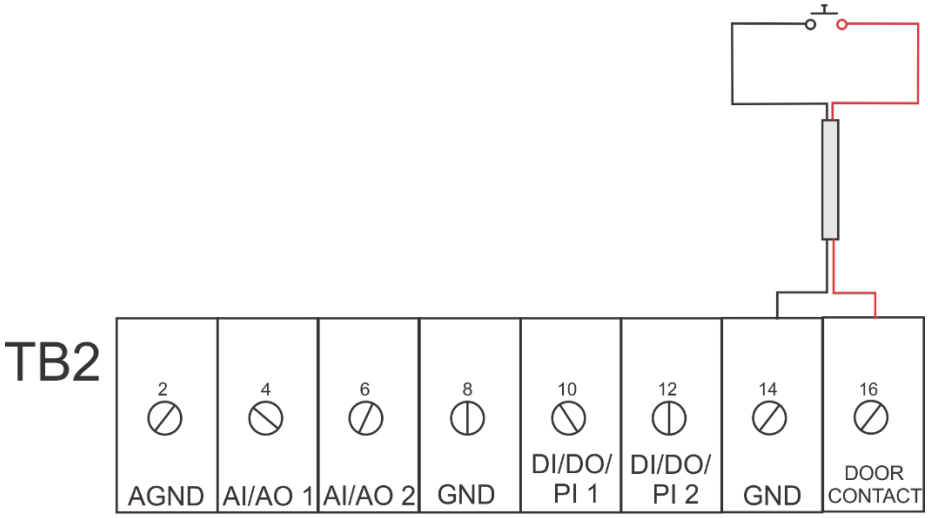
Figure 2-51. Ethernet port jumper



2.14 Security Intrusion Switch

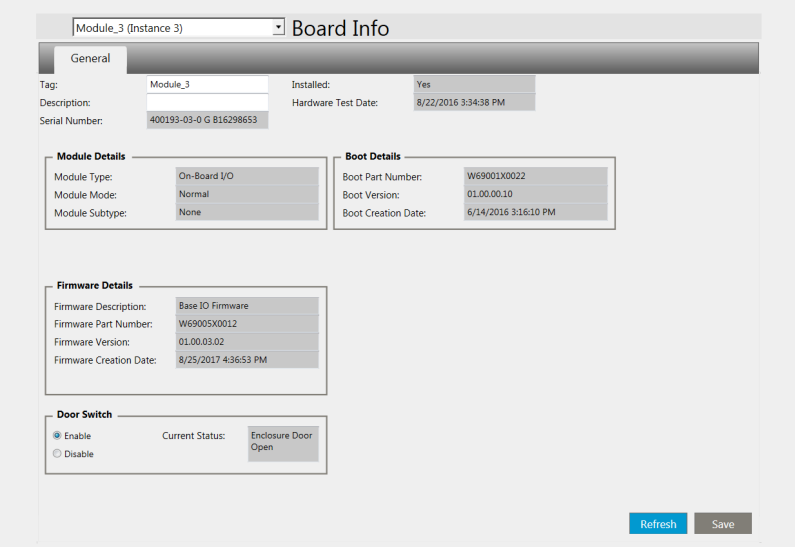
If ordered from the factory, the door contact wires to a momentary switch as shown using cable part number 399331-01-0.

Figure 2-52. Wiring the Door Contact Terminal to a Momentary Switch



If you order the optional security intrusion switch, the flow computer ships from the factory with the door switch option enabled. To verify this, you can run FBxConnect software and select **Services > Board Info.** This allows you to view/modify the enable/disable setting for the **Door Switch.** The door switch is always on **Module_3**.

Figure 2-53. Board Info Screen in FBxConnect



Chapter 3: I/O Configuration and Wiring

This chapter covers the following topics:

- Analog Inputs
- Analog Outputs
- Digital Inputs
- Digital Outputs
- Pulse Inputs
- Connecting the RTD/PRT
- Connecting a Rosemount 4088B Transmitter for Use in a Second Meter Run
- Wiring a Digital Output to the Optional Relay
- Radio Wiring

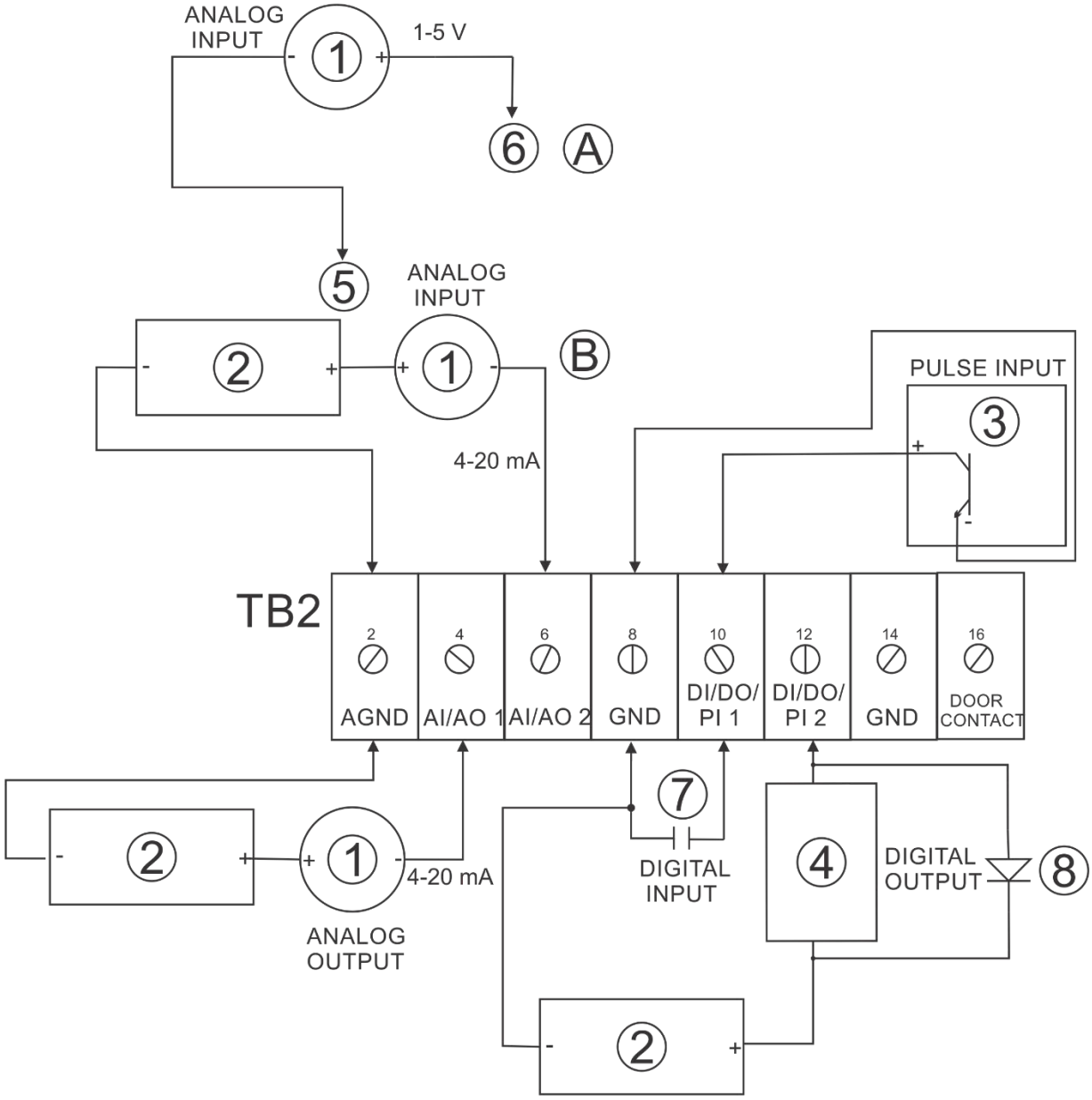
I/O in the FB2200 flow computer comes from the integrated multivariable sensor and RTD connector, the CPU board, as well as the optional mixed I/O modules.

Note
When using a digital output to drive an inductive load (such as a relay coil), place a suppression diode across the load. This protects the DO from the reverse Electro-Motive Force (EMF) spike generated when the inductive load is switched off.

Notes About Power for an External Device Connected to a Flow Computer I/O Point:
If the external device does not include its own integrated power supply, you must provide your own external supply (30Vdc maximum) for that device.

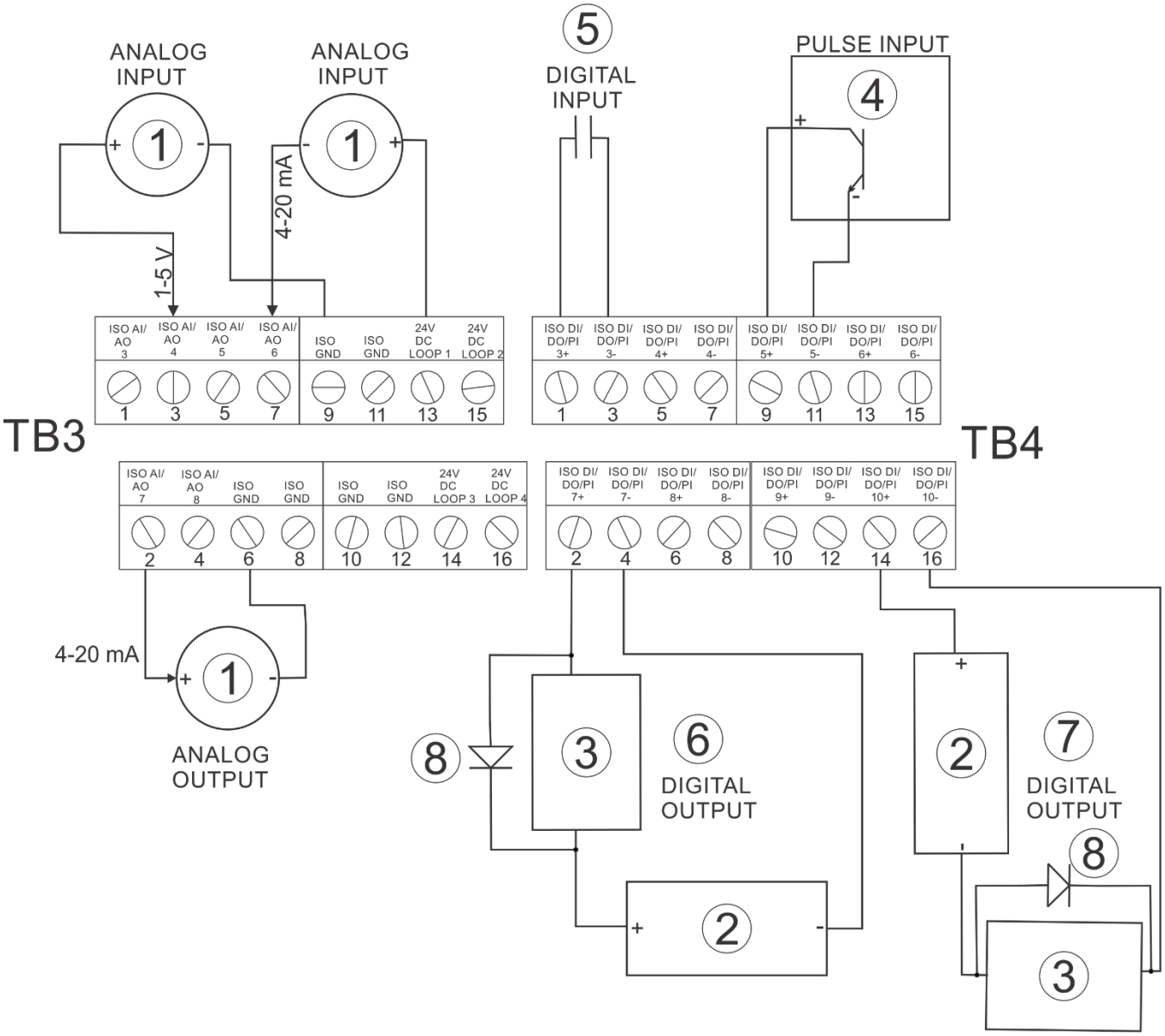
If your FB2200 flow computer includes the optional 8-channel Expansion I/O Module, you *may* be able to use the 24V loop power terminals to power the external device. In this case, the **maximum** load current **cannot exceed** 500 mA.

Figure 3-1. Base I/O (AI/AO 1 & 2, DI/DO/PI 1 & 2)



A When wiring a 1-5 V Analog Input (AI), use configuration at left
B When wiring a 4-20 mA Analog Input (AI), use configuration at left
1 Field Device
2 Power Supply 30Vdc Max
3 Open Drain Type or Open Collector Device (Externally Powered)
4 500 mA load max
5 To AGND
6 To AIAOx
7 Dry contact
8 Suppression diode

Figure 3-2. Wiring for 8-channel Expansion I/O Module and 6-channel Expansion I/O Module



1. Field Device
2. Power Supply 30Vdc Max
3. 500 mA load max
4. Open Drain Type or Open Collector Device (Externally Powered)
5. Dry contact
6. Low Side Switch
7. High Side Switch
8. Suppression diode

3.1 Analog Inputs

The FB2200 flow computer includes two on-board channels you can individually configure as either analog inputs (AI) or analog outputs (AO). The optional 8-channel expansion I/O module includes 4 additional channels you can individually configure as AIs or AOs. In addition, if you purchased the optional 6-channel expansion I/O module, there are two additional channels you can individually configure as either AIs or AOs.

Note

No external resistor is required for a current (mA) device. You can apply a 250 ohm resistor using analog input configuration selections in FBxConnect.

When configured as analog inputs, the channels have the following characteristics:

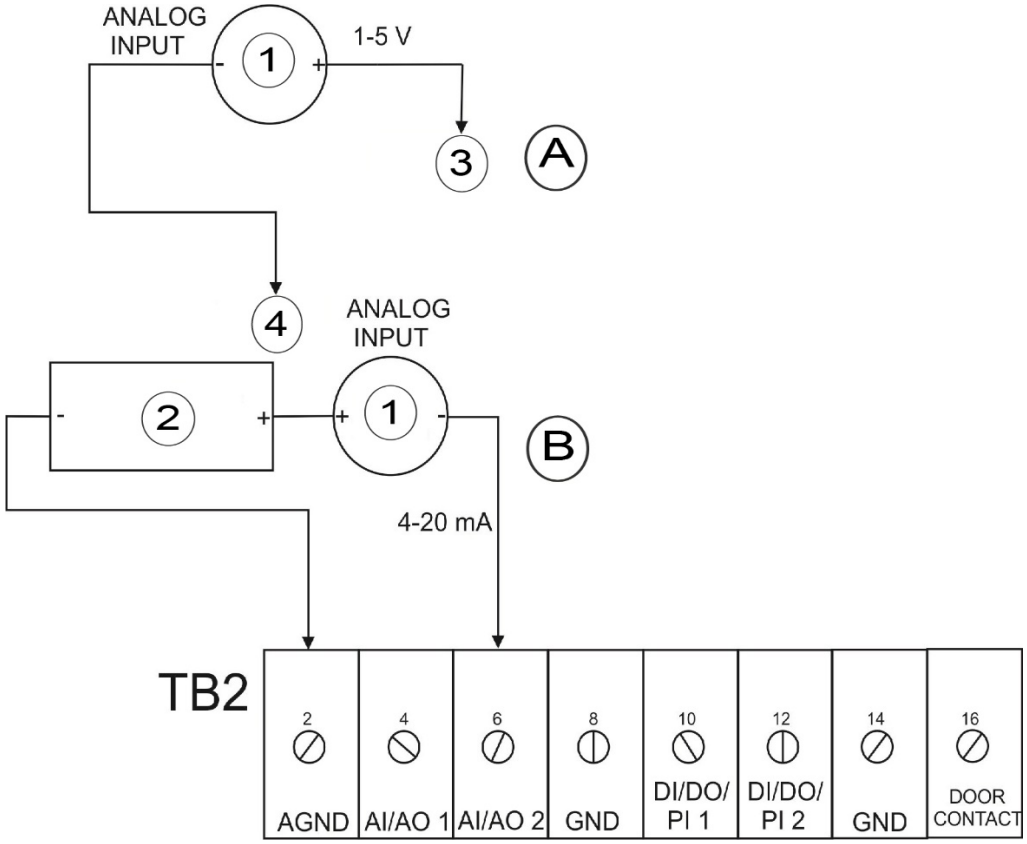
Table 3-1. Analog Input Characteristics

Type	Number Supported	Characteristics
Analog Input (AI)	0 to 8 as follows: ▪ 1 or 2 non-isolated channels on CPU module (AI/AO1 and AI/AO2) always present. You can configure one, both, or neither as AIs. ▪ 1, 2, 3, or 4 additional isolated channels on optional 8-channel expansion I/O module (ISO AI/AO3, ISO AI/AO4, ISO AI/AO5, or ISO AI/AO6). If module is present you can configure any (or none) of the four channels as AIs. ▪ 1 or 2 additional isolated channels on optional 6-channel expansion I/O module (ISO AI/AO7 and ISO AI/AO8). If module is present you can configure one, both, or neither as AIs. This module is allowed only if 8-channel expansion I/O module is also present.	▪ 4 to 20 mA range (@24Vdc), or 1 to 5Vdc ▪ Over range for calibration purposes: 3.2 to 20.8 mA or 0.8 to 5.2 Vdc ▪ AI1 and AI2 require external power when in current mode **only** ▪ Factory calibrated (re-calibration is unnecessary for at least 3 years) ▪ Signal conditioning ▪ When you configure a channel as an AI it cannot be used as an AO

3.1.1 AI Wiring

The following diagrams show how to wire the analog input.

Figure 3-3. AI Wiring: Base I/O (AI/AO1 & AI/AO2 only)



A When wiring a 1-5 V Analog Input (AI), use configuration at left

B When wiring a 4-20 mA Analog Input (AI), use configuration at left

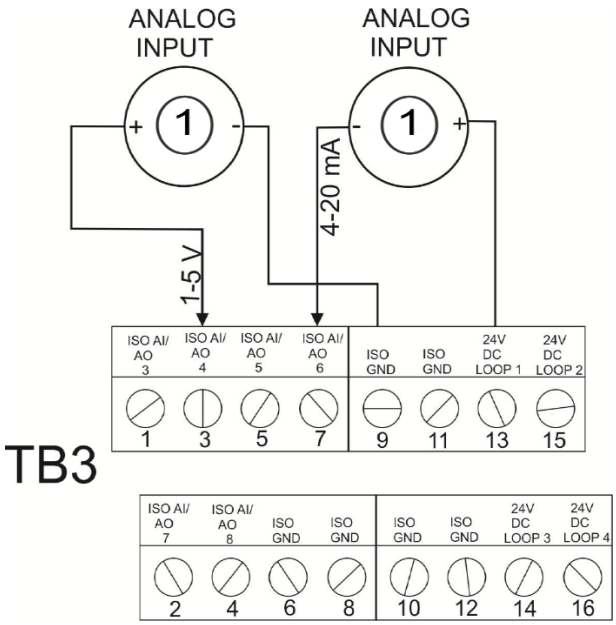
1 Field Device

2 Power Supply 30Vdc Max

3 To AIAOx

4 To AGND

Figure 3-4. AI Wiring: Optional 8-channel Expansion I/O Module (ISO AI/AO 3,4,5,6) and Optional 6-channel Expansion I/O Module (ISO AI/AO 7,8)



1 Field Device

3.2 Analog Outputs

The FB2200 flow computer includes two on-board channels you can individually configure as either analog outputs (AO) or analog inputs (AI). The optional 8-channel expansion I/O module includes 4 additional channels you can individually configure as AOs or AIs. In addition, if you purchased the optional 6-channel expansion I/O module, there are two additional channels you can individually configure as either AOs or AIs.

When configured as analog outputs, the channels have the following characteristics:

Table 3-2. Analog Output Characteristics

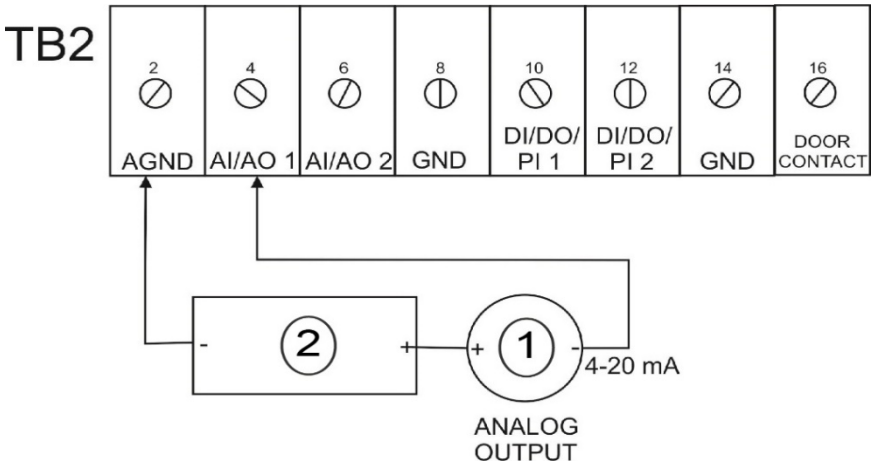
Type	Number Supported	Characteristics
Analog Input (AI)	0 to 8 as follows: ▪ 1 or 2 non-isolated channels on CPU module (AI/AO1 and AI/AO2) always present. You can configure one, both, or neither as AOs. **Note**: If you configure both as AOs we recommend you provide isolation to avoid ground loops, which could affect readings.	▪ 4 to 20 mA range (@24Vdc) ▪ Externally powered field device (Ai/AO1 and AI/AO2) ▪ 24V loop supply powers AO (ISO AI/AO3 through ISO AI/AO8) ▪ AO sinks current to system ground ▪ Factory calibrated (re-calibration is unnecessary for at least 3 years)

- 1, 2, 3, or 4 additional isolated channels on optional 8-channel expansion I/O module (ISO AI/AO3, ISO AI/AO4, ISO AI/AO5, or ISO AI/AO6). If module is present you can configure any (or none) of the four channels as AOs.
- 1 or 2 additional isolated channels on optional 6-channel expansion I/O module (ISO AI/AO7 and ISO AI/AO8). If module is present you can configure one, both, or neither as AOs. This module is allowed only if 8-channel expansion I/O module is also present.
- You can configure a fail state so that on power up or if the CPU fails the output drives to 0 μA
- When you configure a channel as an AO it cannot be used as an AI

3.2.1 AO Wiring

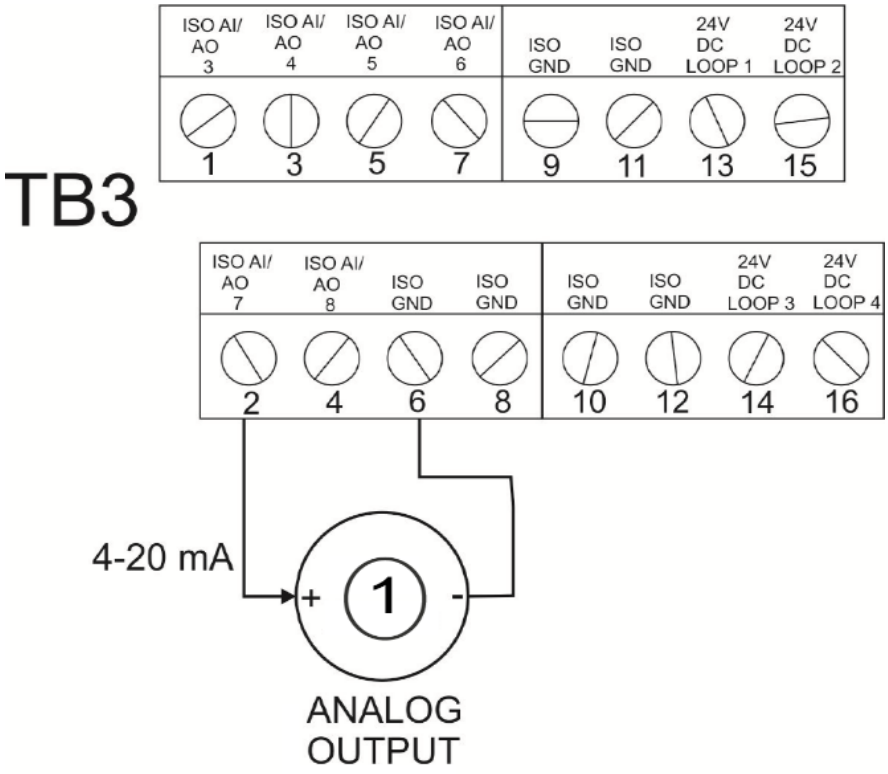
The following diagrams show how to wire the analog output.

Figure 3-5. AO Wiring: Base I/O (AI/AO1 & AI/AO2)



1 Field Device
2 Power Supply 30Vdc Max

Figure 3-6. AO Wiring: Optional 8-channel Expansion I/O Module (ISO AI/AO 3,4,5,6) and Optional 6-channel Expansion I/O Module (ISO AI/AO7 & AI/AO8)



1 Field Device

3.3 Digital Inputs

Depending upon how you ordered it, the FB2200 flow computer includes two, six, or ten channels you can individually configure as digital inputs (DI), digital outputs (DO), or pulse inputs (PI).

When configured as digital inputs, the channels have the following characteristics:

Table 3-3. Digital input Characteristics

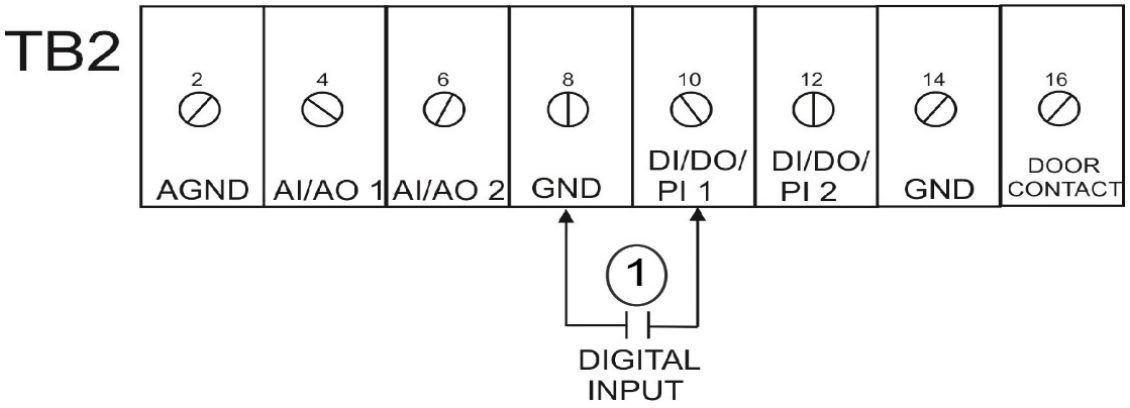
Type	Number Supported	Characteristics
Digital Input (AI)	0 to 8 as follows: ▪ 1 or 2 non-isolated channels on CPU module (DI/DO/PI1 and DI/DO/PI2). Two are always present; you can configure one, both, or neither as DIs. ▪ 1 to 4 additional isolated channels on optional 8-channel expansion	▪ Circuit protection. ▪ 30ms input filtering ▪ Maximum input frequency of 10 Hz ▪ Selectable current source of 66 μA or 2 mA.

Type	Number Supported	Characteristics
	I/O module (ISO DI/DO/PI3 to ISO DI/DO/PI6). If module is present you can configure one, two, three, four, or none of the channels as DIs. ▪ 1 to 4 additional isolated channels on optional 6-channel expansion I/O module (ISO DI/DO/PI7 to ISO DI/DO/PI10). If module is present you can configure one, two, three, four, or none of the channels as DIs. This module is allowed only if 8-channel expansion I/O module is also present.	▪ Either externally driven or internally driven and pulled to ground by dry contact closures or open collector devices ▪ When you configure a channel as a DI it cannot be used as a DO or PI channel

3.3.1 DI Wiring

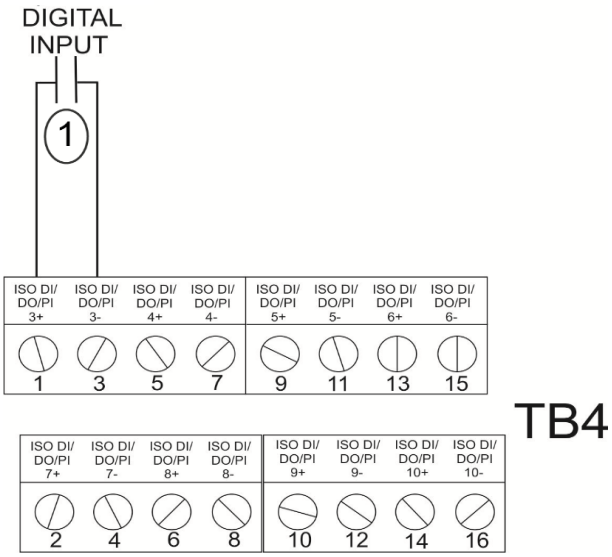
The following diagrams show how to wire the digital input.

Figure 3-7. DI Wiring: Base I/O (DI/DO/PI1 & DI/DO/PI2)



1 Dry contact

Figure 3-8. DI Wiring: 8-channel Expansion I/O Module (ISO DI/DO/PI3,4,5,6) and 6-channel Expansion I/O Module (ISO DI/DO/PI7,8,9,10)



1 Dry contact

3.4 Digital Outputs

Depending upon how you ordered it, the FB2200 flow computer includes two, six, or ten channels you can configure as digital outputs (DO), digital inputs (DI) or pulse inputs (PI).

Note

When using a digital output to drive an inductive load (such as a relay coil), place a suppression diode across the load. This protects the DO from the reverse Electro-Motive Force (EMF) spike generated when the inductive load is switched off.

When configured as digital outputs, the channels have the following characteristics:

Table 3-4. Digital Output Characteristics

Type	Number Supported	Characteristics
Digital Output (DO)	0 to 10 as follows: ▪ 1 or 2 non-isolated channels on CPU module (DI/DO/PI1 and DI/DO/PI2). Two are always present; you can configure one, both, or neither as DOs. ▪ 1 to 4 additional isolated channels on optional 8-channel expansion I/O module (ISO DI/DO/PI3 to ISO	▪ DO is a low-side switch that sinks current to ground ▪ Current rating of 500 mA ▪ Maximum operating frequency of 50 Hz ▪ Pulse off/on time can be configured with a 31 ms minimum

DI/DO/PI6). If module is present you can configure one, two, three, four, or none of the channels as DOs.

- 1 to 4 additional isolated channels on optional 6-channel expansion I/O module (ISO DI/DO/PI7 to ISO DI/DO/PI10). If module is present you can configure one, two, three, four, or none of the channels as DOs. This module is allowed only if 8-channel expansion I/O module is also present.

on-time and a 31 ms minimum off-time

- Software-configurable with an output state for initial power up and in the case of a CPU failure
- Software-configurable failure mode of fail-open, fail-closed, or hold-last-state
- When you configure a channel as a DO it cannot be used as a DI or PI channel

Note

Digital outputs are rated to 500mA maximum. In a small number of applications, however, the load on the DO *could* have an effect on the uncertainty of the analog inputs and outputs. The typical increase in uncertainty is around 0.05% and **only** occurs when **all** of the following are true:

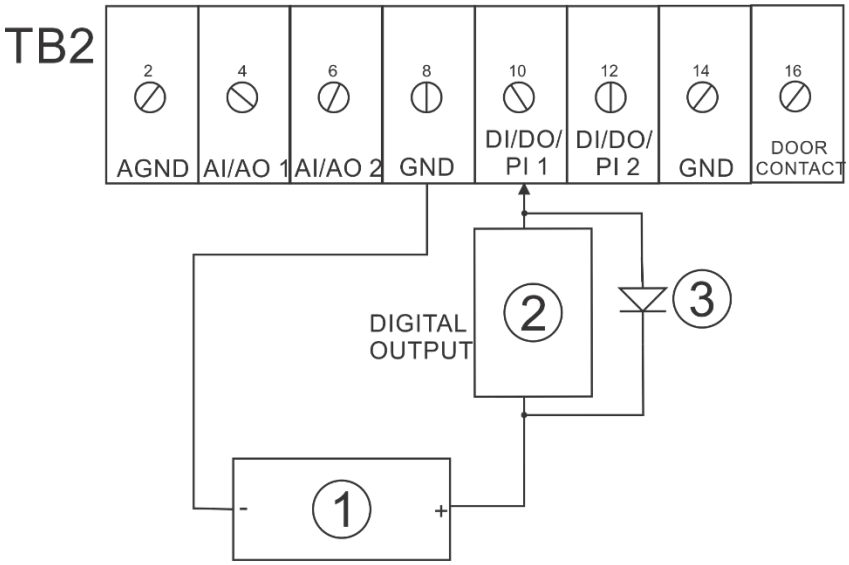
- **Either** of the two *analog* channels in the base I/O is used as an AI (in voltage mode) or as an AO **and**
- **Either** of the two *digital* channels in the base I/O is used as a DO **and**
- The total current load on these two DOs is **greater** than 300mA

Analog inputs in current mode and the I/O channels in the expansion I/O boards are **not** affected.

3.4.1 DO Wiring

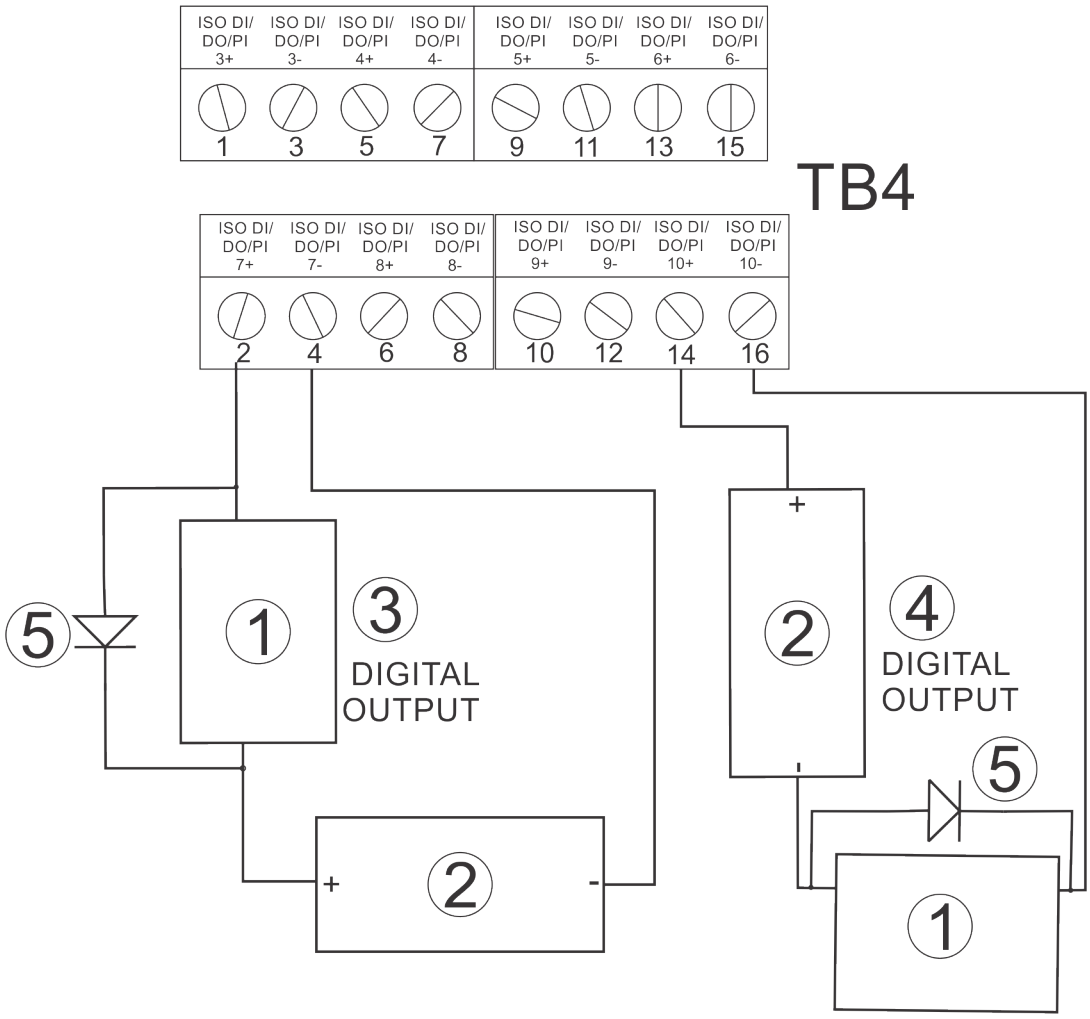
The following diagrams show how to wire the digital output.

Figure 3-9. DO Wiring: Base I/O (DI/DO/PI1 & DI/DO/PI2)



1 Power Supply 30Vdc Max
2 500 mA load max
3 Suppression diode

Figure 3-10. DO Wiring: Optional 8-channel Expansion I/O Module (ISO DI/DO/PI3,4,5,6) and Optional 6-channel Expansion I/O Module (ISO DI/DO/PI7,8,9,10)



1 500 mA load max
2 Power Supply 30Vdc Max
3 Low Side Switch
4 High Side Switch
5 Suppression diode

3.5 Pulse Inputs

Depending upon how you ordered it, the FB2200 flow computer includes two, six, or ten channels you can individually configure as either pulse inputs (PI), digital inputs (DI), or digital outputs (DO).

When configured as pulse inputs, the PI channels have the following characteristics:

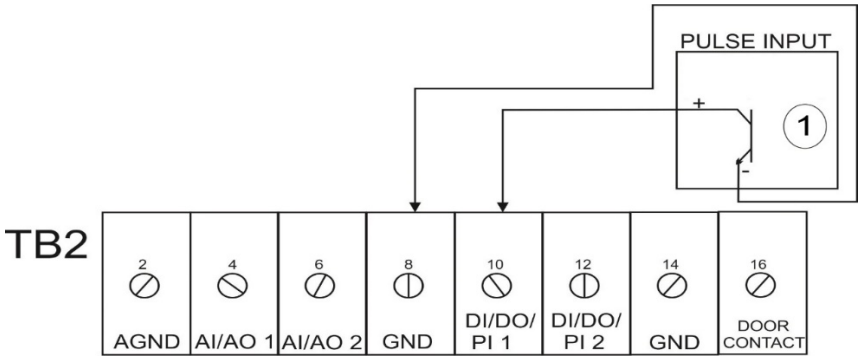
Table 3-5. Pulse Input Characteristics

Type	Number Supported	Characteristics
Pulse Inputs (PI)	0 to 10 as follows: ▪ 1 or 2 non-isolated channels on CPU module (DI/DO/PI1 and DI/DO/PI2). Two are always present; you can configure one, both, or neither as PIs. ▪ 1 to 4 additional isolated channels on optional 8-channel expansion I/O module (ISO DI/DO/PI3 to ISO DI/DO/PI6). If module is present you can configure one, two, three, four, or none of the channels as PIs. ▪ 1 to 4 additional isolated channels on optional 6-channel expansion I/O module (ISO DI/DO/PI7 to ISO DI/DO/PI10). If module is present you can configure one, two, three, four, or none of the channels as PIs. This module is allowed only if 8-channel expansion I/O module is also present.	▪ Supports dry contacts and open collector outputs connected to ground and voltage inputs ▪ Supports single pulse for volume or mass ▪ Input filtering selectable at 30 μs or 1 ms ▪ Frequency range from 0 to 10.5 KHz ▪ Maximum input frequency for the 1 ms filter is 300 Hz ▪ On when greater than 3.0V; off when less than 2.0V ▪ When you configure a channel as a PI it cannot be used as a DI or DO channel

3.5.1 PI Wiring

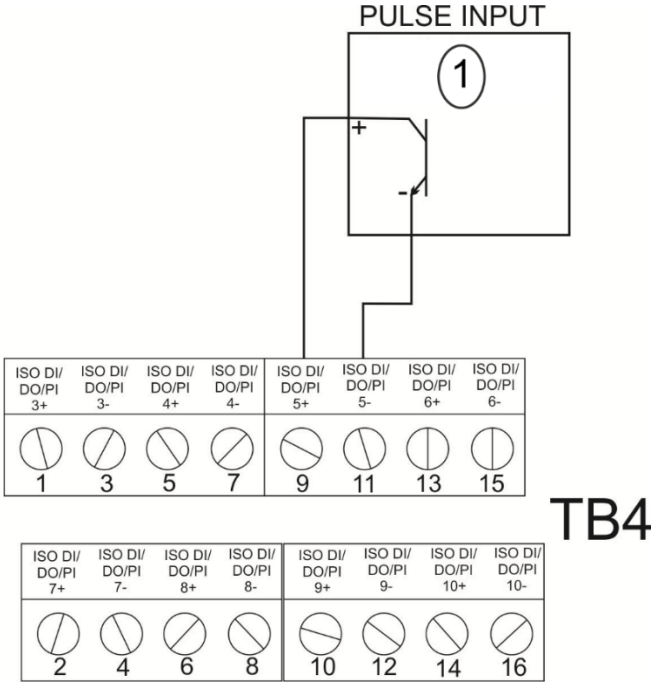
The following diagrams show how to wire the pulse inputs.

Figure 3-11. PI Wiring: Base I/O (DI/DO/PI1 & DI/DO/PI2)



1 Open Drain Type or Open Collector Device (Externally Powered)

Figure 3-12. PI Wiring: Optional 8-channel Expansion I/O Module (ISO DI/DO/PI3,4,5,6) and Optional 6-channel Expansion I/O Module (ISO DI/DO/PI7,8)



1 Open Drain Type or Open Collector Device (Externally Powered)

3.6 Connecting the RTD/PRT

⚠ DANGER

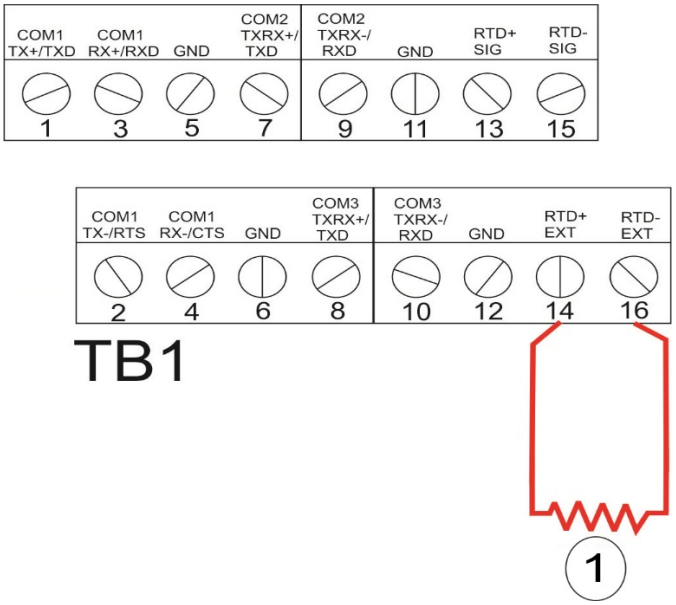
EXPLOSION HAZARD: Ensure the area in which you perform this operation is non-hazardous. Performing this operation in a hazardous area could result in an explosion.

RTD connections reside on the terminal blocks inside the enclosure. The flow computer supports 2-wire, 3-wire, and 4-wire operation for a PT100 RTD. Route the RTD cable through the conduit fittings and connect them on the terminal blocks (as shown on Figure 3-13, Figure 3-14 and Figure 3-15).

Note

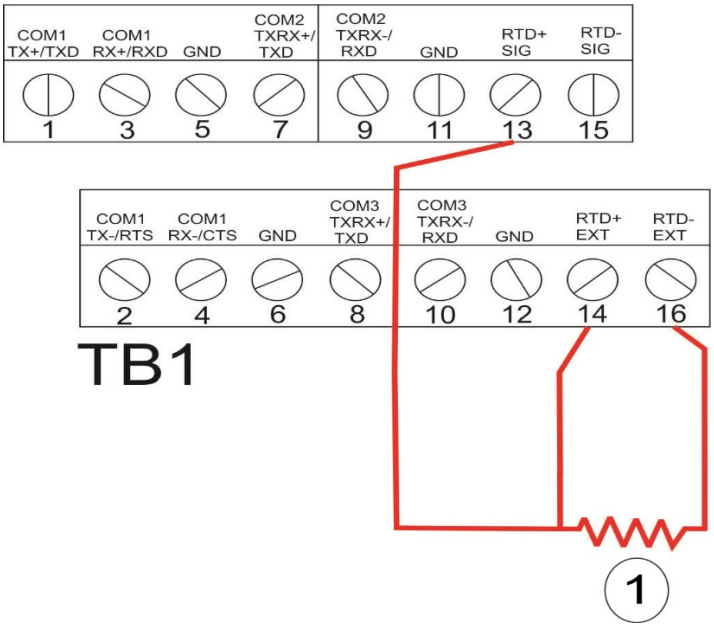
The device defaults to the 4-wire RTD configuration; you can change this setting in FBxConnect.

Figure 3-13. RTD/PRT Wiring for 2-Wire



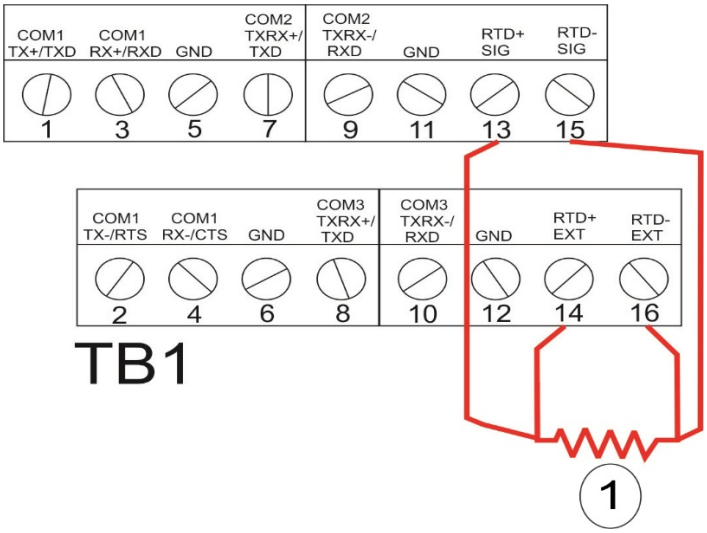
1 2-Wire RTD

Figure 3-14. RTD/PRT Wiring for 3-Wire



1 3-Wire RTD

Figure 3-15. RTD/PRT Wiring for 4-Wire



1 4-Wire RTD

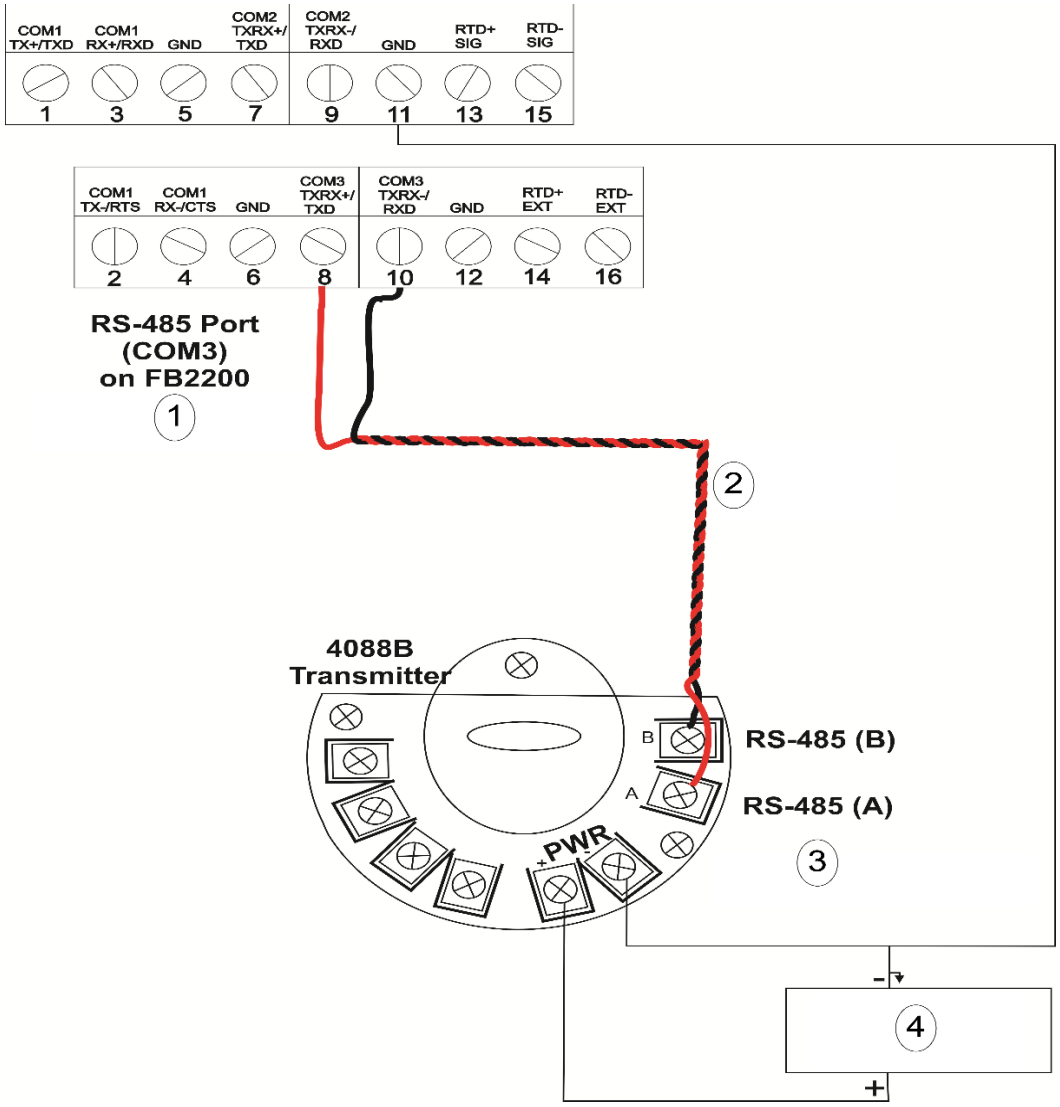
3.7 Connecting a Rosemount 4088B

The FB2200's integral sensor provides data for the first meter run. Data for a second meter run must come from an external transmitter such as the Rosemount 4088B. .

See the *Rosemount™ 4088 Multivariable™ Transmitter Reference Manual* (00809-0100-488, Rev. CB, Feb. 2017) for details on installing the 4088B.

1. Connect the RS-485 terminals for COM3 to the RS-485 terminals on the 4088B using twisted pair wire, as show in the following graphic.

Figure 3-16. Connecting a 4088B Transmitter for a Second Meter Run

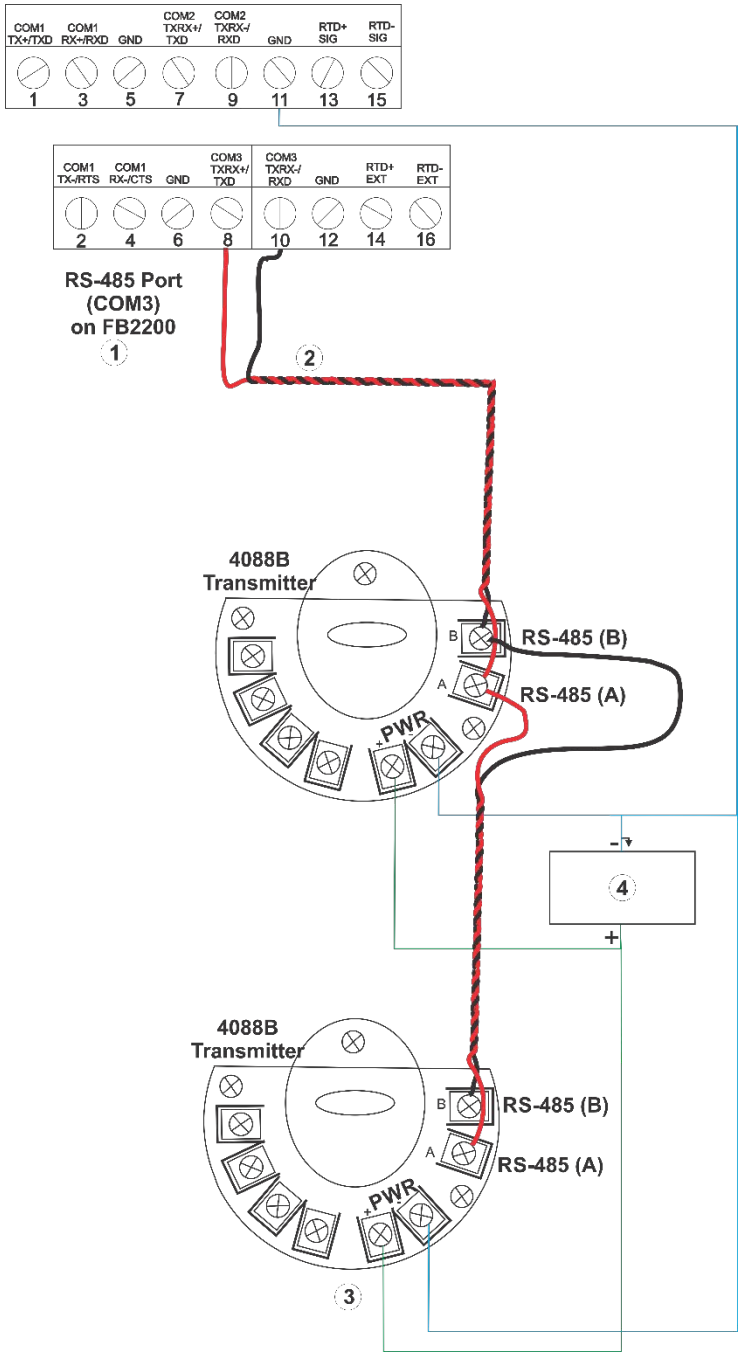


1 Enable termination in software
2 RS-485 bus, twisted pair required
3 Enable AC termination using switches.
4 User-provided power supply (5.4V to 30V)

2. Set switches on the 4088B for bus termination or use a 120-ohm resistor.
3. Using FBxConnect, configure COM3 for RS-485 and enable termination for the port.

If the FB2200 Flow Computer does not include an integral sensor, and you want to measure two meter runs, you must daisy-chain two external transmitters to provide data for the two meter runs.

Figure 3-17. FB2200 with no integral sensor – Daisy Chain Two 4088B



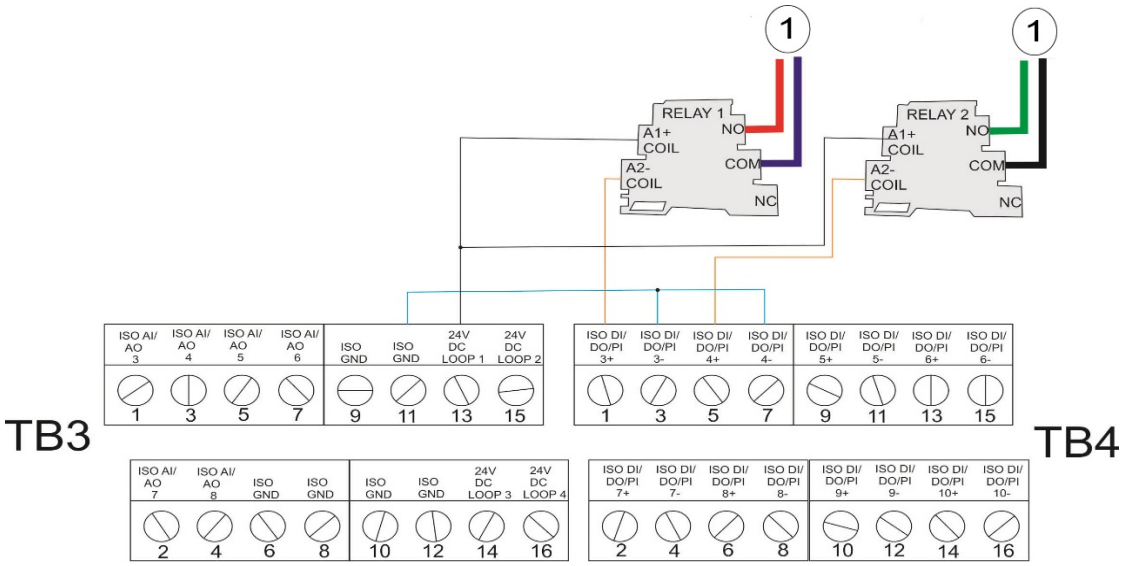
1. Enable termination in software
2. RS-485 bus, twisted pair required
3. Enable AC termination using switches.
4. User-provided power supply (5.4V to 30V)

3.8 Wiring a Digital Output to the Optional Relay

The flow computer supports two optional electro-mechanical relays for switching on/off external circuits or devices. If you order this option, the relays ship from the factory mounted to the top of the battery compartment inside the flow computer enclosure.

You can wire a relay to an isolated DO (*Figure 3-18*). You must also use the isolated GND and provide 24V to power the relay. To attach a wire, insert it into the connector and tighten the adjacent screw to secure it. The NO and COM wires go to the external circuit or device.

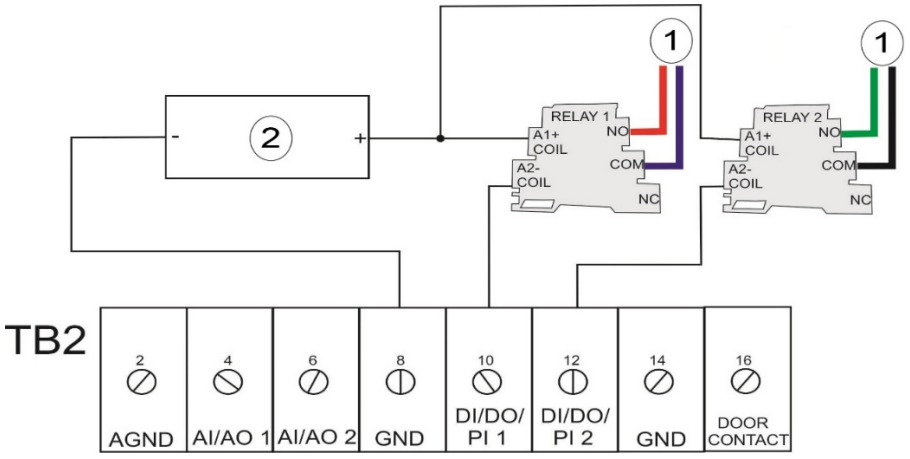
Figure 3-18. Relay Wired to Isolated DO



1 To customer load

Alternatively, you can wire a relay to a non-isolated DO (*Figure 3-19*). In that case, you must use the non-isolated GND and provide 24V to power the relay. To attach a wire, insert it into the connector and tighten the adjacent screw to secure it. The NO and COM wires go to your external circuit or device.

Figure 3-19. Relay Wired to Non-Isolated DO



1 To customer load

2 Power Supply 24Vdc

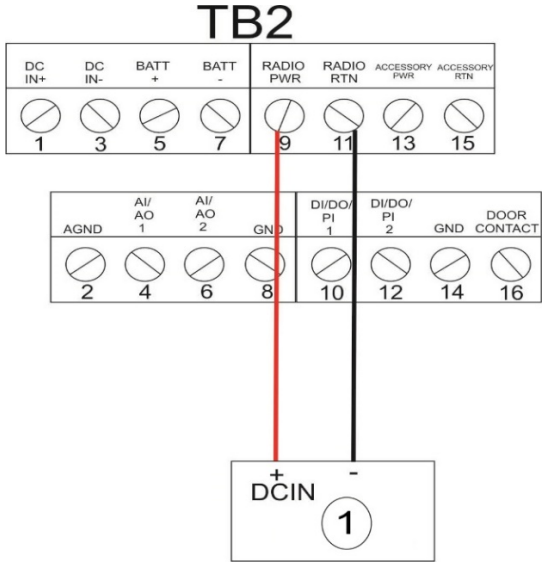
3.9 Radio Wiring

To power a radio, you wire it to the RADIO PWR and RADIO RTN terminals. These follow whatever the power supply provides the flow computer at the DCIN+ terminal.

Rating: DCIN @ 1A.

You must enable radio power In FBxConnect. Select **Configure > System** to bring up the System screen from which you enable radio power.

Figure 3-20. Radio Wiring



1 Radio

Chapter 4: Operation

This chapter covers the following topics:

- Powering Up/Powering Down the Device
- Establishing Communications
- Communicating using the HMI Module

This section describes day-to-day operation of the flow computer including how to turn it on and off and how to communicate with it.

4.1 Powering Up/Powering Down the Device

⚠ DANGER

Do not attempt to connect or disconnect power from the unit in a hazardous area. Ensure the area is non-hazardous. Failure to do so could result in an explosion.

1. Open the enclosure door.

2. Terminal block TB2 (pins 1,3,5,7) includes connections for DC power (DCIN+, DCIN-) and battery/ solar power (BATT+, BATT-). The internal battery (which is also used with solar power) has its own internal connectors.
   - Plug in TB2 (pins 1,3,5,7) to activate DC or battery/solar power. If your device uses an internal battery and it is not connected, connect it as discussed in *2.8.3 Connecting Battery Power*.
   - Unplug TB2 (pins 1,3,5,7) to deactivate DC or battery/solar power.

   This turns on (or shuts OFF) power from either an external power supply or the battery pack/solar panel.

Note
When you turn power on, the backlight on the HMI module lights, momentarily turns off and then remains lit while the INPUT LED blinks. After approximately one minute the initialization process finishes and the HMI starts to display live data.

4.2 Establishing Communications

The flow computer supports three ways to establish communications: through the host SCADA system, through a local laptop computer running FBxConnect, or through the HMI module.

4.2.1 Communicating with the SCADA Host

Communication to the flow computer through a SCADA host computer requires configuration of the host computer software, which varies depending upon whether you are using OpenEnterprise or another host software package. Much of this configuration is beyond the scope of this topic, but no matter which host you are using, there are certain steps you must take:

1. Decide how the SCADA host should communicate with the flow computer. This could be through connection with one of the communication ports. A serial port connection could be a cable directly connected to the SCADA host or there could be intermediate connections through a radio or modem.

2. Decide which communication protocol you will use. This could be DNP3, ROC, Modbus, or BSAP. See these documents for more information:
   - *DNP3 Protocol Specifications Manual (for FB1000 and FB2000)* (D301806X012)
   - *ROC Protocol Specifications Manual (for Emerson FB Series Flow Computers)* (D301828X012)
   - *FBxConnect Configuration Software User Manual* (D301850X012)
   - *BSAP Communication Guide for FB1000/FB2000 Series Flow Computers* (D301808X012)
3. Provide the SCADA host with information about the various parameters it needs to extract from the application running in the flow computer. Typically, the SCADA host software includes a utility that allows you to identify this information so it can be incorporated into the database at the SCADA host.
4. Using whatever human-machine interface (HMI) tools exist for the SCADA host, create graphical displays or reports that include the parameters from the application required for successful operator interaction (setpoints, flow variables and so on).

4.2.2 Communicating with a Laptop Using One of the Serial Ports

- If the flow computer is not awake, you must wake it up first. (See *Section 4.3*)
- Your laptop must have Field Tools software with FBxConnect software installed.
- You must know a valid username/password combination for the flow computer.

⚠ DANGER

EXPLOSION HAZARD: Ensure the area in which you perform this operation is non-hazardous. Performing this operation in a hazardous area could result in an explosion.

1. Connect a cable between a serial port (or serial/USB adapter) on your laptop and port COM2 on the flow computer.
2. Launch Field Tools and add a new serial connection for this device; this launches FBxConnect configuration software. (If you already have an existing saved serial connection for this device in Field Tools, just double-click on it in the Connections list.)
3. Log into the flow computer if prompted.
4. Use the FBxConnect configuration software to view or change any desired parameters.
5. When finished, log off the flow computer and disconnect the cable from its serial port.

4.2.3 Communicating with a Laptop Using Ethernet

Your laptop must have Field Tools software with FBxConnect software installed. Additionally, you must know a valid username/password combination for the flow computer. :

⚠ DANGER

EXPLOSION HAZARD: Ensure the area in which you perform this operation is non-hazardous. Performing this operation in a hazardous area could result in an explosion.

1. Connect a Category 5 shielded cable between an Ethernet port on your laptop and an Ethernet switch for your network.
2. Connect a Category 5 shielded cable between your Ethernet switch and the Ethernet port on the flow computer.
3. Launch Field Tools and add an IP connection for the device then click **Connect** to start the FBxConnect software. (If you already have an existing saved IP connection for this device in Field Tools, just double-click on it in the Connections list.)
4. Log into the flow computer if prompted.
5. Use the FBxConnect software to view/change any desired parameters.
6. When finished, log off from the flow computer and disconnect the cable.

4.2.4 Communicating with a Laptop Wirelessly with FBxWifi

You must have purchased the flow computer with the optional FBxWifi feature in order to connect to a laptop PC wirelessly. Additionally:

- Wi-Fi® must be configured and working on your laptop PC.
- Your laptop PC must have Field Tools software with FBxConnect installed.
- You must know a valid username/password combination for the flow computer.
- You must know the name of the wireless network and the security key required to connect to it.
- Your laptop PC must be within line-of-sight with either the front display of the flow computer or of an external antenna for the FBxWifi.
- If the flow computer is not awake, you must wake it up first. (See *Section 4.3*)

⚠ WARNING

Ensure that you and your laptop PC are in a non-hazardous area.

1. Launch Field Tools software and add a new wireless connection. (If you already have a saved wireless connection for this device in Field Tools, just double-click on it in the Connections list and skip to step 4.)
2. Select the wireless network to which the flow computer belongs and enter the appropriate security key.
3. Click **Connect** to start the FBxConnect software.
4. Log into the flow computer if prompted.
5. Use the FBxConnect software to view or change any desired parameters.
6. When finished, log off the flow computer and disconnect from the wireless network.

4.3 Communicating Using the HMI Module

You must have purchased the flow computer with the HMI module version that includes the optional display. Not all models include the display. Units without the display still include a button to wake up the device and status LEDs.

Notes:

- If the device is configured to require logins to view data, you must know a valid username/password combination for the flow computer.
- To conserve power, the HMI module enters sleep mode after a period of inactivity. Sleep mode disables FBxWifi communication. In FBxConnect, you can configure the

number of minutes of inactivity triggering sleep mode through the LCD Sleep Time parameter. Setting this parameter to 0 disables sleep mode which keeps the HMI module on but uses significantly more power.

To temporarily keep the HMI module out of sleep mode, maintain an active FBxConnect connection. As long as communications remain active, the HMI module will not sleep

1. Go to the front of the flow computer and touch your finger on the glass above the **Hold toWake** button until the display lights up. (This may take several seconds.)

Figure 4-1. Waking the Display



2. If prompted, login using a valid username/password combination. For information on how the buttons work, see *Table 4-1*.

   The display enters Screen Saver Mode where it sequentially presents a series of screens showing details about meter run flow rates, totals, and current process variables.

Figure 4-2. Infrared (IR) Button Location



1 Left Infrared (IR) Button
2 Down Infrared (IR) Button
3 Up Infrared (IR) Button
4 Right Infrared (IR) Button

Note

When using the IR buttons, aim your finger at the round spot just below the arrow.

Table 4-1. Infrared (IR) Buttons on HMI Module

Button	Mode	Use
OR	Screen Saver	▪ Tap once to move up or down one item through list of parameters. ▪ Hold to stay on current parameter.
	Data Entry	▪ Tap (UP) once to move the cursor to the previous character in the list or (DOWN) once to move the cursor to the next character in the list.Hold (UP) or (DOWN) to scroll more quickly through the character list.
	Idle Mode	Hold to wake the display (if screen is off)
	Screen Saver	Log out (if logged on)
	Data Entry	▪ Tap once to move the cursor to the left.Hold to perform action shown on screen (such as “Hold to Accept”)

	Data Entry	▪ Tap once to move the cursor to the right.Hold to perform action shown on screen (such as “Hold to Cancel”)

Symbol(s) representing the status of a value may appear in the upper right of the display, next to the description. Multiple symbols may be shown. If there are no data quality issues, no symbols will be shown.

Table 4-2. Symbols on Display

Symbol	Explanation
🔔	Alarm - The parameter value shown is in an alarm state (High Alarm, Low Alarm, etc.)
*	Override - The parameter value shown is in override mode (i.e. a user entered fixed value)
!	Fault - The parameter value shown is somehow invalid
?	Unverified - For parameter values that require additional validation (beyond simple database min/max range checking, the parameter value shown has not yet been validated by the firmware).

Chapter 5: Service and Troubleshooting

This chapter covers the following topics:

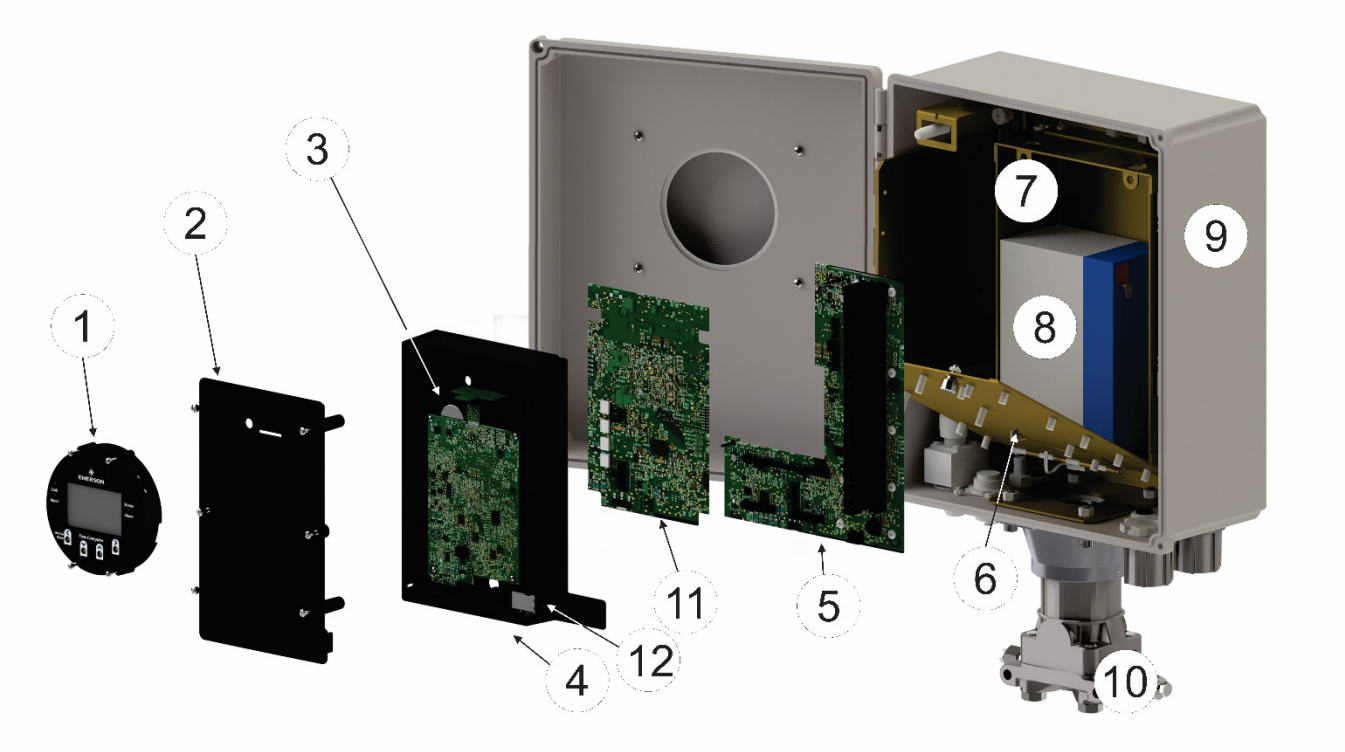
- Returning the Unit for Repairs
- Interpreting the Status LEDs
- Switch and Buttons
- Removing/Replacing the HMI Module
- Replacing the Main Battery Pack
- Removing/Replacing the SRAM Battery
- Upgrading System Firmware

In order to maintain hazardous location certifications, you can only replace components in the field with the exact same part so that the model string on the data plate remains correct. This means you cannot add any hardware not reflected in the model string or upgrade a hardware component to a newer version; any such upgrades are prohibited and void the hazardous location certification. This chapter describes the service tasks that everyone needs to know such as replacing batteries or installing a firmware upgrade. For other field replacements, see the appropriate field replacement guides for that component. Any replacement not covered in this chapter or in the field replacement guides can only be performed at an Emerson-authorized repair facility.



Important
Use only batteries supplied with the flow computer or sold by Emerson Remote Automation Solutions as spare parts for this flow computer. If you substitute a battery you obtain elsewhere you will void your certification unless it is the identical part from the same manufacturer as that supplied with the flow computer from Emerson.

Figure 5-1. FB2200 Flow Computer Components



1	HMI module
2	CPU enclosure cover
3	SRAM backup battery
4	CPU enclosure
5	I/O termination board
6	Battery compartment cover
7	Battery compartment
8	Batterypack
9	Enclosure
10	Sensor assembly
11	8-channel expansionI/O board
12	Ethernet port

5.1 Returning the Unit for Repairs

Only certain field replacement procedures are allowed under warranty and hazardous location certification. Other types of repairs cannot be performed in the field. In those cases, you must ship the unit to an Emerson-authorized repair facility. Contact Emerson Remote Automation Solutions for a return authorization number and instructions for where to ship the unit.

⚠ WARNING

International safety regulations restrict the shipment of lithium batteries. If you need to return the flow computer, remove the lithium battery before you ship the unit. Failure to remove the lithium battery may delay or prevent shipment of the flow computer.

5.2 Interpreting the Status LEDs

There are four (4) status LEDs on the flow computer. The meaning of each LED varies depending upon the color displayed or whether the LED flashes.

Figure 5-2. LED Locations



1 Input LED
2 Link LED
3 Status LED
4 Alarm LED

Table 5-1: LED Descriptions

LED	Color/State	Meaning
Link LED	GREEN	An active wired Ethernet connection exists. Otherwise it is off. (FB1200/FB2200 only)
Input LED	GREEN	One of the IR buttons is being pressed.
	Flashing YELLOW	CPU booting or CPU has not yet recognized HMI module when HMI first powered on; goes off when recognized.
Status LED	GREEN	OK – Main power battery pack charged or not in use.
	Flashing RED	Main power battery pack low. Replace/re-charge lead acid battery pack soon. (If FB1100 Flow Computer with lithium battery pack–replace battery pack.)
	Flashing YELLOW	FB1100 Flow Computer with lithium battery pack only: Unit has switched to C cell battery internal to battery pack. Replace battery pack soon.
	Off	No power
	Flashing GREEN	Main power battery pack charging.
Alarm LED	GREEN	No alarms.
	Flashing RED	HMI firmware update in progress.
	RED	Alarms are present.

Table 5-2. Special LED Sequences using Multiple LEDs

LED Sequence	Color/State
Link, Input, Status, and Alarm all solid RED	HMI module failed. Replace with spare or return for repairs.
Link and Alarm alternately flash RED; sequence repeats	CPU stuck in boot mode. Contact technical support.

5.3 Switch and Buttons

A momentary switch and two push-buttons on the HMI module provide trouble-shooting options for the flow computer.

Figure 5-3. Switch and Buttons



⚠ WARNING

DANGER TO PERSONNEL AND EQUIPMENT

Switch any process this flow computer controls over to whatever manual/backup system you have.

⚠ DANGER

EXPLOSION HAZARD: Never remove end cap(s) in a hazardous location. Removing end cap(s) in a hazardous location could result in an explosion.

Table 5-3. Switch and Buttons

Button Name	Purpose	Procedure
SYSTEM RESET	**Resets Power**. This momentary toggle switch interrupts power to the flow computer to reset it. This initiates a system reboot without losing the existing configuration, alarms, events, and history.	Move the SYSTEM RESET switch down towards the “SYSTEM RESET” label. Unit powers off and then restarts.
A	**Clears SRAM memory**. Clearing SRAM memory deletes current configuration data as well as	1. Press and hold the **A** button. 2. While continuing to hold the **A** button, move the SYSTEM

Button Name	Purpose	Procedure
	alarms, events, and history. IP address and security credentials are not deleted. If configured to do so, the device will restore configuration from FLASH memory. If not configured to restore from FLASH, you must reconfigure the device from scratch or load an existing saved solution file.	RESET switch down towards the “SYSTEM RESET” label, or remove and replace the power supply. 3. Release the **A** button to initiate a clear SRAM memory command. The system clears SRAM during the power up sequence.
B	**Full reset to factory default settings.** In certain rare cases it may become necessary to reset the flow computer to factory default settings. The most common reason for this would be if you forgot your login credentials and cannot connect to the device or you enabled DNP3 SAv5 security and then later you forget your DNP3 SAv5 key and cannot connect to the device. Prior to firmware revision 2.17, this would require you to return the flow computer to our factory for a complete reset. **Beginning with revision 2.17, you can perform the complete factory reset yourself but only if you have direct physical access to the device.** The factory reset erases all configuration settings including IP address, user credentials and flash memory contents. Configure the device from the beginning as if it was newly received from the factory.	**1.** Press and hold the **B** button. **2.** While continuing to hold the **B** button, move the SYSTEM RESET switch down towards the “SYSTEM RESET” label, or remove-and-replace the power supply. **3.** Release the **B** button to initiate a hardware factory reset. The system reboots with factory defaults during the power up sequence.

5.4 Removing/Replacing the HMI Module

You do not need to power down the unit to remove/replace the HMI module.

⚠ DANGER

Ensure the flow computer is in a non-hazardous area. Never remove/replace the HMI module in a hazardous area.

1. Open the enclosure.
2. Loosen the four captive fastening screws on the HMI module.

Figure 5-4. Captive Fastening Screws



3. Grasp the HMI module and remove it by gently pulling it straight out.
4. To replace the HMI module, line up the printed circuit board (PCB) with the slot on the back and gently press it back on. Tighten the four captive fastening screws.
5. Close the enclosure.

5.5 Replacing the Main Battery Pack

Periodically you must replace the main battery pack.

Figure 5-5. Main Battery Pack



The device provides a battery cable with two pairs of battery connectors, enabling you to hot-swap the battery pack in a non-hazardous location. You attach the new battery pack to the free connector (leaving the old one connected), and then disconnect the old battery pack.

⚠ DANGER

EXPLOSION HAZARD: Ensure the area in which you perform this operation is non-hazardous. Performing this operation in a hazardous area could result in an explosion.

⚠ DANGER

EXPLOSION HAZARD: Do not disconnect equipment unless power has been removed or the area is known to be non-hazardous.

⚠ DANGER

EXPLOSION HAZARD: Substitution of any components may impair suitability for Class I, Division 2.

⚠ DANGER

EXPLOSION HAZARD: Do not replace batteries unless power has been switched off or the area is known to be non-hazardous. Batteries must only be changed in an area known to be non-hazardous.

⚠ WARNING

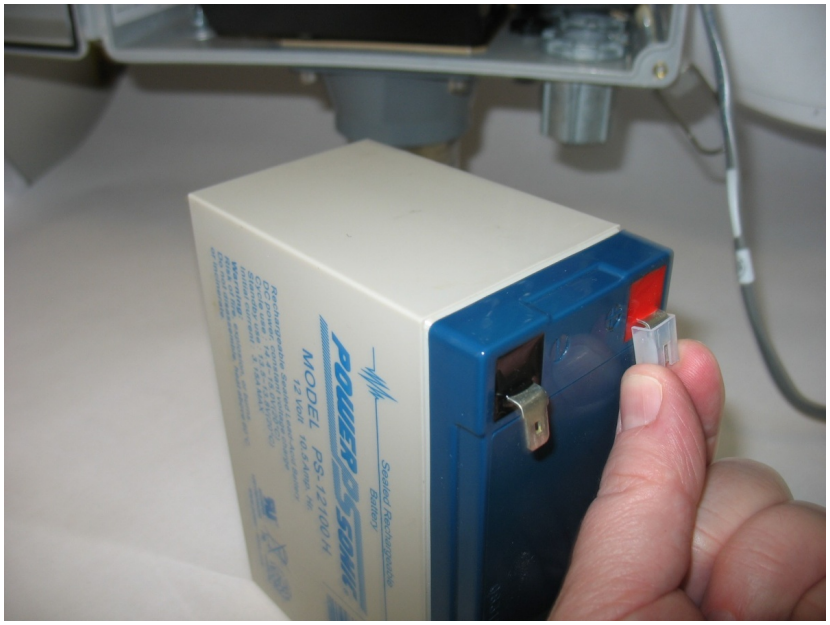
There are no user-serviceable parts inside the battery pack. Do not open the battery pack as you may damage the battery pack or injure yourself.

You need a Phillips-head screwdriver to perform this procedure.

Keep the replacement battery pack handy during the procedure.

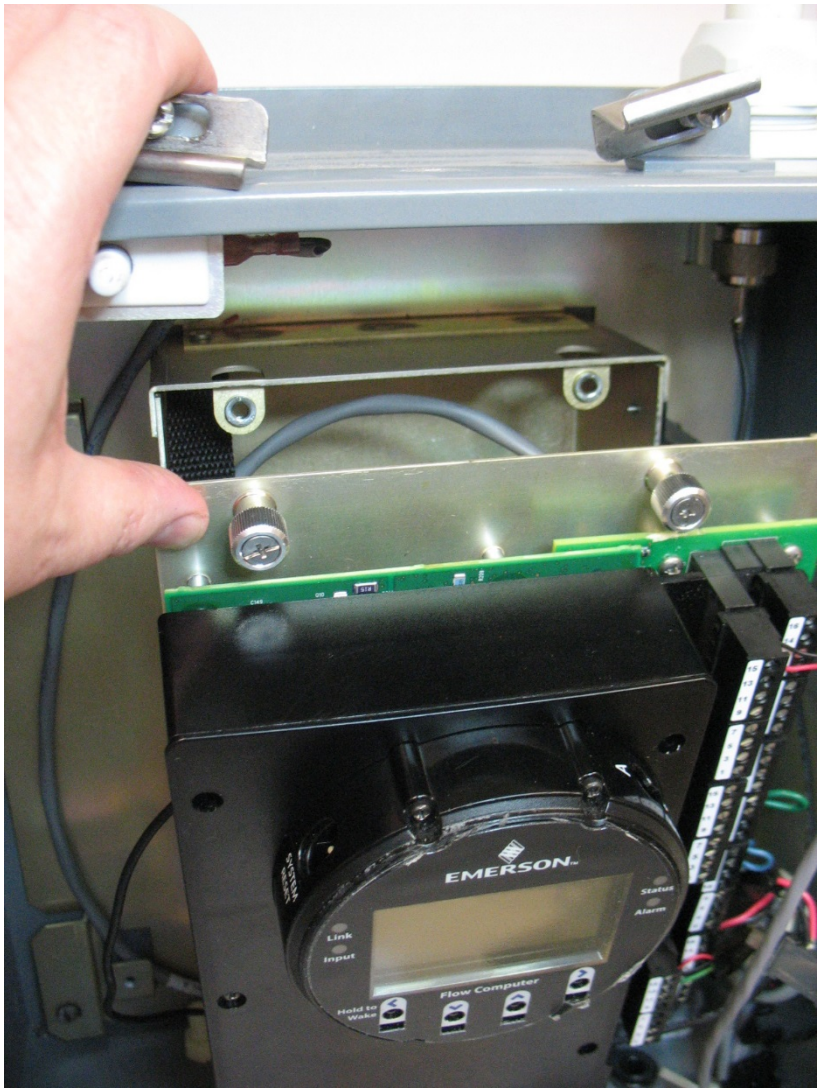
1. Remove the plastic tabs covering the connectors on the new battery pack.

Figure 5-6. Remove Plastic Tabs from New Battery Pack



2. Open the enclosure.
3. Loosen the two captive fastening screws at the top of the of the battery compartment and hold the battery compartment door as you carefully rotate the electronics assembly towards you to reveal the inside of the battery compartment. A strap prevents the front of the compartment from rotating too far forward.

Figure 5-7. Loosen Captive Fastening Screws and Rotate Assembly Forward



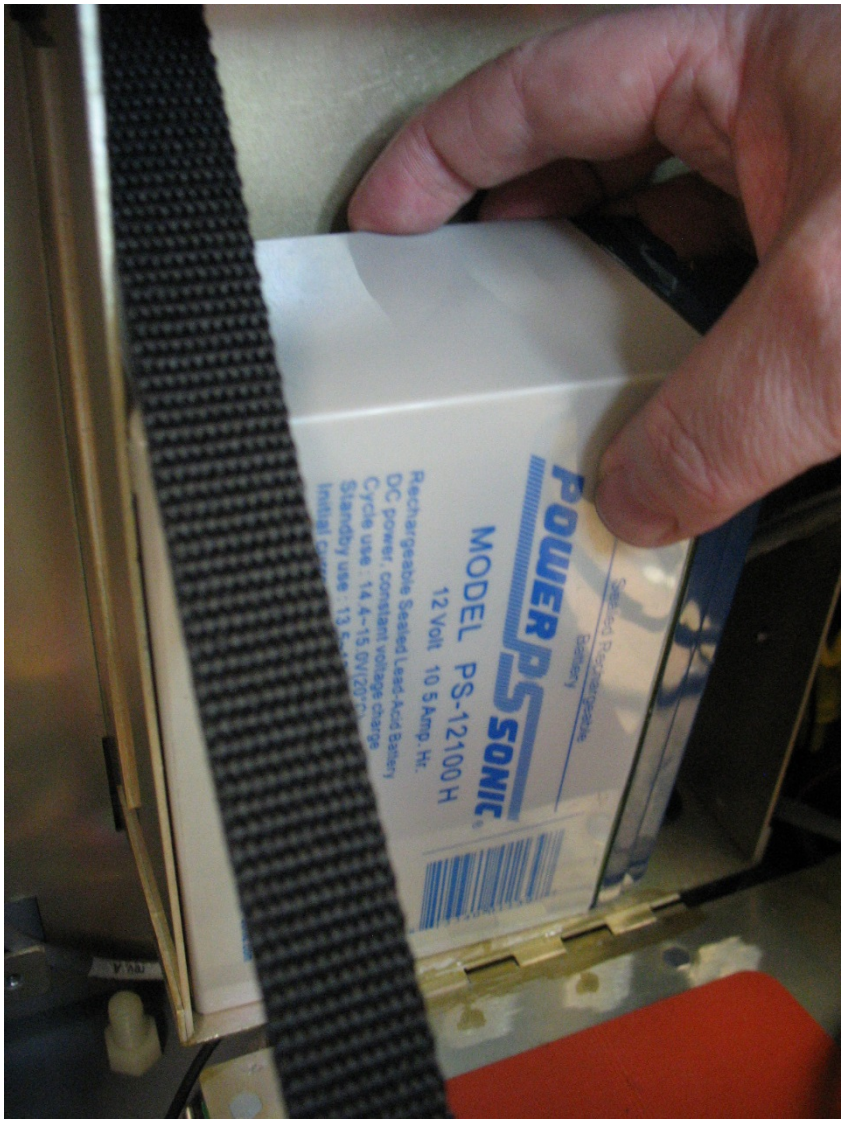
4. Remove the battery:

   If a hook-and-loop pad holds the battery, see the instructions in Step 5.

   If a strap holds the battery, skip to Steps 6 and 7.

5. Follow this step if you have the configuration where a hook-and-loop pad on the back of the battery secures it to the back of the battery compartment (otherwise skip to Steps 6 and 7). Leave the connectors on the current battery connected. Place your fingers behind the battery pack and pry it off the fastener on the back of the compartment; you may need to use both hands. Gently lift the battery with the battery cable attached out of the compartment. Now skip to Step 8.

Figure 5-8. Pry Out the Old Battery Pack – Leave Connected to Cable



6. If you have an internal solar regulator installed in the battery compartment, you must remove the termination cover. Remove the two screws (left and right) that fasten the termination cover to the solar regulator, and then set the termination cover aside. (If you don't have an internal solar regulator, skip to Step 7.)

Figure 5-9. Remove the Termination Cover (if present)



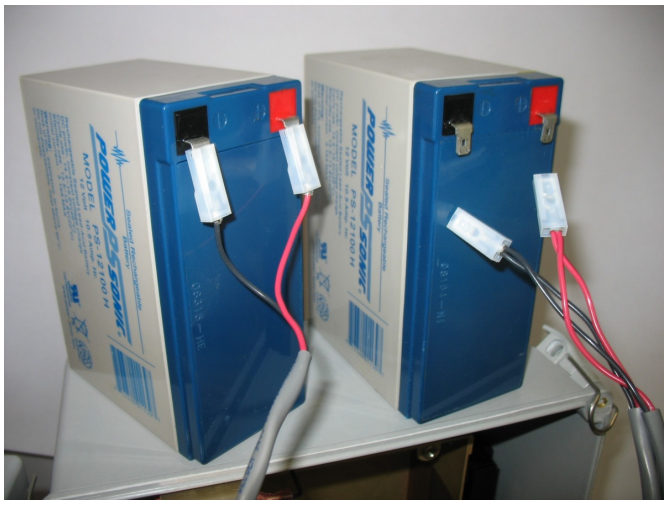
7. A strap with a hook and loop fastener holds the battery in place. Unstrap the battery but leave the connectors on the current battery connected. Gently lift the battery with the battery cable attached out of the compartment.

Figure 5-10. Unstrap the Old Battery Pack – Leave Connected to Cable



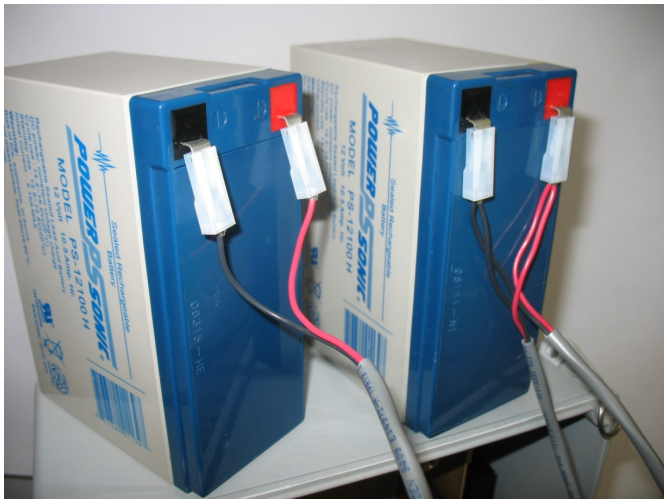
8. Place the old battery on top of the flow computer enclosure and place the new battery next to it.

Figure 5-11. Old Battery (left) and New Battery (right) Sit on Enclosure



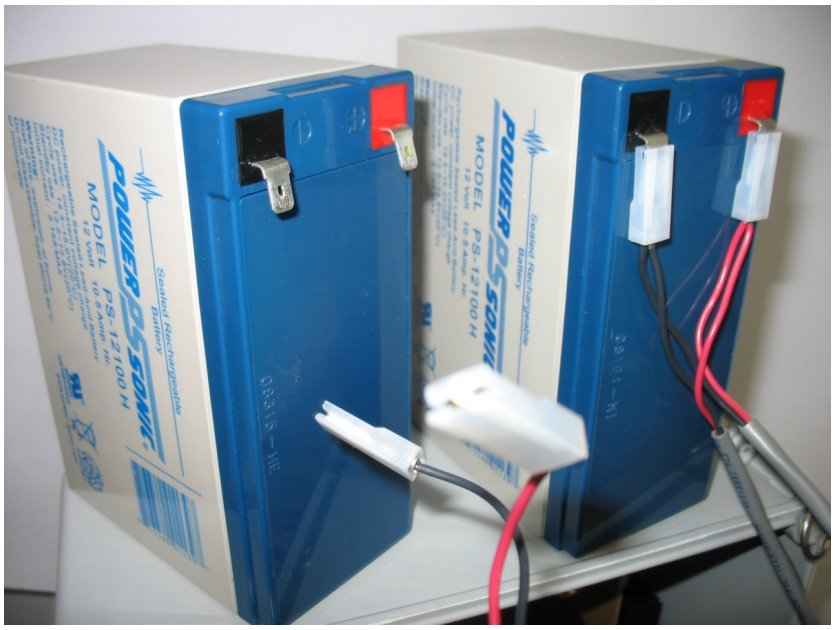
9. The battery cable is divided into two branches, each with its own pair of connectors. Take the free pair of connectors and connect them to the **new** battery; the red (positive) wire connector attaches to the red connection point on the new battery and the black (negative) wire connector attaches to the black connection point on the new battery.

Figure 5-12. Connect New Battery – Both Now Connected



10. Now disconnect the **old** battery from its connectors and set the old battery aside (be sure to dispose of it safely according to local regulations).

Figure 5-13. Old Battery Disconnected (left), New Battery Remains Connected (right)



11. Put the battery in the battery compartment:

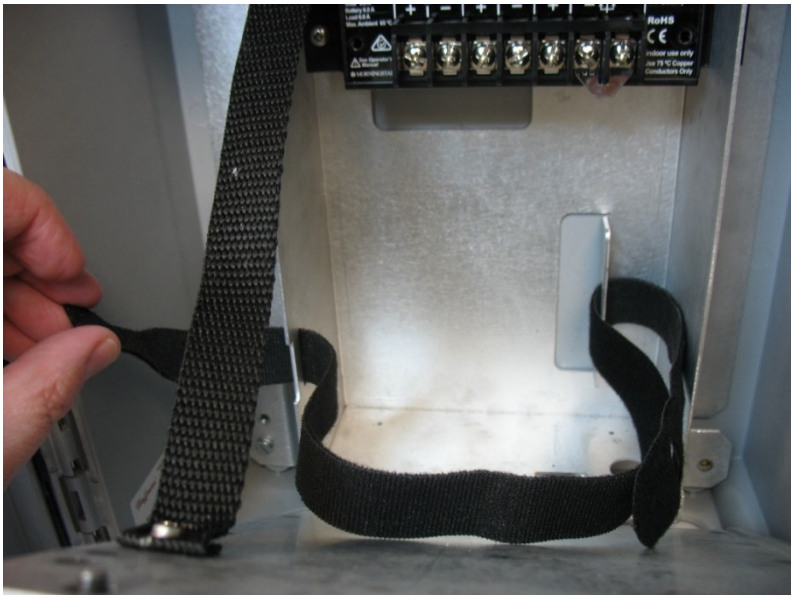
    If a hook-and-loop pad holds the battery, see the instructions in Step 12.

    If a strap holds the battery, skip to Steps 13 through 18.

12. Pick up the new battery and align it with the lower left edge of the battery compartment. Press it against the back of the compartment so the fastener pad on the back of the battery secures to the back of the battery compartment. Route the wires of the free portion of the battery cable so that they sit in the open area at the top of the battery compartment. Skip to Step 19.

13. Thread the battery strap through the holes of the battery compartment, if it is not already threaded.

Figure 5-14. Thread the Battery Strap



14. Pick up the new battery and carefully ease it into the battery compartment with the writing on the battery facing out and the connectors on the upper right-hand side. Nothing (including the strap) can be **behind** the battery.

Figure 5-15. Ease the Battery into the Battery Compartment



15. Carefully push the battery under the solar regulator (if present) and against the back of the compartment, now strap it in tightly by pulling the ends of the strap.

Figure 5-16. Tighten the Battery Strap



16. The strap includes a narrow opening into which you can slide the other end of the strap to help you tighten it.

Figure 5-17. Opening in the Battery Strap



17. Route the extra portion of the strap as well as the wires of the free portion of the battery cable so that they sit in an open area of the battery compartment.
18. If you had to remove the termination cover of an internal solar regulator (Step 6), re-attach the termination cover.
19. Rotate the electronics assembly up against the battery compartment and tighten the captive fastening screws with a torque value of 2 to 4 in-lbs (0.2 to 0.5 N m) to close the compartment.
20. Close the enclosure.

5.6 Removing/Replacing the SRAM Battery

A lithium coin cell battery provides backup power for the SRAM and the real time clock. The SRAM backup battery can last for up to 10,000 hours of cumulative operation, and only runs if the main power system fails. You do not need to power down the unit to replace the SRAM backup battery.

Important

- If the unit is ever powered down without the SRAM battery installed, SRAM data is lost. Always back up your data before you remove the SRAM battery if you know that main power will also be off.
- Replacement SRAM backup batteries **must** be either Rayovac® Model BR2335 **or** Panasonic® Model BR2330.

DANGER

Ensure the flow computer is in a non-hazardous area. Never open the enclosure in a hazardous area.

DANGER

EXPLOSION HAZARD: Do not disconnect equipment unless power has been removed or the area is known to be non-hazardous.

DANGER

EXPLOSION HAZARD: Substitution of any components may impair suitability for Class I, Division 2.

DANGER

EXPLOSION HAZARD: Do not replace batteries unless power has been switched off or the area is known to be non-hazardous. Batteries must only be changed in an area known to be non-hazardous.

1. Open the enclosure.
2. Loosen the two captive fastening screws on the cover of the black CPU enclosure (which has the HMI module attached to it) and place it aside.

Figure 5-18. Loosen Captive Fastening Screws

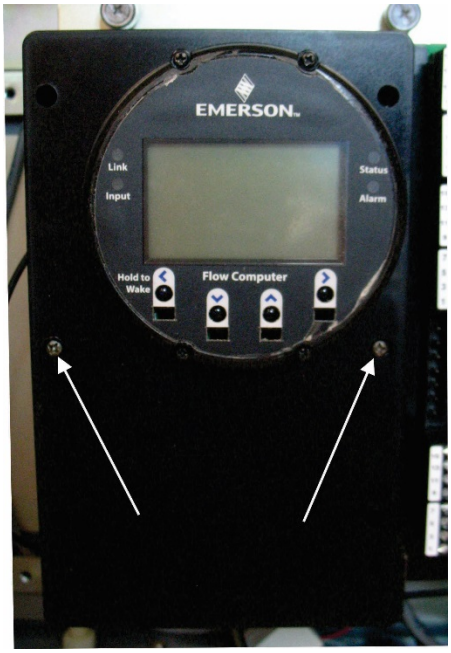
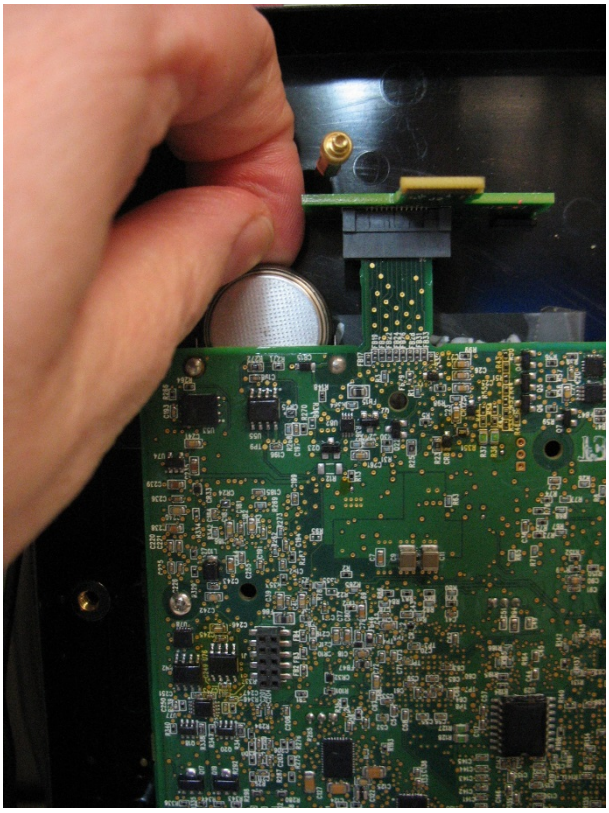


Figure 5-19. Remove the CPU Enclosure Cover



3. Grasp the coin cell battery and with your fingernail in the groove of the top of the battery, slide it out of its slot.

Figure 5-20. Coin Cell Battery Removal/Replacement



4. Insert the new coin cell battery in the slot. The negative side (shiny side with no writing on it) must be facing outwards (towards where the CPU enclosure cover would be).

⚠ CAUTION

When inserting the SRAM coin cell battery, push the battery gently into its slot until it stops. The battery should slide in easily. Do not use excessive force.

5. Reattach the cover of the CPU enclosure.
6. Close the enclosure.

5.7 Upgrading System Firmware

Periodically Emerson releases new system firmware for the flow computer to introduce new features or update system functions.

You must know a valid username/password combination for the flow computer to complete this process.

⚠ DANGER

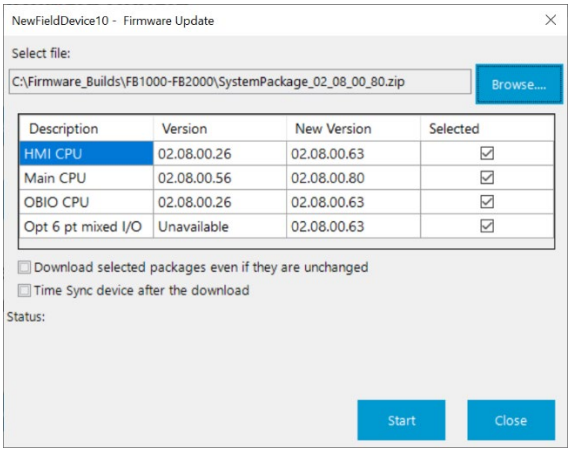
EXPLOSION HAZARD: Ensure the area in which you perform this operation is non-hazardous. Performing this operation in a hazardous area could result in an explosion.

Important

- A power loss occurring during a firmware update to a unit with a dead SRAM coin cell battery can corrupt SRAM memory and place the flow computer in a continuous boot cycle, requiring you to return the device to the factory for repairs. To avoid this, be sure to replace the SRAM coin cell battery when its power is low. To check this in FBxConnect, click **Services > System Power** and look at the **SRAM Battery Status** field on the display.
- When upgrading system firmware version 01.*xx.xx.xx* to version 2.05.*xx.xx* or newer, allow up to 10 minutes to complete the upgrade and **do not** power cycle the unit.

1. Launch Field Tools and use FBxConnect to connect to the flow computer.
2. Select the **Services** tab, then click **Firmware Update**.
3. Click **Configuration Save** to save the flow computer's configuration.
4. Click **History Collection** to save the historical data contained in the flow computer.
5. Click **Firmware Update**.
6. In the Firmware Update dialog box, click **Browse** and navigate to the zip file containing your new system firmware. The grid updates with details of the firmware version currently in the device, and the firmware version in the zip file.

Figure 5-21. Firmware Update Dialog Box



7. Select the checkbox in the **Selected** column to choose the firmware. If you are downloading the **same** version that is already installed on the device, select **Download Even If Unchanged**.
8. Select **Time Sync device after the download** if you want to sychronize the flow computer's clock with your PC clock after the download completes.
9. Click **Start** to begin the firmware download. Allow the download to proceed to completion. If you choose to cancel the firmware download before it completes, the system restores the current version already in the device.

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