LINCO

TA-1000 Plus Temperature Averager

Hardware User Manual

Manual No. 50258174, Rev. 02

Important Safety Information

Symbols and Terms Used in this Manual

WARNING: This symbol identifies information about practices or circumstances that can lead to personal injury or death, property damage or economic loss.

CAUTION **Indicates actions or procedures which if not performed correctly may lead to personal injury or incorrect function of the instrument or connected equipment.**

Important **Indicates actions or procedures which may affect instrument operation or may lead to an instrument response which is not planned.**

Note Indicates additional information about specific conditions or circumstances.

Symbols Marked on Equipment

Attention! Refer to manual

Protective (earth) ground

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Contents

Section 1—Introduction

Overview

The LINCO* TA-1000 Plus Temperature Averager receives pulses from a flow-measuring device such as a positive displacement (PD) meter. As each pulse is received, it measures the temperature, adds the temperature into a rolling counter, divides the total temperature by the number of readings and displays the average flow-weighted temperature for the batch. The accumulated probe (pulse) count may be cleared to start a new batch.

Two fail-safe relay output contacts provide an alarm if a temperature probe fails, a temperature is outside the acceptable range, the processor fails or power is seriously depleted or cut off. If the TA-1000 Plus is equipped with analog inputs, the relay output will also signal an out-of range input. If equipped with a net pulse output option, the device can be used to transmit a compensated volume to another device.

The TA-1000 Plus uses a single-thermistor probe that delivers highly accurate measurements without periodic recalibration. The device is available in a CSA-approved explosion-proof or weatherproof package and may be powered with a 120 VAC or an 8 to 30 VDC power supply. Single-channel and dual-channel versions are available.

Weatherproof Package

The weatherproof TA-1000 Plus (Figure 1.1) features a compact molded fiberglass-reinforced polyester enclosure with an easy-to-read LCD display and display control switch mounted in the door. Three conduit hubs are installed in the bottom for wiring. An optional custody transfer lockout kit provides added security. (See Section 6—Spare Parts, Page 59 and Appendix D—Installing the Weatherproof Custody Transfer Lockout Kit, Page D-1 for further information about ordering and installing the custody transfer lockout kit.)

Users configure the device using three buttons mounted on the circuit board inside the enclosure. A reset button for clearing probe count, alarms and analog input averages is also provided on the circuit board.

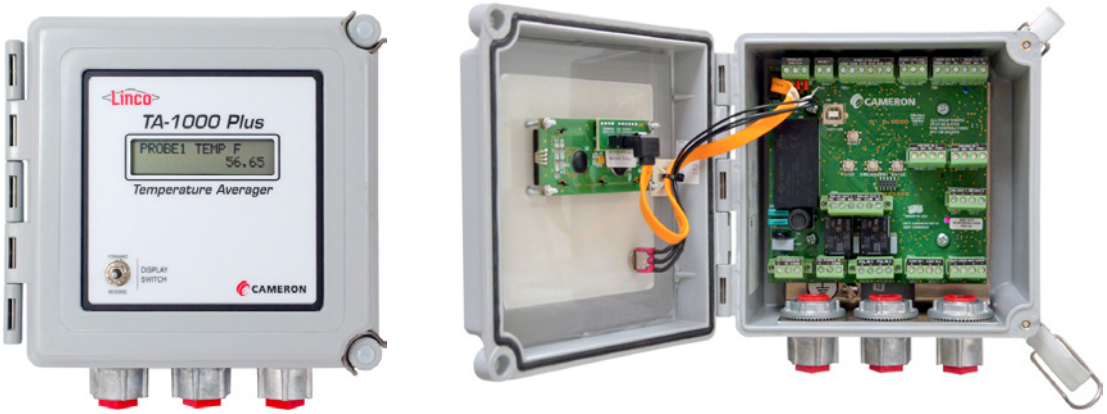

Figure 1.1—TA-1000 Plus weatherproof package

Explosion-Proof Package

The explosion-proof TA-1000 Plus (Figure 1.2, Page 6) features a cast aluminum enclosure with an easy-to-read display, two external switches, and a conduit opening in the bottom for wiring. The switch mounted on the right side of the enclosure allows the user to pace through the parameters displayed on the LCD. The switch mounted on the left side is used to reset totals, alarms and analog input averages. Three buttons positioned just below the display provide access to configuration settings when the enclosure lid is removed.

An optional terminal housing can be connected to the bottom conduit opening to provide more entries for field wiring, if desired (Figure 1.2). The terminal housing is recommended for all two-channel models and any single-channel model used with analog inputs/outputs or digital (relay) outputs. The display and reset switches described above can be mounted in the terminal housing without violating hazardous area certification.

Important **The terminal housing must be installed at the factory. The addition of a terminal housing to an existing device violates CSA certification regulations.**

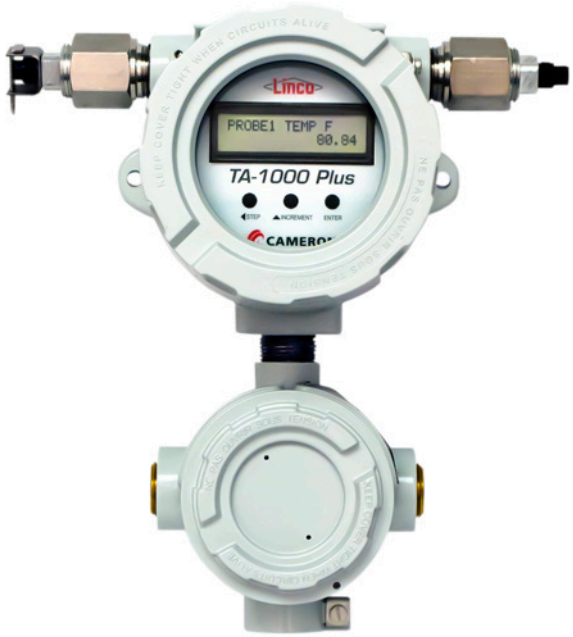

Figure 1.2— TA-1000 Plus explosion-proof package with optional terminal housing

Display

The display provides a real-time readout of process temperature (measured by the probe), average temperature, total counts, counts per hour and alarm count. In devices equipped with optional I/O, the display may also include:

- Measurements from other devices connected to the TA-1000 Plus
- Volume correction factor
- Net volume

The integral backlight is designed to light the LCD when the display control switch is in use. Backlighting will turn off approximately 90 seconds after the last press of the control switch. The backlight will remain on when the temperature is below 32°F.

Standard I/O

Every TA-1000 Plus includes the following standard features:

- One or two temperature inputs (customer choice)
- Two pulse (flow) inputs
- Two digital (relay) outputs

Temperature

The temperature input is a single-element probe sold by Cameron. The dual-channel TA-1000 Plus device will accept inputs from two probes.

Flow

Flow input pulses may be 9–30 VDC pulses, 120 VAC pulses or dry contact closures.

Digital Outputs

Digital outputs can be configured to trigger an alarm when a parameter goes outside its designated range. They can also be used to control divert valves in devices configured for BS&W monitoring. BS&W control can be used to open a divert valve on a LACT unit when the BS&W percentage is greater than the programmed setpoint or to alarm when the BS&W measurement is out of range.

The digital outputs can be configured to respond to any alarm condition, a probe alarm, or an analog input (BS&W setpoint, pressure or density) alarm when an analog input is enabled. If equipped with a net pulse output option, the device can be used to transmit a compensated volume to another device. The alarm output is an SPDT relay output with normally-open and normally-closed contacts.

Common causes of TA-1000 Plus alarms are:

- Probe or probe wiring failure
- Faulty temperature circuitry
- Measured value out of range (for temperature, pressure, density or BS&W)

Optional I/O

Optional features include:

- Modbus communications (RS-232 and RS-485)
- Analog inputs/outputs (1 or 2)
- Compensated volume/net pulse output

Modbus Communications

When Modbus communications option is enabled, Port 2 provides RS-485 and RS-232 communications, allowing a Modbus master device to access TA-1000 Plus measurements. See Appendix A—TA-1000 Plus Protocol, Page A-1 for a description of Modbus protocol registers supported.

Analog Inputs

Analog inputs can be configured for use with a 0–5 V, 1–5 V or 4–20 mA signal and can be used as inputs for BS&W content, pressure or other analog measurements.

Analog Outputs

Analog outputs can be configured for transmitting live temperature, average temperature or analog input values (when analog inputs are enabled).

Compensated Volume/Net Pulse Output

The compensated volume/net pulse output option allows the user to input a meter factor and an API gravity to calculate the net volume corrected to 60°F. If pressure and temperature compensation is desired, a live pres-

sure can be brought into the TA-1000 Plus using an optional analog input.

The correction calculation uses API MPMS Chapter 11.1 to calculate the volume correction factor (VCF) of crude oil using the entered API gravity and average temperature, for a temperature base of 60°F and a pressure base of 14.73 psia. The temperature correction is in accordance with API Table 6A: Generalized Crude Oil Volume Correction Factors.

The VCF and net volume values are automatically displayed when the compensated volume/net pulse output option is enabled. The compensated volume can be sent to an external device as a pulse output using Digital Output 2.

Product Identification

Each device is labeled with a serial tag that identifies the product by model number and serial number, the operating temperature range of the device, certification details and hazardous area precautions (Figure 1.3).

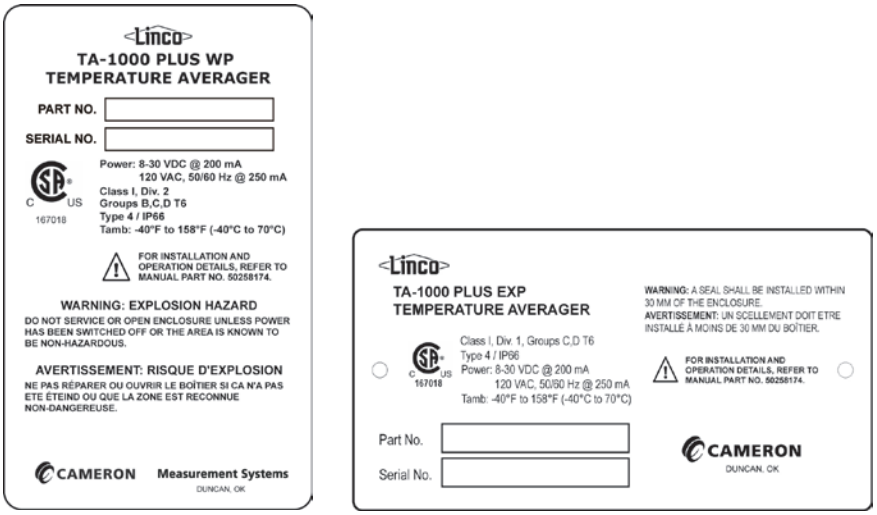

Figure 1.3—Example product markings

Specifications

Table 1.1—TA-1000 Plus Specifications

Category	Description	Specification
Electrical Safety Classification (CSA-approved for US and Canada)	Explosion-proof	CSA Class I, Div. 1, Groups C and D, T6
	Weatherproof	CSA Class I, Div. 2, Groups B, C, D, T6
Enclosure	Explosion-proof	Cast aluminum, painted with epoxy and polyurethane
		Type 4/IP66 rating
		Dimensions: 6.8” H × 10.33” W × 5.69” D
		Dimensions with optional terminal housing: 11.53” H × 10.33” W × 5.69” D
	Weatherproof	Molded fiberglass-reinforced polyester, Lexan polycarbonate viewing window
		Type 4/IP66 rating
		Dimensions: 6.91” H × 6.5” W × 4.25” D

Table 1.1—TA-1000 Plus Specifications

Category	Description	Specification
Weight	Explosion-proof	5.2 lb
	Explosion-proof with Optional Terminal Housing	8.1 lb
	Weatherproof	3.2 lb
System Power		120 VAC, 50/60 Hz @ 250 mA
		8–30 VDC @ 200 mA
Operating Temperature		-40°F to 158°F (-40°C to 70°C)
Display	Backlit LCD	2 rows, 16 alphanumeric characters per row
		Automatic scrolling, user configurable
	LCD Readout Parameters	Probe temperature
		Probe count
		Probe average temperature
		Pulse input count
		Counts per hour
		Probe alarm
		BS&W (live reading, average and alarm with analog input option)
		Pressure (live reading, average and alarm with analog input option)
		Other (live reading, average and alarm with analog input option)
		Volume correction factor (with compensated volume/net pulse output option)
		Net volume (with compensated volume/net pulse output option)
Controls	Explosion-proof	External display switch (right conduit entry) cycles forward through LCD readout parameters
		External reset switch (left conduit entry) resets totals and alarms and is protected by a custody transfer lockout
		Keypad buttons (STEP, INCREMENT, ENTER) allow device configuration (remove lid to access)
	Weatherproof	External display switch cycles forward or backward through LCD readout parameters
		Internal reset button resets totals and alarms
		Internal buttons (STEP, INCREMENT, ENTER) allow device configuration
Communications		Port 1 (USB) reserved for diagnostic use
		Port 2, optional (serial RS-232 or RS-485 port communications)
		RTU Modbus protocol

Table 1.1—TA-1000 Plus Specifications

Category	Description	Specification
I/O, Standard	Temperature Probe Input	Quantity: 1 per channel (2 possible)
		Supports single-element thermistor probe
		Operating Temperature: -40°F to 257°F (-40°C to 125°C)
		Accuracy ±0.15°F (± 0.08°C)
		24-bit self-calibrating ADC (interchangeable probes)
		Automated wire length compensation
	Volume (Pulse) Input	Quantity: 1 per channel (2 possible)
		Optically-isolated input
		Dry contact closure, 180 Hz maximum (with PulseIn Filter disabled; see Disabling the Pulse Input Filter, page 40 for more information.)
		AC input, 120 VAC, 180 Hz maximum (with PulseIn Filter disabled; see Disabling the Pulse Input Filter, page 40 for more information.)
		DC input, 9 to 30 VDC, 230 Hz maximum (with PulseIn Filter disabled; see Disabling the Pulse Input Filter, page 40 for more information.)
	Digital/Relay Outputs	Quantity: 2
		SPDT dry contact relays rated for 5 amp at 120 VAC/30 VDC
		Pulse duration: 1 second
		Alarm on invalid probe, pulse input or analog input, where applicable
		BS&W divert valve control (with analog input option enabled)
		Net pulse output (with compensated volume/net pulse output option enabled)
I/O, Optional	Analog Inputs	Quantity: 1 or 2 (customer choice)
		Configurable as 0–5 VDC, 1–5 VDC, or 4–20 mA signal
		Provides readings from a pressure transmitter, densitometer or BS&W detector
		Averages measurements from any device with a 0–5 VDC, 1–5 VDC, or 4–20 mA output
		Accuracy: ±0.030% of span @ 77°F (25°C)
		Temperature effect: ±0.25% of span over operating temperature range
		Impedance: >60 Kohm for voltage inputs (approximately 250 ohm for 4–20 mA input)
		Transmitter voltage supply: AC-powered: 24 VDC @ 20 mA DC-powered: 8–30 VDC
		Single-ended inputs
		Sample rate: 1 second
		24-bit self-calibrating ADC

Table 1.1—TA-1000 Plus Specifications

Category	Description	Specification
I/O, Optional	Analog Outputs	Quantity: 1 or 2 (customer choice)
		Configurable for transmitting a live probe temperature, an average temperature or an analog input value (in devices equipped with analog inputs)
		Type 4–20 mA, optically-isolated, externally powered
		Accuracy: ±0.1% of span @ 77° F (25° C)
		Temperature effect: ±27.8 ppm/°F (±50 ppm/°C)
		Output load R (ohms) = {supply (volts)–8}/0.02
		Maximum voltage: 30 VDC
		D/A resolution: 16 bits
	Compensated Volume	API MPMS 11.1-compliant temperature compensation
		Compensates for pressure when a live pressure input is supplied via Analog 1
		For use with single-flow measurement channel
		Allows the unit to perform net volume calculations based on user-entered gravity and meter factor along with a TA-1000 Plus-supplied average temperature and raw pulse input
	Net Pulse Output	Quantity: 1
		Outputs compensated net volume using Digital Output 2
Alarm Relay		Alerts user to a temperature or analog input reading that remains outside the specified range for four consecutive flow counts
		User-configurable temperature limits (high, low)
		Default fail temperature alarms determined by probe operating range
Data Storage		Non-volatile FRAM memory ensures data is never lost and operates at higher speeds than traditional memory types
		No lithium battery required

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Section 2—Installing the TA-1000 Plus (Weatherproof)

Overview

The TA-1000 Plus is fully assembled and ready for mounting at the time of shipment (see Figure 2.1, Page 14 for device dimensions). Before installing, please carefully review this section to familiarize yourself with recommended installation procedures and certification requirements.

Important **The TA-1000 Plus weatherproof package is suitable for use in Class I, Div. 2, Groups B, C and D or non-hazardous locations only.**

Preparations

Before installing the TA-1000 Plus, review the following list of considerations for successful installation and operation:

1. Does the intended mounting location offer easy access and visibility and is it free of vibration (which can interfere with device accuracy)?
2. Do you have a power source of 120 VAC or 8–30 VDC on-site? An earth ground is required for either AC or DC operation. For wiring power to the TA-1000 Plus, 16 AWG wire is recommended.
3. Do you have a temperature probe and four-conductor wire for each channel to be used (a maximum of two channels are supported)? The temperature probe input requires four connecting wires for each probe.
4. Have you considered temperature transmission distance when selecting wiring size? Temperature probes may be located up to 1200 feet away from the TA-1000 Plus. Distances of up to 500 feet require 18 to 20 AWG wire. Distances of 500–1200 feet require 16 AWG wire.
5. Are you installing a low point or drip loop in the conduit below the temperature probe and thermowell? The drip loop allows condensation to accumulate in the low point of the conduit instead of the probe and can prevent probe failure.
6. Do you have a meter pulse input for each channel to be used? Each channel can be connected to either a dry contact closure (no external power source), a 9–30 VDC pulse or a 120 VAC meter pulse. The 120 VAC meter pulse allows for connection to most existing LACT control panels and eliminates the need for a separate meter transmitter. A wire size of 18 to 20 AWG is recommended for this service.

Important **AC and DC wiring should be run in separate conduits. If the dry contact closure meter pulse option is used, the interconnecting wiring can be run in the same conduit as the temperature probe wiring. When a common metallic conduit is used, shielded cables are not required for short runs. When a long conduit run is required or the conduit is run near high-current devices, shielded cable must be used.**

Weatherproof Package Mounting Options

The TA-1000 Plus can be panel-mounted with the mounting hardware supplied or pole-mounted with an optional pole-mount kit (see Section 6—Spare Parts, Page 59 for ordering information).

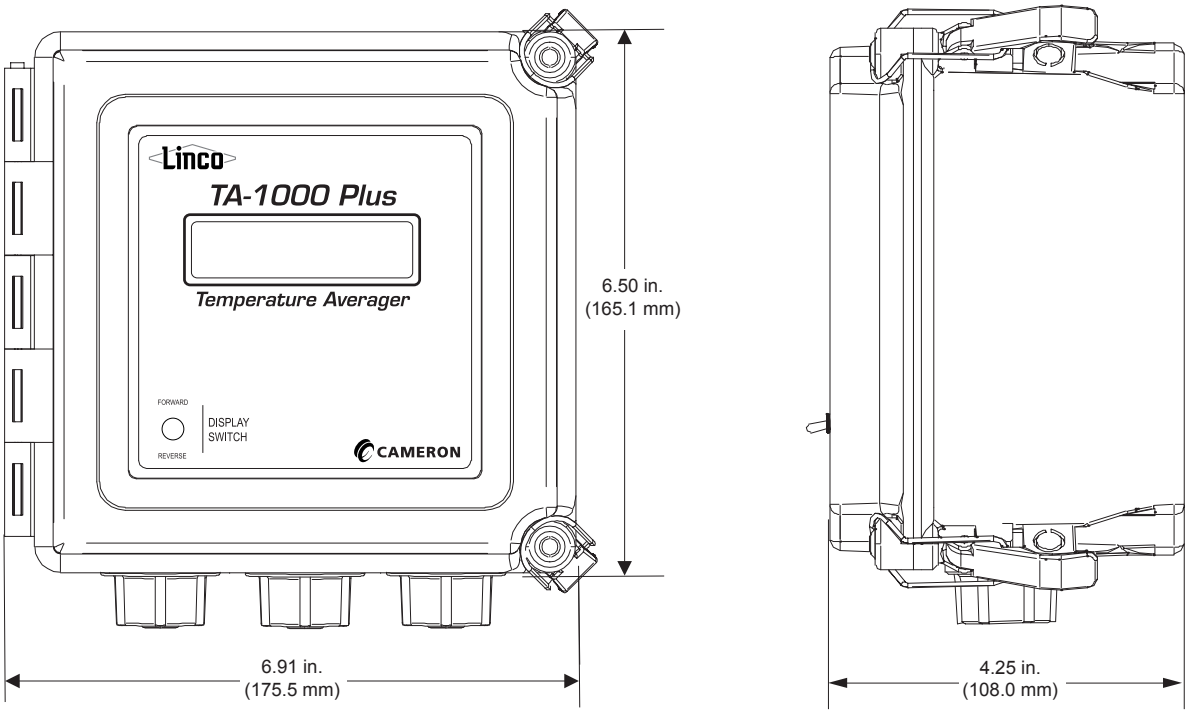


Figure 2.1—Typical weatherproof package dimensions

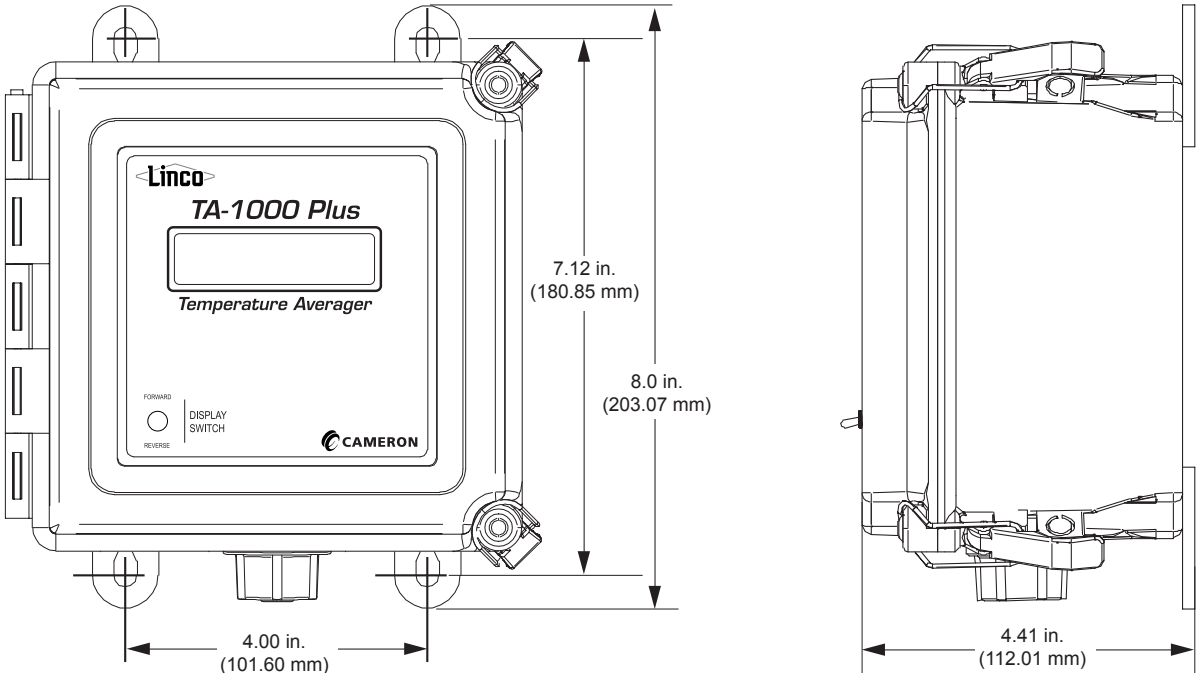


Figure 2.2—Typical dimensions for panel-mount installation, weatherproof package (two outside conduit hubs hidden in this view)

Panel-Mounting the Device

The weatherproof TA-1000 Plus can be mounted to a panel using the mounting clips provided with the device. To install the device on a panel, perform the following steps (dimensions provided in Figure 2.2, Page 14):

1. Attach the plastic mounting tabs to the back of the device, as shown in Figure 2.3.
2. Place the device against the panel to which it will be mounted and mark the location of the mounting holes.

Note The TA-1000 Plus should be positioned for easy access and visibility.

3. Drill out the marked holes.
4. Insert the bolts through the back of the panel into the mounting tabs (Figure 2.3).
5. Screw the provided lugs onto the bolts and tighten to secure.

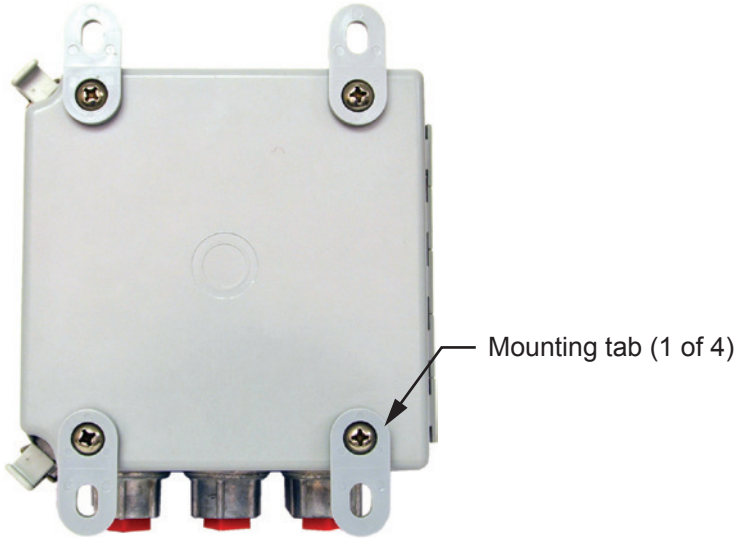


Figure 2.3—Tabs for mounting weatherproof TA-1000 Plus to a panel

Installing on a Vertical Pipe

The weatherproof TA-1000 Plus can be mounted to a 2-inch pole with an optional pole-mount kit (includes two panels, four screws and two U-bolts). To install the TA-1000 Plus on a vertical pole, perform the following steps (dimensions provided in Figure 2.5, Page 16):

1. Place the enclosure on its face.
2. Dry fit the brackets with the mounting holes in the enclosure so that a bracket extends to the top and bottom.
3. Place two washers inside each screw hole inset in the enclosure and position the brackets on top of the washers so that the enclosure screw holes align with the outer holes of the bracket.
4. Insert the screws in the inside holes of the bracket (Figure 2.4, Page 16) and tighten with a screwdriver.
5. Place the U-bolts around the vertical pipe section and through the mounting plate (Figure 2.5, Page 16).
6. Fasten the mounting plate with the lock washers and nuts supplied with the U-bolts.

Figure 2.4—Brackets for mounting weatherproof TA-1000 Plus to vertical pipe

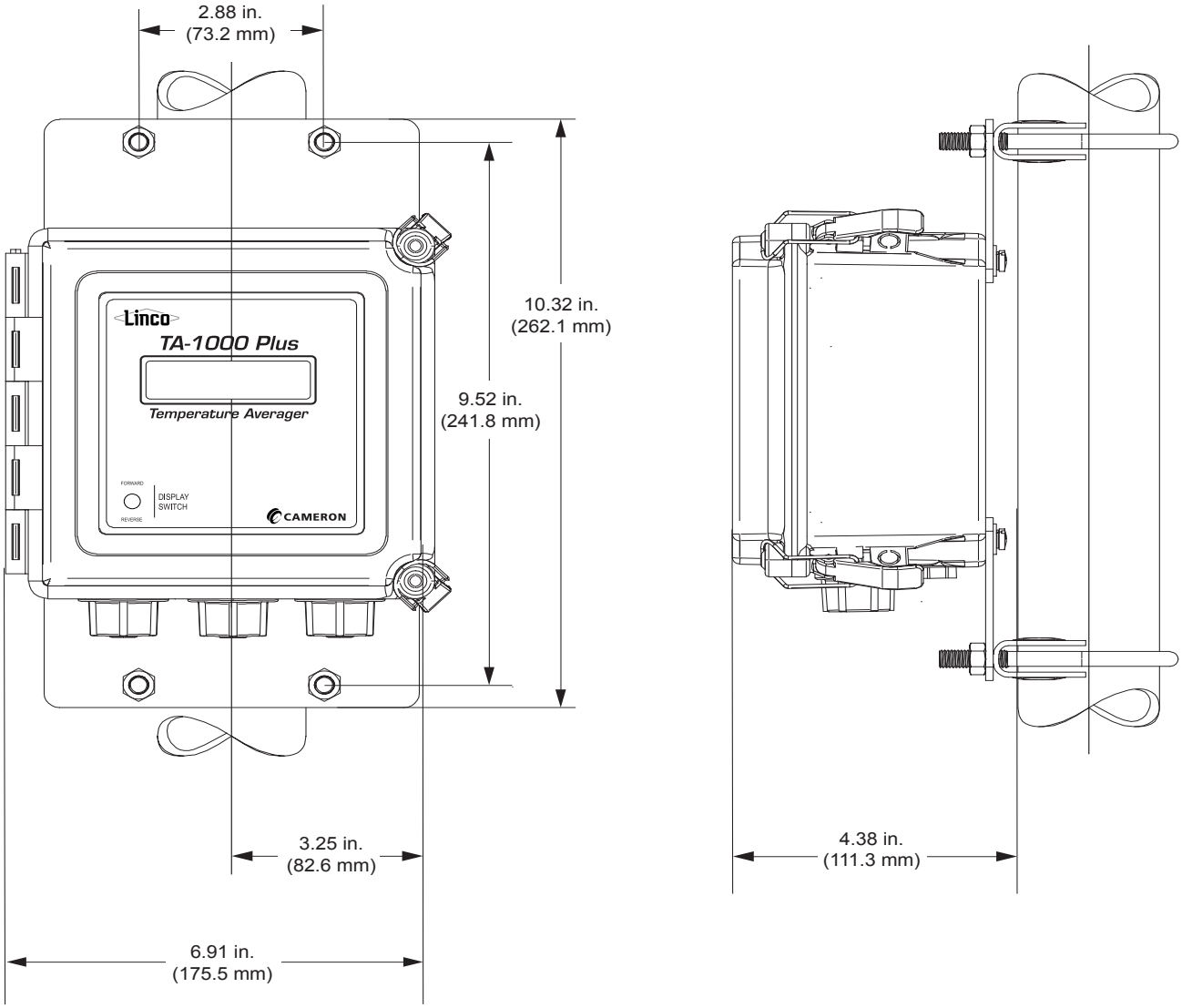


Figure 2.5—Typical dimensions for pole-mount installation,weatherproof package

Weatherproof Package Field Wiring Connections

CAUTION **Before attempting any wiring, ensure that all power is disconnected. Before reapplying power, ensure that all wiring connections are secure and connected properly. All electrical wiring should be installed in accordance with the latest National Electric Codes and should conform to all local code requirements.**

All field wiring enters the weatherproof TA-1000 Plus through three conduit hubs in the bottom of the enclosure and connects to the circuit assembly inside. Unused hub entries should be plugged, as shown in Figure 2.6.

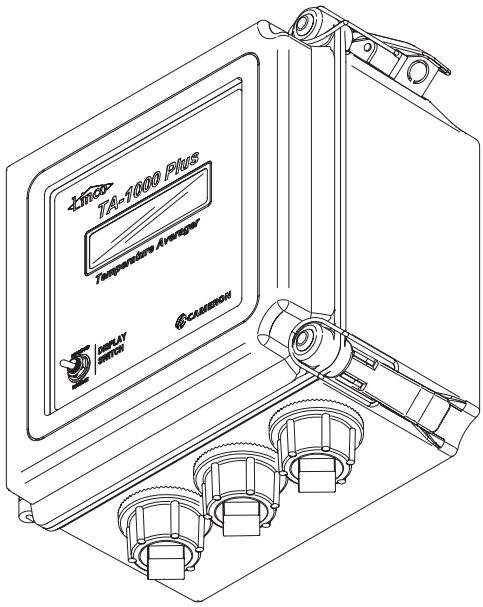


Figure 2.6—Conduit hubs with plugs

Wiring Procedure

CAUTION **All field wiring must conform to the National Electric Code, NFPA 70, Article 501-4(b) for installations within the United States or as specified in Section 18-156 of the Canadian Electrical Code for installations within Canada. Local wiring ordinances may also apply. All field wiring must have a wire range of 22 to 14 AWG, insulation rated for 120 VAC or above and copper or copper-clad aluminum conductors. Terminal block screws must be tightened to a minimum torque of 5 to 7 inch lbs to secure the wiring within the terminal block. Only personnel who are experienced with field wiring should perform these procedures.**

The instrument must be grounded with a protective earth grounding conductor in accordance with national and local electrical codes. See Step 7 of the wiring procedure below.

To wire the weatherproof TA-1000 Plus for operation, complete the following field connections while referencing the wiring diagrams shown in Figure 2.8, Page 19 and Figure 2.9, Page 20:

1. Disconnect all power to the device.
2. Unlatch the door of the enclosure to access the circuit assembly.

3. Verify that the following factory connections are secure:
   a. The J1 connection on the display assembly mounted inside the door is connected to the J2 connection on the circuit board by a SATA cable.
   b. The door-mounted display switch is connected to TB1 (Display Switch) on the circuit board.
4. Connect the flowmeter or pulse input wiring. For an AC or DC pulse input, use TB12. For a dry contact input, use TB13.
5. Connect communications wiring to the RS-232 port (TB3) or the RS-485 port (TB4), if applicable.
6. Connect probe input wiring using TB6 and TB7.
7. Connect wiring for optional I/O (if appropriate) as follows:
   a. Connect analog input signals wiring to TB5.
   b. Connect analog output signals wiring to TB8.
   c. Connect digital (relay) output signals wiring to TB9. The relay output contact(s) shut down the metering system in case of power failure, internal watchdog failure or temperature probe alarm. Contacts are 5-amp SPDT dry contact relays. The alarm relay de-energizes in an alarm condition to provide fail-safe operation.
   d. If a remote reset input is desired, terminate the wiring at TB2. This input connection can be used for a customer-supplied dry contact switch or for triggering an automatic reset with a signal from another device, such as a programmable logic controller (PLC).
7. Route a protective earth grounding conductor into the enclosure with the incoming power conductors to ground the TA-1000 Plus in accordance with national and local electrical codes. Connect the ground wire to the internal ground lug located just below the circuit board on the support bracket (see Figure 2.7).
8. Connect external power wiring to TB10 (AC) or TB11 (DC), as appropriate.
9. To prevent moisture and corrosive vapors from entering the unit, plug all unused conduit openings entering the TA-1000 Plus. For additional protection, moisture-absorbing desiccant packs are included with each unit.

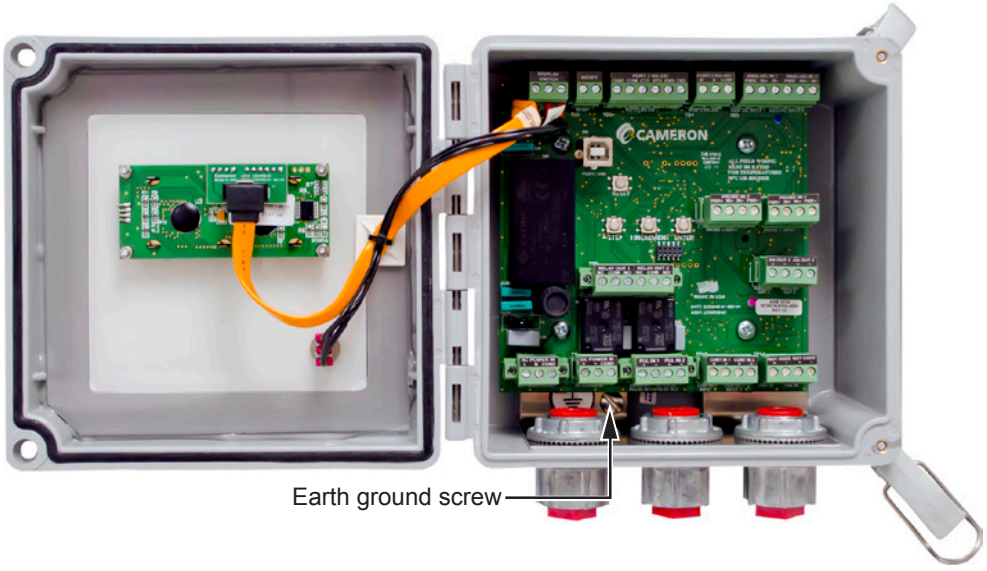
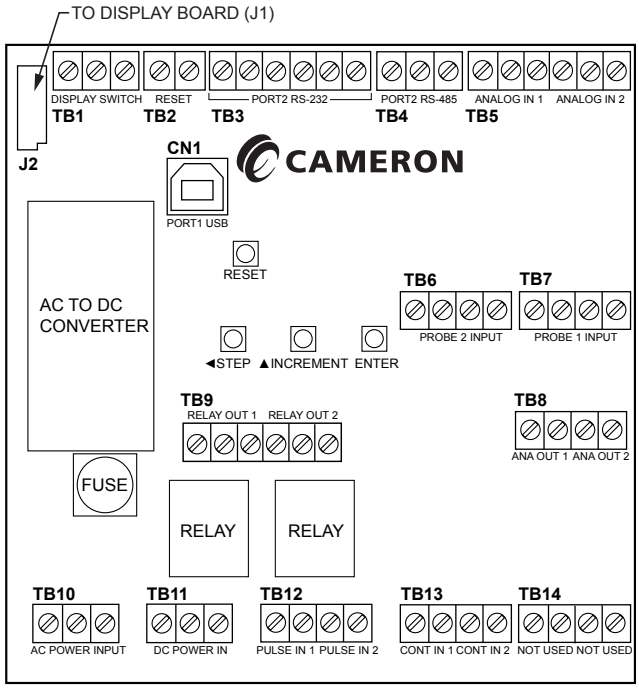
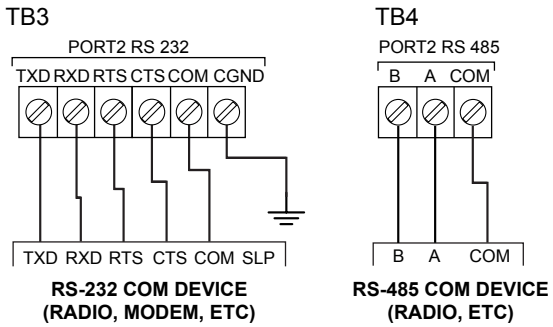


Figure 2.7—Protective earth ground screw location in weatherproof enclosure

Wiring Diagrams (WP)

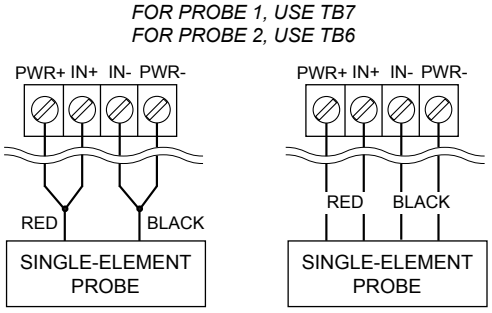


COMMUNICATION

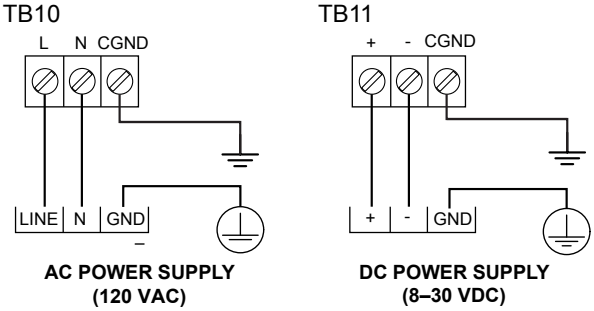


Note: If failure to communicate occurs, swap RXD and TXD wires (RS-232) or A and B wires (RS-485) on the device side.

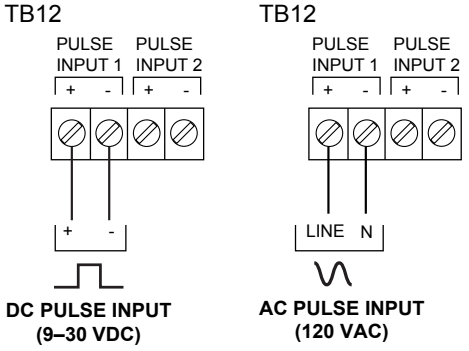
PROBE



POWER



PULSE INPUT



CONTACT INPUT

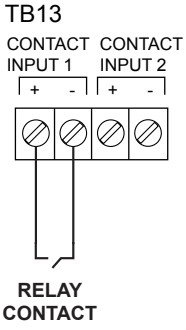


Figure 2.8—Wiring diagrams for TA-1000 Plus, weatherproof package

Wiring Diagrams for Optional I/O (WP)

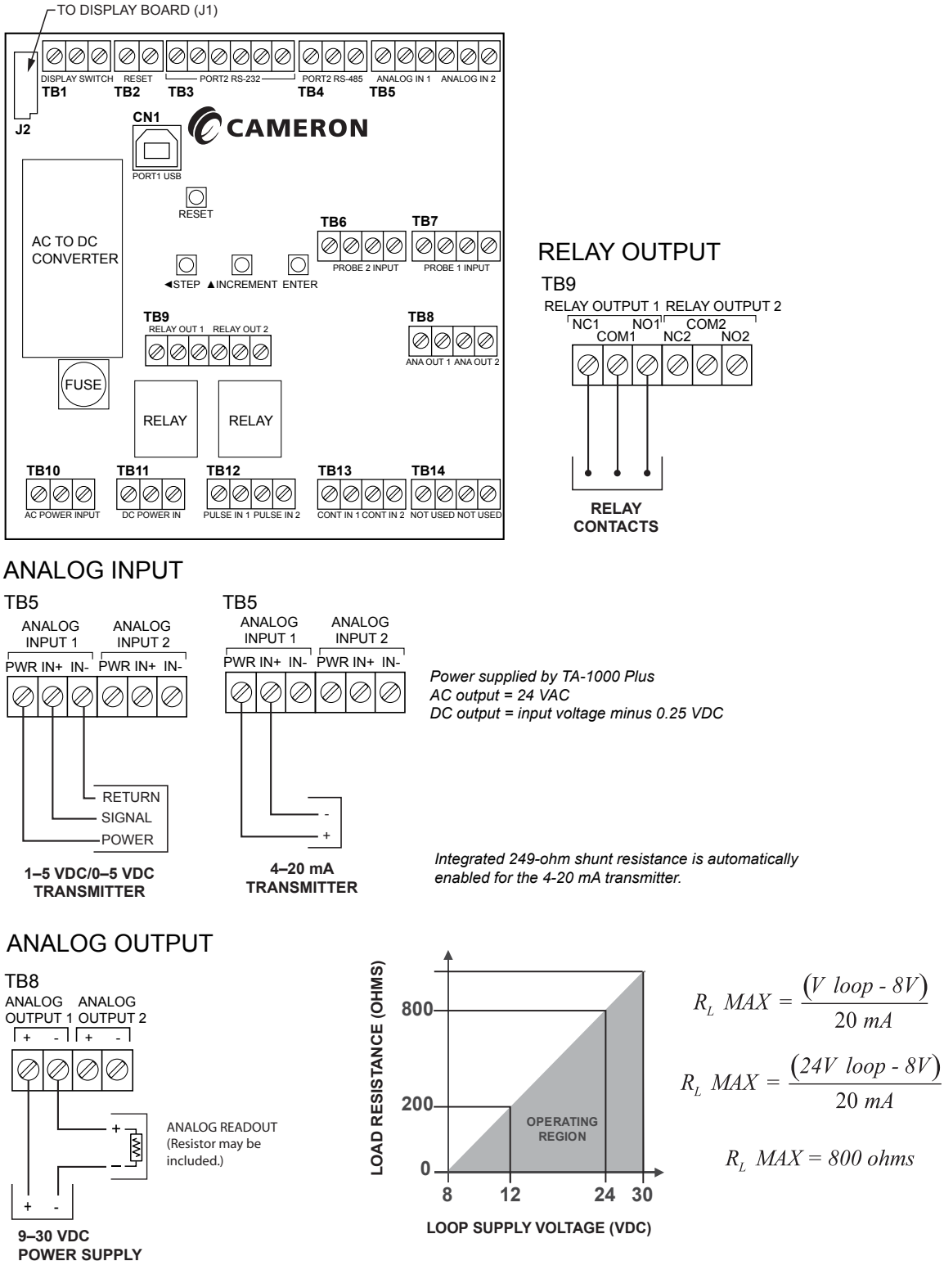


Figure 2.9—Wiring diagrams for TA-1000 Plus, weatherproof package, optional inputs/outputs

Section 3—Installing the TA-1000 Plus (Explosion-proof)

Overview

The TA-1000 Plus is fully assembled and ready for mounting at the time of shipment (see Figure 3.1, Page 22 for device dimensions). Before installing, please carefully review this section to familiarize yourself with recommended installation procedures and certification requirements.

Important **The TA-1000 Plus explosion-proof package is suitable for use in Class I, Div. 1, Groups C and D locations only.**

Preparations

Before installing the TA-1000 Plus, review the following list of considerations for successful installation and operation:

1. Does the intended mounting location offer easy access and visibility and is it free of vibration (which can interfere with device accuracy)?
2. Do you have a power source of 120 VAC or 8–30 VDC on-site? An earth ground is required for either AC or DC operation. For wiring power to the TA-1000 Plus, 16 AWG wire is recommended.
3. Do you have a temperature probe and four-conductor wire for each channel to be used (a maximum of two channels are supported)? The temperature probe input requires four connecting wires for each probe.
4. Have you considered temperature transmission distance when selecting wiring size? Temperature probes may be located up to 1200 feet away from the TA-1000 Plus. Distances of up to 500 feet require 18–20 AWG wire. Distances of 500–1200 feet require 16 AWG wire.
5. Are you installing a low point or drip loop in the conduit below the temperature probe and thermowell? The drip loop allows condensation to accumulate in the low point of the conduit instead of the probe and can prevent probe failure.
6. Do you have a meter pulse input for each channel to be used? Each channel can be connected to either a dry contact closure (no external power source), a 9–30 VDC pulse or a 120 VAC meter pulse. The 120 VAC meter pulse allows for connection to most existing LACT control panels and eliminates the need for a separate meter transmitter. A wire size of 18–20 AWG is recommended for this service.

Important **AC and DC wiring should be run in separate conduits. If the dry contact closure meter pulse option is used, the interconnecting wiring can be run in the same conduit as the temperature probe wiring. When a common metallic conduit is used, shielded cables are not required for short runs. When a long conduit run is required or the conduit is run near high-current devices, shielded cable must be used.**

Explosion-proof Package Mounting Options

The explosion-proof TA-1000 Plus can be panel-mounted with customer-supplied hardware or pole-mounted using an optional hardware kit (Figure 3.2, Page 22).

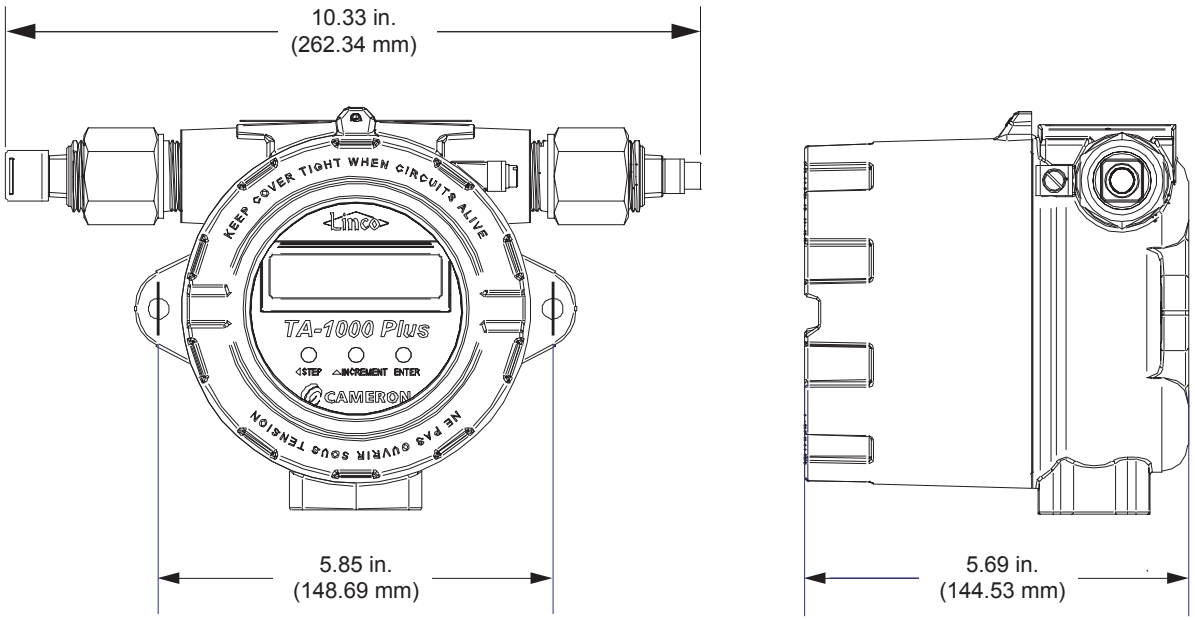


Figure 3.1—Typical explosion-proof package dimensions

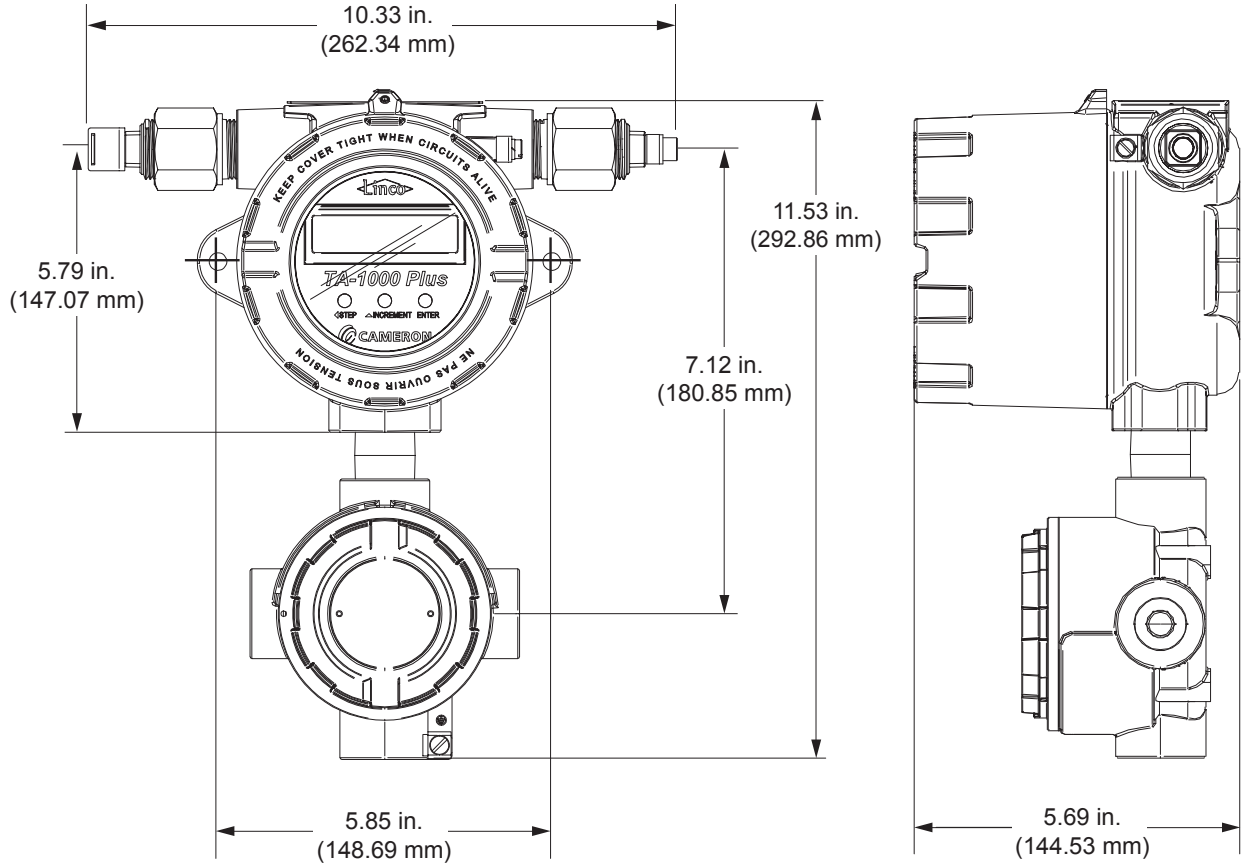


Figure 3.2—Typical explosion-proof package dimensions with optional terminal housing

Panel-Mounting the Device

The explosion-proof TA-1000 Plus enclosure is manufactured with integral mounts or "ears," enabling a user to panel-mount the device with standard bolts and nuts. To mount the device to a panel, perform the following steps:

1. Place the device against the panel and mark the location of the bolt holes in the mounting ears.

Note The TA-1000 Plus should be positioned for easy access and visibility.

2. Drill out the marked bolt holes.
3. Insert bolts through the mounting ears on either side of the device (Figure 3.3) and into the panel.
4. Install nuts onto the bolts until finger-tight and tighten with a wrench to secure.

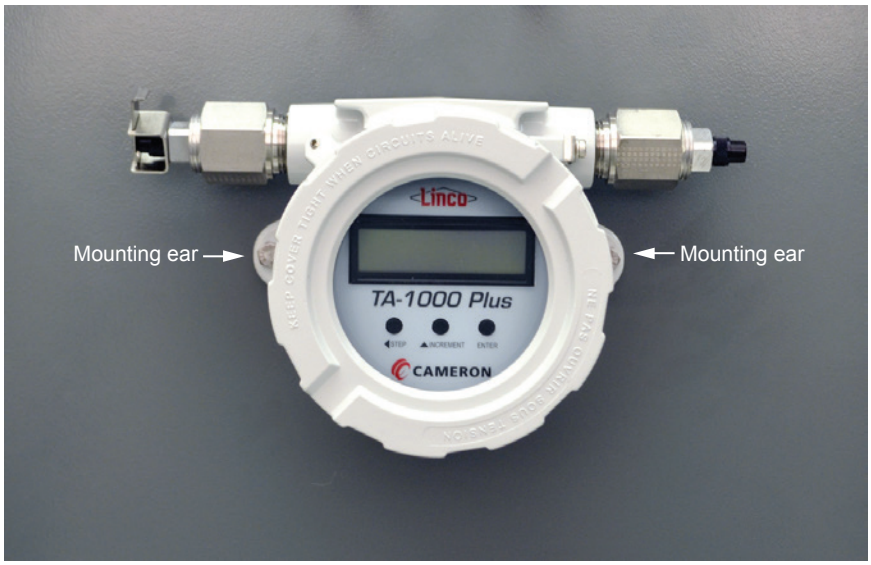


Figure 3.3—Explosion-proof TA-1000 Plus showing location of mounting ears

Installing on Vertical Pipe

To mount the explosion-proof TA-1000 Plus using the optional pole-mount kit (includes metal bracket, 2 U-bolts, 2 bolts and 2 nuts), perform the following steps:

1. Connect the mounting bracket to the TA-1000 Plus using the two bolts provided.
2. Position the U-bolts around the pipe and through the metal bracket.
3. Align the metal bracket against the pole so that the U-bolts pass through the mounting holes in the bracket. Place the mounting plate over the threaded ends of the U-bolts and against the bracket and secure the U-bolts with the nuts provided (Figure 3.4, Page 24).

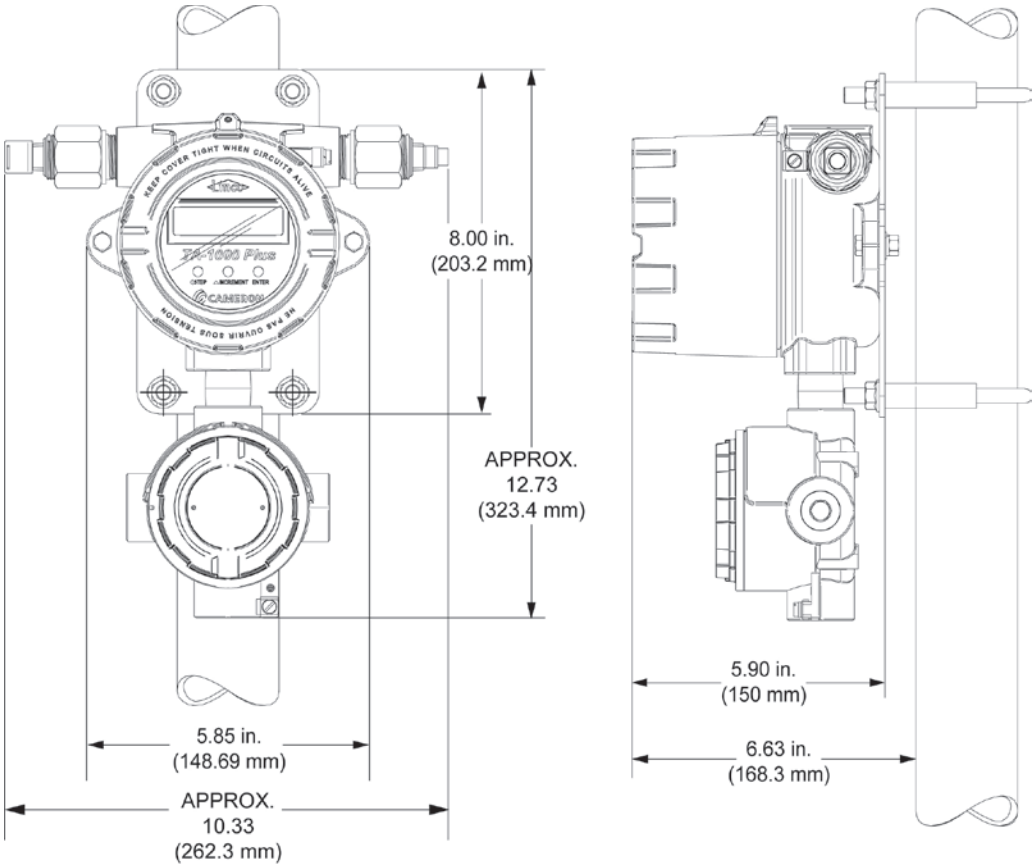


Figure 3.4—Typical explosion-proof package dimensions for pole-mount installation

Explosion-proof Package Field Wiring Connections

CAUTION **Before attempting any wiring, ensure that all power is disconnected. Before reapplying power, ensure that all wiring connections are secure and connected properly. All electrical wiring should be installed in accordance with the latest National Electric Codes and conform to all local code requirements.**

Field wiring enters the explosion-proof TA-1000 Plus through the bottom conduit opening or through the conduit openings in the optional terminal housing and connects to the circuit boards inside.

Wiring Procedure

CAUTION **All field wiring must conform to the National Electric Code, NFPA 70, Article 501-4(b) for installations within the United States or as specified in Section 18-156 of the Canadian Electrical Code for installations within Canada. Local wiring ordinances may also apply. All field wiring must have a wire range of 22 to 14 AWG, insulation rated for 120 VAC or above and copper or copper-clad aluminum conductors. Terminal block screws must be tightened to a minimum torque of 5 to 7 inch lbs. to secure the wiring within the terminal block. Only personnel who are experienced with field wiring should perform these procedures.**

The instrument must be grounded with a protective earth grounding conductor in accordance with national and local electrical codes. See Step 3e of the wiring procedure below.

To wire the TA-1000 Plus for operation, complete the following field connections while referencing the wiring diagrams shown in Figure 3.6, Page 26 and Figure 3.7, Page 27:

1. Disconnect all power to the device.
2. Remove the lid from the explosion-proof enclosure, remove two screws from the top circuit assembly and lift the top circuit assembly forward with the ribbon cable intact. All terminal blocks on both the top and bottom circuit boards should be readily accessible.
3. Complete wiring of the bottom circuit board as follows:
   a. Verify that the external display control switch wiring is terminated at TB1.
   b. Verify that the external reset switch wiring is terminated at TB2.
   c. Connect digital output signals wiring to TB9. The relay output contact(s) shut down the metering system in case of power failure, internal watch dog failure or temperature probe alarm. Contacts are 5-amp SPDT dry contact relays. The alarm relay de-energizes in an alarm condition to provide fail-safe operation.
   d. Connect external power wiring to TB10 (AC) or TB11 (DC), as appropriate.
   e. Route the protective earth grounding conductor into the enclosure with the incoming power conductors and terminate it to the screw in the top of the enclosure (Figure 3.5). Alternatively, connect an earth ground conductor to the external stainless steel ground lug on the TA-1000 Plus explosion-proof enclosure and to a ground rod or other suitable system earth ground.
   f. Connect the flowmeter or pulse input wiring. For an AC or DC pulse input, use TB12. For a dry-contact input, use TB13.
4. Complete the top circuit board wiring as follows:
   a. Connect communications wiring to TB3 (RS-232) or TB4 (RS-485), if applicable.
   b. Connect the probe input(s) wiring to TB6 and TB7.
   c. Connect analog input signals wiring to TB5, if applicable.
   d. Connect analog output signals wiring to TB8, if applicable.

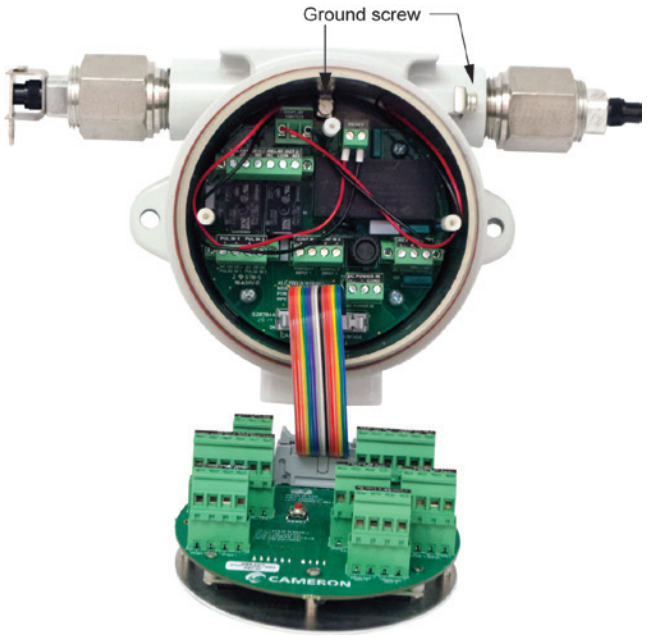
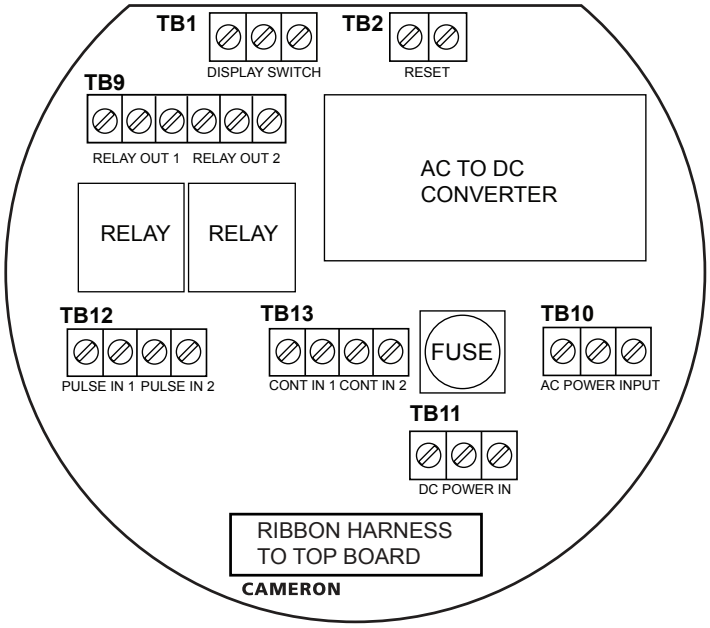
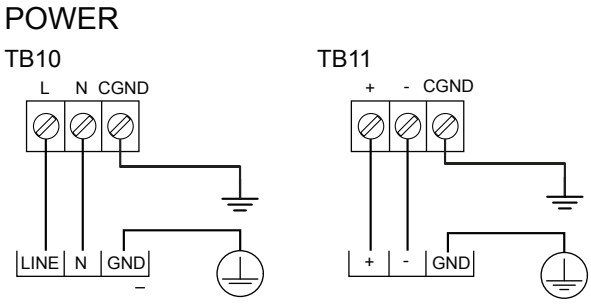
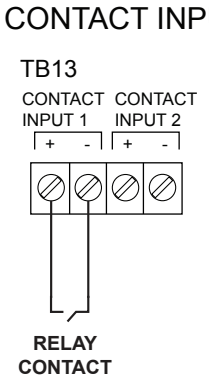


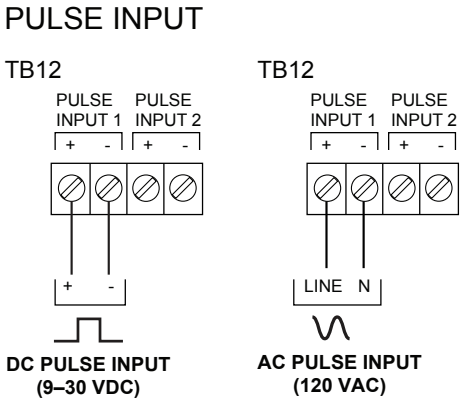
Figure 3.5—Explosion-proof ground screw locations

Wiring Diagrams for Bottom Circuit Board (EXP)









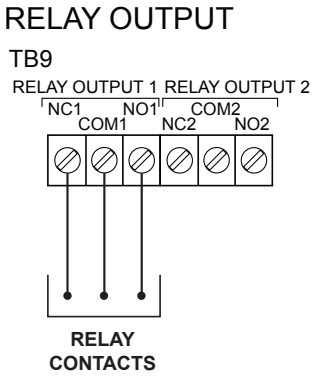


Figure 3.6—Wiring diagrams for explosion-proof TA-1000 Plus bottom circuit board

Wiring Diagrams for Top Circuit Board (EXP)

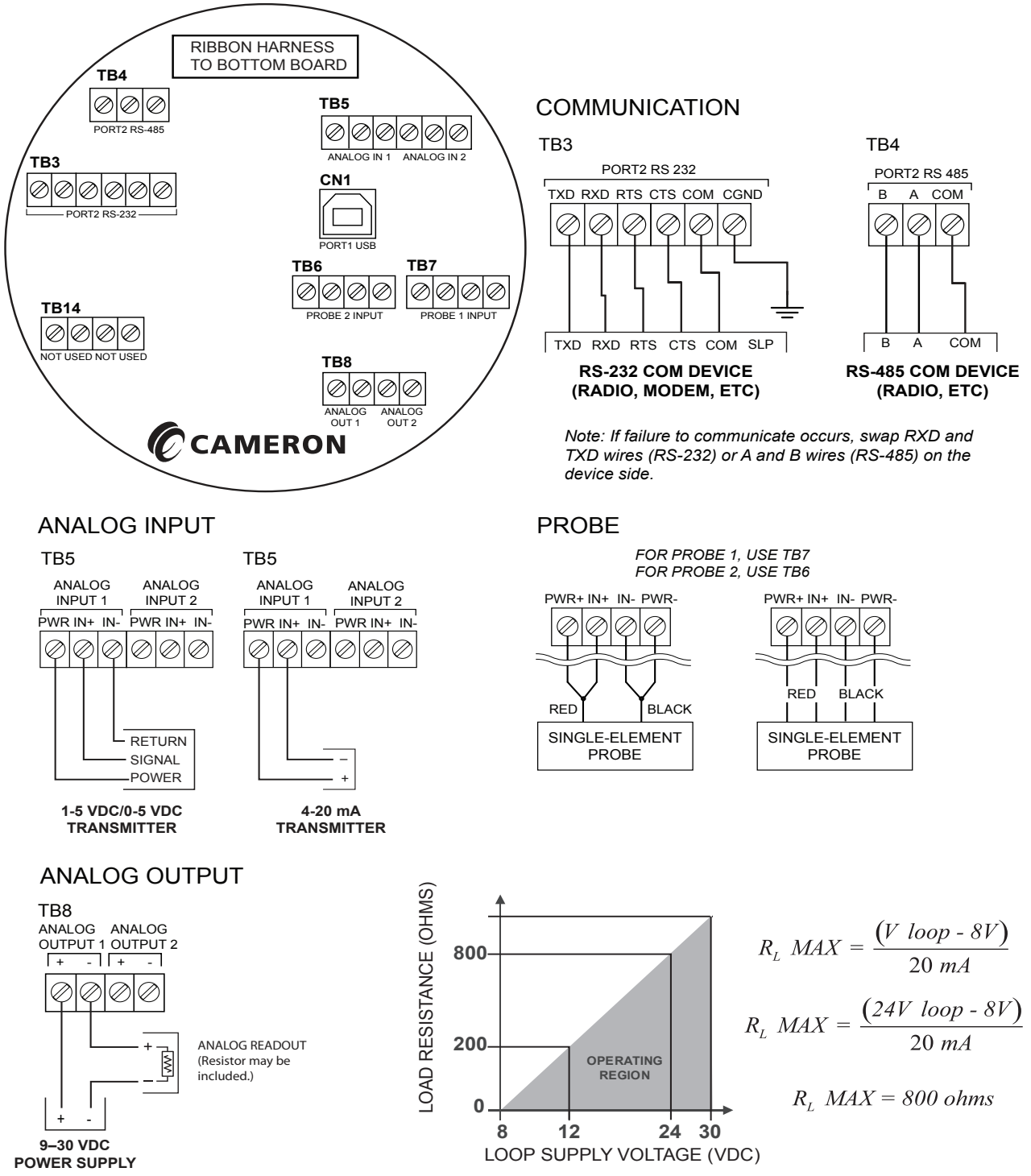


Figure 3.7—Wiring diagrams for explosion-proof TA-1000 Plus top circuit board

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Section 4—Configuring and Resetting the TA-1000 Plus

The TA-1000 Plus (weatherproof and explosion-proof) features an LCD display that can be configured for auto-scrolling or for stationary display of various measurements and calculations. The parameters displayed will vary with the type of device (single or dual channel) and options purchased.

Every TA-1000 Plus will display four readings and two reset readouts for each probe input enabled (Table 4.1). Additional readouts will appear when analog input, meter factor or net pulse output options are purchased and enabled (Table 4.2 and Table 4.3).

Table 4.1—Display Readouts (default)

Readout	Description
Probe Temp F	Live temperature in °F to nearest 0.1°
Probe Count	Number of input pulses or temperature samples
Probe AVG	Average calculated temperature to nearest 0.1° F (running total of temperatures divided by total temperature samples)
Probe CPH	Number of input counts per hour (rate value updates after each count input)
Probe Reset	Clears totals/averages for each channel and resets pulse input count to zero (see Resetting Probe Totals, Alarms and Input Averages, Page 41)
Probe Alarm	Indicates and clears all temperature-related alarms (see Resetting Probe Totals, Alarms and Input Averages, Page 41)

Table 4.2—Analog Input Readouts (optional)

Readout	Description
BS&W %	Percentage of sediment and water in the process fluid
BS&W AVG	Average of all BS&W percentages recorded in a flow cycle
BS&W Alarm	Number of BS&W alarm conditions occurring in flow cycle; an alarm is typically triggered by a BS&W reading that remains outside the specified range for four consecutive flow counts
Pressure psi	Live pressure
Pressure AVG	Average pressure recorded in flow cycle
Pressure Alarm	Number of pressure alarm conditions occurring in flow cycle; an alarm is typically triggered by a pressure reading that remains outside the specified range for four consecutive flow counts
Other	Unspecified input (can be used for any measurement that can be input as an analog signal)
Other AVG	Average measurement recorded in flow cycle
Other Alarm	Number of “other” alarm conditions occurring in flow cycle; an alarm is typically triggered by a reading that remains outside the specified range for four consecutive flow counts

Table 4.3—Volume Correction Readouts (compensated volume option)

Readout	Description
Probe VCF	Volume correction factor (VCF); a value near 1 that is calculated using the entered API gravity and average temperature, for a temperature base of 60° F in accordance with API MPMS Chapter 11.1
Probe Net	Net volume, compensated for temperature and pressure differences (net volume = probe count × meter factor × VCF)

Viewing Parameters

Weatherproof Package

In the weatherproof TA-1000 Plus, a display switch on the door (Figure 4.1) enables the user to pace the display forward (FWD) or backward (REV). To change the display, press and release the switch repeatedly in either direction until the desired display appears. When the last parameter in the display sequence appears, the next press of the switch will begin the sequence again. This wrap function works in forward and reverse.

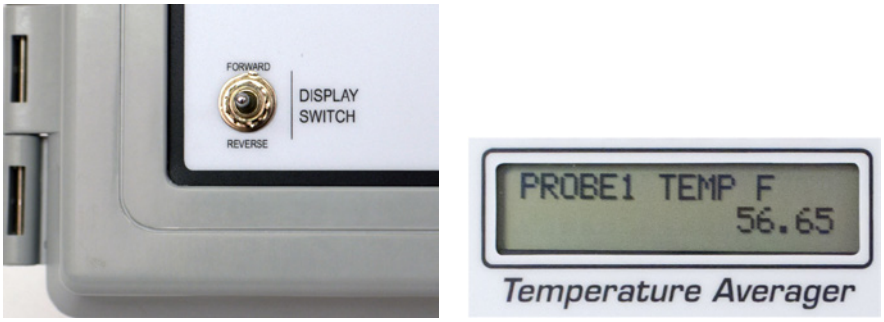


Figure 4.1—Weatherproof package display switch

Explosion-proof Package

In the explosion-proof TA-1000 Plus, a push-button switch is factory-installed in the top right conduit opening (Figure 4.2), enabling the user to pace the display forward. To change the display, press and release the switch repeatedly until the desired parameter appears. The display advances forward only.

Note	If an optional terminal housing is purchased with a TA-1000 Plus, a user can relocate the display switch to a different conduit entry. If the display switch location is changed, the instructions attached to the lid that refer to switch locations will no longer be accurate.

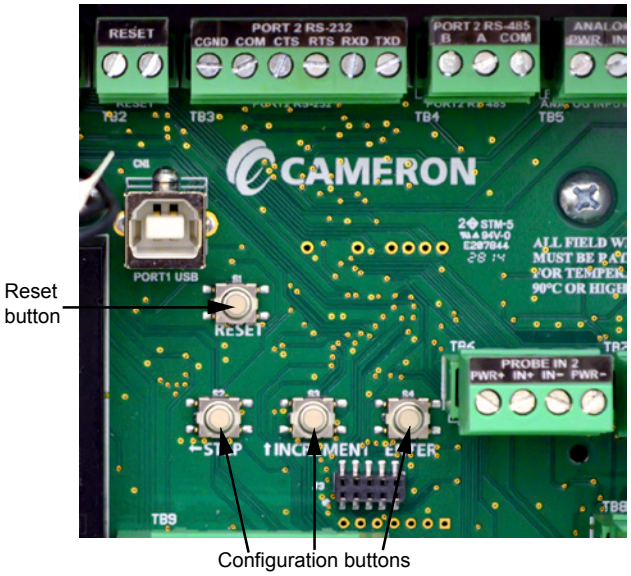
Figure 4.2—Explosion-proof package display switch

Configuring the Device

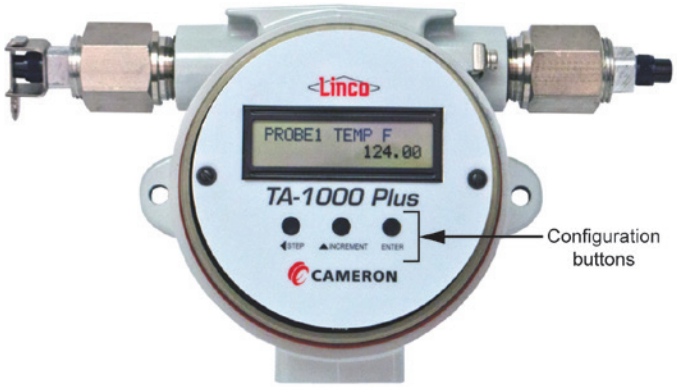
Configuration Menus

Configuration menus are accessed with three buttons—STEP, INCREMENT and ENTER. These buttons will be referenced repeatedly in the following configuration procedures.

In the weatherproof package, the three configuration buttons—STEP, INCREMENT and ENTER—are located near the center of the circuit board inside the enclosure. Unlatch and open the enclosure to access the buttons.



In the explosion-proof package, the three configuration buttons—STEP, INCREMENT and ENTER—are located on the faceplate below the display. Loosen the set screw in the lid of the enclosure and remove the lid to access the buttons.



Enabling Display Scrolling

By default, the display is advanced manually with the display switch. A user can enable automatic LCD scrolling of measurement parameters by changing a configuration setting. To enable scrolling,

1. Locate the STEP, INCREMENT and ENTER buttons on your device (see Configuration Menus above for assistance).
2. Press the STEP and ENTER buttons simultaneously, then release to enter the configuration menu.
3. Press ENTER repeatedly to advance the display to “LCD Scrolling” (Figure 4.3, Page 32).
4. Press INCREMENT to toggle the selection from “Off” to “On.”

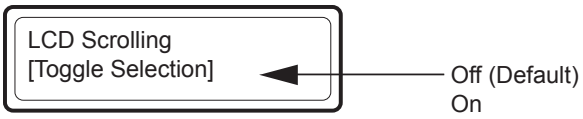


Figure 4.3—Enabling automatic scrolling

The integral backlight illuminates the LCD when the display switch is in use. Backlighting will turn off approximately 90 seconds after the last press of the display switch.

When scrolling is enabled, pressing the display switch temporarily disables the scrolling and returns the switch to manual control. Scrolling will resume 2 minutes after the last press of the switch.

Configuring Modbus Communications

Note Modbus communications is an optional feature. The following procedure pertains only to devices purchased with this option. Port 1 (USB) is reserved for diagnostic use only; therefore, configuration of Port 1 is not required for general TA-1000 Plus use.

Before attempting to communicate with the TA-1000 Plus via RS-232 or RS-485 communications, you must configure a slave address and baud rate for the device. Baud rate is the number of bits/second on the serial port. The baud rate setting must match the setting of the master device polling the TA-1000 Plus.

To enter a slave address and baud rate, perform the following steps:

1. Locate the STEP, INCREMENT and ENTER buttons on your device (see Configuration Menus, Page 31 for assistance).
2. Press the STEP and ENTER buttons simultaneously, then release to enter the configuration menu.
3. Press ENTER repeatedly to advance the display to the Slave Address 2 menu (Figure 4.4, Page 33).
4. Enter the desired slave address as follows:
   a. Press STEP to select the digit to be changed.
   b. Press INCREMENT to change the value. The valid range for a slave address is 1 to 251 (252 to 255 are reserved).
   c. Repeat steps 4a and 4b as necessary to enter more than one digit.
   d. Press ENTER to advance to the Baud Rate 2 selection menu (Figure 4.4, Page 33).
5. From the Baud Rate 2 selection, press INCREMENT to select the desired baud rate. the TA-1000 Plus supports a baud range of 300 to 38.4 kbps.

Note Port 2 is protected from high-voltage transients.

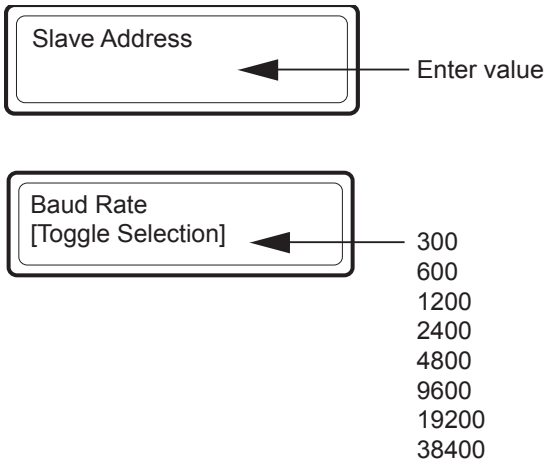


Figure 4.4—Configuration menus for slave address and baud rate

Configuring Analog Inputs

Note Analog inputs are optional features. The following procedure pertains only to devices purchased with this option.

The TA-1000 Plus supports up to two analog inputs. Each can be configured for a 0–5 VDC, 1–5 VDC or 4–20 mA signal and can be used to receive readings from a pressure transmitter, densitometer or BS&W detector. Alternatively, an analog input can be used to read measurements from any device with a 0–5 VDC, 1–5 VDC or 4–20 mA output.

Important **When two probes are enabled, Analog Input 1 should be used with Pulse Input 1/Probe 1 and Analog Input 2 should be used with Pulse Input 2/Probe 2. This is especially important for users who require meter factor volume compensation for temperature and pressure. Because Probe 1/Pulse Input 1 is always used for net volume calculation, the pressure input used for compensating flow volume must be connected to Analog Input 1. Analog Input 2 measurements are not available for volume compensation.**

BS&W Input

An analog input can be connected to a BS&W detector for use in monitoring a BS&W content and diverting flow when the BS&W content exceeds a user-defined setpoint or is outside the configured BS&W range. To configure a BS&W input, perform the following steps:

1. Locate the STEP, INCREMENT and ENTER buttons on your device (see Configuration Menus, Page 31 for assistance).
2. Press INCREMENT and ENTER buttons simultaneously, then release to enter the configuration menu (Figure 4.5, Page 34).
3. Press INCREMENT if necessary to advance the display to “BS&W.” Press ENTER.
4. The AI Setting selection will appear. Press INCREMENT to select one of three available input signals (1–5 VDC, 0–5 VDC or 4–20 mA). Press ENTER.
5. The BS&W Range selection will appear. Press INCREMENT to select the range desired for BS&W detection (0–5%, 0–10%, 0–20% or 0–100%). If the BS&W input will be used to divert flow, keep in mind that the smaller the range, the more sensitive the TA-1000 Plus will be to changes and the quicker it will react when the BS&W value exceeds the configured maximum allowable percentage (setpoint). Press ENTER.

6. The BS&W Divert Set selection will appear. If the BS&W input will be used to divert flow, continue with steps 6a and 6b. If the BS&W input will be used only to monitor the process fluid content and will not be used to divert flow, proceed to Step 7.

   a. Enter the desired setpoint percentage in the BS&W Divert Set menu. Press STEP to select the digit to be changed. Press INCREMENT to change the value. Repeat until all digits are entered. Press ENTER.

   b. The BS&W Time Delay selection will appear. To prevent erratic on/off triggering of the divert valve when BS&W readings approach the setpoint, enter the number of seconds that the BS&W must remain out of tolerance before flow will be diverted. The default value is 30 seconds. Press STEP to select the digit to be changed and press INCREMENT to change the value. Repeat until all digits are entered. Press ENTER to save and exit the menu.

   If the BS&W live reading goes above the divert setpoint value or goes outside the configured range, the TA-1000 Plus' delay timer will be activated. If the value remains out of tolerance at the end of the delay period, flow will be diverted to a holding tank, flow loop, etc. If the value comes back inside the tolerance and remains there for 1/10th of the configured delay period (for example, 9 seconds when the time delay is set for 90 seconds), the divert valve will close and the timer will stop.

7. If the BS&W input will be used only to monitor the process fluid content and will not be used to divert flow, the default settings for BS&W Divert Set and BS&W Time Delay selections may be retained. Press ENTER twice to bypass the BS&W Divert Set and BS&W Time Delay menus.

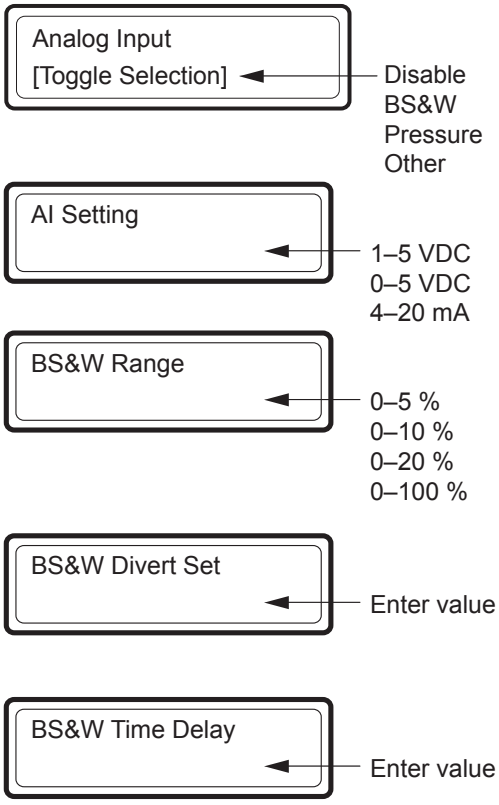


Figure 4.5—Configuration menu for BS&W input

Pressure Input

When the device is equipped with the compensated volume/net pulse output option, a pressure input can be used to compensate a flow volume back to standard conditions in accordance with the API MPMS Chapter 11.1 standard. The pressure input must be connected to Analog Input 1 for use in correcting volume. See Enabling Volume Compensation, Page 36 for additional details.

To configure a pressure input, perform the following steps:

1. Locate the STEP, INCREMENT and ENTER buttons on your device (see Configuration Menus, Page 31 for assistance).
2. Press INCREMENT and ENTER buttons simultaneously, then release to enter the configuration menu (Figure 4.6).
3. Press INCREMENT if necessary to advance the display to “Pressure.” Press ENTER.
4. The AI Setting selection will appear. Press INCREMENT to select one of three available input signals (1–5 VDC, 0–5 VDC or 4–20 mA). Press ENTER.
5. The Pressure Range selection will appear. Press INCREMENT to select the range desired for the pressure (0–150 PSI, 0–200 PSI, 0–500 PSI, 0–1500 PSI or 0–3000 PSI). Press ENTER to save and exit the menu.

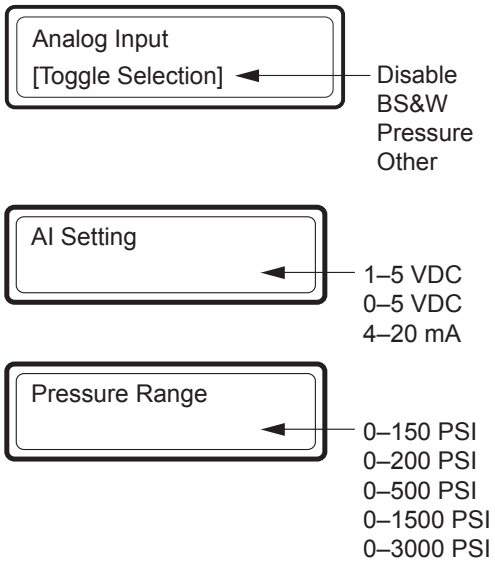


Figure 4.6—Configuration menu for pressure input

Other Input

The “Other” input can be used with any measurement that can be input via an analog signal. To configure an “Other” input, perform the following steps:

1. Locate the STEP, INCREMENT and ENTER buttons on your device (see Configuration Menus, Page 31 for assistance).
2. Press INCREMENT and ENTER buttons to enter the configuration menu (Figure 4.7, Page 36).
3. Press INCREMENT if necessary to advance the display to “Other.” Press ENTER.
4. The AI Setting selection will appear. Press INCREMENT to select one of three available input signals (1–5 VDC, 0–5 VDC or 4–20 mA). Press ENTER.

5. The Other Fullscale selection will appear. Enter the desired full scale value for the input parameter as follows:
   a. Press STEP to select the digit to be changed and press INCREMENT to change the value.
   b. Repeat until all digits are entered. Press ENTER to save and exit the menu.

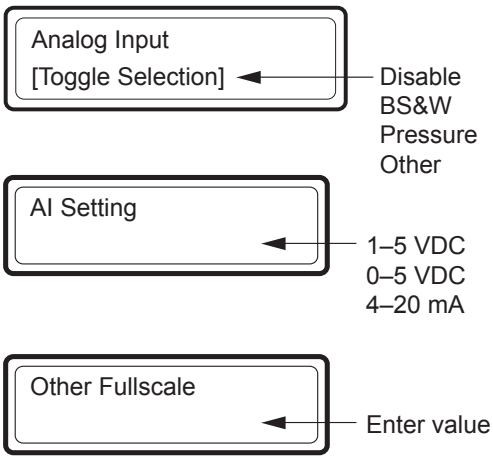


Figure 4.7—Configuration menu for unspecified "Other" analog input

Enabling Volume Compensation

Note Compensated volume/net pulse output is an optional feature. The following procedure pertains only to devices purchased with this option.

The compensated volume/net pulse output option allows the user to automatically calculate the net volume corrected to 60° F. If pressure and temperature compensation is desired, a live pressure can be brought into the TA-1000 Plus using an optional analog input.

The correction calculation uses API MPMS Chapter 11.1 to calculate the volume correction factor (VCF) of crude oil using the entered API gravity and average temperature, for a temperature base of 60°F and a pressure base of 14.73 psia. The temperature correction is in accordance with API Table 6A: Generalized Crude Oil Volume Correction Factors.

The VCF and net volume values are automatically displayed on the LCD when the compensated volume/net pulse output option is enabled.

Important **The compensated volume/net pulse output option supports a net output using Digital Output 2. See Digital Output, Page 37 for more information about this digital output selection.**

To enable volume compensation, perform the following steps:

1. Locate the STEP, INCREMENT and ENTER buttons on your device (see Configuration Menus, Page 31 for assistance).
2. Press INCREMENT and ENTER buttons simultaneously, then release to enter the configuration menu (Figure 4.8, Page 37).
3. Press INCREMENT to advance the display to "Meter Factor." Enter the meter factor supplied from the meter proving.

a. Press STEP to select the digit to be changed and press INCREMENT to select the new digit.

b. Repeat until all digits are entered. Press ENTER to save and exit the menu.

4. Enter the API gravity of the process fluid as determined from a sample analysis as follows:

a. Press STEP to select the digit to be changed and press INCREMENT to change the value (Figure 4.8).

b. Repeat until all digits are entered. Press ENTER to save and exit the menu.

Note If the API gravity is unknown, the API gravity value will default to 35 (the industry standard baseline for crude oil).

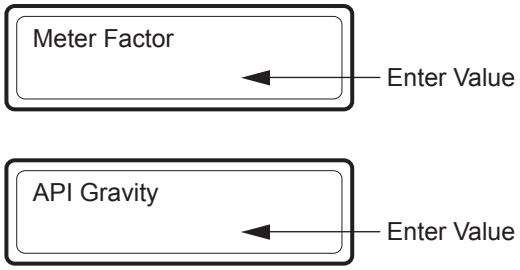


Figure 4.8—Configuration menus for compensated volume inputs

Configuring Outputs

The TA-1000 Plus supports two standard digital outputs and up to two optional analog outputs.

Note Analog outputs are optional features. The following analog output configuration procedure pertains only to devices purchased with this option.

Digital Output

The TA-1000 Plus is equipped with two mechanical SPDT relays that can be configured for use as an alarm or as a means of diverting flow when the TA-1000 Plus is used for BS&W monitoring. TA-1000 Plus alarms may be activated by probe or probe wiring failure, faulty temperature circuitry or an out-of-range measurement. By default, the device also alarms on system failures such as power failure, low-voltage conditions and internal processor failure.

Configuration options include “Disable,” “Any Alarm,” and “Probe Alarm.” If analog inputs are present in the TA, the digital output configuration options will include alarms for those parameters.

The alarm relay is energized when no alarm conditions exist to provide a “fail-safe” mode of operation. Four or more alarm counts will de-energize the alarm relay.

When an analog input is configured for BS&W, the digital output can be used to divert flow when conditions exceed configured limits. See BS&W Input, Page 33, for details.

When the compensated volume/net pulse output option is enabled, Digital Output 2 is used to send the output signal to a waiting device. Net pulse output is available only with Digital Output 2.

To configure a digital output, perform the following steps:

1. Locate the STEP, INCREMENT and ENTER buttons on your device (see Configuration Menus, Page 31 for assistance).

2. Press INCREMENT and ENTER buttons simultaneously, then release to enter the configuration menu (Figure 4.9).
3. Press INCREMENT if necessary to advance the display to "Digital Output."
4. Press INCREMENT to select an output parameter (any alarm, probe alarm, analog input alarm, BS&W divert set or net pulse). Press ENTER to save and exit the menu.

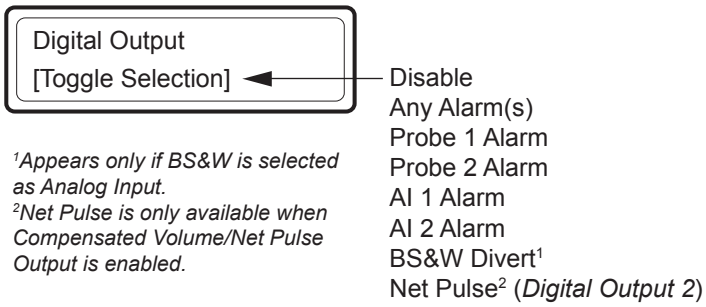


Figure 4.9—Configuration menu for digital output

Analog Output

In devices equipped with analog outputs, the outputs can be configured for transmitting a live probe temperature or average temperature or an analog input value.

To configure an analog output, perform the following steps:

1. Locate the STEP, INCREMENT and ENTER buttons on your device (see Configuration Menus, Page 31 for assistance).
2. Press INCREMENT and ENTER buttons to enter the configuration menu (Figure 4.10).
3. Press ENTER to advance the display to "Analog Output."
4. Press INCREMENT to select an output parameter (temperature, average temperature or analog input) Press ENTER.

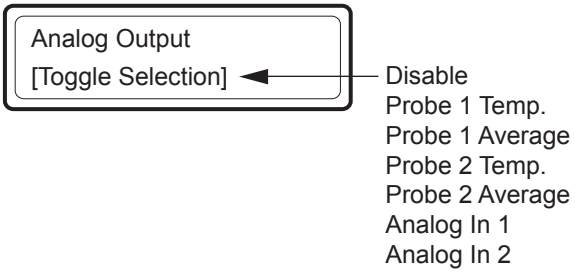


Figure 4.10—Configuration menu for analog output

Configuring a Custom Probe Fail Alarm

By default, a probe fail alarm is generated when the process fluid temperature falls below or rises above the probe operating range. However, some applications require the user to take action before the temperature reaches these levels. The TA-1000 Plus allows the user to determine custom low and high setpoints for triggering a fail alarm.

For example, in some applications, steam injection can cause the paraffin coating inside some pipelines to melt. If the process fluid is allowed to flow at high temperatures, the paraffin can dissolve in the fluid, then

separate out in a holding tank as the temperature cools. The ability to establish an alarm when the process fluid is approaching the paraffin melting point allows the user to better manage this risk.

Understanding Factory Default Fail Values

The low and high fail values observed in the Probe Alarm Low and Probe Alarm Hi menus represent the points at which an alarm will trigger. When the temperature falls below the low fail setpoint or rises above the high fail setpoint and remains there for four consecutive probe counts, a probe alarm count will begin and the LCD will display "ERROR <" or "ERROR >" and a pre-programmed fail value of 60° F (Table 4.4). The probe alarm is latched and will not clear automatically. See Clearing Alarms, Page 42 for instructions on resetting a latched alarm.

Note The default high and low fail setpoints are 5% outside the actual probe range limits to ensure the validity of an alarm condition.

Table 4.4—Probe Fail Setpoints

Probe Type	Probe Operating Range	Displayed Value (Adjusted by 5%)
Single-Element	-40° F to 257° F	-42° F to 269.85° F
Dual-Element	-22° F to 212° F	-23.1° F to 226° F

Custom Fail Alarms

Configuring a custom Probe Alarm Low and/or Probe Alarm Hi alarm essentially changes the point at which an alarm will be activated. Instead of relying on the probe operating range limits to trigger a fail alarm, the user determines the setpoint at which the alarm will trigger.

When the process temperature exceeds the limits of the user-configured setpoints, a probe alarm count will begin and "ALARM <" or "ALARM >" will appear on the display. If the temperature exceeds the probe's established limits, the "ALARM" indication will be replaced by an "ERROR" readout.

Figure 4.11 illustrates how user-specified setpoints can help to ensure that process temperatures will not exceed the expected range for an application. A custom fail condition can also be configured to trigger a digital output to divert flow or perform another user-specified function.

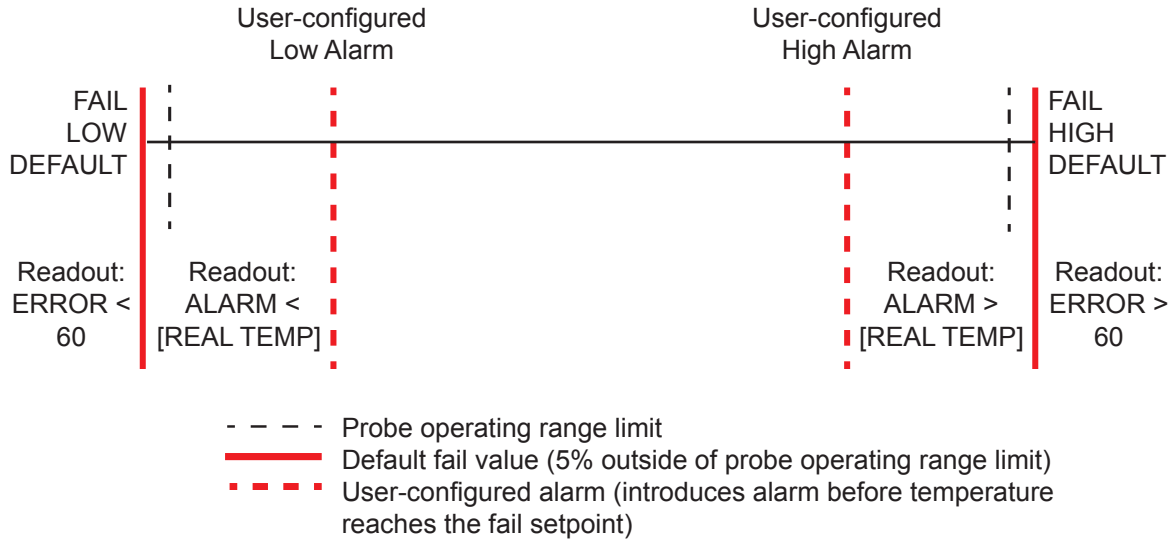


Figure 4.11—Custom fail alarm

Establishing a Custom Fail Alarm

To enter setpoints for a custom fail alarm range, perform the following steps:

1. Locate the STEP, INCREMENT and ENTER buttons on your device (see Configuration Menus, Page 31 for assistance).
2. Press the STEP and ENTER buttons simultaneously, then release to enter the configuration menu (Figure 4.12).
3. Press ENTER to select "Single Element" probe type or press INCREMENT to toggle the display setting from "Single-Element" to "Dual-Element" and press ENTER. The Probe Alarm Low menu will appear.

Figure 4.12—Probe Alarm menus

4. Enter the low-temperature setpoint desired for the custom fail alarm.
   a. Press STEP to select the digit to be changed and press INCREMENT to change the value.
   b. Repeat until all digits are entered.
   c. Press ENTER. The Probe Alarm Hi menu will appear.
5. Enter the high-temperature setpoint desired for the custom fail alarm, repeating steps 4a and 4b. Press ENTER.
6. Repeat steps 4 and 5 for a second probe, if applicable.
7. Press ENTER repeatedly to accept the other menu settings and advance to the end of the sequence until "Saving" appears on the screen.

Disabling the Pulse Input Filter

The TA-1000 Plus contains two built-in noise filters that improve the accuracy of counts in systems where pulses are generated less than once per second. If pulses are generated faster than once per second, however, performance may be improved by disabling the filter as follows:

1. Locate the STEP, INCREMENT and ENTER buttons on your device (see Configuration Menus, Page 31 for assistance).
2. Press STEP and ENTER simultaneously, then release to enter the configuration menu.
3. Press ENTER until the PulseIn1 Filter menu appears (Figure 4.13). The bottom readout should display the default setting, "Enable."

Figure 4.13—PulseIn Filter menus

4. Press INCREMENT to change the PulseIn1 Filter setting to “Disable.”
5. Press ENTER to accept the change and advance to the PulseIn2 Filter menu. Again, the bottom readout should display the default setting, “Enable.”
6. If you are using Pulse Input 2, press INCREMENT to change the PulseIn2 Filter setting to “Disable.”
7. Press ENTER the accept the change, then continue to press ENTER repeatedly to advance through the remainder of the menu selections until “Saving” appears on the LCD.

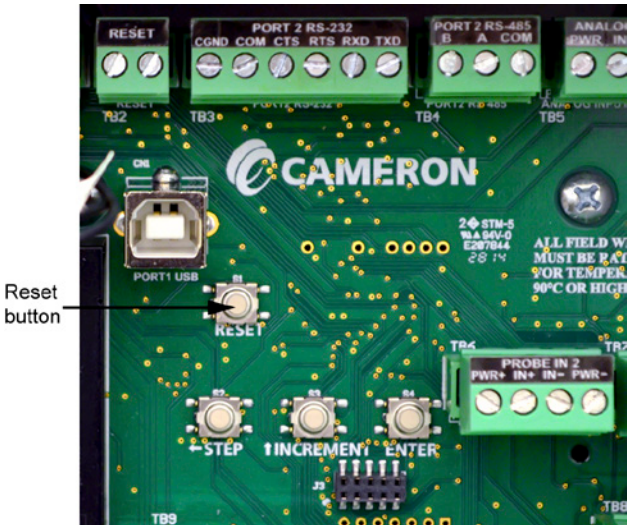
Note If noise is detected after disabling the filter, contact Cameron for further instruction.

Resetting Probe Totals, Alarms and Input Averages

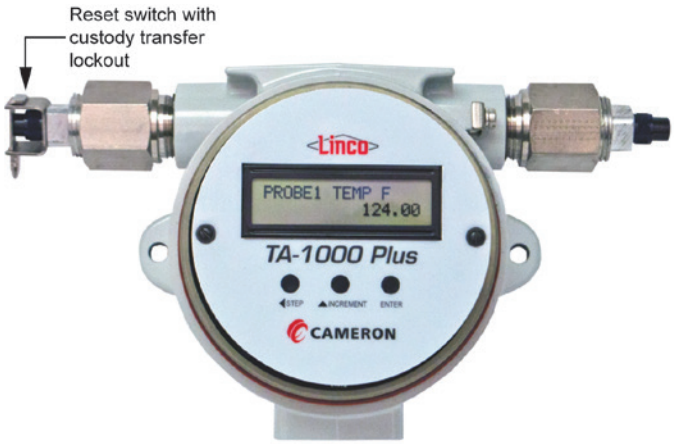
Probe counts, alarms and analog input averages are periodically reset to mark the beginning of a new batch of measurements.

Reset Control

In the weatherproof package, a Reset button is located in the upper left corner of the circuit board inside the enclosure. Unlatch and open the enclosure lid to access the Reset button.



In the explosion-proof package, resets are performed using an external switch installed in the left conduit opening. Unlock the custody transfer lockout and remove the metal tab to access the Reset switch.



Resetting Probe Totals

To reset totals, perform the following steps:

1. Locate the reset button/switch on your device (see Reset Control, Page 41 for assistance).
2. Pace the display until “Probe 1 Reset” or “Probe 2 Reset” appears (see Viewing Parameters, Page 30 for assistance).
3. Press the reset button/switch for 5 seconds and release for 5 seconds.
4. Press the reset button/switch again for 5 seconds and release.
5. The readout sequence will be temporarily interrupted. “Completed” will appear in the display.

Overflow Totals

With each pulse received, the TA-1000 Plus adds the measured temperature to an accumulated temperature total, which is used to calculate average flow-weighted temperature. Over time, if the probe count is not cleared, the accumulated temperature will overflow the device’s capacity and the reading will revert to “0”. The number of days required to reach the overflow point will vary depending on the temperatures being measured, but as a general rule, users should reset the probe count at least once every 2 months.

Clearing Alarms

The TA-1000 Plus displays alarm status for temperature probes and analog inputs.

The display will indicate “0” if no alarm conditions are present. If alarm conditions are present or have occurred, the Alarm display will indicate the number of counts observed since the alarm condition was detected.

An alarm is initiated when an input device (temperature or analog measurement) is out of range for 4 or more consecutive pulses during flowing conditions. Temperature alarms can be caused by probe or probe wiring failure or faulty temperature circuitry. Alarms are latched and alarm counts will be displayed until they are manually cleared from the device. Alarm counts are stored in memory and will be retained even during a power outage.

To reset an alarm,

1. Locate the reset button/switch on your device (see Reset Control, Page 41 for assistance). For the explosion-proof device, release the metal tab on the lockout to access the switch.
2. Select the ALARM display for the parameter in question (see Viewing Parameters, Page 30 for assistance).
3. Press the reset button/switch for 5 seconds and release for 5 seconds.
4. Press the reset button/switch again for 5 seconds and release.
5. The display should indicate “0” to verify the alarm is cleared.

Clearing Input Averages

When analog inputs are enabled, the TA-1000 Plus will continuously average input values and display those averages. It is recommended that these values be zeroed each time the user resets the probe counts and totals.

To reset an analog input average,

1. Locate the reset button/switch on your device (see Reset Control, Page 41 for assistance). For the explosion-proof device, release the metal tab on the lockout to access the switch.

2. Select the AVG display for the input parameter (see Viewing Parameters, Page 30 for assistance).
3. Press the reset button/switch for 5 seconds and release for 5 seconds.
4. Press the reset button/switch again for 5 seconds and release.
5. The display should indicate “0” to verify that the average is cleared.

Securing the Device After Reset

Weatherproof Package

To secure the weatherproof TA-1000 Plus, latch the enclosure and insert locks in the corner clamps provided. For added security, an optional custody transfer lockout kit is available. See Section 6—Spare Parts, Page 59 and Appendix D—Installing the Weatherproof Custody Transfer Lockout Kit, Page D-1 for ordering and installation information.

Explosion-proof Package

To secure the explosion-proof TA-1000 Plus, depress the reset switch slightly and slide the metal tab of the custody transfer lockout over the switch (Figure 4.14). Secure with a customer-supplied lock.

Figure 4.14—Explosion-proof enclosure reset switch custody transfer lockout

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Section 5—TA-1000 Plus Maintenance

The TA-1000 Plus is engineered to provide years of dependable service with minimal maintenance. All configuration settings are stored in non-volatile FRAM memory; therefore, configuration settings will not be lost in the event of power loss.

In the event a malfunction or hardware failure occurs, review this section for troubleshooting tips and circuit assembly replacement procedures.

Obtaining Technical Assistance

Knowing which functions are enabled in a TA-1000 Plus is key to a Cameron technician's ability to troubleshoot a suspected malfunction. Enabled functions are identified by a factory-programmed function ID, which is easily retrieved from the device if the processor and display are functioning. Before contacting Cameron to report a suspected malfunction, please retrieve your device's Function ID as follows:

1. Locate the STEP, INCREMENT and ENTER buttons on your device (see Configuration Menus, Page 31 for assistance).
2. Press the STEP and INCREMENT buttons simultaneously, then release to enter the menu. The model number and firmware version will appear, followed by the Function ID.
3. Note the Function ID, which will appear as a six-character hexadecimal beginning with "0x," as shown in Figure 5.1.

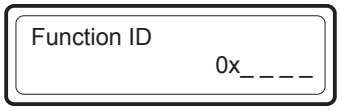

Figure 5.1–Function ID display

Note The board temperature in °F and in °C and the system voltage will appear after the Function ID. The normal parameter display will resume momentarily.

Circuit Assembly Replacement—Weatherproof

WARNING: To prevent ignition of hazardous atmospheres, do not open the enclosure while circuits are alive. The TA-1000 Plus poses no hazard when opened in a safe area.

Important Static electricity can damage a circuit board. Handle new boards only by their edges and use proper anti-static techniques (such as wearing anti-static wrist strap or touching metal to establish an earth ground) prior to handling a board.

To replace the circuit assembly, perform the following steps:

1. Disconnect all power to the device.
2. Release the latches and open the enclosure door to access the circuit assembly (Figure 5.2, Page 46).

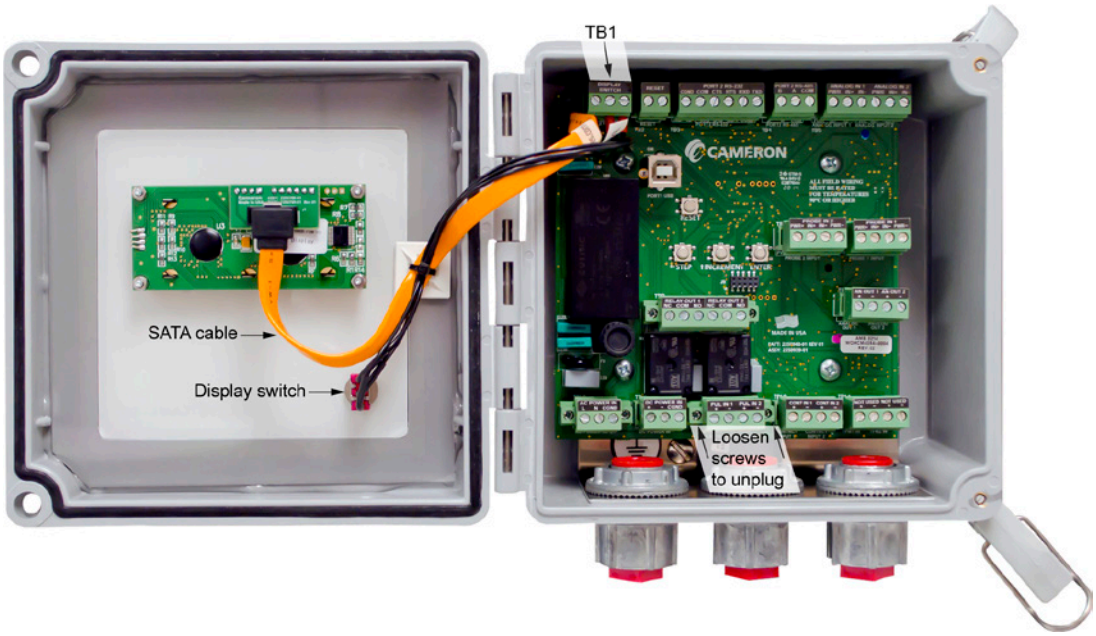

Figure 5.2—Weatherproof circuitry

3. Disconnect the SATA cable connecting the circuit board to the display assembly by depressing the metal clip on the right side of the cable connector (Figure 5.3).

Figure 5.3—SATA cable clip

4. Unplug the display switch from TB1, located in the upper left corner of the circuit board (Figure 5.2).
5. Unplug the terminal blocks from the existing board, loosening screws where applicable.
6. Using a standard blade screwdriver, remove the four mounting screws located on the circuit board. Carefully lift the circuit assembly from the enclosure (Figure 5.4, Page 47).
7. Tighten standoffs attached to the mounting plate (Figure 5.5, Page 47).
8. Remove the replacement circuit assembly from its packaging.
9. Remove the terminal block plugs from the new circuit board.

Note Cameron recommends retaining the terminal block plugs for spare parts.

10. Carefully fit the new circuit assembly in place and reattach it using the four mounting screws removed in Step 6.
11. Plug in the terminal blocks removed in Step 7, checking to ensure that no wires are loose.

12. Plug the display switch into TB1 on the circuit board.
13. Reconnect the SATA cable to J2 on the circuit board.
14. Close the enclosure door, secure the latches and restore power to the device.

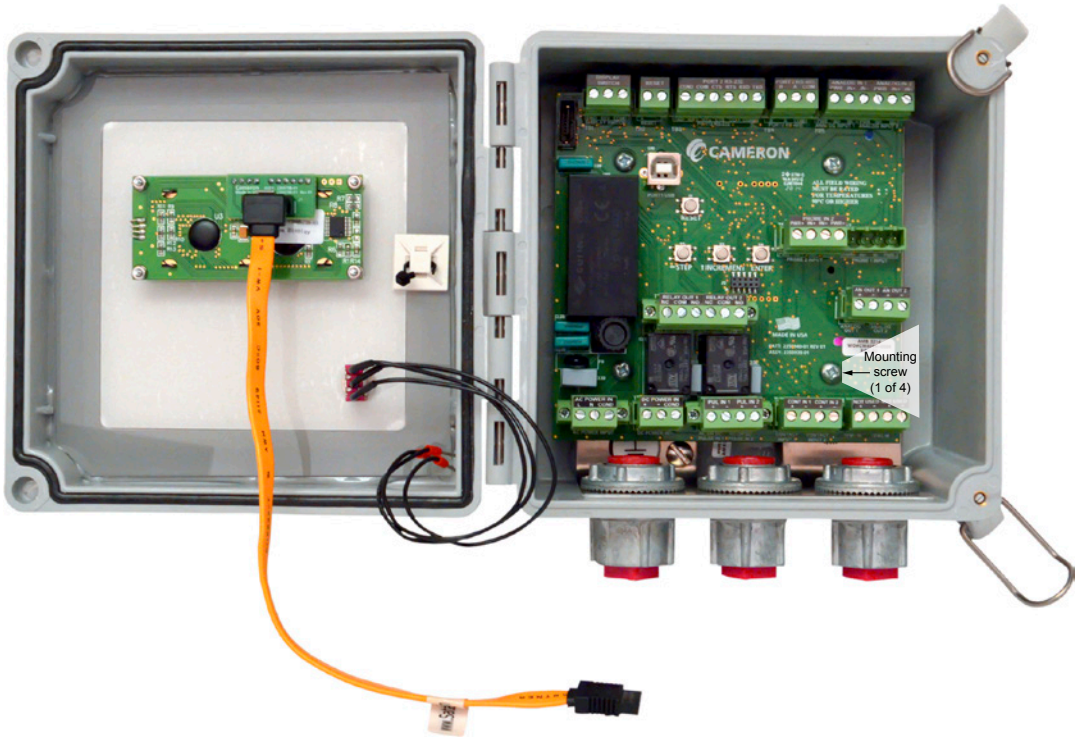

Figure 5.4—Location of circuit board mounting screws

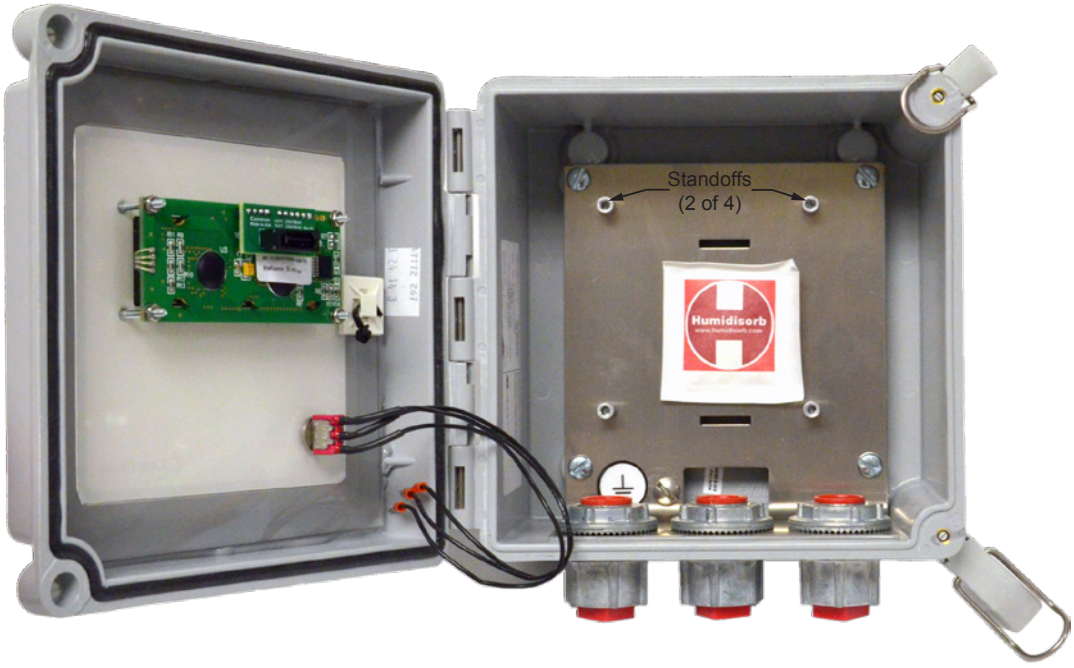

Figure 5.5—Weatherproof board removed

Note If reusing terminal blocks to avoid reconnecting wires, ensure the terminal blocks are functioning as intended. Additional pluggable terminal blocks are included with each replacement circuit assembly and should be retained as spares if they are not used during circuit assembly replacement.

Display Replacement—Weatherproof

WARNING: To prevent ignition of hazardous atmospheres, do not open the enclosure while circuits are alive. The TA-1000 Plus poses no hazard when opened in a safe area.

To replace the display of the TA-1000 Plus, perform the following steps:

1. Disconnect power to the device.
2. Open the door to the enclosure.
3. Disconnect the SATA cable from the display panel and the circuit board and discard.
4. Remove the nuts and washers from the display mounting posts. Set aside for later use.
5. Carefully lift the display assembly from the mounting posts.
6. Remove the replacement display assembly from its packaging.
7. Carefully fit the replacement display assembly in place and reattach using the four washers and nuts removed in Step 4.
8. Connect the replacement SATA cable to the display panel and the circuit board.
9. Close the enclosure door, secure the latches and restore power to the device.

Circuit Assembly Replacement—Explosion-proof

WARNING: To prevent ignition of hazardous atmospheres, do not open the enclosure while circuits are alive. The TA-1000 Plus poses no hazard when opened in a safe area.

Important **Static electricity can damage a circuit board. Handle new boards only by their edges, and use proper anti-static techniques (such as wearing anti-static wrist strap or touching metal to establish an earth ground) prior to handling a board.**

Replacing the Top Circuit Assembly

The explosion-proof TA-1000 Plus includes two circuit board assemblies. The top circuit assembly includes an LCD board and a circuit board containing probe input, analog input/output and communications connections. The LCD board and circuit board are packaged as a single assembly for replacement purposes.

To replace the top circuit assembly, perform the following steps:

1. Disconnect all power to the device.
2. Loosen the set screw on the enclosure, if necessary.
3. Open the enclosure cover and loosen the two mounting screws and washers on either side of the display (Figure 5.6, Page 49) to release the top circuit assembly from its mount.

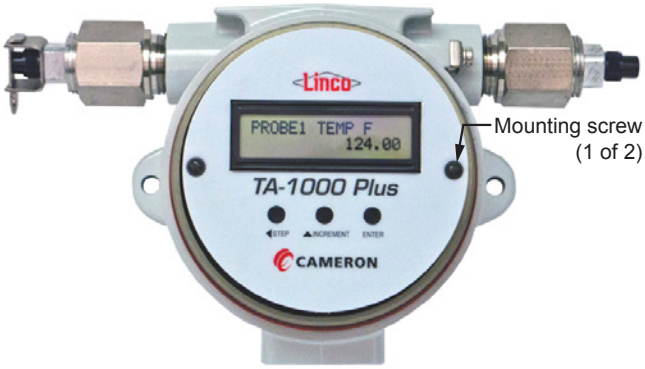

Figure 5.6—Location of mounting screws

4. To access the circuit board connections, lift out the top circuit assembly and lay it flat with the display facing downward, as shown in Figure 5.7.

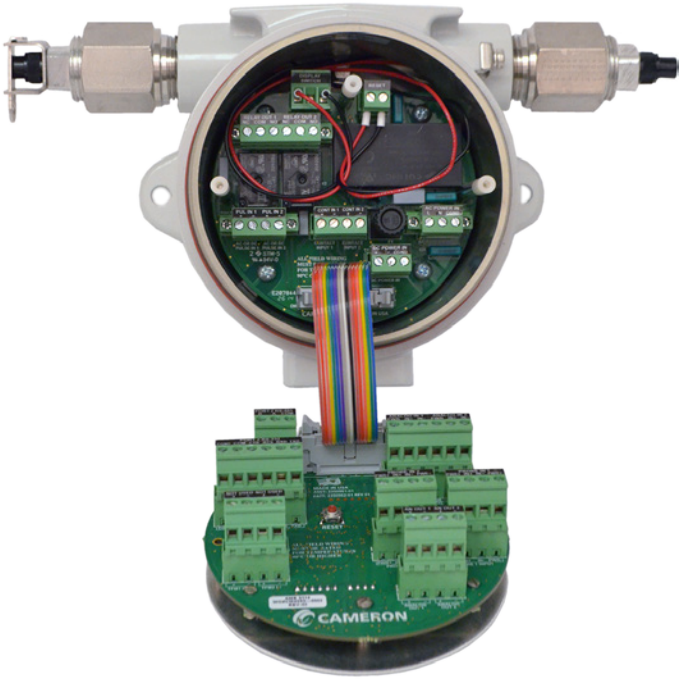

Figure 5.7—Top circuit assembly removed from explosion-proof enclosure

5. Record the locations of all wired connections on the top circuit assembly.
6. Disconnect the ribbon cable from the latched connector (Figure 5.8, Page 50) on the top circuit assembly.
7. From the terminal block side of the display circuit assembly, remove the two faceplate screws at the top and bottom of the board (Figure 5.8, Page 50) and gently separate the faceplate from the top circuit assembly (Figure 5.9, Page 50).

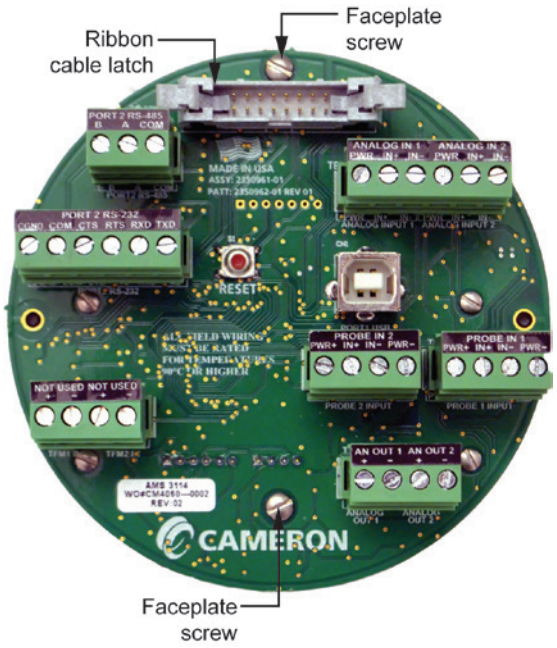

Figure 5.8—Top circuit assembly

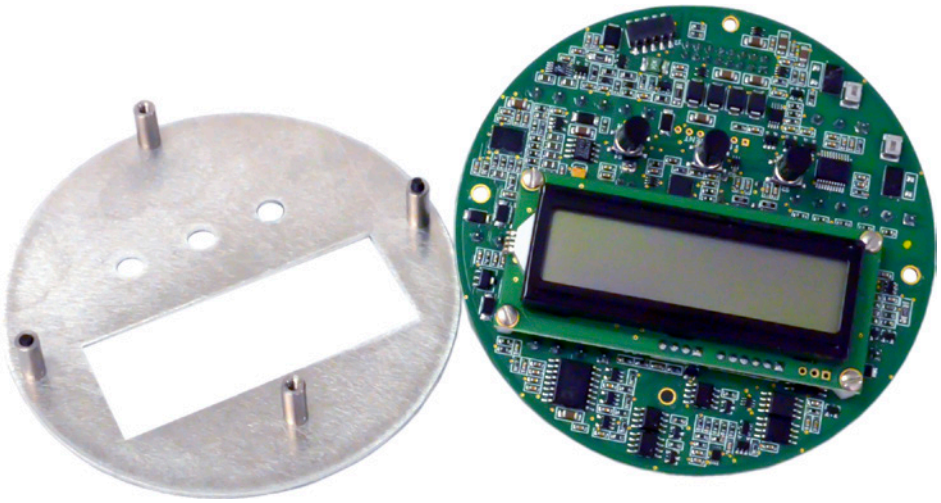

Figure 5.9—Separation of faceplate from top circuit assembly

8. Unplug the terminal blocks from the top circuit board and discard the assembly.
9. Align the faceplate removed in Step 7 with the new top circuit assembly so that the cutout frames the LCD display and the three round holes fit over the black buttons as shown in Figure 5.10, Page 51. The integral standoffs on the faceplate should align with holes at the top and bottom of the top circuit assembly.
10. Replace the two screws removed in Step 7 to secure the faceplate to the top circuit assembly.
11. Reconnect the ribbon cable to the latched connector on the top circuit assembly. Ensure that the ribbon cable faces the center of each circuit board, as shown in Figure 5.11, Page 51.
12. Reconnect the terminal blocks removed in Step 8, taking care not to strain the ribbon cable.

13. With the display facing upward, reposition the assembly on top of the standoffs shown in Figure 5.12 so that the standoffs on the left and right align with the mounting holes in the top circuit assembly.

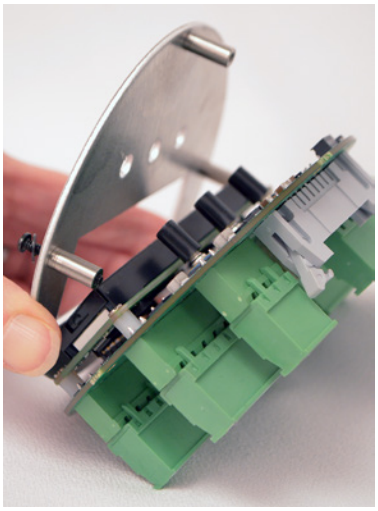

Figure 5.10—Attachment of faceplate to new top circuit assembly

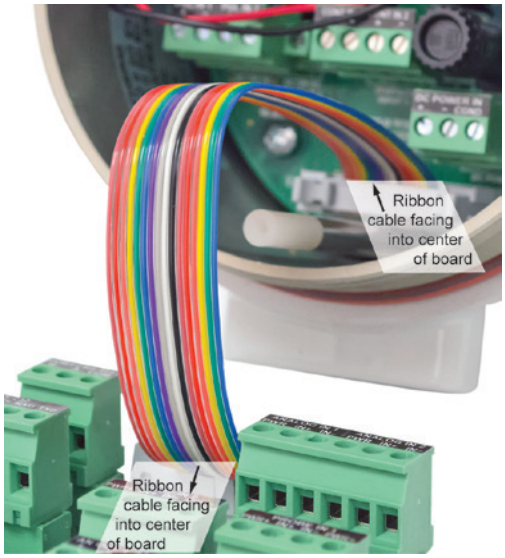

Figure 5.11—Ribbon cable orientation

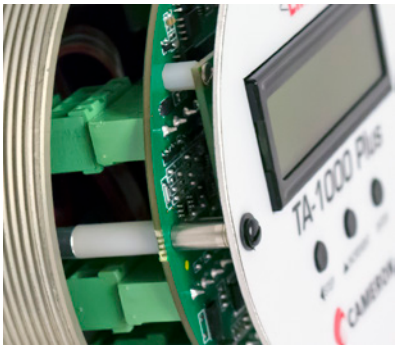

Figure 5.12—Alignment of top circuit assembly over standoffs

14. Tighten the screws and washers loosened in Step 3 to secure the new top circuit assembly in the enclosure.
15. Replace the enclosure cover and tighten.
16. Close the enclosure door, secure the latches and restore power to the device.

Replacing the Bottom Circuit Assembly

The explosion-proof TA-1000 Plus includes two circuit board assemblies. The bottom circuit assembly includes an AC/DC converter and power, pulse input, contact input and digital (relay) output connections. Factory-wired connections for the display switch and reset switch are also on this board.

To replace the bottom circuit assembly, perform the following steps:

1. Disconnect all power to the device.
2. Loosen the set screw on the enclosure, if necessary.
3. Open the enclosure cover and loosen the two screws and washers on either side of the display (Figure 5.13, Page 52) to release the top circuit assembly from its mount.

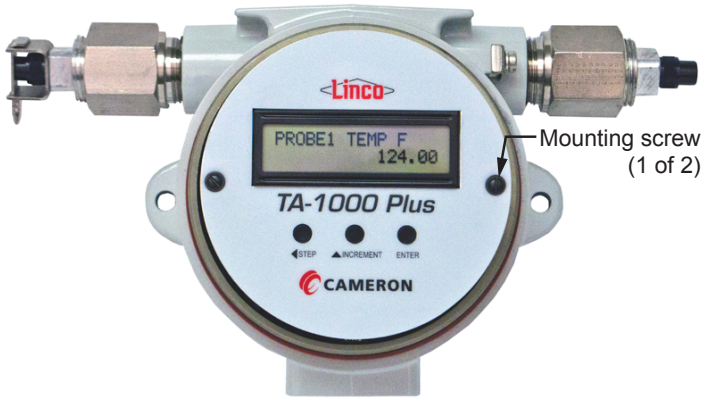

Figure 5.13—Faceplate showing location of mounting screws

4. Lift out the top circuit assembly to access the bottom circuit assembly (Figure 5.14, Page 53).
5. Disconnect the ribbon cable from the latched connector on the bottom circuit assembly (see Figure 5.15, Page 53) and set the top circuit assembly aside.
6. Unplug the display and reset switch terminal blocks and any other wired terminal blocks from the bottom circuit board. Loosen the screws in terminal blocks as applicable.
7. Unscrew the four mounting screws (Figure 5.15, Page 53) and remove the bottom circuit assembly from the enclosure.
8. Remove the plastic standoffs and screws securing them to the bottom circuit assembly and discard the assembly. The standoffs and screws will be reused with the replacement bottom circuit assembly.
9. Carefully remove the new bottom circuit assembly from its packaging.
10. Connect the standoffs removed in Step 8 to the new bottom circuit assembly, as shown in Figure 5.16, Page 53.

Note There are two long standoff assemblies and two short standoff assemblies. The two long standoff assemblies should be mounted on the sides of the board and the short standoff assemblies should be mounted in the top and bottom of the board.

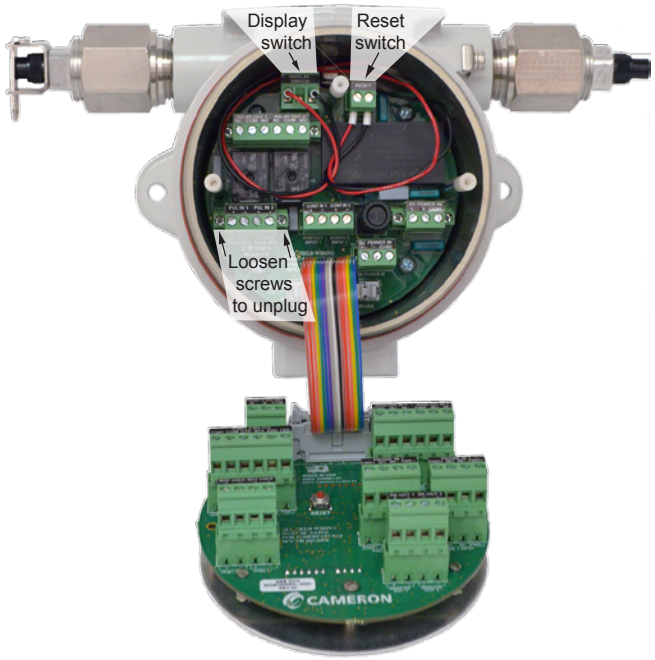

Figure 5.14—Display switch and reset switch locations

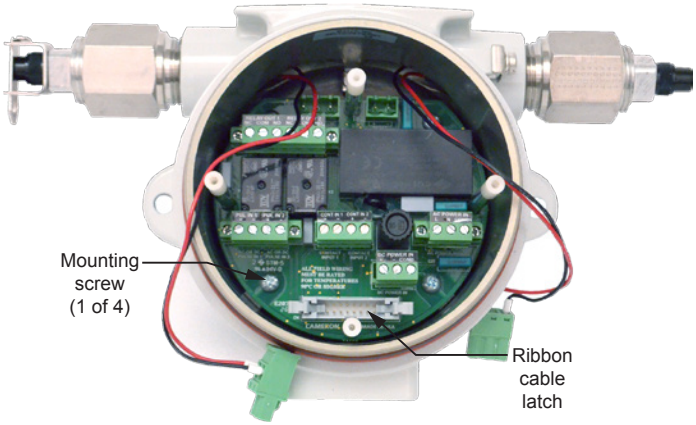

Figure 5.15—Bottom circuit board showing location of mounting screw and ribbon cable latch

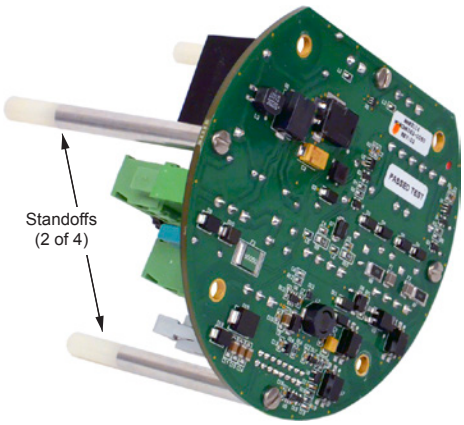

Figure 5.16—Bottom circuit assembly

11. Tighten the standoffs in the back of the enclosure (Figure 5.17).

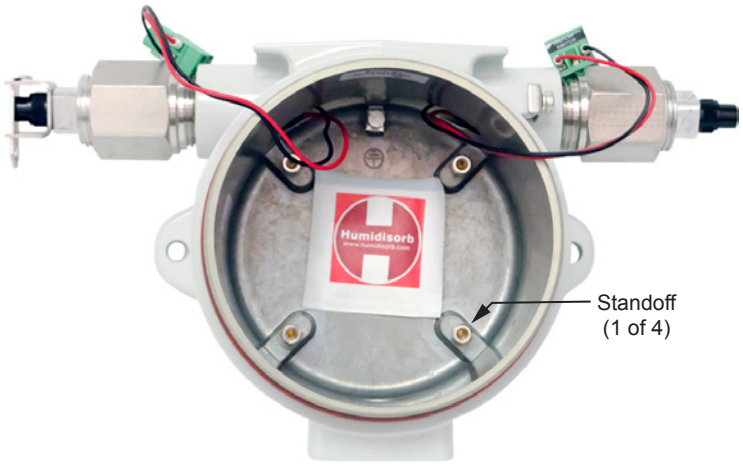

Figure 5.17—Empty explosion-proof enclosure showing standoff locations

12. Place the new bottom circuit assembly into the enclosure with the straight side of the circuit board at the top of the enclosure, resting just below the ground screw and secure with the screws removed in Step 7.
13. Grasp the top circuit assembly removed in Step 4 and reconnect the attached ribbon cable to the bottom circuit assembly as shown in Figure 5.11, Page 51.
14. Reconnect the terminal blocks on the bottom circuit assembly, taking care not to strain the ribbon cable.
15. With the display facing upward, reposition the top circuit assembly on top of the standoffs shown in Figure 5.12, Page 51 so that the standoffs on the left and right align with the mounting holes in the top circuit assembly.
16. Tighten the screws and washers loosened in Step 3 to secure the new top circuit assembly in the enclosure.
17. Replace the enclosure cover, tighten and restore power to the device.

Troubleshooting

CAUTION **Before attempting any wiring, ensure that all power is disconnected. Before reapplying power, ensure that all wiring connections are secure and connected properly.**

All field wiring must conform to the National Electric Code, NFPA 70, Article 501-4(b) for installations within the United States or as specified in Section 18-156 of the Canadian Electrical Code for installations within Canada. Local wiring ordinances may also apply. All field wiring must have a wire range of 22 to 14 AWG and insulation rated for 120 VAC or above and copper or copper-clad aluminum conductors. Terminal block screws must be tightened to a minimum torque of 5 to 7 inch-lbs to secure the wiring within the terminal block. Only personnel who are experienced with field wiring should perform these procedures.

The instrument must be grounded with a protective earth grounding conductor in accordance with national and local electrical codes.

Weatherproof Package

Symptom	Corrective Action(s)
No Display	1. Verify the voltage of the power source with a voltmeter. 2. Remove ALL power. 3. Remove the fuse and test with an ohmmeter. For AC operations, check the 1 amp fuse “F4”. If the fuse is open, replace it with an approved 5×20 mm, 1 amp, 250 VAC rated fuse. Only the following fuses are approved for use with the TA-1000 Plus: LITTELFUSE Part No. 0215001.HXP and BEL FUSE INC. Part No. 5HT 1-R. Cameron also supplies these approved fuses. 4. Ensure that all cables are properly connected and all terminal connections are snug. 5. If the power source is supplying the correct voltage and cables and terminal connections are in good working order, replace the circuit board(s).
Fuses Open Frequently or Periodically	1. If the AC fuse “F4” opens each time it is replaced, do not install a larger fuse. 2. Replace the circuit board and return the defective board to Cameron for service.
Display Does Not Update	1. Cycle the display control switch slowly in the forward direction, then in reverse. 2. If the display does not respond, power down the unit for one minute. 3. Restore power. 4. If the display still does not update, replace the circuit board and the SATA cable.
Display Is Distorted	1. Ensure the display cable is securely connected to the display board and the circuit board. 2. Power down the unit for one minute. 3. Restore power. 4. If the display remains distorted, replace the display and the display cable. 5. If display distortion persists, replace the circuit board.
Counts Do Not Advance with Flow	1. Set the display to count for the channel in question. 2. Ensure the display updates. If not, refer to Display Does Not Update. 3. Check the wiring diagram to determine if the pulse input is wired for 120 VAC, 9-30 VDC or dry contact operation. Refer to the appropriate pulse input section below to troubleshoot.
Counts Do Not Advance with Flow (AC Pulse Operation)	1. On channel 1, place a voltmeter across Terminals 1 and 2 (PUL IN 1) of terminal block TB12. For AC pulse operation on channel 2, place the voltmeter across Terminals 3 and 4 (PUL IN 2) of the same terminal block. The voltmeter should alternate between 120 and 0 VAC for each unit of measure (barrels). 2. If there is no AC voltage, or if the voltage remains at 120 VAC continuously, the problem is in the equipment furnishing the meter pulse. 3. If the voltage cycles properly but the counts do not advance on the display, disable the PulseIn Filter (see Disabling the Pulse Input Filter, Page 40). If ineffective, then replace the bottom circuit board.

Symptom	Corrective Action(s)
Counts Do Not Advance with Flow (DC Pulse Operation)	1. On channel 1, place a voltmeter across Terminals 1 and 2 (PUL IN 1) of terminal block TB12. For DC pulse operation on channel 2, place the voltmeter across Terminals 3 and 4 (PUL IN 2) of the same terminal block. The voltmeter should alternate between 0 VDC and 9-30 VDC for each unit of measure (barrels). 2. If there is no DC voltage, or if the voltage remains at 9-30 VDC continuously, the problem is in the equipment furnishing the meter pulse. 3. If the voltage cycles properly but the counts do not advance on the display, disable the PulseIn Filter (see Disabling the Pulse Input Filter, Page 40). If ineffective, then replace the bottom circuit board.
Counts Do Not Advance with Flow (Dry Contact Operation)	1. Place a voltmeter across Terminals 1 and 2 (CONT IN 1) of terminal block TB13. For pulse operation on channel 2, place the voltmeter across Terminals 3 and 4 (CONT IN 2) of the same terminal block. The voltmeter should alternate between 5 and 0 VDC for each unit of measure (barrels). a. If there is not DC voltage or if the voltage remains at 5 VDC, the problem is in the equipment furnishing the meter pulse. b. If the voltage cycles properly but the counts do not advance on the display, disable the PulseIn Filter (see Disabling the Pulse Input Filter, Page 40). If ineffective, then replace the bottom circuit board. c. Check the count operation by removing field wiring from terminal block TB13. Using a voltmeter, verify a reading of approximately 5 VDC across Terminals 1 and 2 (CONT IN 1) of TB12 and Terminals 3 and 4 (CONT IN 2) of TB13. a. If voltage is not read in either channel, the circuit board is faulty and should be replaced. b. If voltage is present, cycle the display to the Count position, jumper across Terminal 1 and 2 (CONT IN 1) of TB12 or Terminals 3 and 4 (CONT IN 2) of TB13 for several seconds, then remove the jumper. The display should advance counts. If the display advances, the unit is operating properly for dry contact operation.
Displays Incorrect Temperature or Temperature Alarm	1. Cycle the display to the Alarm 1 or Alarm 2 position to determine which channel alarmed. Note the total number of alarm counts. Four or more alarm counts will de-energize the alarm relay. 2. Clear the alarm using the reset switch. See Clearing Alarms, Page 42. 3. Cycle the display to the Probe 1 or Probe 2 position. If the display shows “Temp Error,” the probe temperature could be out of range or the probe wiring or circuit board may be faulty. 4. Gently pull on the probe wires to terminal blocks TB6 and TB7 to ensure they are securely fastened to the terminals. 5. Check all other probe field wiring for correct and secure connections. 6. Temporarily connect another temperature probe to the probe input in question. If the temperature reads accurately, the probe or the field wiring are faulty. 7. If two probe inputs are enabled and another probe is not available, connect the probe in question to the other channel. Cycle the display to the Probe Temp F position for the connected probe (Probe 1 or Probe 2) to read the temperature. a. If the temperature reads accurately, the circuit board is faulty and should be replaced. b. If the display shows “Temp Error” and the probe is wired correctly, the probe or field wiring is faulty and should be replaced. 8. Check the probe thermowell for moisture content and check the seal around the top of the thermowell. If moisture is detected, replace the probe to ensure accurate temperature data and reseal the thermowell.

Explosion-proof Package

Symptom	Corrective Action(s)
No Display	1. Verify the voltage of the power source with a voltmeter. 2. Remove ALL power. 3. Remove the fuse and test with an ohmmeter. For AC operations, check the 1 amp fuse "F4". If the fuse is open, replace it with an approved 5×20 mm, 1 amp, 250 VAC rated fuse. Only the following fuses are approved for use with the TA-1000 Plus: LITTEL-FUSE Part No. 0215001.HXP and BEL FUSE INC. Part No. 5HT 1-R. Cameron also supplies these approved fuses. 4. Ensure that all cables are properly connected and all terminal connections are snug. 5. If the power source is supplying the correct voltage and cables and terminal connections are in good working order, replace the circuit board(s).
Fuses Open Frequently or Periodically	1. If the AC fuse "F4" opens each time it is replaced, do not install a larger fuse. 2. Replace the bottom circuit board and return the defective board to Cameron for service.
Display Does Not Update	1. Pace the display slowly forward. If the display does not respond, turn off the power for one minute and then turn on the power again. 2. If the display does not update after power cycling, replace the top circuit board, which includes the display.
Counts Do Not Advance with Flow	1. Set the display to count for the channel in question. 2. Ensure the display updates. If not, refer to Section 1—Introduction above. 3. Check the wiring diagram to determine if the pulse input is wired for 120 VAC, 9-30 VDC, or dry contact operation. Refer to the appropriate pulse input section below to troubleshoot.
Counts Do Not Advance with Flow (AC Pulse Operation)	1. On channel 1, place a voltmeter across Terminals 1 and 2 (PUL IN 1) of terminal block TB12. For AC pulse operation on channel 2, place the voltmeter across Terminals 3 and 4 (PUL IN 2) of the same terminal block. The voltmeter should alternate between 120 and 0 VAC for each unit of measure (barrels). 2. If there is no AC voltage, or if the voltage remains at 120 VAC continuously, the problem is in the equipment furnishing the meter pulse. 3. If the voltage cycles properly but the counts do not advance on the display, disable the PulseIn Filter (see Disabling the Pulse Input Filter, Page 40). If ineffective, then replace the bottom circuit board.
Counts Do Not Advance with Flow (DC Pulse Operation)	1. On channel 1, place a voltmeter across Terminals 1 and 2 (PUL IN 1) of terminal block TB12. For DC pulse operation on channel 2, place the voltmeter across Terminals 3 and 4 (PUL IN 2) of the same terminal block. The voltmeter should alternate between 0 VDC and 9-30 VDC for each unit of measure (barrels). 2. If there is no DC voltage, or if the voltage remains at 9-30 VDC continuously, the problem is in the equipment furnishing the meter pulse. 3. If the voltage cycles properly but the counts do not advance on the display, disable the PulseIn Filter (see Disabling the Pulse Input Filter, Page 40). If ineffective, then replace the bottom circuit board.

Symptom	Corrective Action(s)
Counts Do Not Advance with Flow (Dry Contact Operation)	1. Place a voltmeter across Terminals 1 and 2 (CONT IN 1) of terminal block TB13. For pulse operation on channel 2, place the voltmeter across Terminals 3 and 4 (CONT IN 2) of the same terminal block. The voltmeter should alternate between 5 and 0 VDC for each unit of measure (barrels). a. If there is not DC voltage or if the voltage remains at 5 VDC, the problem is in the equipment furnishing the meter pulse. b. If the voltage cycles properly but the counts do not advance on the display, disable the PulseIn Filter (see Disabling the Pulse Input Filter, Page 40). If ineffective, then replace the bottom circuit board.
	2. Check the count operation by removing field wiring from terminal block TB13. Using a voltmeter, verify a reading of approximately 5 VDC across Terminals 1 and 2 (CONT IN 1) and Terminals 3 and 4 (CONT IN 2) of TB13. a. If voltage is not read in either channel, the bottom circuit board is faulty and should be replaced. b. If voltage is present, cycle the display to the Count position, jumper across Terminal 1 and 2 (CONT IN 1) or Terminals 3 and 4 (CONT IN 2) of TB13 for several seconds, then remove the jumper. The display should advance counts. If the display advances, the unit is operating properly for dry contact operation.
Counts Are Incorrect	1. Ensure that the display updates. If the display does not update, counts may be lost. Refer to Section 1—Introduction, Page 5. 2. If the counts are higher than normal, the cause may be noise generated from external high current devices. 3. If counts are high and the pulse input to the TA-1000 Plus is from an AC control panel, the pulses may be cycled erroneously each time the unit is stopped and started. 4. If the AC power has brown outs or power dips, the TA-1000 Plus may be in a protective sleep state, resulting in lost counts. If 98% or more counts are received, the average temperature will be accurate. 5. If the steps above do not resolve the issue, further noise mitigation steps may be required. Contact Cameron for technical assistance.
Displays Incorrect Temperature or Temperature Alarm	1. Cycle the display to the Alarm 1 or Alarm 2 position to determine which channel alarmed. Note the total number of alarm counts. Four or more alarm counts will de-energize the alarm relay. 2. Clear the alarm using the reset switch. See Clearing Alarms, Page 42. 3. Cycle the display to the Probe 1 or Probe 2 position. If the display shows “Temp Error,” the probe temperature could be out of range or the probe wiring or circuit board may be faulty. 4. Gently pull on the probe wires to terminal blocks TB6 and TB7 to ensure they are securely fastened to the terminals. 5. Check all other probe field wiring for correct and secure connections. 6. Temporarily connect another temperature probe to the channel in question. If the temperature reads accurately, the probe or the field wiring are faulty. 7. If dual channels are enabled and another probe is not available, connect the probe in question to the other channel. Cycle the display to the Probe position of the other channel to read the temperature. a. If the temperature reads accurately, the circuit board is faulty and should be replaced. b. If the display shows “Temp Error” and the probe is wired correctly, the probe or field wiring is faulty and should be replaced. c. Check the probe thermowell for moisture content and check the seal around the top of the thermowell. If moisture is detected, replace the probe to ensure accurate temperature data and reseal the thermowell.

Section 6—Spare Parts

WARNING: EXPLOSION HAZARD – Substitution of components may impair suitability for Class I, Div. 2 areas. Use of spare parts other than those identified by Cameron International Corporation voids hazardous area certification. Cameron bears no legal responsibility for the performance of a product that has been serviced or repaired with parts that are not authorized by Cameron.

Table 6.1—TA-1000 Plus Spare Parts

Quantity	Part Number	Description
1	50275791	Fuse, 1 amp, 250 VAC, 5×20 mm, Ceramic, Time-lag
1	9A-100002605	Desiccant, Humidisorb, Self Regenerate, 2 in. × 2 in. Packet with Adhesive
Explosion-proof Enclosure		
1	50267637	Display Switch with Extension, 3/4-in. Female Pipe Thread, Explosion-proof
1	50271475	Reset Switch with Extension, 3/4-in. Female Pipe Thread, Explosion-proof, with Custody Transfer Lockout
1	Contact Cameron	Circuit Assembly, TA-1000 Plus, AC Board, Explosion-proof
1	Contact Cameron	Circuit Assembly, TA-1000 Plus, Main Board, Explosion-proof
1	50268905	Kit, Pole-Mount, TA-1000 Plus, Explosion-proof
1	76524123	Ribbon Cable, AC Board to Main Board, Explosion-proof
1	9A-99064006	Pipe Plug, 3/4-14 NPT, 10 mm Hex Socket, Brass, Explosion-proof
Weatherproof Enclosure		
1	50262916	Display Switch with Cable Assembly, Weatherproof
1	2350798-01	Display Assembly and SATA Cable, TA-1000 Plus, Weatherproof
1	Contact Cameron	Circuit Assembly, TA-1000 Plus, Main Board, Weatherproof
1	50275693	Kit, Pole Mount, TA-1000 Plus, Weatherproof
1	9A-100001795	Conduit Hub, 1/2 in., Weatherproof
1	2350358-01	Plug, Square Head, 1/2-in. NPT, Plastic, Red, Weatherproof
1	50275694	Custody Transfer Lockout Kit, Weatherproof

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Appendix A—TA-1000 Plus Protocol

Firmware Version: 1.00

Register Table Version: 1

Introduction

The communications protocol for the TA-1000 Plus is in accordance with Modicon, Inc. RTU Mode Modbus as described in *Modicon Modbus Protocol Reference Guide*, PI-MBUS-300 Rev. J, June 1996. All registers are implemented as 4X or holding registers. Reading of registers is implemented via function code 03H (Read Holding Registers). Writing to registers is implemented via function code 10H (Preset Multiple Registers).

Supported Commands

The Modbus® functions supported by the TA-1000 Plus are as follows:

Function Code (Hex)	Description
03	Read Holding Registers
10	Preset Multiple Registers
11	Report Slave ID

For the read holding and preset multiple registers, the instrument supports the full 250 bytes of data in a message. This corresponds to 125 registers in 16-bit holding register size and 62 registers in 32-bit holding register size.

The report slave ID function code returns the following registers:

- Product Code
- Register Table Number
- Firmware Version
- Manufacture Date
- Sales Date
- Serial Number 1
- Serial Number 2
- 2 bytes reserved
- Connected Port (0 = connected to Port 1; 1 = connected to Port 2)
- 2 bytes reserved
- Port Slave Address
- Port Baud Rate
- Port Bus Delay
- Port Bus Timeout
- 2 bytes reserved
- 2 bytes reserved
- 2 bytes reserved
- 2 bytes reserved

Data Types

Various data types are implemented in the TA-1000 Plus. The following table lists the formats and the numbers of bytes and registers associated with each type:

Data Type	Byte Count	Register Count
Floating Point (FP)	4	2
Floating Point (FP32)	4	1
Unsigned Word (U16)	2	1
Unsigned Word (U32)	4	2

The word ordering for multiple register data types, such as floating-point numbers or long integers, is for the most significant word to appear first in the message.

The Unsigned Word (U16) type is used for 16-bit integers and fits into one register.

Registers

Each register has an access type (read-only or read/write) as described below:

Access Types	Description
Read-only (RO)	Register can only be read
Read/Write (RW)	Register can be read and written

The registers are grouped into Modbus® map blocks according to function. The TA-1000 Plus contains the following map functions:

Map	Starting Register	Page Number
Control Registers	70	Page A-2
System Configuration	1000	Page A-3
Communications Configuration	1100	Page A-4
Probe 2 Configuration	2200	Page A-7
Probe 1 Configuration	2400	Page A-7
Analog Input 1 Configuration	2500	Page A-7
Analog Input 2 Configuration	2600	Page A-8
Master Configuration	2700	Page A-4
Holding Registers (32-bit)	7000	Page A-10
Holding Registers (16-bit)	8000	Page A-8
Alarm Status Register	9900	Page A-8

Note All registers cited in this document refer to the address of the register that appears in the actual Modbus® message. For example, register 8000 has an address of 0x1F40 hexadecimal in the message.

Control Registers

Register (Decimal)	Register (Hex)	Description	Data Type	Access
70	46	Control Register 1	U16	RW

The Control Registers allow specific functions to be implemented via the communications port. The following table shows the value to be written to the control register to implement the desired function.

Code	Function
31000	Reset all totals and counts (simultaneously execute functions for Codes 31002, 31003, 31004 and 31010)
31002	Reset Probe 2 total and count
31003	Reset Analog Input 1 total and count and BS&W 1 divert signal, if applicable
31004	Reset Analog Input 2 total and count and BS&W 2 divert signal, if applicable
31010	Reset Probe 1 total and count and net volume
32000	Reset all alarms, counts and alarm states (simultaneously execute functions for Codes 32001–32004)
32001	Reset Probe 1 alarm count and alarm state
32002	Reset Probe 2 alarm count and alarm state
32003	Reset Analog Input 1 alarm count and alarm state
32004	Reset Analog Input 2 alarm count and alarm state
33000	Reset all totals, alarm counts and alarm states (simultaneously execute functions for Codes 33001–33004)
33001	Reset Probe 1 total, count, alarm count, alarm state and net volume
33002	Reset Probe 2 total, count, alarm count and alarm state
33003	Reset Analog Input 1 total, count, alarm count and alarm state and BS&W 1 divert signal
33004	Reset Analog Input 2 total, count, alarm count and alarm state and BS&W 2 divert signal (if applicable)

System Configuration

Register (Decimal)	Register (Hex)	Description	Data Type	Access
1000	0x03E8	Product Code	U16	RO
1001	0x03E9	Register Table Version	U16	RO
1002	0x03EA	Firmware Version	U16	RO
1003	0x03EB	Manufacture Date	U16	RO
1004	0x03EC	Sales Date	U16	RO
1005	0x03ED	Serial Number High	U16	RO
1006	0x03EE	Serial Number Low	U16	RO

Product Code

The Product Code is a read-only parameter used for identifying a TA-1000 Plus device. This parameter is defined at the factory.

Firmware Version/Register Table Version

The Firmware Version and Register Table Version numbers are set by the factory and are read-only. To determine the version number, read the appropriate register and divide the value by 100. The general format for version numbers is A.BC. For example the firmware register number is read as 0xA7 hexadecimal. This represents the value 167 and a firmware version of 1.67.

Manufacture Date/Sales Date

These parameters are set at the factory and are read-only. These registers are formatted as MMYY. For example, a value of 0913 represents the date September 2013.

Communications Configuration

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
1100	0x044C	Port 1 – Port Usage 0 = Slave	U16	RW	0
1101	0x044D	Port 1 –Slave Address [1–65535, excluding 252–255 and 64764]	U16	RW	1
1102	0x044E	Port 1 – Baud Rate 0 = 300 1 = 600 2 = 1200 3 = 2400 4 = 4800 5 = 9600 6 = 19200 7 = 38400	U16	RW	5
1103	0x044F	Port 1 – Bus Delay (mS of delay before transmitting data)	U16	RW	10
1104	0x0450	Port 1 – Bus Timeout (mS of delay before resetting communcations)	U16	RW	50
1105	0x0451	Port 2 – Port Usage 0 = Slave	U16	RW	0
1106	0x0452	Port 2 Slave Address [1–65535, excluding 252–255 and 64764]	U16	RW	1
1107	0x0453	Port 2 - Baud Rate 0 = 300 1 = 600 2 = 1200 3 = 2400 4 = 4800 5 = 9600 6 = 19200 7 = 38400	U16	RW	5
1108	0x0454	Port 2 – Bus Delay (mS of delay before transmitting data)	U16	RW	10
1109	0x0455	Port 2 – Bus Timeout (mS of delay before resetting communications)	U16	RW	50

Master Configuration

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
2700	0x0A8C	Probe Type 0 = Single Element 1 = Dual Element	U16	RO	from System Menu settings
2701	0x0A8D	Analog Input 1 Model 0 = Disable 1 = BS&W 2 = Pressure 3 = Other	U16	RO	1

Master Configuration

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
2702	0x0A8E	Analog Input 2 Model 0 = Disable 1 = BS&W 2 = Pressure 3 = Other	U16	RO	0
2703	0x0A8F	Analog Output 1 Model 0 = Disable 1 = Probe 1 Instant Reading 2 = Probe 1 Average Reading 3 = Probe 2 Instant Reading 4 = Probe 2 Average Reading 5 = Analog Input 1 Instant Reading 6 = Analog Input 2 Instant Reading	U16	RO	1
2704	0x0A90	Analog Output 2 Model 0 = Disable 1 = Probe 1 Instant Reading 2 = Probe 1 Average Reading 3 = Probe 2 Instant Reading 4 = Probe 2 Average Reading 5 = Analog Input 1 Instant Reading 6 = Analog Input 2 Instant Reading	U16	RO	1
2705	0x0A91	Digital Output 1 Model 0 = Disable 1 = Any Alarms 2 = Probe 1 Alarm 3 = Probe 2 Alarm 4 = Analog Input 1 Alarm 5 = Analog Input 2 Alarm 6 = BS&W 1 Divert 7 = BS&W 2 Divert	U16	RO	0
2706	0x0A92	Digital Output 2 Model 0 = Disable 1 = Any Alarms 2 = Probe 1 Alarm 3 = Probe 2 Alarm 4 = Analog Input 1 Alarm 5 = Analog Input 2 Alarm 6 = BS&W 1 Divert 7 = BS&W 2 Divert 8 = Net Pulse	U16	RO	0
2707	0x0A93	Pressure 1 Range 0 = 0–150 PSI 1 = 0–200 PSI 2 = 0–500 PSI 3 = 0–1500 PSI 4 = 0–3000 PSI	U16	RO	0
2708	0x0A94	Pressure 2 Range 0 = 0–150 PSI 1 = 0–200 PSI 2 = 0–500 PSI 3 = 0–1500 PSI 4 = 0–3000 PSI	U16	RO	0

Master Configuration

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
2709	0x0A95	Analog Input 1 (Input Setting) 0 = 1–5 VDC 1 = 0–5 VDC 2 = 4–20 mA	U16	RO	0
2710	0x0A96	Analog Input 2 (Input Setting) 0 = 1–5 VDC 1 = 0–5 VDC 2 = 4–20 mA	U16	RO	0
2711		Reserved			
2712		Reserved			
2713	0x0A99	BS&W 1 Divert Time Delay (seconds)	U16	RO	90
2714	0x0A9A	BS&W 2 Divert Time Delay (seconds)	U16	RO	90
2715	0x0A9B	BS&W 1 Divert Time Delay Off (seconds)	U16	RO	10% of Register 2713
2716	0x0A9C	BS&W 2 Divert Time Delay Off (seconds)	U16	RO	10% of Register 2714
2717	0x0A9D	BS&W 1 Range 0 = 0.00–5.00% 1 = 0.00–10.00% 2 = 0.00–20.00% 3 = 0.00–100.00%	U16	RO	0
2718	0x0A9E	BS&W 2 Range 0 = 0.00–5.00% 1 = 0.00–10.00% 2 = 0.00–20.00% 3 = 0.00–100.00%	U16	RO	0
2719	0x0A9F	BS&W 1 Maximum %	U16	RO	5
2720	0x0AA0	BS&W 2 Maximum %	U16	RO	5
2721	0x0AA1	BS&W 1 Setpoint %	FP	RO	1
2723	0x0AA3	BS&W 2 Setpoint %	FP	RO	1
2725	0x0AA5	Other 1 Fullscale	FP	RO	100
2727	0x0AA7	Other 2 Fullscale	FP	RO	100
2729–2736		Reserved			
2737	0x0AB1	Meter Factor	FP	RO	1
2739	0x0AB3	API Gravity	FP	RO	35
2741	0x0AB5	Probe 1 Wire Compensation (ohm)	FP	RO	0
2743	0x0AB7	Probe 2 Wire Compensation (ohm)	FP	RO	0
2745–2751		Reserved			
2753	0x0AC1	LCD Back Light Enable	U16	RO	0
2754	0x0AC2	LCD Auto Scrolling 0 = Enabled 1 = Disabled	U16	RO	1
2755	0x0AC3	TA PI1 Filter Status 0 = Enable 1 = Disable	U16	RW	1
2756	0x0AC4	TA PI1 Filter Maximum Count	U16	RW	1
2757	0x0AC5	TA PI1 Filter Damp Time	U16	RW	0

Master Configuration

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
2758	0x0AC6	TA PI2 Filter Status 0 = Enable 1 = Disable	U16	RW	1
2759	0x0AC7	TA PI2 Filter Maximum Count	U16	RW	1
2760	0x0AC8	TA PI2 Filter Damp Time	U16	RW	0

Probe 1 Configuration

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
2400–2407		Reserved			
2408	0x0968	Probe 1 – Fail Value	FP	RO	60
2410–2413		Reserved			
2414	0x096E	Probe 1 – Sensor Range Low	FP	RO	from Probe Type settings
2416	0x0970	Probe 1 – Sensor Range High	FP	RO	from Probe Type settings

Probe 2 Configuration

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
2200–2207		Reserved			
2208	0x08A0	Probe 2 – Fail Value	FP	RO	60
2210–2213		Reserved			
2214	0x08A6	Probe 2 – Sensor Range Low	FP	RO	from Probe Type settings
2216	0x08A8	Probe 2 – Sensor Range High	FP	RO	from Probe Type settings

Analog Input 1 Configuration

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
2500–2503		Reserved			
2504	0x09C8	A1 – Input Configuration 0 = 1–5 VDC 16 = 0–5 VDC 32 = 4–20 mA	U16	RO	from Setup Menu settings
2505–2513		Reserved			
2514	0x096E	A1 – Sensor Range Low	FP	RO	from Setup Menu settings
2516	0x0970	A1 – Sensor Range High	FP	RO	from Setup Menu settings
2518	0x09D6	A1 – Unit Scale Factor	FP	RO	from Setup Menu settings
2520	0x09D8	A1 – Unit Offset Factor	FP	RO	from Setup Menu settings

Analog Input 2 Configuration

Register (Decimal)	Register (Hex)	Description	Data Type	Access	Default
2600–2603		Reserved			
2604	0x0A2C	A2 – Input Configuration 0 = 1–5 VDC 16 = 0–5 VDC 32 = 4–20 mA	U16	RO	from Setup Menu settings
2605–2613		Reserved			
2614	0x0A36	A2 – Sensor Range Low	FP	RO	from Setup Menu settings
2616	0x0A38	A2 – Sensor Range High	FP	RO	from Setup Menu settings
2618	0x0A3A	A2 – Unit Scale Factor	FP	RO	from Setup Menu settings
2620	0x0A3C	A2 – Unit Offset Factor	FP	RO	from Setup Menu settings

Alarm Status Register

Register (Decimal)	Register (Hex)	Description	Data Type	Access
9906	0x26B2	Alarm Status	U32	RO

Bit No.	Description
31–16	Reserved
15–8	Reserved
7	BS&W 2 Divert Condition (with Setpoint Delay timer) 0 = Unexpired 1 = Expired
6	BS&W 1 Divert Condition (with Setpoint Delay timer) 0 = Unexpired 1 = Expired
5	BS&W 2 Divert Condition (with Out-of-Range alarm)
4	BS&W 1 Divert Condition (with Out-of-Range alarm)
3	Analog Input 2 Alarm Status
2	Analog Input 1 Alarm Status
1	Probe 2 Alarm Status
0	Probe 1 Alarm Status

Modbus Holding Registers (16-bit)

Register (Decimal)	Register (Hex)	Description	Data Type	Access
8000–8101		Reserved		
8102	0x1FA6	FR1 Compressibility	FP	RO
8104	0x1FA8	FR1 Density	FP	RO
8106	0x1FAA	FR1 Base Compressibility	FP	RO
8108	0x1FAC	FR1 Base Density	FP	RO
8100–8117		Reserved		
8118	0x1FB6	FR1 Specific Gravity	FP	RO

Modbus Holding Registers (16-bit)

Register (Decimal)	Register (Hex)	Description	Data Type	Access
8120	0x1FB8	FR1 Viscosity	FP	RO
8122	0x1FBA	FR1 Isentropic Exponent	FP	RO
8124–8335		Reserved		
8336	0x2090	Probe 2 Instant Reading	FP	RO
8338–8379		Reserved		
8380	0x20BC	Probe 1 Instant Reading	FP	RO
8382–8467		Reserved		
8468	0x2114	Analog Input 1 Instant Reading	FP	RO
8470–8511		Reserved		
8512	0x2140	Analog Input 2 Instant Reading	FP	RO
8514–8573		Reserved		
8574	0x217E	Live Probe 1 Temperature	FP	RO
8576	0x2180	Live Probe 2 Temperature	FP	RO
8578	0x2182	Live Analog 1	FP	RO
8580	0x2184	Live Analog 2	FP	RO
8582–8709		Reserved		
8710	0x2206	Probe 1 Run Time	FP	RO
8712	0x2208	Probe 1 Temperature (°F)	FP	RO
8714	0x220A	Probe 1 Counts	FP	RO
8716	0x220C	Probe 1 Total Temperature (°F)	FP	RO
8718	0x220E	Probe 1 Average Temperature (°F)	FP	RO
8720	0x2210	Probe 1 Counts per Hour (CPH)	FP	RO
8722	0x2212	Probe 1 Alarm Counts	FP	RO
8724	0x2214	BS&W 1 (%)	FP	RO
8726	0x2216	BS&W 1 Counts	FP	RO
8728	0x2218	BS&W 1 Total (%)	FP	RO
8730	0x221A	BS&W 1 Average (%)	FP	RO
8732	0x221C	BS&W 1 Alarm Counts	FP	RO
8734	0x221E	Pressure 1 (PSI)	FP	RO
8736	0x2220	Pressure 1 Counts	FP	RO
8738	0x2222	Pressure 1 Total (PSI)	FP	RO
8740	0x2224	Pressure 1 Average (PSI)	FP	RO
8742	0x2226	Pressure 1 Alarm Counts	FP	RO
8744	0x2228	Other 1 Fullscale	FP	RO
8746	0x222A	Other 1 Counts	FP	RO
8748	0x222C	Other 1 Total	FP	RO
8750	0x2230	Other 1 Average	FP	RO
8752	0x2232	Other 1 Alarm Counts	FP	RO
8754–8757		Reserved		
8758	0x2236	Volume Correction Factor	FP	RO
8760	0x2238	Net Volume	FP	RO

Modbus Holding Registers (16-bit)

Register (Decimal)	Register (Hex)	Description	Data Type	Access
8762	0x223A	Probe 2 Run Time	FP	RO
8764	0x223C	Probe 2 Temperature (°F)	FP	RO
8766	0x223E	Probe 2 Counts	FP	RO
8768	0x2240	Probe 2 Total Temperature (°F)	FP	RO
8770	0x2242	Probe 2 Average Temperature (°F)	FP	RO
8772	0x2244	Probe 2 Counts per Hour (CPH)	FP	RO
8774	0x2246	Probe 2 Alarm Counts	FP	RO
8776	0x2248	BS&W 2 (%)	FP	RO
8778	0x224A	BS&W 2 Counts	FP	RO
8780	0x224C	BS&W 2 Total (%)	FP	RO
8782	0x224E	BS&W 2 Average (%)	FP	RO
8784	0x2250	BS&W 2 Alarm Counts	FP	RO
8786	0x2252	Pressure 2 (PSI)	FP	RO
8788	0x2254	Pressure 2 Counts	FP	RO
8790	0x2256	Pressure 2 Total (PSI)	FP	RO
8792	0x2258	Pressure 2 Average (PSI)	FP	RO
8794	0x225A	Pressure 2 Alarm Counts	FP	RO
8796	0x225C	Other 2 Fullscale	FP	RO
8798	0x225E	Other 2 Counts	FP	RO
8800	0x2260	Other 2 Total	FP	RO
8802	0x2262	Other 2 Average	FP	RO
8804	0x2264	Other 2 Alarm Counts	FP	RO
8806–8809		Reserved		
8810	0x226A	Analog Output 1 Output (mA)	FP	RO
8812	0x226C	Analog Output 2 Output (mA)	FP	RO

Modbus Holding Registers (32-bit)

Register (Decimal)	Register (Hex)	Description	Data Type	Access
7000–7050		Reserved		
7051	0x1B8B	FR1 Compressibility	FP	RO
7052	0x1B8C	FR1 Density	FP	RO
7053	0x1B8D	FR1 Base Compressibility	FP	RO
7054	0x1B8E	FR1 Base Density	FP	RO
7055–7058		Reserved		
7059	0x1B93	FR1 Specific Gravity	FP	RO
7060	0x1B94	FR1 Viscosity	FP	RO
7061	0x1B95	FR1 Isentropic Exponent	FP	RO
7062–7167		Reserved		

Modbus Holding Registers (32-bit)

Register (Decimal)	Register (Hex)	Description	Data Type	Access
7168	0x1C00	Probe 2 Instant Reading	FP	RO
7169–7189		Reserved		
7190	0x1C16	Probe 1 Instant Reading	FP	RO
7191–7233		Reserved		
7234	0x1C42	Analog Input 1 Instant Reading	FP	RO
7235–7255		Reserved		
7256	0x1C58	Analog Input 2 Instant Reading	FP	RO
7257–7286		Reserved		
7287	0x1C77	Live Probe 1 Temperature	FP	RO
7288	0x1C78	Live Probe 2 Temperature	FP	RO
7289	0x1C79	Live Analog 1	FP	RO
7290	0x1C7A	Live Analog 2	FP	RO
7291–7354		Reserved		
7355	0x1CBB	Probe 1 Run Time	FP	RO
7356	0x1CBC	Probe 1 Temperature (°F)	FP	RO
7357	0x1CBD	Probe 1 Counts	FP	RO
7358	0x1CBE	Probe 1 Total Temperature (°F)	FP	RO
7359	0x1CBF	Probe 1 Average Temperature (°F)	FP	RO
7360	0x1CC0	Probe 1 Counts per Hour (CPH)	FP	RO
7361	0x1CC1	Probe 1 Alarm Counts	FP	RO
7362	0x1CC2	BS&W 1 (%)	FP	RO
7363	0x1CC3	BS&W 1 Counts	FP	RO
7364	0x1CC4	BS&W 1 Total (%)	FP	RO
7365	0x1CC5	BS&W 1 Average (%)	FP	RO
7366	0x1CC6	BS&W 1 Alarm Counts	FP	RO
7367	0x1CC7	Pressure 1 (PSI)	FP	RO
7368	0x1CC8	Pressure 1 Counts	FP	RO
7369	0x1CC9	Pressure 1 Total (PSI)	FP	RO
7370	0x1CCA	Pressure 1 Average (PSI)	FP	RO
7371	0x1CCB	Pressure 1 Alarm Counts	FP	RO
7372	0x1CCC	Other 1 Fullscale	FP	RO
7373	0x1CCD	Other 1 Counts	FP	RO
7374	0x1CCE	Other 1 Total	FP	RO
7375	0x1CCF	Other 1 Average	FP	RO
7376	0x1CD0	Other 1 Alarm Counts	FP	RO
7377–7378		Reserved		
7379	0x1CD3	Volume Correction Factor	FP	RO
7380	0x1CD4	Net Volume	FP	RO
7381	0x1CD5	Probe 2 Run Time	FP	RO
7382	0x1CD6	Probe 2 Temperature (°F)	FP	RO
7383	0x1CD7	Probe 2 Counts	FP	RO

Modbus Holding Registers (32-bit)

Register (Decimal)	Register (Hex)	Description	Data Type	Access
7384	0x1CD8	Probe 2 Total Temperature (°F)	FP	RO
7385	0x1CD9	Probe 2 Average Temperature (°F)	FP	RO
7386	0x1CDA	Probe 2 Counts per Hour (CPH)	FP	RO
7387	0x1CDB	Probe 2 Alarm Counts	FP	RO
7388	0x1CDC	BS&W 2 (%)	FP	RO
7389	0x1CDD	BS&W 2 Counts	FP	RO
7390	0x1CDE	BS&W 2 Total (%)	FP	RO
7391	0x1CDF	BS&W 2 Average (%)	FP	RO
7392	0x1CE0	BS&W 2 Alarm Counts	FP	RO
7393	0x1CE1	Pressure 2 (PSI)	FP	RO
7394	0x1CE2	Pressure 2 Counts	FP	RO
7395	0x1CE3	Pressure 2 Total (PSI)	FP	RO
7396	0x1CE4	Pressure 2 Average (PSI)	FP	RO
7397	0x1CE5	Pressure 2 Alarm Counts	FP	RO
7398	0x1CE6	Other 2 Fullscale	FP	RO
7399	0x1CE7	Other 2 Counts	FP	RO
7400	0x1CE8	Other 2 Total	FP	RO
7401	0x1CE9	Other 2 Average	FP	RO
7402	0x1CEA	Other 2 Alarm Counts	FP	RO
7403–7404		Reserved		
7405	0x1CED	Analog Output 1 Output (mA)	FP	RO
7406	0x1CEE	Analog Output 2 Output (mA)	FP	RO

Appendix B—Wiring Recommendations for 2-Conductor Cable

Cameron recommends the use of 4-conductor cable with single-element probes in new TA-1000 Plus installations. However, the TA-1000 Plus can be used with 2-conductor cable with no loss of accuracy if the following procedure is followed to compensate for the added wire resistance.

Note If the existing wiring is 3-conductor cable, use only two of the conductors.

WARNING: Before servicing the TA-1000 Plus, disconnect all power sources/signal sources or verify that the atmosphere is free of hazardous gases. Do not remove the cover while circuits are alive. The TA-1000 Plus poses no hazard when opened in a safe area.

Changing Probe Wire Compensation Settings

To ensure best accuracy with the TA-1000 Plus when 2-conductor wiring is used, the following wiring procedure must be used. This procedure will apply a compensation algorithm to compensate for the wire resistance produced by 2-conductor wiring.

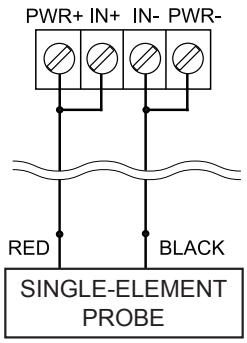

Figure B.1—Wiring diagram for two-conductor TA-1000 Plus cable

To wire a probe to a TA-1000 Plus using long lengths of existing three-conductor wiring, perform the following steps, referencing Figure B.1 as needed:

1. Disconnect existing probe wire from the three-conductor TA-1000 Plus wiring.
2. Jumper the IN– and PWR– terminals of the probe terminal block (TB6 or TB7) together and connect one of the wires to the PWR- terminal of the probe terminal block.
3. Jumper together the IN+ and PWR+ terminals of the probe terminal block (TB6 or TB7) and connect one of the wires to the PWR+ terminal of the probe terminal block.
4. Short the positive and negative TA-1000 Plus wires together at the end of the cable where the probe will be connected.
5. Configure the TA-1000 Plus wire compensation setting as follows:
   a. Press STEP and ENTER simultaneously, then release to enter the configuration menu (Figure B.2, Page B-2).

b. Press ENTER until “Probe Wire Comp” appears. If there are two probes connected to the TA-1000 Plus, there will be a Probe Wire Comp setting for each probe in the menu. Be sure to select the setting that corresponds to the probe terminal block you are wiring.

c. Press INCREMENT to change the setting to RECALCULATE.

d. Press ENTER repeatedly to advance through the remainder of the menu selections until “Saving” appears on the LCD.

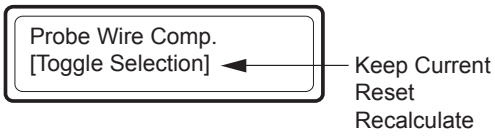

Figure B.2—Probe Wire Compensation menu

6. Connect the probe to the field wiring.

Appendix C—Dual-Element Probe Systems

CAUTION **Before attempting any wiring, ensure that all power is disconnected. Before reapplying power, ensure that all wiring connections are secure and connected properly.**

All field wiring must conform to the National Electric Code, NFPA 70, Article 501-4(b) for installations within the United States or as specified in Section 18-156 of the Canadian Electrical Code for installations within Canada. Local wiring ordinances may also apply. All field wiring must have a wire range of 22 to 14 AWG and insulation rated for 120 VAC or above and copper or copper-clad aluminum conductors. Terminal block screws must be tightened to a minimum torque of 5 to 7 inch-lbs to secure the wiring within the terminal block. Only personnel who are experienced with field wiring should perform these procedures.

The instrument must be grounded with a protective earth grounding conductor in accordance with national and local electrical codes.

Installing a Dual Probe

A dual-element probe is manufactured with an integral three-conductor power cable (see the wire connections labeled brown, red and green in Figure C.1). A section of four-conductor wire is required to connect it to the four-position terminal block of the TA-1000 Plus. Wire in accordance with Figure C.1.

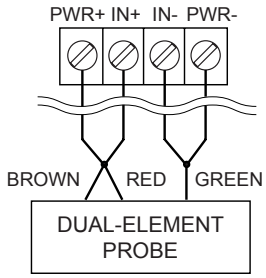

Figure C.1—Wiring diagram for a four-wire dual-element probe

Changing the Device Configuration for Use with a Dual Probe

When the TA-1000 Plus is used with a dual probe, two configuration changes may be necessary:

- The probe type setting must be changed (see Selecting the Probe Type, Page C-2).
- If two-conductor wiring is used to connect the TA-1000 Plus to a remote probe, a wire resistance compensation should also be applied to ensure accurate temperature measurements with the dual probe. See Appendix B—Wiring Recommendations for 2-Conductor Cable, Page B-1 for details and wire as shown in Figure C.2, Page C-1.

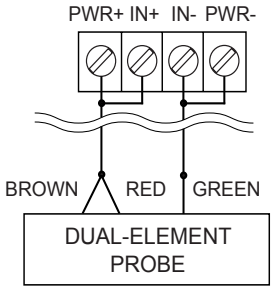

Figure C.2—Wiring diagram for two wire dual-element probe

Selecting the Probe Type

Note By default, the TA-1000 Plus is configured for use with a single-element probe. When a dual-element probe is used, the probe type change is important because of differences in the temperature ranges of single-element and dual-element probes. If the configuration change is not made, the TA-1000 Plus values will be inaccurate.

To configure the TA-1000 Plus probe type for use with a dual-element probe,

1. Press the STEP and ENTER buttons simultaneously, then release to enter the configuration menu (Figure C.3).

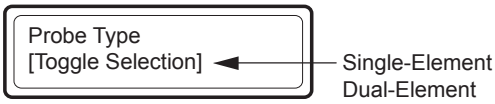

Figure C.3—Probe Type menu

2. Press INCREMENT to toggle the display setting from “Single-Element” to “Dual-Element.”
3. Press ENTER repeatedly to accept the other settings in the menu and advance to the end of the sequence until “Saving” appears on the screen.

Appendix D—Installing the Weatherproof Custody Transfer Lockout Kit

An optional custody transfer lockout kit can be ordered for the weatherproof TA-1000 Plus (see Section 6—Spare Parts, Page 59 for part number). To install the kit, perform the following steps:

1. Remove the existing latches as follows:
   a. Unlatch the latches.
   b. Insert a flat-edged screwdriver into the crevice between the latch and the enclosure, press down gently to unseat the bottom latch.
   c. Pull the latch straight down to remove it from the enclosure.
   d. From the inside of the enclosure door, insert a screwdriver into the round recessed area in each corner of the door and push gently to release the latch caps from the door panel. A hole will remain in each of the previously latched corners of the door.
2. Close the enclosure lid.
3. Remove the custody transfer lockout hex screws from the packaging.
4. Insert the lockout hex screws into the holes in the top and bottom corners of the door panel and turn them clockwise to tighten (Figure D.1).

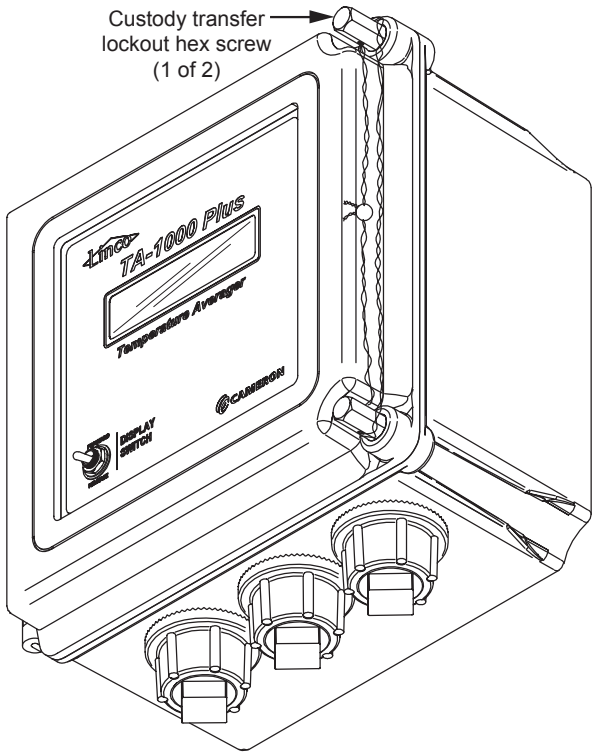

Figure D.1—Weatherproof enclosure with custody transfer lockout kit and lead seal installed

5. Thread wire through the holes in the lockout hex screws, as shown in Figure D.1.
6. Twist wire until taut and seal.

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Appendix E—Legacy TA-1000 Board Replacement

In addition to the CSA-certified compact TA-1000 Plus, Cameron offers a retrofit kit for extending the life of existing TA-1000 devices. The retrofit kit includes new circuitry and cables and can be installed in the field for minimal disruption to operations.

Installing a Weatherproof Retrofit Kit

To install the retrofit kit in a legacy weatherproof enclosure,

1. Disconnect all power to the device.
2. Release the door latches and open the enclosure (Figure E.1).

Figure E.1—TA-1000 weatherproof package

3. Disconnect the 16-conductor ribbon cable from the circuit board.
4. Disconnect the display switch from the door panel. Remove the nut and washers from the switch control on the outside of the door, and then reach inside the door to pull the switch through the hole.
5. Disconnect the reset switch from the metal bracket inside the enclosure using the same process as described in step 4.
6. Remove the four screws from the display board on the inside door panel and discard the display board. Retain the screws for later use.
7. Remove the four screws securing the circuit board to the enclosure and discard the circuit board.
8. Remove the circuit board and aluminum mounting plate assembly from the retrofit kit packaging and install it in the enclosure using the screws removed in Step 7 (Figure E.2, Page E-2).

Figure E.2—TA-1000 weatherproof enclosure with retrofit circuit board installed

9. Insert the new display switch (Figure E.3) into the hole in the door where the original switch was installed.
   a. Place the rubber gasket over the switch knob and from the inside of the door, and place the knob end through the hole in the door.
   b. While holding the switch in place from the inside, secure the switch from the outer side of the door with a large flat washer, a toothed lock washer and a nut.
   c. Position the switch so that switch movement is vertical from center to forward and center to reverse, then tighten the nut on the outside of the enclosure door.

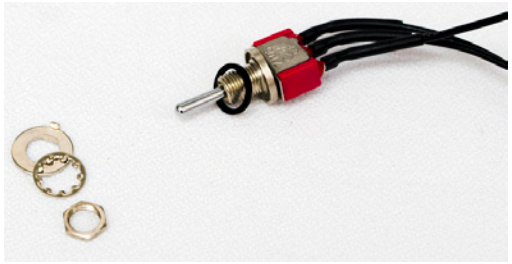

Figure E.3—Display switch components

10. Wire the display switch to TB1 (display switch) as follows, referencing Figure E.4, Page E-3 as needed:
   a. Wire the center conductor to the COM position on TB1.
   b. Wire the bottom conductor to the FWD position on TB1.
   c. Wire the top conductor to the REV position of TB1.
   d. Plug TB1 into the circuit board.

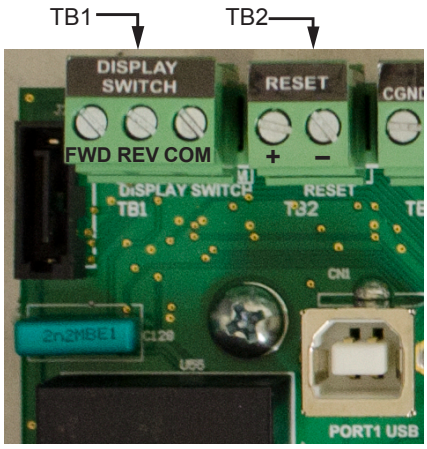

Figure E.4—Terminal blocks 1 and 2 indicating wiring positions

11. Install the new reset switch into the metal bracket mounted inside the door using the instructions from Step 8 to position the rubber gasket, washers and nut (Figure E.5).

Figure E.5—Installation of retrofit reset switch

12. Wire the reset switch to TB2 (reset switch) as follows, referencing Figure E.4 as needed:
    a. Wire the center conductor to the – position on TB2.
    b. Wire the two remaining conductors to the + position on TB2.
    c. Plug TB2 into the circuit board.
13. Connect the SATA cable for the new display to the J2 connector on the circuit board (Figure E.6, Page E-4).

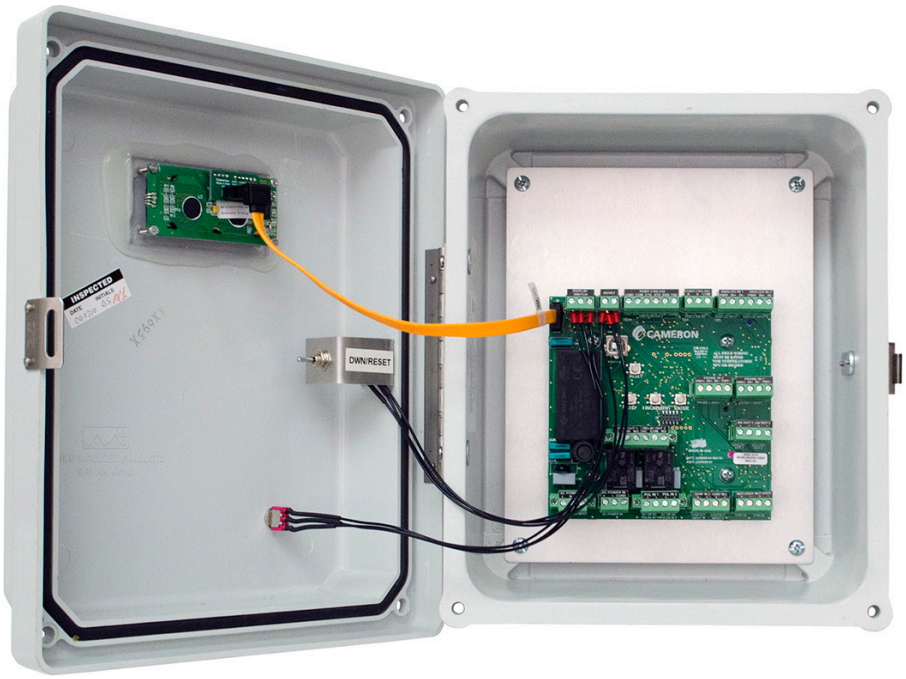

Figure E.6—TA-1000 weatherproof enclosure showing completed retrofit

14. Close the door and fasten the latches.
15. Restore power to the device.

Installing an Explosion-proof Retrofit Kit

To install the retrofit kit in a legacy explosion-proof enclosure,

1. Disconnect all power to the device.
2. Unscrew the enclosure lid and remove it.

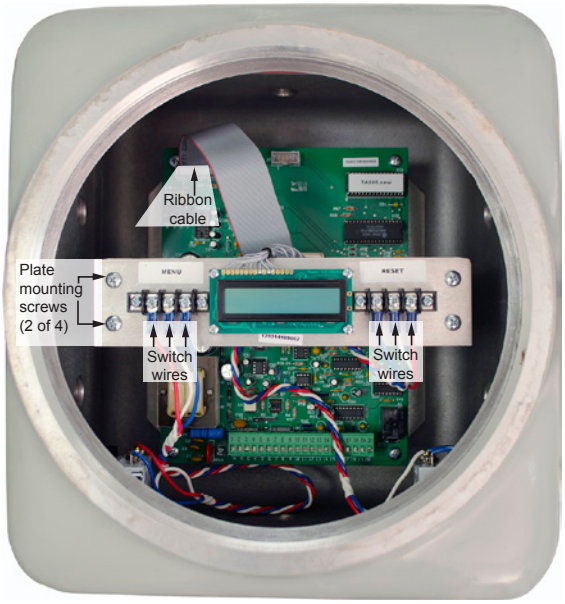

Figure E.7—TA-1000 explosion-proof package with lid removed

3. Unplug the thick gray ribbon cable (Figure E.7, Page E-4) from the circuit board.
4. Disconnect the switch wires (Figure E.7, Page E-4) from the terminal strips mounted to the metal plate across the top of the enclosure and move the wires to the side.
5. Unscrew the four screws holding the metal plate in place (Figure E.7, Page E-4) and lift out the existing display and the metal plate. Discard the metal plate and display and retain the screws for later use.
6. Unscrew the four mounting screws securing the circuit board to the bottom of the enclosure (Figure E.8). Remove and discard the circuit board. Retain the screws for later use.
7. Tighten the standoffs in the bottom of the enclosure (Figure E.9).

Figure E.8—Mounting screw locations

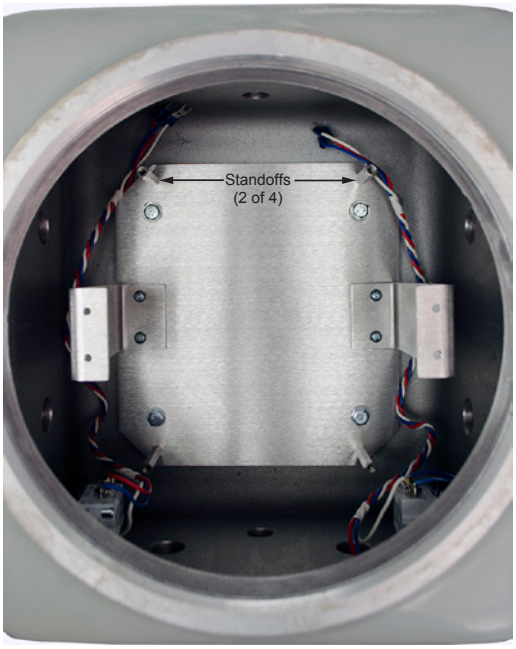

Figure E.9—Standoff locations

8. Insert the new circuit board assembly into the enclosure and secure using the four screws removed in Step 6, as shown in Figure E.10.

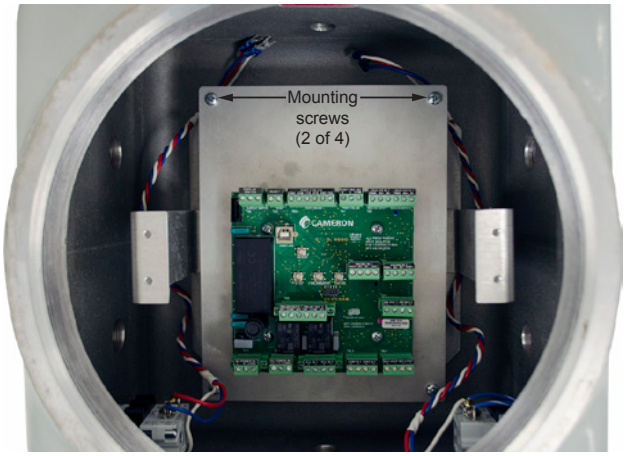

Figure E.10—New circuit board showing mounting screws

9. Remove the two-prong connectors from the ends of the display switch and reset switch wires (Figure E.11), then strip away the outer layer to expose the stranded wire.

Figure E.11—Switch wires showing two-prong connectors

10. Connect the reset switch wires to TB2 on the circuit board (Figure E.12) as follows:
    a. ***White:*** COM (–)
    b. ***Blue and Red (Combined):*** RESET (+)

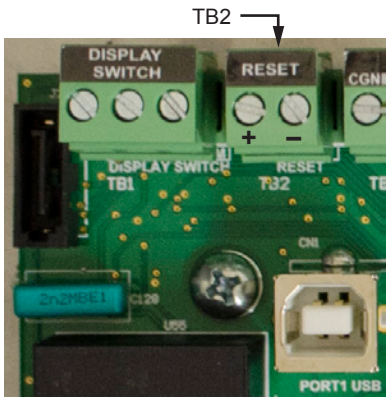

Figure E.12—Location of TB2 (reset switch) showing wiring labels

Note The blue and red wires for the reset switch share a single terminal location (+) on the new circuit board, which allows the user to reset the device by turning the reset switch/key forward or backward.

11. Connect the display switch wires stipped in Step 9 to TB1 on the circuit board (Figure E.13) as follows:
    a. ***White:*** COM
    b. ***Blue:*** REV
    c. ***Red:*** FWD

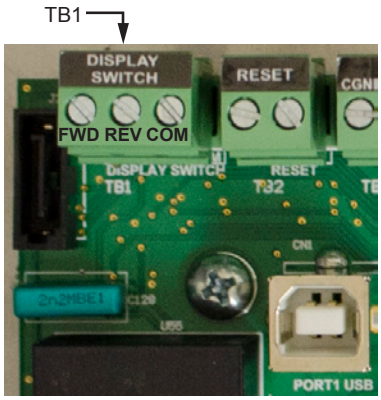

Figure E.13—Location of TB1 (display switch) showing wiring labels

12. Connect the orange SATA cable to the J2 connector on the circuit board (Figure E.14).

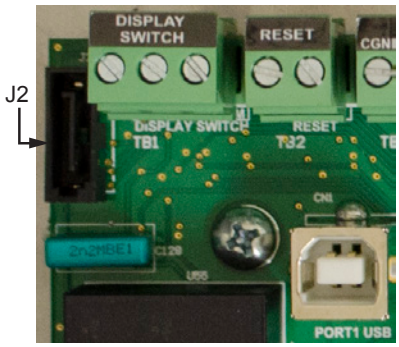

Figure E.14—Closeup of J2 connector

13. Place the new display assembly on the existing standoffs/supports and fasten in place using the screws removed in Step 6 (Figure E.15, Page E-8).

Figure E.15—New display and mounting bracket showing SATA cable location for reference

14. Replace the enclosure lid and tighten securely.
15. Restore power to the device.

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