Coriolis
Mass Flow Meters

Coriolis Flow Meters

RCT1000 with RCS018…300 Sensors for Hazardous Locations

Badger Meter

CRL-QS-01552-EN-05 April 2019

Quick Start Guide

CONTENTS

PURPOSE OF THIS DOCUMENT

The purpose of this document is to provide you with an overview of the installation, wiring and basic configuration of the Coriolis RCT1000 flow meter. For detailed information, see the "Coriolis Flow Meters User Manual" and the "Coriolis RCTX Control Drawing", both of which can be found on the USB memory stick included with the meter or downloaded from *www.badgermeter.com*.

SAFETY

Safety Symbol Explanations

⚠DANGER Indicates a hazardous situation, which, if not avoided, *will* result in death or serious personal injury.

⚠WARNING Indicates a hazardous situation, which, if not avoided, *could* result in death or serious personal injury.

⚠CAUTION Indicates a hazardous situation, which, if not avoided, *could* result in minor or moderate personal injury or damage to property.

Electrical Symbol Explanations

Electrical Symbols					
Function	**Direct Current**	**Alternating Current**	**Earth (Ground)**	**Protective Ground**	**Chassis Ground**
Symbol					

RCT1000 transmitters employ modular construction and provide electrical safety for the operator.

Safety Precautions

⚠DANGER

THE POWER SUPPLY BOARD CAN HAVE LINE VOLTAGES APPLIED TO IT. DISCONNECT ELECTRICAL POWER BEFORE OPENING THE INSTRUMENT ENCLOSURE. USE WIRING PRACTICES THAT CONFORM TO LOCAL AND NATIONAL CODES WITHIN THE REGION WHERE THE PRODUCT IS INSTALLED. [FOR EXAMPLE: THE NATIONAL ELECTRICAL CODE® HANDBOOK IN THE U.S.; CANADIAN ELECTRIC (CE) CODE IN CANADA].

⚠CAUTION

IF THE EQUIPMENT IS USED IN A MANNER NOT SPECIFIED BY THE MANUFACTURER, THE PROTECTION PROVIDED BY THE EQUIPMENT MAY BE IMPAIRED.

⚠WARNING

DANGER OF BREAKAGE DUE TO CORROSIVE OR ABRASIVE FLUIDS.

- ***VERIFY THE COMPATIBILITY OF THE PROCESS FLUID WITH THE SENSOR MATERIAL.***
- ***ENSURE THE RESISTANCE OF ALL FLUID-WETTED MATERIALS IN THE PROCESS.***
- ***KEEP WITHIN THE SPECIFIED PRESSURE AND TEMPERATURE RANGE.***

PRODUCT LABEL

Hazardous Location

Integral Sensor and Transmitter

Sensors with integral mount transmitters have a single tag on the sensor. The specific certifications listed on the tag depend on the sensor part number.

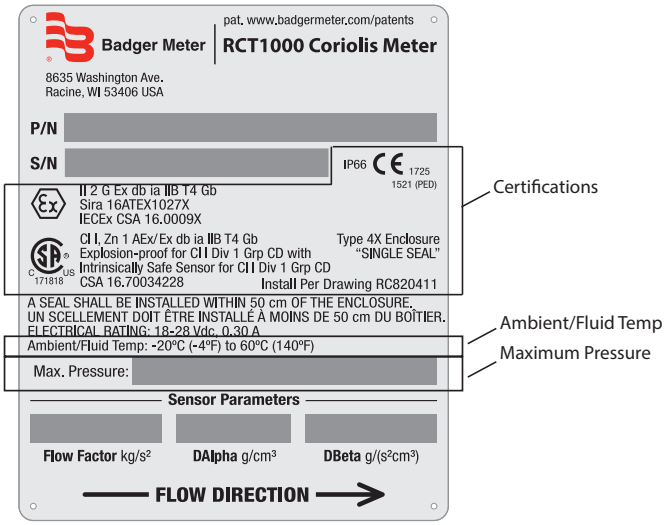


Figure 1: Hazardous location sensor tag examples

Remote Transmitter

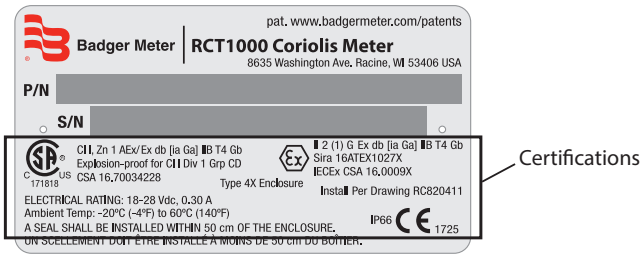


Figure 2: Remote transmitter tag example

Remote Sensor

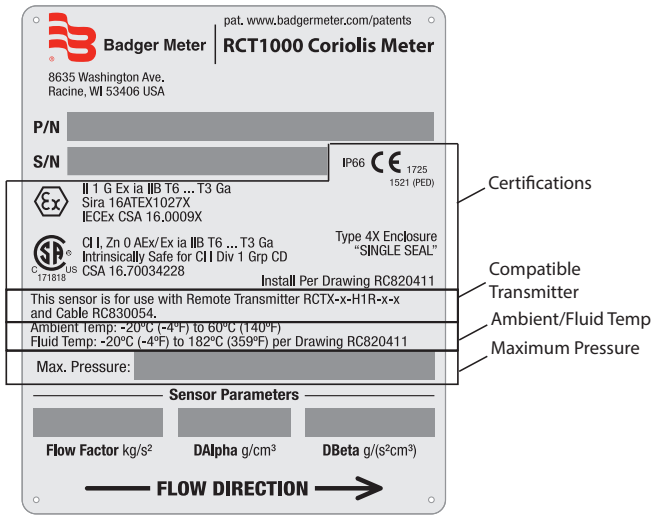


Figure 3: Remote sensor tag example

DIMENSIONS

RCS018…RCS300 Sensor Dimensions

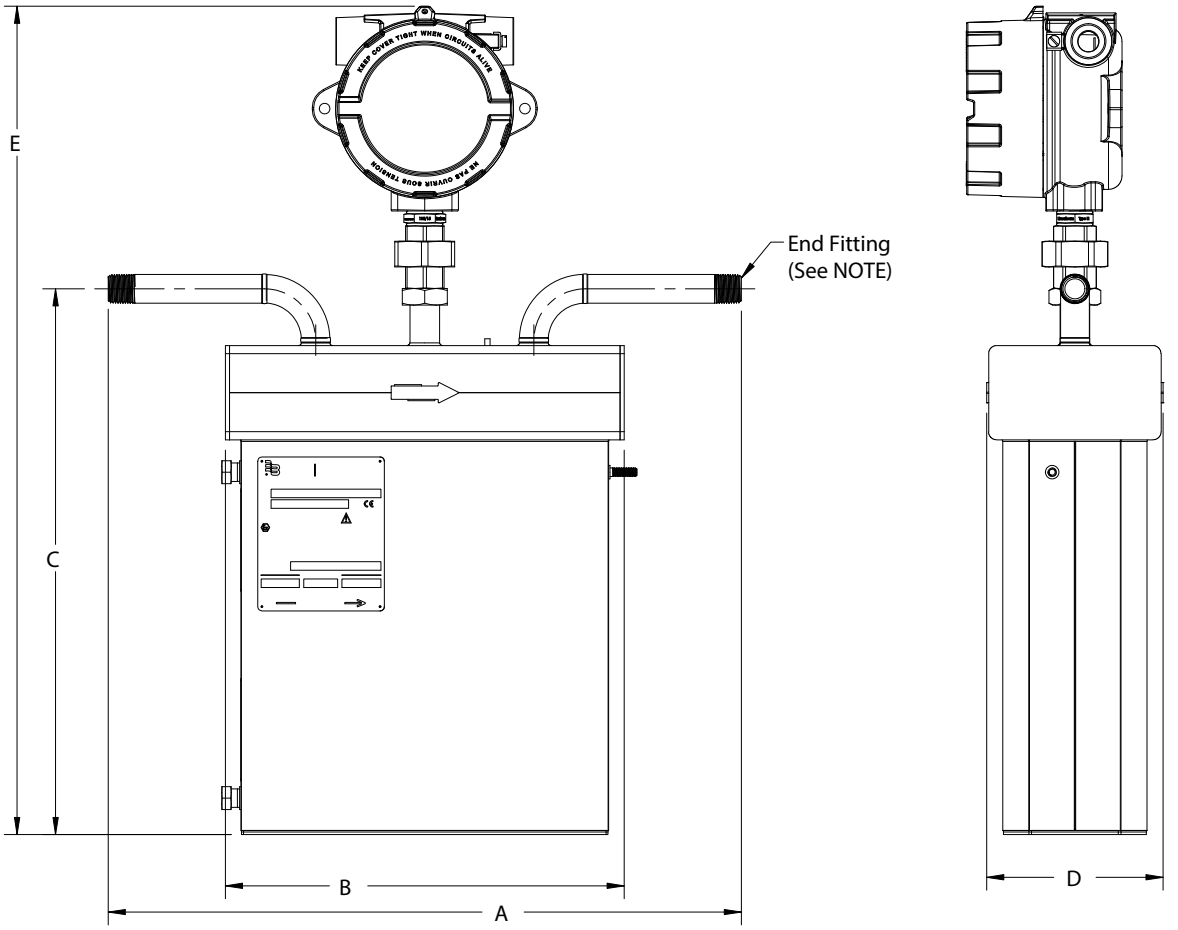


Figure 4: Large sensor dimensions

Sensor	Nominal Size	A[1]	B	C	D	E (Standard) [4]	E (Remote)
RCS018	1/2 in.	13.6 in. (346 mm) [1]	7.1 in. (180 mm) [1]	8.5 in. (217 mm) [2]	4.4 in. (113 mm) [2]	19.3 in. (489 mm)	18.3 in. (464 mm)
RCS025	1/2 in.	16.0 in. (406 mm) [1]	9.0 in. (228 mm) [1]	9.9 in. (253 mm) [2]	4.4 in. (113 mm) [2]	20.7 in. (525 mm)	19.7 in. (500 mm)
RCS050	1/2 in.	18.5 in. (470 mm) [1]	11.6 in. (296 mm) [1]	15.9 in. (405 mm) [2]	5.1 in. (131 mm) [2]	24.2 in. (615 mm)	23.2 in. (590 mm)
RCS100	1 in.	23.2 in. (590 mm) [1]	16.8 in. (426 mm) [1]	27.6 in. (700 mm) [2]	6.4 in. (163 mm) [2]	34.3 in. (870 mm)	33.3 in. (845 mm)
RCS200	2 in.	26.4 in. (670 mm) [2]	18.5 in. (472 mm) [2]	28.6 in. (726 mm) [3]	7.9 in. (203 mm) [3]	33.4 in. (848 mm)	32.4 in. (823 mm)
RCS300	3 in.	40.9 in. (1040 mm) [2]	28.7 in. (728 mm) [2]	40.4 in. (1028 mm) [3]	9.5 in. (243 mm) [3]	45.3 in. (1150 mm)	44.3 in. (1125 mm)

[1] ± 0.12 in (3 mm)
[2] ± 0.15 in (4 mm)
[3] ± 0.24 in (6 mm)
[4] ± 0.39 in (10 mm)

NOTE: End fittings can be NPT (shown), Class 150 or Class 300 ANSI flanges, or other; dimensions A and C do not change.

RCTX Remote Mount Electronics Enclosure Dimensions

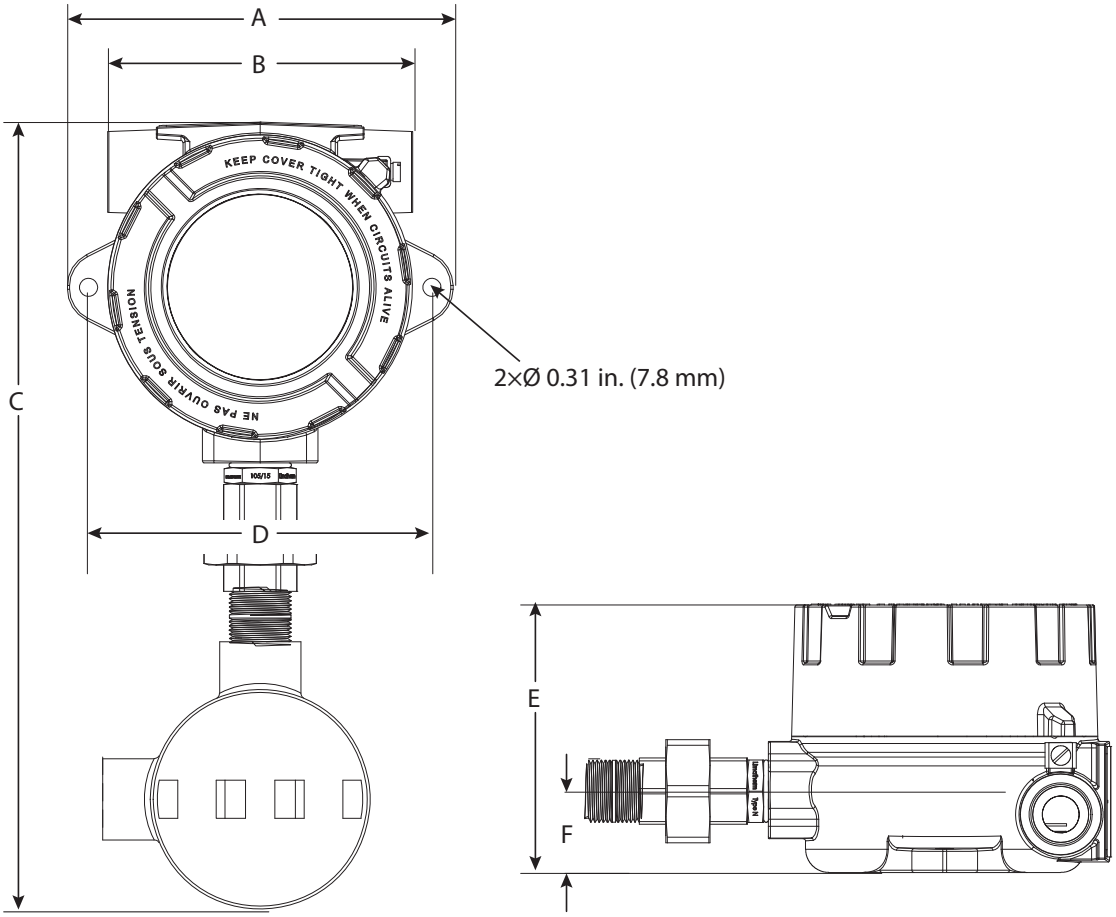


Figure 5: RCTX remote mount dimensions

A	B	C	D	E	F
6.57 in. (167 mm)	5.20 in. (132 mm)	13.43 in. (341 mm)	5.85 in. (148.7 mm)	4.57 in. ± 0.12 in. (116 mm ± 3 mm)	1.37 in. (35 mm)

RCTX Remote Mount Conduit Outlet Box Dimensions

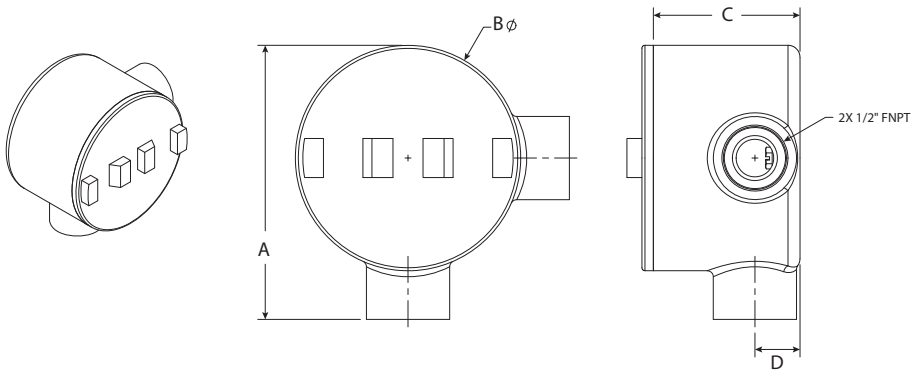


Figure 6: Conduit outlet box for remote mount

A	B	C	D
4.5 in. (116 mm)	3.75 in. (95 mm)	2.4 in. (62 mm)	0.75 in. (19 mm)

INSTALLATION OVERVIEW

In general, the following steps are required to install and put the meter into service.

1. Unpack meter components and transport to the installation location.
2. Install the transmitter and sensor.
3. Connect the signal cable between the transmitter and the sensor, if required.
4. Install any required I/O wiring.
5. Wire power to the transmitter.
6. Power up the transmitter.
7. Perform initial zeroing of the meter.
8. Perform firmware setup starting at the *Home* screen.
9. Put the meter into service.

PRODUCT UNPACKING AND INSPECTION

Upon receipt of the product, perform the following unpacking and inspection procedures.

NOTE: If damage to the shipping container is evident upon receipt, request the carrier to be present when the product is unpacked.

Carefully open the shipping package and follow any instructions that may be marked on the exterior. Remove all cushioning material surrounding the product and carefully lift the product from the package.

Retain the package and all packing material for possible use in reshipment or storage.

Visually inspect the product and applicable accessories for any physical damage such as scratches, loose or broken parts or any other sign of damage that may have occurred during shipment.

NOTE: If damage is found, request an inspection by the carrier's agent within 48 hours of delivery and file a claim with the carrier. A claim for equipment damage in transit is the sole responsibility of the purchaser.

TRANSPORTING THE METER

The following instructions apply to transporting the meter to its final installation point:

- Transport the devices in the shipping containers in which they came.
- Do not remove covers or caps fitted to the process connections until immediately before installation. The covers prevent mechanical damage to the sealing faces and the ingress of foreign matter into the measuring tube during transportation and storage.
- Do not lift assembled metering systems by the transmitter housing. Use webbing slings attached around the two process connections. Do not use chains, as they could damage the housing.

⚠WARNING

THERE IS A RISK OF INJURY IF THE MEASURING DEVICE SLIPS. THE CENTER OF GRAVITY OF THE ASSEMBLED MEASURING DEVICE MIGHT BE HIGHER THAN THE POINTS AROUND WHICH THE SLINGS ARE ATTACHED. AT ALL TIMES, THEREFORE, MAKE SURE THE DEVICE DOES NOT UNEXPECTEDLY TURN AROUND ITS AXIS OR SLIP.

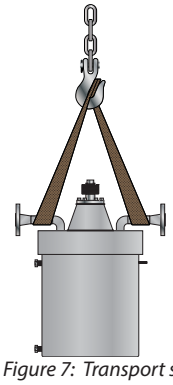


Figure 7: Transport sling

SENSOR INSTALLATION

Before installation, configuration or operation, familiarize yourself with the equipment and operating requirements by reading all sections of this manual. Make sure the site has been thoroughly prepared and is suitable for installation.

Preinstallation Considerations

IMPORTANT

Remove all process connection caps and make sure process connections are open.

- Support and align piping connections to prevent side loading of the mating surfaces.
- RCS018 and larger sensors are designed to be supported by the process flange connection. No additional supports are needed for meter housing.
- To reduce the influence of pipe vibration on RCS018 and larger meters, use Stauff style clamps to help with supporting process piping.
- Mount full port ball valves (isolation valves) on either side of the meter for zero calibration purposes.
- Mount control valves downstream of the flow meter to prevent possible cavitation, especially when measuring liquids with low boiling points (see *Figure 8)*.
- Install the sensor in a section of the piping where it always remains full, unless the application is designed to drain with no flow.
- Vertical piping installations should have the flow going up through the sensor. See *Figure 13 on page 12*.

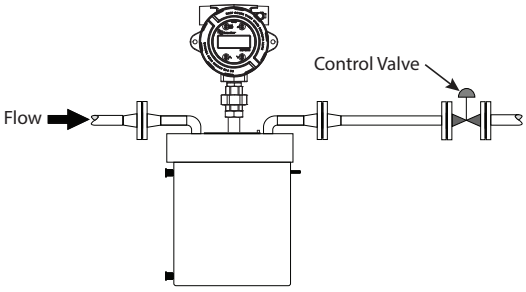


Figure 8: Control valve location

- When using hose connections, use a short section of rigid pipe on each side of the sensor for proper support. The sensor should not hang from hose connections. See *Figure 16 on page 13* and *Figure 14 on page 12)*.
- Use caution with fluids that harden or solidify at rest. Do not pass fluids that react together through the same flow sensor. Do not cover transmitter with insulation material.
- If heat tracing is used, be aware of the maximum temperature limits of the meter.
- Use of armored hoses as sensor vibration isolators may be required when a high amount of ambient vibration is present (see *Figure 14 on page 12* and *Figure 15 on page 12)*.
- Verify that particulate matter is small enough to pass through the flow sensor. Add a filter to the system, if necessary.
- Verify that the flow sensor is earthed/grounded at the earth connector located on the sensor side. An AWG #10 or larger protective ground must be connected to the side grounding terminal for the system to work correctly (see *Figure 12 on page 11*, *Figure 13 on page 12* and *Figure 16 on page 13)*.
- Avoid high sources of EMF that can be produced by large transformers, large motors and VFDs without chokes.

⚠WARNING

THE SENSOR IS PURGED WITH DRY NITROGEN AT THE FACTORY. THE TWO PURGE PLUGS SHOULD NOT BE REMOVED. IF THEY ARE REMOVED FOR ANY REASON, RETURN THE UNIT TO THE FACTORY TO BE RE-PURGED AND SEALED. CONSULT FACTORY FOR SUPPORT.

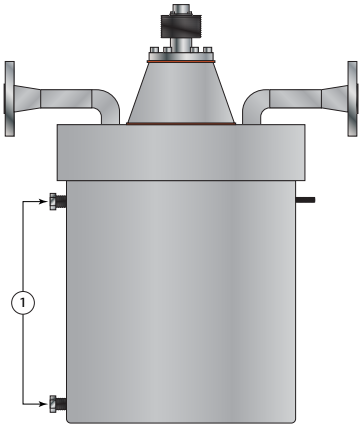


Figure 9: Purge ports

1	Port	Nitrogen purge

Sensor Mounting Positions and Locations

- Always mount the sensor downstream of the flow.
- Use vibration-reducing pipe supports approximately 3 and 6 pipe diameters from the end of the sensor in all applications.
- Install the sensor in a section of the piping where it always remains full, unless the application is designed to drain with no flow. See *Figure 16 on page 13*.

Vertical Mounting with Tubes to the Side, Flow Going Down

The mounting orientation shown in *Figure 11* is recommended for installation in an open vertical pipeline. If you MUST use this configuration, make sure to use an isolation valve or other pipe restriction to prevent the sensor from running empty while measurement is being taken.

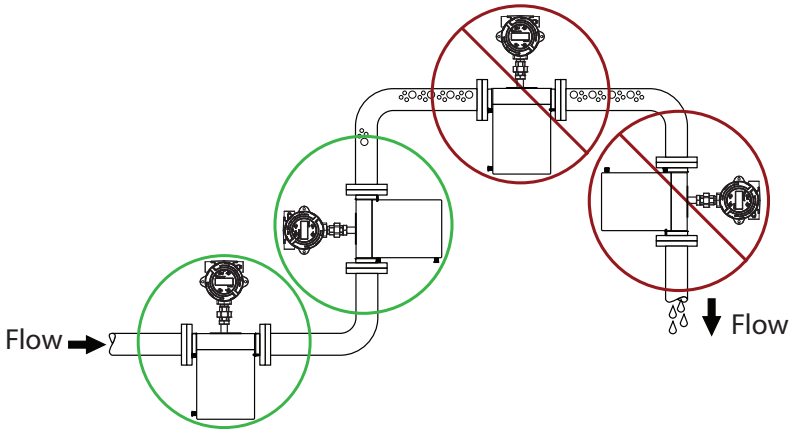
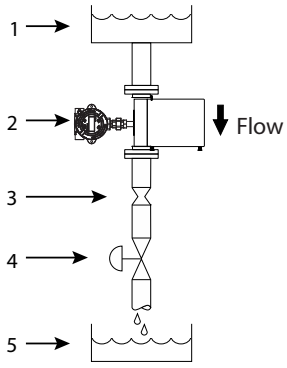


Figure 10: Mounting positions and locations



1	Supply Tank
2	Sensor
3	Pipe Restriction
4	Valve
5	Batching Tank

Figure 11: Tubes to the side with flow going down)

Horizontal Mounting with Tubes Down

The mounting orientation shown in *Figure 12* is recommended for liquid applications.

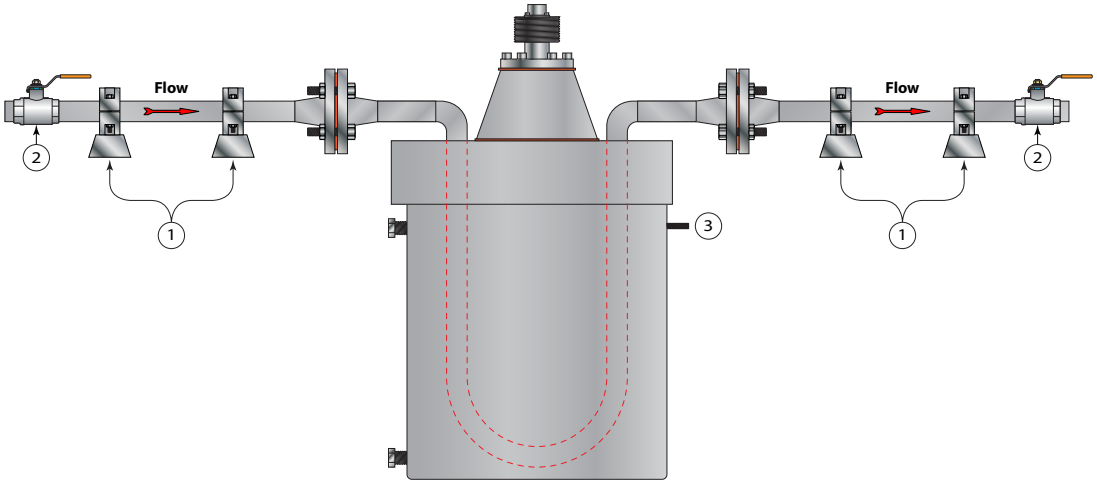


Figure 12: Tubes down (liquids)

1	Supports—**Customer supplied**	Rigid pipe supports approximately 3 and 6 pipe diameters from the end of the sensor
2	Isolation Valves—**Customer supplied**	Full port ball
3	Ground	Protective (earth), 10 AWG (4 mm^2) minimum

Horizontal Mounting with Tubes Up

The mounting orientation shown in *Figure 13* is recommended for gas or slurry applications where condensate may be present.

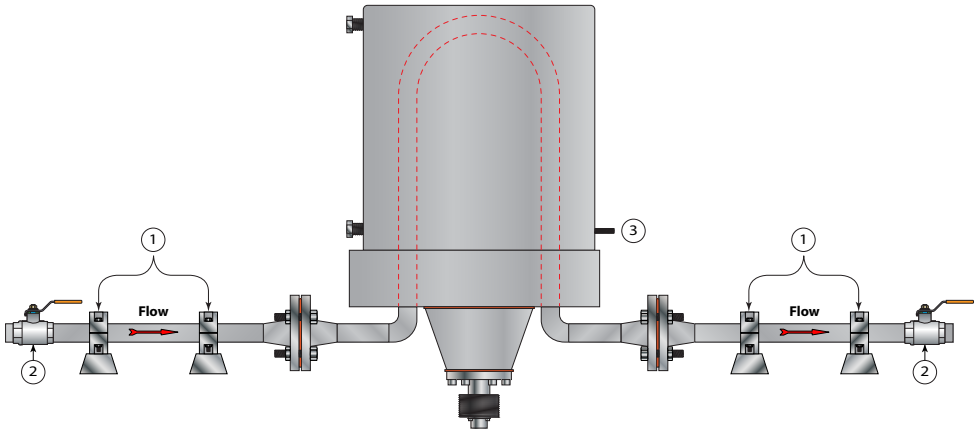


Figure 13: Tubes up (gases and slurries)

1	Supports—**Customer supplied**	Rigid pipe supports approximately 3 and 6 pipe diameters from the end of the sensor
2	Isolation Valves—**Customer supplied**	Full port ball
3	Ground	Protective (earth), 10 AWG (4 mm²) minimum

Horizontal Position with Flexible Armored Hoses

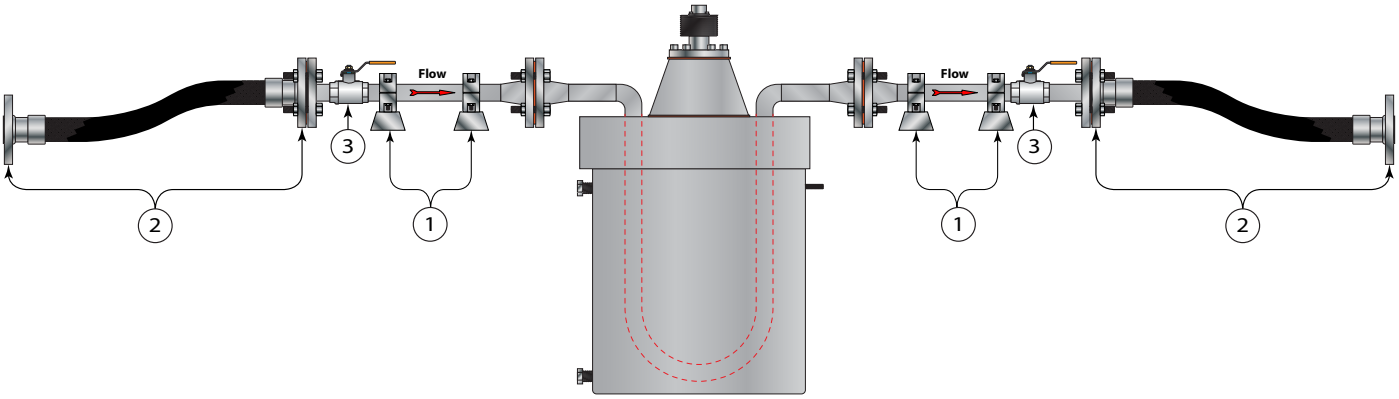


Figure 14: Flexible armored hoses

1	Supports—**Customer supplied**	Rigid pipe supports approximately 3 and 6 pipe diameters from the end of the sensor
2	Hose—**Customer supplied**	Flexible armored
3	Isolation Valves—**Customer supplied**	Full port ball

Horizontal Position with Flexible Armored Hose Loops

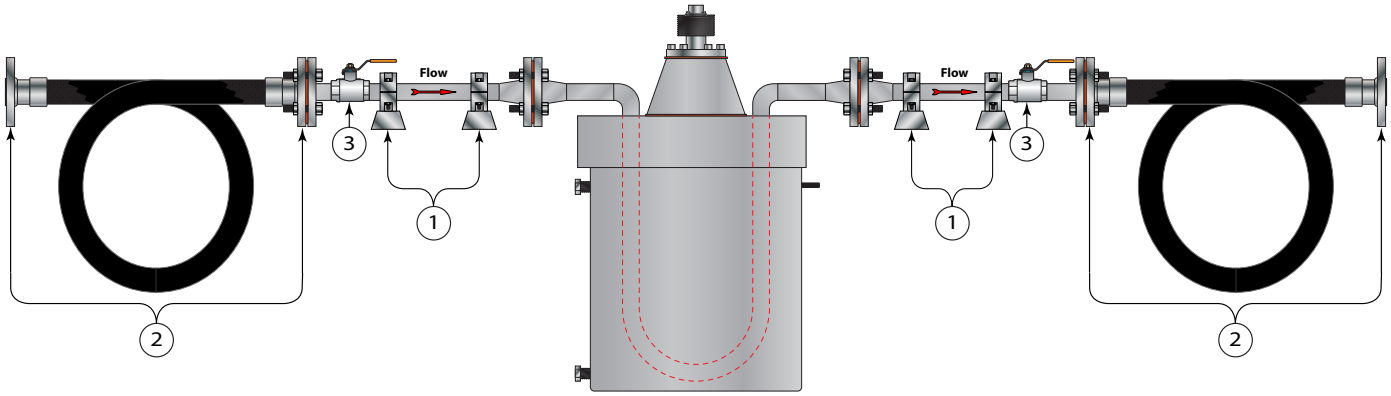


Figure 15: Flexible armored hose loops

1	Supports—**Customer supplied**	Rigid pipe supports approximately 3 and 6 pipe diameters from the end of the sensor
2	Hose—**Customer supplied**	Flexible armored
3	Isolation Valves—**Customer supplied**	Full port ball

Vertical Mounting with Tubes to the Side, Flow Going Up

The mounting orientation shown in *Figure 16* is recommended for self-draining configurations.

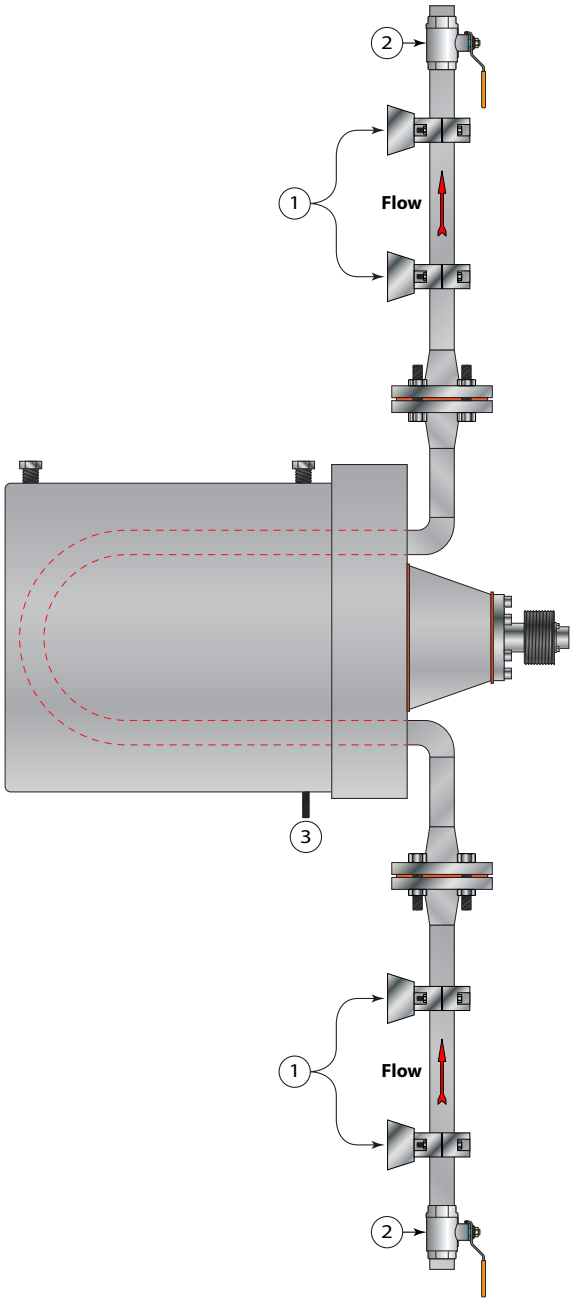


Figure 16: Tubes to the side with flow going up (self-draining)

1	Supports—**Customer supplied**	Rigid pipe supports approximately 3 and 6 pipe diameters from the end of the sensor
2	Isolation Valves—**Customer supplied**	Full port ball
3	Ground	Protective (earth), 10 AWG (4 mm^2) minimum

TRANSMITTER INSTALLATION

For wiring details, see the "Coriolis Flow Meters RCTX Control Drawing" included with this product or download it from *www.badgermeter.com*.

RCTX Transmitters

The RCTX transmitter is either integrated into the sensor or mounted remotely from the sensor. Install the transmitter in an area convenient for observing the LCD readout (RCTX with Display ONLY), programming and servicing.

- Transmitter/Sensor for hazardous locations
- Mount where little vibration exists
- Mount where protected from corrosive fluids
- Transmitter's ambient temperature limits – 4…140° F (–20…60° C)
- Keep out of direct sunlight. Direct sunlight may increase transmitter temperature above maximum temperature
- Allow enough room for maintenance and conduit entrances

RCTX with Display ONLY

OBSERVE PRECAUTIONS FOR HANDLING ELECTROSTATIC-SENSITIVE DEVICES.

The display is designed to be oriented in any 90-degree position based on the orientation of the transmitter/sensor.

To rotate the orientation of the display board:

1. Turn off power to the unit.
2. Turn the cover counterclockwise to unscrew it.
3. Use a Phillips screwdriver to remove the 4 screws holding the display board (hold display board as the last screw is removed so the board does not drop down when mounted vertically).
4. Re-position the display board and secure with the four screws.
5. Install the cover.

NOTE: Use 3/4 inch 14NPT fittings/plugs to maintain the explosion-proof integrity of the enclosure.

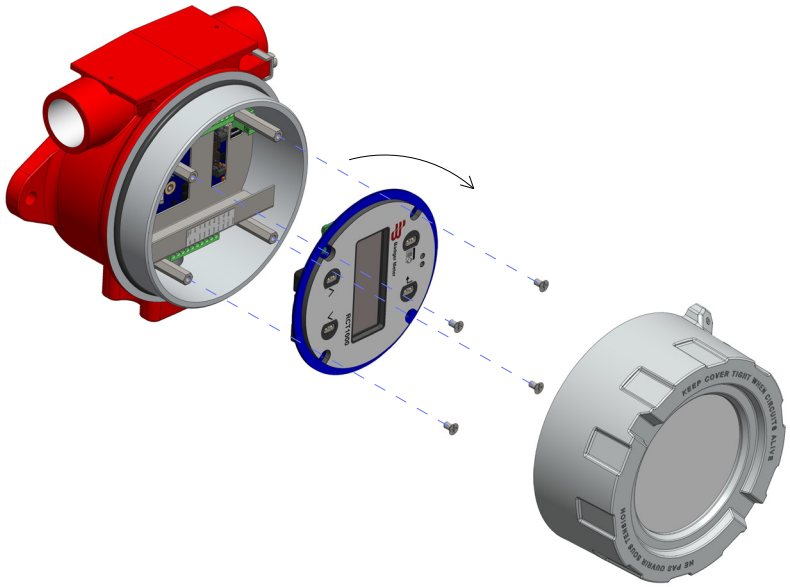


Figure 17: Display board rotated 90°

RCTX Transmitters with Integral Mount

To rotate the orientation of the transmitter relative to the sensor:

1. Loosen the 1-3/4 in. union hex nut. Be careful to not loosen the feedthrough to the enclosure.
2. Turn the transmitter. Do not turn beyond 180 degrees.
3. When the orientation is correct, tighten the nut to wrench tight.

To route the power cables:

Route the power and I/O cables into the transmitter via the explosion-proof conduit holes located on each side of transmitter housing.

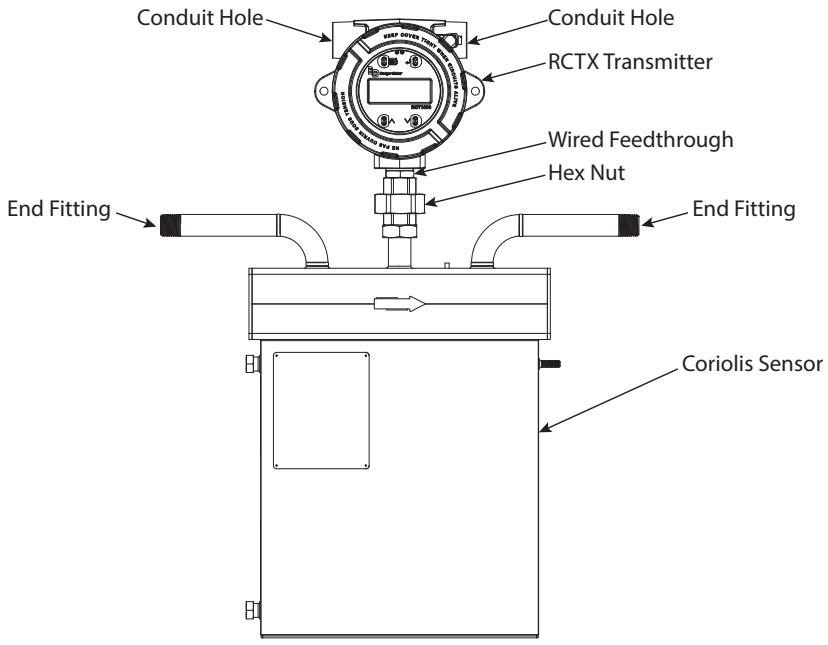


Figure 18: Sensor with integrated RCTX transmitter

RCTX Transmitters with Remote Mount

Route the power and I/O cables into the transmitter via the explosion-proof conduit holes located on each side of transmitter housing.

NOTE: Use 3/4 inch 14NPT fittings/plugs to maintain the explosion-proof integrity of the enclosure.

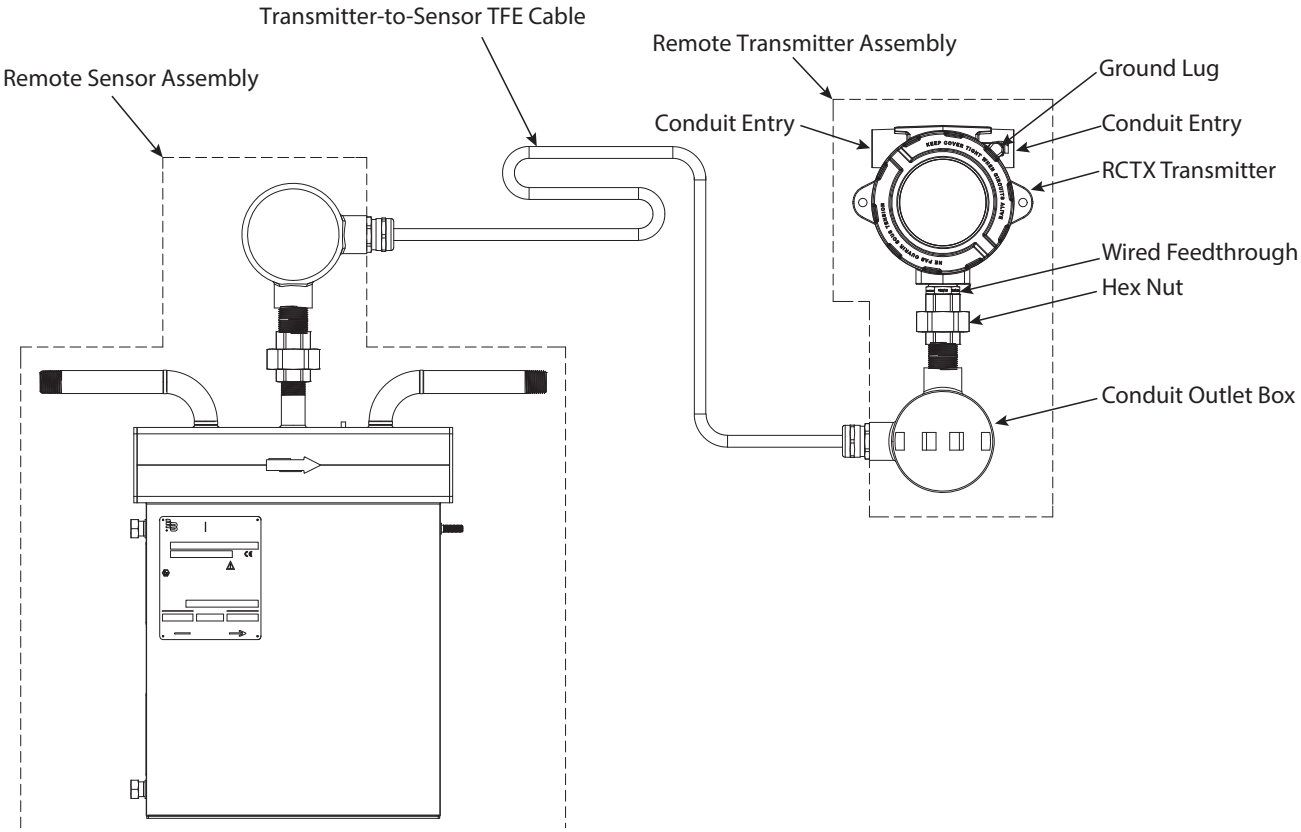


Figure 19: Sensor with remote RCTX transmitter

Locking the Transmitter Cover

To prevent the cover from loosening due to vibration, tighten the setscrew into the enclosure. See *Figure 20*.

To lock the cover on the transmitter housing, remove the setscrew and thread a customer-supplied chain or cable through the setscrew hole and the hole on the nearest tab. See *Figure 20*.

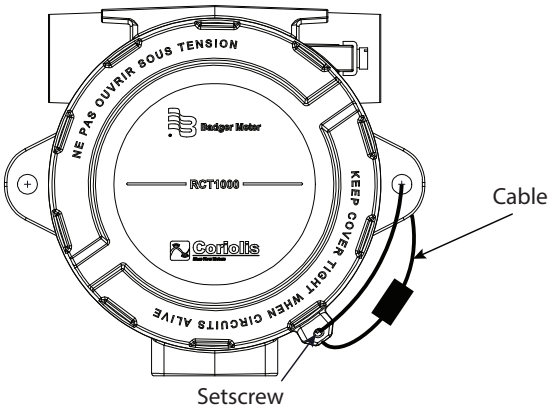


Figure 20: Securing the enclosure cover

GROUND/EARTH CONNECTION

Earthing Using Rigid Pipe

⚠WARNING

FOR RCTX TRANSMITTERS, USE A POSITIVE GROUNDING RIGID PIPE CONNECTOR. THIS CONNECTOR ACTS AS A PROTECTIVE GROUND AND MUST BE CONNECTED TO AN APPROPRIATE GROUNDING LOCATION.

EU Earthing Without Rigid Pipe

General
All wiring practices should comply to the NEC Article 500 or Canadian Electrical Code (CEC) Part I and Part II or IEC 60079–14 as required by local and/or national codes.

Connecting or disconnecting devices:

- Make sure the supply voltage is switched off and the transmitter is in a non-hazardous area.
- Use connecting cables rated for a continuous service temperature of –10…95° C (Tamb max +20° C).
- Use only certified (conforming to IEC 60079–14 Electrical Installations in Hazardous Areas) cable glands and conduit hole plugs.
- Seal unused entry holes with approved sealing plugs that correspond to the type of protection NEMA 4 or IP-66 as required for the installation area. The sealing plugs included with the transmitter meet this requirement and are compliant to both standards.

Potential equalization (earth bonding)
As a condition of safe use, both an internal and external earth bond are required.

- Internal earth bond is made at the protective earth terminal on terminal block TB101 (for RCTX). Earth bond conductors must be the same gauge or larger than the power supply conductors.
- The external bond is satisfied by connecting the enclosure chassis through hard conduit or a ground lug.

OPENING THE COVER AND REMOVING THE DISPLAY BOARD

OBSERVE PRECAUTIONS FOR HANDLING ELECTROSTATIC-SENSITIVE DEVICES.

1. Turn off power to the unit.
2. Grasp the enclosure cover and turn it counter-clockwise until it separates from the enclosure body. Set the cover aside.
3. Use a Phillips screwdriver to remove the 4 screws holding the display board to the standoffs (hold display board as the last screw is removed so the board does not drop down when mounted vertically). See *Figure 21*.
4. Gently turn over the display board.
5. Open the tabs on the header assembly to release the cable ribbon connector. See *Figure 22*.
6. Remove the display board.

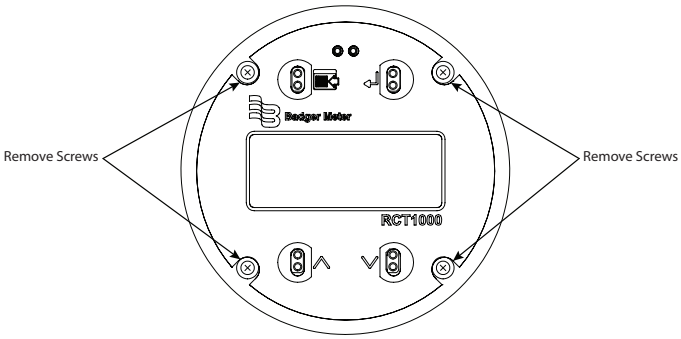


Figure 21: Phillips head screws

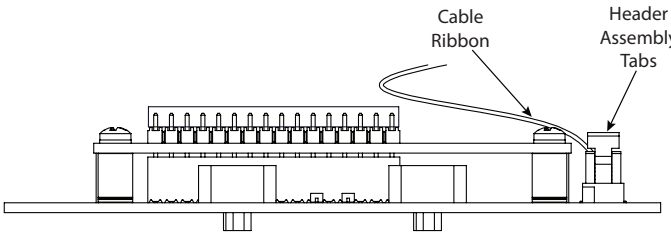


Figure 22: Release cable ribbon

DC POWER CONNECTIONS

NOTE: Use a small bladed screwdriver to secure wires to the connectors.

The RCTX operates from a 18…28V DC Class 2 source, as long as the source is capable of supplying a minimum of 7W.

1. Connect an 18…28V DC Class 2 power source as illustrated in the schematic in *Figure 23*. Terminal blocks in the RCTX accommodate wire gauges up to 16 AWG.
2. A switch or circuit breaker is required in the installation.
   a. The switch or circuit breaker must be in close proximity of the RCTX and within easy reach of the operator.
   b. The switch or circuit breaker must be marked as the disconnect device for the RCTX.

NOTE: DC power input is protected with an internal 1.5 Amp, Slo-Blo, surface mount (non-field serviceable) fuse. This fuse protects only for a catastrophic failure and must be returned to factory for servicing if blown.

NOTE: User shall provide external circuit breaker at the source for normal operation.

NOTE: RCTX with Display: Must remove display board for terminal block access. See *"" on page 16*.

TB100

See *Figure 23*.

1 VIN (Power Source 18…28V DC)

2 VCOM (Power Source Common)

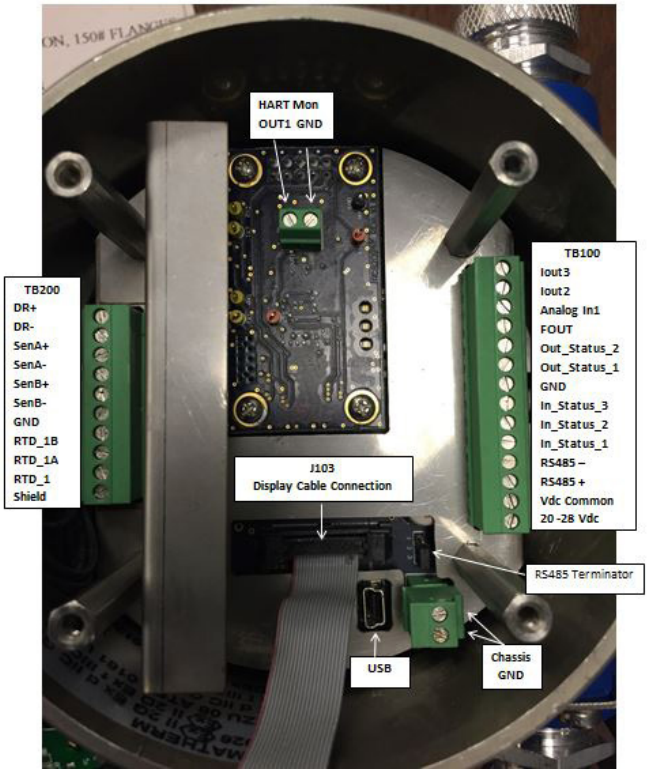


Figure 23: Wiring reference: RCTX with display, shown with display board removed for clarity

INPUTS / OUTPUTS

The transmitter powers the current loop. Applying power from any other external device or load will result in damage to the transmitter.

NOTE: The *IOut1* (HART Option), *IOut2*, and *IOut3* designations can represent any parameters. Units of measure are (appropriately) different.

The frequency/pulse output signal is available as open drain (100 mA sinking max).This channel is user-selected to operate as a straight frequency output, a pulse output or a PWM output suitable for totalizing.

The two digital output signals are available as open drain (100 mA sinking max.). Each open drain output requires a pullup resistor to DC voltage of 5…28V DC to form a positive voltage pulse. Make this connection in the users' equipment, since the preferred voltage should be available there.

The three digital inputs (DC voltage of 5…28V DC) are used to initiate many of the transmitter's advanced functions.

The analog input (0…5V maximum) is used to form a ratio between the analog input and an analog signal from other devices.

RCTX TB100 Interface

Terminal	Signal Name	Dir	Signal Description
1	18-28Vdc	In	18…28V DC, 15W max.
2	Vdc Common	In	Power Source Common **NOTE:** This is NOT same signal as GND. This signal is isolated by an internal common mode filter choke from GND
3	RS485+	I/O	RS485+ Communications (Diff Pair)
4	RS485-	I/O	RS485- Communications (Diff Pair)
5	In_Status_1	In	Digital Input (Low: 0V DC, Active High: 5…28V DC)
6	In_Status_2	In	Digital Input (Low: 0V DC, Active High: 5…28V DC)
7	In_Status_3	In	Digital Input (Low: 0V DC, Active High: 5…28V DC)
8	GND	—	Signal GND (GND for all signals with the exception of power in)
9	Out_Status_1	Out	Digital Open Drain Output. Requires an external pullup resistor to 5…28V DC max. to provide a positive voltage level (100 mA max. sink current)
10	Out_Status_2	Out	Digital Open Drain Output. Requires an external pullup resistor to 5…28V DC max. to provide a positive voltage level (100 mA max. sink current)
11	Frequency Output	Out	Digital Open Drain Output. Requires an external pullup resistor to 5…28V DC max. to provide a positive voltage level. (10k Hz max. frequency)
12	Analog In1	In	Analog Input, 0…5V max.
13	IOut2	Out	Analog Output, 4…20mA (500 Ohm load max.) active
14	IOut3	Out	Analog Output, 4…20mA (500 Ohm load max.) active

HART Module TB1 Interface

Transmitter must be ordered with HART card installed.

Terminal	Signal Name	Dir	Signal Description
1	IOut1	Out	Analog Output, 4…20mA (500 Ohm load max.)/HART communications
2	GND	—	Signal GND (GND for all signals with the exception of power in)

RCTX TB101 Interface

Terminal	Signal Name	Dir	Signal Description
1	CHASSIS GND	—	Electrical conductivity via internal standoffs to RCTX enclosure. Termination for cable shields
2	CHASSIS GND	—	Electrical conductivity via internal standoffs to RCTX enclosure. Termination for cable shields

RCTX Interface Diagrams

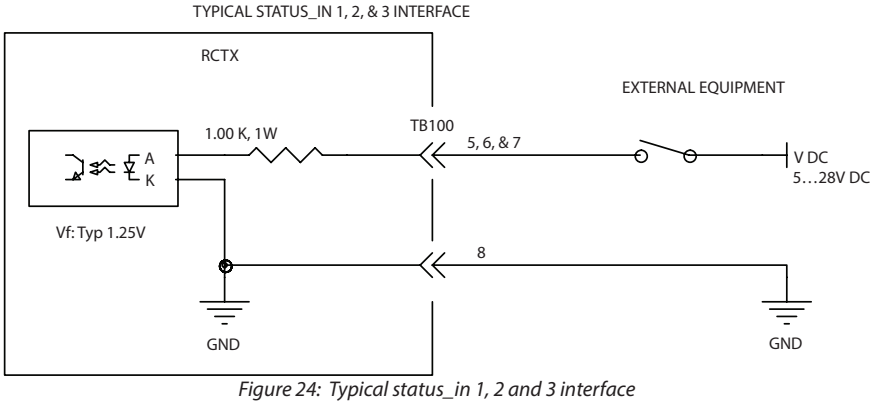


Figure 24: Typical status_in 1, 2 and 3 interface

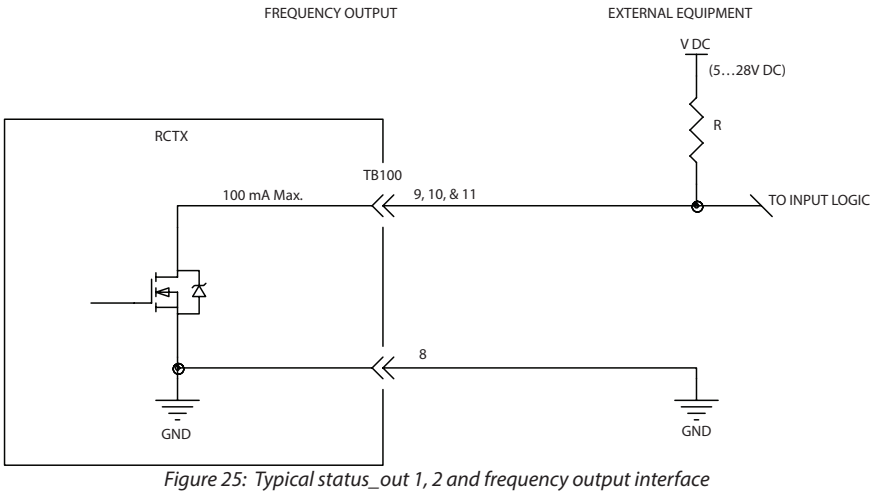


Figure 25: Typical status_out 1, 2 and frequency output interface

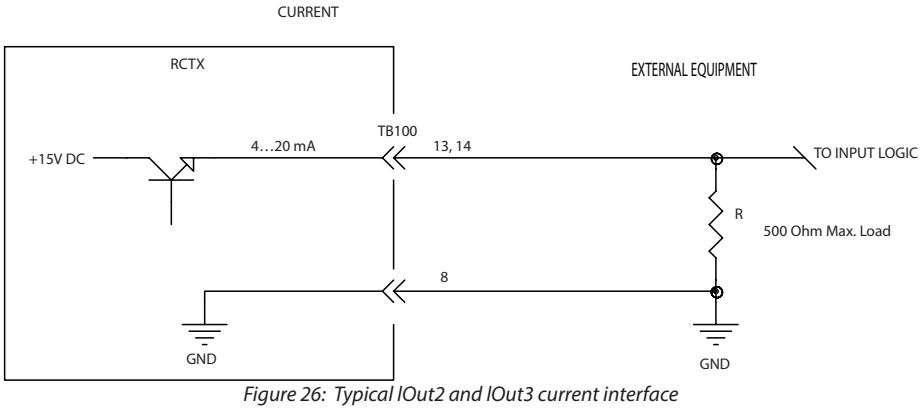


Figure 26: Typical IOut2 and IOut3 current interface

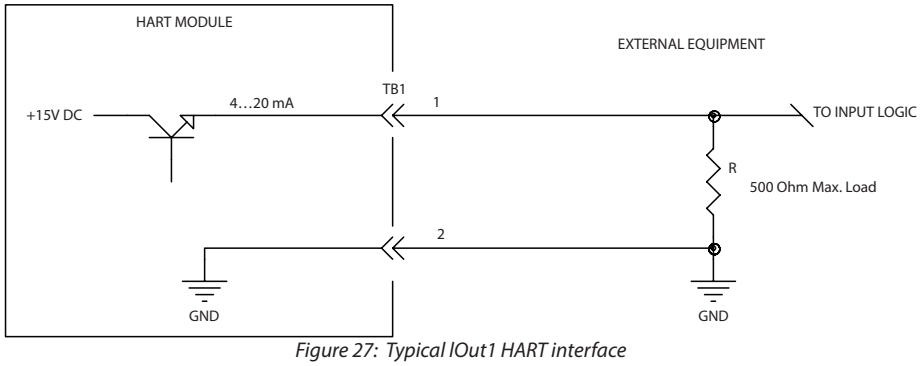


Figure 27: Typical IOut1 HART interface

Replacing the Display Board

OBSERVE PRECAUTIONS FOR HANDLING ELECTROSTATIC-SENSITIVE DEVICES.

1. Turn off power to the unit.
2. Grasp the enclosure cover and turn it counter-clockwise until it separates from the enclosure body. Set the cover aside.
3. Use a Phillips head screwdriver to remove the 4 screws holding the display board to the standoffs. See *Figure 28*.
4. Gently turn over the display board.
5. Open the tabs on the header assembly to release the cable ribbon connector. See *Figure 29*.

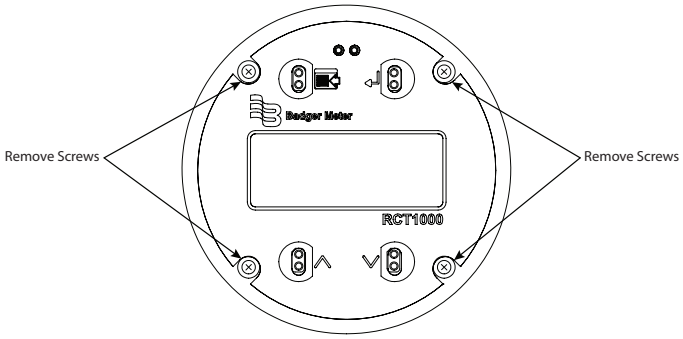


Figure 28: Phillips head screws

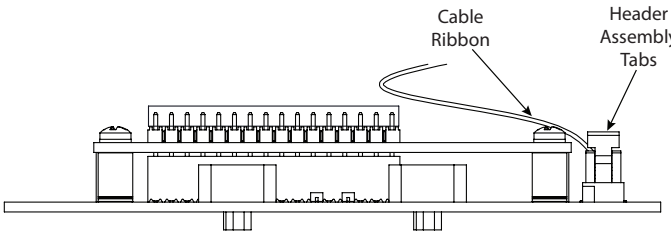


Figure 29: Release cable ribbon

6. Attach the cable ribbon connector to the header assembly of the new display board.
7. Fold the cable ribbon between the standoffs to avoid pinching it with the new board.
8. Secure the display board with the 4 Phillips head screws removed in step 3.
9. Replace the cover.

Replacing the Covers

Turn the covers clockwise and hand-tighten.

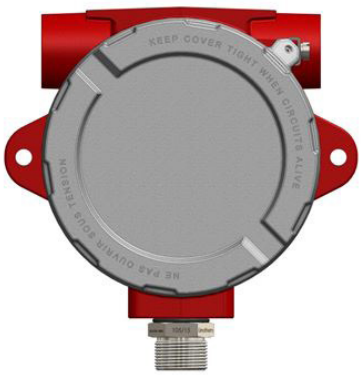


Figure 30: RCTX

Figure 31: RCTX with display

NOTE: If the optical buttons are not working properly, check that the windowed cover is fully tightened. The buttons will not activate if the window is too far away.

SENSOR CONNECTIONS

- Integral RCTX transmitters are prewired to the sensor at the factory (no wiring required).
- Remotely mounted RCTX transmitters must be wired to the sensor during installation.

NOTE: The black wire with the ring connector terminates at the transmitter. The thicker white wire terminates at the sensor.

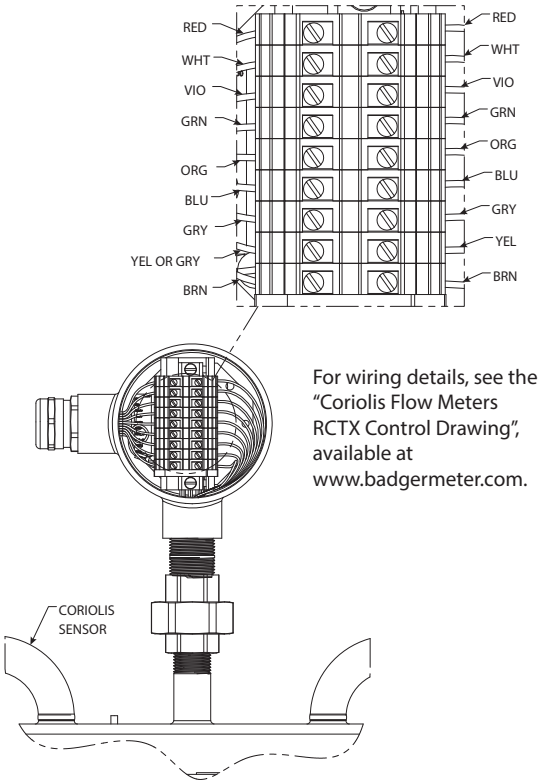


Figure 32: Remote mounted hazardous location sensorg

Remote RCTX Terminal Boxes

The sensor wiring in the main transmitter enclosure is prewired. If the cable must be replaced, open the contact on the terminal block, insert a small tool or screwdriver and slide toward the wire opening.

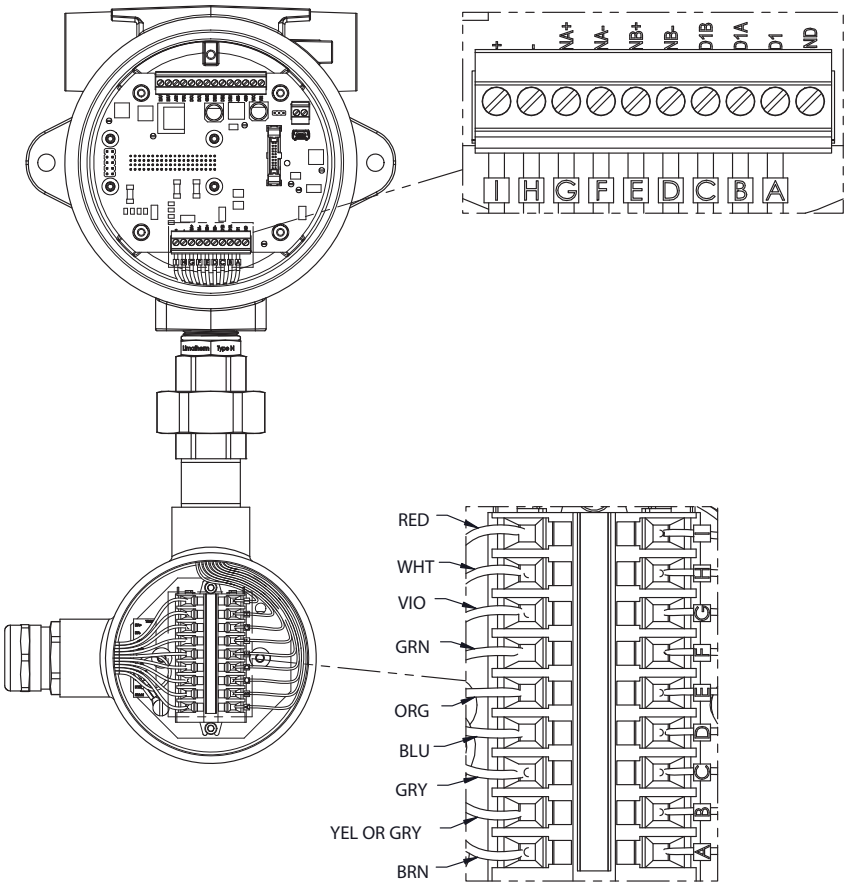


Figure 33: Remote RCTX terminal boxes

TRANSMITTER SETUP

Commissioning of the RCT1000 Coriolis system can be accomplished via the keypad on the transmitter, or through the RCT Console, a free software program included on the USB thumb drive provided with purchase. This software is also available for download at *www.badgermeter.com*.

For assistance with basic system requirements and configuring the software with the sensor and transmitter pair, refer to the user manual. The manual is available online at *www.badgermeter.com* and is also on the provided USB thumb drive.

The following procedure outlines the commissioning of the system via the keypad on the transmitter.

Basic Operation

Using the Keypad

The buttons are used individually to execute a command or effect a change, according to the mode of the firmware.

Button presses are time sensitive. The firmware recognizes two button press durations known as *Press* and *Long Press*. A *Press* lasts for less than two seconds. A *Long Press* lasts longer than two seconds.

Conventions

Name	Icon	Functions
Menu/ Exit		Shows the menu system from the *Home* screen. If the user is in the menu system, Menu/Exit returns to the parent menu of the displayed menu/parameter. During editing, a Long Press cancels the editing without any value change. During editing, a short Press changes the value to zero. If *WARNING* is shown in 4th line, then a short Press shows the *WARNINGS* screen. If *WARNING* is shown in 4th line, then a Long Press returns the user to the parent screen or allows the user to enter the menu system from the *Home* screen.
Up Arrow		In parameter value editing mode, a Long Press moves the cursor one position to the right and a short Press changes a character. In menus and parameter lists, a short Press moves a menu or parameter list up.
Down Arrow		In parameter value editing mode, a Long Press moves the cursor one position to the left and a short Press changes a character. In menus and parameter lists, a short Press moves a menu or parameter list down.
Enter		If a menu item is shown in the active line, then a short Press enters into that menu. If a parameter is shown in the active line, then a Long Press starts parameter value editing mode if the parameter's access rights and the set password allow it. If a parameter is edited, then a Long Press closes the parameter editor and saves any new change.

Table 1: Keyboard icons

The Active Line

The RCT1000 transmitter uses the concept of the Active line to make changes to the transmitter's instructions. The active line is the topmost line on the display and whatever parameter or menu is on the active line can be edited or stepped into.

NOTE: If the optical buttons are not working properly, check that the windowed cover is fully tightened. The buttons will not activate if the window is too far away.

NOTE: The active line is only used in editing mode or menu navigation.

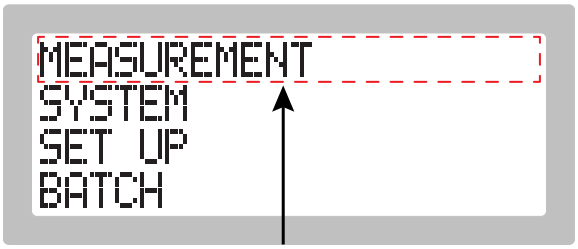


Figure 34: The active line

NOTE: Some displays, calibrations and setup parameters are password protected. The proper password level must be used to gain access to password protected parameters.

Meter Checks

1. Confirm the flow sensor has been installed correctly.
2. Confirm the transmitter has been installed correctly.
3. Confirm all transmitter connections have been made correctly to the sensor.
4. Confirm the *Flow Factor* and *Density* calibration constants are the same on both the serial tags and calibration documents.
5. Familiarize yourself with the basic operation of the transmitter keypad.
6. Power up the transmitter. The display reads the current firmware version and does a self test.
7. Fill the flow sensor with fluid, passing the fluid through for at least ten minutes at a flow rate greater than twenty percent of the rated capacity of the meter.
8. Perform a zero calibration, see *"Sensor Check" on page 28*.

Startup Screens

NOTE: Screens may differ depending on firmware version and enabled options.

1. Example of startup splash screen.

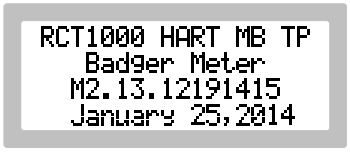


Figure 35: Splash screen

2. The transmitter is looking to see if there is a sensor connected. The Initializing text will display for one minute if no sensor is connected.

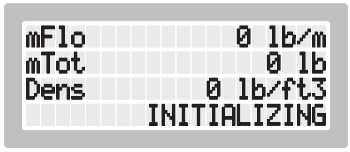


Figure 36: Transmitter initializing

3. If there is a sensor connected, the screen should look similar to this, if there is no flow and the meter is full of fluid.

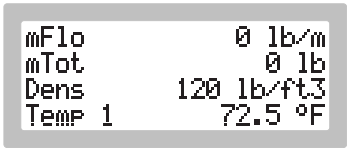


Figure 37: Sensor connected–no flow

4. If there is fluid flow, the screen will look similar to this.

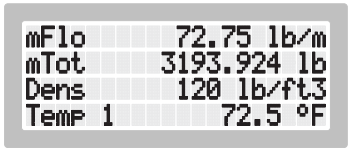
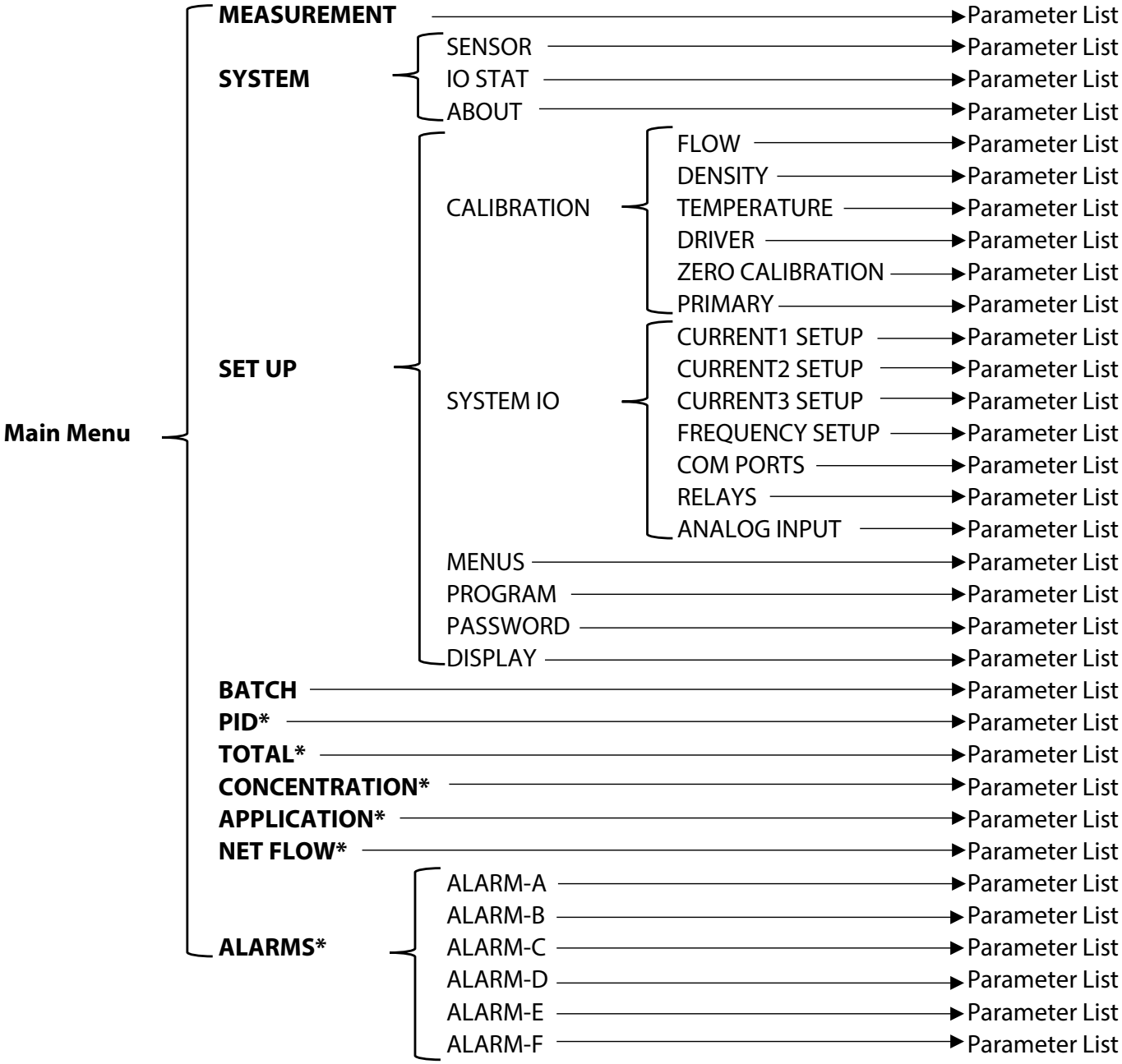


Figure 38: Sensor connected–with flow

5. If there is no sensor connected, the screen will change from *INITIALIZING* to *WARNING*.

Figure 39: No sensor warning screen

MENU MAP



*Hidden menus. Must be Enabled to view.

Figure 40: Menu map

KEYBOARD LOCK

The optical buttons on the hazardous location RCTX transmitter may be locked to prevent accidental activation of the buttons. To unlock, press the Up arrow, Down arrow, Menu/Exit and Enter buttons sequentially, in a reverse "Z" pattern. See *Figure 41*. With each correct button press, two dark blocks appear at the bottom of the warning screen, beginning on the left. See *Figure 42*.

The Lockout function can be enabled or disabled through parameter *KbLock* (303).

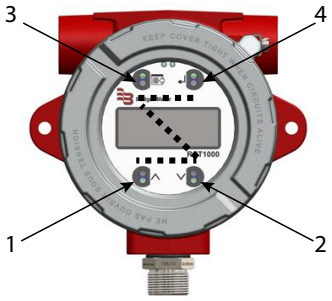


Figure 41: Unlock keyboard

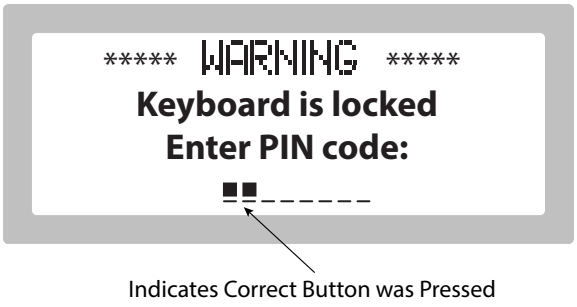


Figure 42: Enter PIN code

SYSTEM PASSWORDS

1. From the *Home* screen, press **Menu** to enter the top level menus.
2. Use **Up** or **Down** to scroll until *SET UP* is in the active line of the display, then press **Enter**.
3. From the *SET UP* prompt, press **Up** or **Down** until the display shows *Password*.

NOTE: In this menu, there are two parameters. *PWLv1* indicates the password level entered, if any. *PWSet* is the parameter used to change the password level.

4. To change to another password level, use **Up** or **Down** until *PWSet* is in the active line of the display, then press and hold **Enter**.
5. A cursor will appear under the first character of the password.
   a. Using **Up** or **Down**, increment or decrement the value as needed.
   b. To move the cursor to the next character space, press and hold **Up** to move the cursor to the right or press and hold **Down** to move the cursor to the left.
   c. Follow this procedure to enter the required password PIN (personal identification number), then press and hold **Enter** to save the password.

Default Passwords

The default system passwords PINs (personal identification numbers) are:

Engineer: 525

Technician: 604

Operator: 117

NOTE: Each higher password level inherits the capabilities of any passwords below it.
To change the password PINs associated with each password level, refer to the "Coriolis Flow Meters User Manual" available at *www.badgermeter.com*.

SENSOR CHECK

It is important to check that the sensor and transmitter are correctly matched. Unmatched sensor and transmitter pairs will produce inaccurate readings.

To check that the correct sensor has been connected to the correct transmitter, refer to the calibration documents that are sent with the meter system. The Flow Calibration Report includes vital information pertaining to the specific sensor and transmitter pair. Under "Product Information" there are fields for both sensor and transmitter model number and serial number.

Look at the outside of the sensor and transmitter and locate the serial tags. Pair the transmitter to the appropriate sensor by matching the serial numbers as indicated on the calibration report.

After the transmitter is powered on, make sure the calibration constants entered into the transmitter match the information provided on the serial tags and the calibration documents.

- Flow Factor (FloFct): Main Menu > Set Up > Calibration > Flow
- DAlpha: Main Menu > Set Up > Calibration > Density
- DBeta: Main Menu > Set Up > Calibration > Density

If the numbers entered in the transmitter do not match what was provided on the serial tags and the calibration report, contact the factory for assistance.

INITIAL ZEROING PROCEDURE

Priming for Zero

This procedure requires a password level of Operator or higher.

The flow sensor must be completely full at stable process temperature and pressure before zeroing the system.

Even if the flow sensor has already been filled, circulate fluid for a minimum of 10 minutes at a flow rate greater than 20% of the rated full scale value of the flow sensor to purge both the process piping and sensor of air.

NOTE: Do not attempt the initial startup procedure with a partially filled sensor.

NOTE: If the process temperature or pressure changes significantly, the meter may need to be re-zeroed. If the meter is to be re-zeroed, make sure the meter is completely full and flow is shut off by first closing the downstream blocking valve and then the upstream blocking valve to prevent the potential for cavitation in the sensor. Stopping the pump or relying on check valves does not ensure the zero flow condition necessary to perform the system zero.

Zeroing the System

NOTE: The system must be zeroed after installation and before normal operation.

1. Run flow through the sensor at the highest possible rate for several minutes to eliminate any entrained gases in liquid systems.
2. Stop all flow and close the downstream and upstream blocking valves. Close the downstream valve first to prevent draining of the system.
3. From the *Home* screen, press **Menu** to enter into the top level menus.
4. Use **Up** or **Down** to scroll through the list until *SET UP* appears in the active line, then press **Enter**.
5. Use **Up** or **Down** to scroll through the list until *CALIBRATION* appears in the active line, then press **Enter**.
6. Use **Up** or **Down** to scroll through the list until *ZERO CALIBRATION* appears in the active line, then press **Enter**.
7. Use **Up** or **Down** to scroll through the list until *START ZERO* appears in the active line.

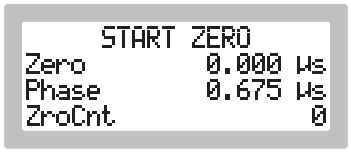


Figure 43: Start zero screen

8. Press and hold **Enter** to initiate a zero calibration.

9. Press **Menu** until the top level menu screen is reached.
10. Use **Up** or **Down** to scroll through the list until *MEASUREMENT* is in the active line, then press **Enter**.
11. Use **Up** or **Down** to find the *mFlo* parameter. It should read all zeros.
12. Return to the *Home* screen. If there is a prompt to backup the transmitter, choose this action. If the prompt to backup the transmitter does not appear prior to getting to the *Home* screen, backup the transmitter manually. See *"Manual Transmitter Backup" on page 31*. Open the blocking valves. The meter is now ready to use.

HOME SCREEN SETUP

The RCT1000 transmitters feature a home screen to allow users to view whichever parameter is required to be in view at all times.

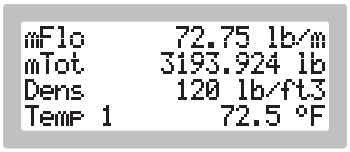


Figure 44: Home screen example

The transmitters have a four line display, but the *Home* screen holds eight parameters that are viewable at one time. Using **Up** or **Down**, users can view these parameters as this list scrolls and wraps around.

To set up the parameters for the *Home* screen:

1. From the *Home* screen, press **Menu** to step into the high level menus.
2. Using **Up** or **Down**, scroll through the list until *SET UP* appears in the active line and press **Enter**.
3. Using **Up** or **Down**, scroll until *DISPLAY* appears in the active line and press **Enter**.
4. Using **Up** or **Down**, scroll through the parameter list. Parameters are named *Param1*…*Param8*. These parameters correlate the order and ID for the parameters to be displayed on the *Home* screen. The parameter under *Param1* will be the default parameter listed on the first line of the *Home* screen, *Param2*…*8* follow suit.

NOTE: On the *Home* screen, use **Up** or **Down** to scroll through the available parameters.

Home screen Line 1	Param1	Home screen Line 5	Param5
Home screen Line 2	Param2	Home screen Line 6	Param6
Home screen Line 3	Param3	Home screen Line 7	Param7
Home screen Line 4	Param4	Home screen Line 8	Param8

5. To select the parameters to display, place the required *Param1*…*8* in the active line and press and hold **Enter**.
6. Using **Up** or **Down**, scroll through the list of available parameters that can be seen on the *Home* screen.
7. Once a required parameter is seen, press and hold **Enter** to save the change. This parameter will now be listed to the line assigned on the *Home* screen.
8. After the required parameters to be viewed have been set, press **Menu** until the *Home* screen is reached.

Enable/Disable Hidden Menus

1. From the *Home* screen, press **Menu** to enter the top level menus.
2. Using **Up** or **Down**, scroll through the list of available menus until *SET UP* is in the active line and press **Enter**.
3. Using **Up** or **Down**, scroll through the list of available menus until *MENUS* is in the active line and press **Enter**.

There are seven additional menus that can be enabled or disabled:

MnuBatch (Batch Controller Menu)

MnuPID (PID Controller Menu)

MnuTot (Totalizer Menu)

MnuAlarm (User Defined Alarm Menu)

MnuConc (Concentration Menu)

MnuApp (Special Application Menu)

MnuNet (Net Flow Menu)

4. To enable or disable one of these menus, use **Up** or **Down** to scroll through the list and place the required menu to be *Enabled* or *Disabled* into the active line of the display.
5. Press and hold **Enter**.
6. Use **Up** or **Down** to scroll through the available options (*Show menu* or *Hide menu*).
7. To show the menu, select *Show menu,* then press and hold **Enter**. To hide the menu, select *Hide menu,* then press and hold **Enter**.

NOTE: Enabled/shown menus will appear on the top level menu structure.

HMI EXAMPLES

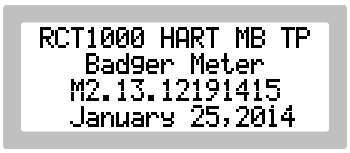


Figure 45: Example of startup screen

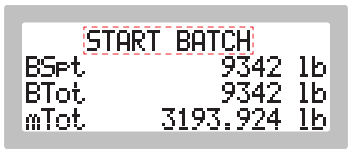


Figure 46: Example of a command

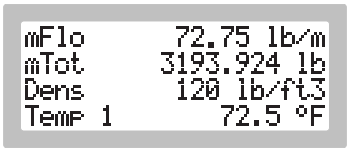


Figure 47: Home screen or base parameter level within a menu

Figure 37 is also an example of parameters where units, resolution and value can be changed, password permitting.

NOTE: Measured or calculated values cannot be changed.

Figure 48: Example of transmitter being in menus or submenus

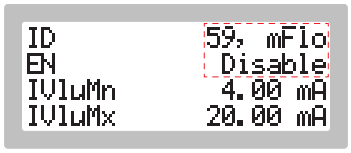


Figure 49: Example of parameters with enumerations

EDITING PARAMETER UNITS, VALUES AND RESOLUTION

There are two ways to change the units, values and resolution associated with a parameter. It can either be done from the user-defined *Home* screen or from stepping into the menus and changing the parameter at the bottom (parameter) level of the menu structure.

To change these items:

1. Scroll **Up** or **Down** until the required parameter is in the active line, then press and hold **Enter**.
2. The default item to be edited first is the value of the unit. Use **Up** or **Down** to change the value of the highlighted character. Press and hold **Up** to move the cursor to the right or press and hold **Down** to move the cursor to the left.

NOTE: Measured values, such as *mFlo* (mass flow rate) cannot be changed. An attempt to do so will do nothing.

3. After changing the value, press **Enter**.
4. The next item to be edited is the unit of the parameter. Use **Up** or **Down** to scroll through the list of available units. Once the required unit appears, press **Enter**.
5. After step four, the next item to be changed is the resolution. This will appear in a #.## format. Use **Up** to increase the resolution or **Down** to decrease the resolution. The number of pound signs after the decimal indicates the resolution that will be set.
6. Press and hold **Enter** to save changes made to the parameter.

NOTE: Bypass any of the three edits by pressing **Enter**. The parameter will not save until you press and hold **Enter.**

NOTE: Not all parameters have values, resolutions or units associated with them. If an item is not available for the parameter, the item will not appear.

NOTE: Parameters with lists and no measured or calculated value with units, values and resolutions associated with them, still follow the same format for editing. Once the parameter is in edit mode, the list will appear and the user can scroll through the available list for the parameter. After the required one appears, press and hold **Enter** to save the parameter with the list item selected.

FLOW DIRECTION

If the fluid flow is reverse of the meter flow and reading negative flow when positive flow is desired, change the mass flow linearization factor *mLinFct* from 1 to –1. Changing this parameter requires the proper security level.

1. Navigate to *Main Menu* > *SETUP* > *CALIBRATION* > *FLOW*.
2. Scroll until *mLinFct* is the first line on the screen.
3. Press and hold **ENTER** to enter the editing mode.
4. Scroll down to change positive (+) to negative (–) and press **ENTER** to accept the change.
5. To exit the menus, press **MENU** at each new menu. A prompt to back up the parameters appears before exiting the Main Menu and returning to the Home Screen.

BACKING UP THE TRANSMITTER

There are three ways to create backups:

- Automatically through flagged parameters (see the "Coriolis Flow Meters User Manual" for a list of flagged parameters.)
- Manually through the HMI
- Through the RCT Console software

Automatic Transmitter Backup

The automatic backup feature prompts you to initiate a backup. There are certain parameters within the transmitter that are flagged to create a backup if they are changed. These are parameters that have a significant impact on the configuration, whether it is a meter zero or a density factor.

Any time one of these is changed, it will signal the transmitter of the change. Once the user steps back out to the *Home* screen, prior to entering the *Home* screen, a prompt like this will appear. Follow the on-screen commands to either create or cancel the backup.

Figure 50: Parameter change triggered backup

Manual Transmitter Backup

To create backups manually through the HMI:

1. From the *Home* screen, press **Menu** to enter the top level menus.
2. Using **Up**, **Down** and **Enter**, navigate to the *SET UP* > *CALIBRATION* > *PRIMARY* menu.
3. Scroll **Up** or **Down** through the list of available parameters and place *BackUp* on the active line.
4. Press and hold **Enter** to bring the parameter into editing mode.
5. When in editing mode, a cursor will appear under the enumeration text shown to the right of the parameter name. Use **Up** or **Down** to switch the entry from *Idle* to *Backup* (see *Figure 51*).

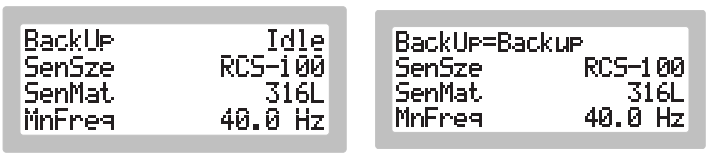


Figure 51: Backup triggered from menu

6. Press and hold **Enter** to save the change and initiate the command. *WARNING* will appear on the bottom right of the display. This is a temporary indication a backup has been created.

Transmitter Backup Using RCT Console Software

Refer to the RCT Console Help file for information on how to back up through the RCT Console.

OUTPUT CONFIGURATION

Current Outputs

The RCTX transmitters have two current outputs plus a current output with HART (if the HART option is installed) that can send signals to peripheral devices (such as loop-powered remote indicators, controllers and similar equipment). These outputs may be independently set by the user, via software or keypad, for any range between 0…22 mA with 4…20 mA being the default. The maximum load (loop) impedance for each output is 500 Ω.

Normally the *IOut1* output is set for mass flow. However, this can represent other parameters. In these cases, the units of measure are (appropriately) different.

The *Main Menu* > *SETUP* > *SYSTEM IO* menu contains three current output channels:

- *CURRENT1 SETUP*
- *CURRENT2 SETUP*
- *CURRENT3 SETUP*

NOTE: Password level must be Technician or Engineer to change settings.

1. Enable the current output *EN*.
2. Assign the parameter to use with the current output *ID*.
3. Enter minimum current *IVluMn* and the minimum value of the assigned parameter *VluMn*.
4. Enter maximum current *IVluMx* and the maximum value of assigned parameter *VluMx*.

Example

Parameter	Setting	Parameter	Setting
EN	Enable	—	—
ID	59, mFlo	—	—
IVluMn	4 mA	VluMn	100 lb/min
IVluMx	20 ma	VluMx	1000 lb/min

Test Current

To test the current output:

1. In the current menu, set the test output (TstOut) to the desired current.
2. Check that the current output is enabled (EN).
3. Enable the test current for the specific current output:
   HART Current Output 1 **+Alt1** (126)
   Current Output 2 **+Alt2** (127)
   Current Output 3 **+Alt3** (231)

Monitor Current

The current for each of the outputs can be viewed:

HART Current Output 1 **IOut1** (120)
Current Output 2 **IOut2** (121)
Current Output 3 **IOut3** (229)

Frequency, Pulse and PWM Outputs

The frequency channel has three modes. The first is straight frequency output in the range of 63…10,000 Hz with 3000 Hz being the typical maximum. The second is a pulse output (one pulse per every defined mass unit). The third is a pulse-width modulation (PWM) output that varies the ratio of on time to a set period. The output can be configured for one of the three modes.

The frequency channel can drive external devices such as rate indicators, batch totalizers and similar devices. Access the frequency setup parameters through the *Main Menu > SETUP > SYSTEM I/O > FREQUENCY SETUP* menu. Selecting *FREQUENCY SETUP* enters the frequency/pulse out menu.

NOTE: Password level must be Technician or Engineer to change settings.

1. Assign the parameter to the ID parameter.
2. Select output mode *PlsOM* (130).
   - ◊ Frequency
   - ◊ Pulse
   - ◊ PWM

Frequency Output

1. From the *Frequency Output* menu, enable the pulse/frequency output *FrqOEN* (129) and *EN* (Enable).
2. Assign the parameter to use with the frequency output *ID*. The default is the mass flow rate *mFlo* (59).
3. Enter *FrqMn* and the minimum value of the assigned parameter *VluMn*.
4. Enter the maximum frequency *FrqMx* and the maximum value of assigned parameter *VluMx*.

Test Frequency
To test the frequency output at a fixed value, set the output *TstOut* to the desired frequency and enable the test frequency *+AltFrq* (128). Check that *FrqOEN* and *EN* are enabled. While the test frequency is enabled, the warning message *"6, Freq. out error"* shows on the transmitter.

Monitor Frequency
To monitor the frequency output, view *FrqOut* (122).

Pulse Output

1. From the *Frequency Output* menu, enable the pulse/frequency output *FrqOEN* (129) and *EN* (Enable).
2. Assign the parameter to use with the pulse output *PlsID* (131). The default is the mass totalizer *mTot* (80).
3. Enter total amount per pulse in *PlsSze* (132). The pulse width is fixed at 7 ms. Make sure that the pulse cannot trigger faster than every 14 ms for a 50% duty cycle at maximum flow rate.
   Example: Maximum mass flow rate is 600 lb/min or 10 lb/s, then the minimum pulse size is 0.14 lb.
   10 lb/s * 0.014 s - 0.14 lb

   If the pulse size or mass totalizer is negative, a warning message shows on the transmitter.

6, Freq. out error	Frequency output is enabled, but it is in test mode or has an invalid setting. Test frequency *+AltFrq* (128) is enabled. Minimum frequency *FrqMn* is negative or minimum and maximum values are swapped.
7, pulse out error	Assigned totalizer is negative or invalid pulse settings. Check the totalizer value and pulse size *PlsSze* (132) for a negative value.
34, Fl low limit	Value of measured parameter is below the minimum value VluMn.

COMMUNICATION WIRING AND SETUP

All RCT1000 transmitters include EIA-485 and USB programming ports.

NOTE: An RS485 Terminator resistor is provided for when end-of-line termination is required. The RCTX and RCTX with Display transmitters are shipped from factory with the shunt jumper in "Not Terminated" position.

EIA-485 Port

The EIA-485 port is used for network connections and supports two protocol options: Modbus RTU and BMI Massmeter.

USB Programming Port

The USB programming port is used for connecting a computer with RCT Console configuration and diagnostic software to the RCT transmitter. The USB programming port supports two protocol options: Modbus RTU and BMI Massmeter. RCT Console defaults to BMI Massmeter but can be changed to Modbus RTU if required. Both ports remain active while RCT Console is communicating with the transmitter through the USB port. The transmitter may not be able to respond to all requests if both the EIA-485 and USB programming ports are busy.

EIA-485 / Modbus RTU

See "RCT1000 Modbus RTU Communication Protocol" user manual, available at *www.badgermeter.com*.

Optional HART Communication Card

See the "Coriolis Flow Meter HART Bidirectional Communication Protocol Data Access" user manual, available at *www.badgermeter.com*.

Optional Ethernet Communication Card

An optional Ethernet communication card can be ordered on the Coriolis transmitter by including the "E" designation in the Communication Protocol block in the part number construction.

The Ethernet card supports both Modbus TCP/IP and EtherNet/IP protocols. Configuring the Ethernet IP address requires a computer with an Ethernet port.

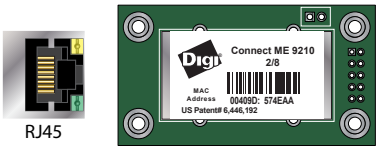


Figure 52: Ethernet card

See "RCT1000 Modbus RTU Communication Protocol" user manual, " RCT1000 EtherNet/IP Communication Protocol" user manual and " RCT1000 Modbus TCP/IP Communication Protocol" user manual, available at *www.badgermeter.com*.

TROUBLESHOOTING

Navigation During an Alarm Condition

When any sort of warning occurs, the keypad functionality changes—a momentary press of the **Menu/Back** button brings up the *Warnings* menu. At this time, you may feel you are stuck in a loop toggling back and forth between the Display and an alarm or warning.

To navigate to the Root list of menus, press and hold the **Menu/Back** button to move back in the directory.

This may be required in order to change the scaling of an output channel or to see what may be causing the alarm condition to occur.

Only during alarm or warning conditions will you need to use the long press function on the Menu/Back button to move back up the menu list. See *"Transmitter-to-Sensor Connections" on page 37* for further details.

WARNING Help

Any warning that appears on the transmitter will be erased from the screen once the problem has been fixed.

To clear WARNINGS:

1. Press **Menu** to bring up the *WARNINGS* window, which lists all current alarms and faults in the transmitter.
2. Press the arrow buttons to move the alarm or warning to the active line and press **Enter**.
   The display will prompt more information about the alarm or fault. It will display the time and date of the error.
3. To clear the warning, press and hold **Menu**. The screen will return to the menu related to the error.

NOTE: If the error is still present, the WARNING message will come back.

⚠WARNING

DO NOT REMOVE OR REPLACE FUSE WHEN IT IS ENERGIZED.

Identifying System Faults

When a fault is suspected:

1. Identify the general symptom and, if possible, the fault type by referring to the tables in this section.
2. When the fault has been identified, run through the checks detailed to correct the problem.
3. Re-zero the system.

Red/Green LED Diagnostics

The red and green LEDs located on the transmitter are basic diagnostic indicators. Blinking LEDs can indicate an alarm level that can be used to identify the type of error that has occurred.

Startup

On power up, it is normal for the red LED to be on (solid) for a few seconds, then blink for up to a minute while the sensor stabilizes. Anytime the red LED is on, or blinking after one minute past power up, a sensor problem exists that requires further investigation.

Blink Code

The LEDs are ON/OFF blink coded according to the following logic:

- Neither LED on: check for power. The LED should always be on.
- Red LED solid: severe failure (level 7 and 8).
- Red LED blinking: high or low limit indicator, a level 1 or 2 warning indication, no effect to accurate measurement.
- Green LED solid: the startup drive hammer is engaged.
- Green LED blinking slow (blink 1/sec): normal sensor diagnostic, no flow.
- Green LED blinking fast: normal sensor diagnostic, flow > low flow cut off (or need to zero).

When first installed, the meter must be filled and zeroed. Before zeroing, the green LED may indicate a flow rate. After the zero process it should indicate no flow by blinking at the slow rate.

Indicated Error Levels

Error levels 1 or 2 are high or low limit indications, such as one of the user-settable alarm limits, one of the 4…20 mA limits or frequency output scaling limits is exceeded. Error levels 1…5 have no effect on accurate fluid measurement and totalization. Level 6…8 errors are more severe and accurate measurements cannot be achieved. Level 6…8 errors are:

- Measurement error (IFCPU)
- Tube frequency error
- RTD1 error
- No answer from IFCPU
- Sensor warning
- Driver overflow (> 100%)
- Flash CSC is bad. Flash backup created during startup

Error Messages

NOTE: Under certain conditions, multiple error/alarm conditions may exist. If alarms keep appearing, identify the message and keep taking corrective action until all messages cease.

Error Message	Alarm Level	Error Description	Possible Faults and Corrections
Code Error Xram Error EEPROM Error Back-up Error Back-up Recovered	7-8	Microprocessor program error, RAM error, EEPROM error or EEPROM back-up error. An internal hardware problem exists. This is NOT user programmable	If errors are intermittent but persistent, there may be a hardware problem on the CPU board. A *System Reset* may recover functional memory. If not, call the factory.
No Sensor Signal	6	Sensor errors caused by RTD circuit, sensor tubes resonance error (frequency out of programmed limits or no detector signal(s) from sensor). Common causes are open/ shorted sensor coils, sensor wiring, defective interface or driver cards or incorrectly programmed frequency limits.	No feedback from the sensing coils (*CoilA* and *CoilB* are less than 19 mV). The problem could be a bad drive coil, sensor wiring or defective driver or interface card.
Sensor Warning			Driver set point error. Sensor voltage outside of driver set point (*DrvSpt*) by ± 5%.
Resonance Error			Tube resonance limits (70…200 Hz) are being exceeded. Sensor operating frequency exceeds *MxFreq* or is less than *MnFreq*.
Temp. Error			Temperature (RTD) measurement error. Problem could be sensor wiring, control/relay card problem or processor (CPU) card.
HW Limit IOut1 HW Limit IOut2 HW Limit IOut3 HW Limit on Freq.	5	Hardware limits exceeded on output channels, or attempt to zero the unit with flow present. These items are not user programmable, as they are functions of the hardware.	The computed output exceeds hardware limits. For example, if the HW limits on Freq analog channels are set to 0…20 mA and the channel is scaled to 0…100 lb/min on current channel two, if the flow is 105 lb/min, the computed output will exceed the programmed limit. In this case, *HW Limit IOut2* will be displayed.
IOut1 High/Low Limit IOut2 High/Low Limit IOut3 High/Low Limit Freq High/Low Limit	4	Software limits (set points) on the analog and frequency output channels are being exceeded.	The computed output is below the programmed low limit or above the programmed high limit. For Example, if the upper span of the frequency was set to 1000 Hz at 1000 lb/min and the low end was 1015 lb/min the "Freq. High Limit" alarm would be displayed. If the flow was 90 lb/min, the "Freq. Low Limit" would be displayed.
Cntr. High/Low Limit	4	PID output limits are being exceeded.	The computed output of the PID is greater than 100% (high alarm) or under 0% (low alarm).
Answer Error	3	Master/slave communication error on the serial communications port. These types of errors are only associated with serial communications. These errors would normally indicate a hardware or software failure in the host device.	The "master" unit transmitted to the "slave" unit, but received a message with an error in transmission or no answer was given.
Master Time-Out			The "master" unit transmitted to the "slave" unit, but received no reply.
Master Duplex			The "master" unit transmitted to the "slave" unit, but received a reply before it was ready.
COM-Duplex	2	Communication errors on the serial port. Serial port alarms turn on Opto #1, but are NOT user programmable. These alarms normally indicate a hardware problem in an external device.	A message was received in transmitting.
COM-Command			An error in the command field.
COM-Bad ID			An error in the ID field.
COM-Bad Unit			An error in the units field.
COM-Long Message			The received message was too long.
COM-Short Message			The received message was too short.
COM-Bad Conv			The floating point conversion was incorrectly formatted.
COM-Bad Overrun			The character buffer over-ran or the baud rate may be wrong.
COM-Timeout			Make sure connection, baud rates and addresses are correct.
COM-Bad SOH			
High/Low Flow High/Low Total High/Low Density High/Low Batch High/Low Temperature High/Low Alarm Limit	1	High and low limits for user defined alarms have been exceeded.	These alarms are user programmable with Opto #2 becoming active. The user may set the level(s) of data that would trigger the high or low alarm. For example, a batch alarm could be "tied" to the current batch amount, *BTot*, such that if a batch set point, *BSpt*, exceeding a receiving tanks capacity was entered, Opto #2 would activate (after *BTot* was exceeded highlighting the potential problem).
Zero Flow Error		The zero offset exceeds the low flow cutoff.	Make sure the sensor is full of fluid and that there is no flow. Set *ZroL* to 5%. Try to zero the meter again. Reset *ZroL* to 1% after a successful zero.

Table 2: Error messages

Troubleshooting Symptoms

Symptom	Possible Cause	Recommended Action
Transmitter appears to not power up	**Inadequate or no power** **Blown fuse**	Confirm power is available to the transmitter.
		Measure voltage at the power terminals and check that the voltage matches the labels by the power terminals.
		Check that the power terminal block is firmly seated.
		For AC power, verify that the 115V/230V switch is in the correct position.
		Check the fuse near the power terminals. If fuse is blown, verify the voltage and polarity is correct and replace the fuse.
		Check that at least one LED on the main board is lit. If no LEDs are lit and the above actions are completed, replace the transmitter.
		Check that the ribbon cable from the main board to the keypad/display is firmly seated.
		Cycle power to the transmitter.
		Replace the transmitter if following the above actions does not resolve the issue.
Mass flow reading appears to be too high or too low	**Installation issues** **Process issues** **Improper zeroing of the meter** **Incorrect parameter settings**	Check the installation of the sensor according to installation instructions.
		Run HealthTrack, the advanced function in RCT Console configuration software, to record critical measurements. Multiple, vital parameters can be viewed in a single snap-shot to assist with diagnosing issues.
		Check for mechanical vibrations or process loop instability. The impact of vibrations might be visible in the parameter. • System > Sensor > *CoilAv* should be 60 mV (±3 mV). • Isolate the meter from the mechanical vibration.
		Check process loop for entrained air which will impact the mass flow.
		Check that there is no air in the sensor when zeroing the meter. Make sure that flow has completely stopped and all blocking valves are closed. Re-zero the meter.
		Verify that the calibration factors on the sensor are entered correctly to the transmitter. • Set Up > Calibration > Flow > *FloFct* (Flow Factor) • Set Up > Calibration > Density parameters: *DAlpha* and *DBeta*
Abnormal or Incorrect Mass Flow Readings	**Installation issues Flow instability**	Run HealthTrack, the advanced function in RCT Console configuration software, to record critical measurements. Multiple, vital parameters can be viewed in a single snap-shot to assist with diagnosing issues.
		Check for mechanical vibrations. Impact of mechanical vibrations might be visible in the parameters. System > Sensor > *DrvOut* and *Freq* (tube frequency) readings. *DrvOut* should be between 10…95% and *Freq* should be between: • 90…115 Hz (RCS005) • 170…220 Hz (RCS008) • 80…110 Hz (RCS018…050) • 40…90 Hz (RCS100…300) The frequency stability should be better than ± 0.01 Hz for a good measurement.
		Isolate the meter from the mechanical vibration.
		Another cause of instability is excessive flow rate. The flow shouldn't exceed 100% of the rating of the meter. Under *Main Menu* > *MEASUREMENT*, check parameter *%mFlo*. If the value is greater than 100%, the process is exceeding the max flow rate of the meter.
		Check process loop for variations of entrained air which will impact the mass flow.
		Check for pump induced flow instability.
		Modify *Mass Flow Dampening* parameter to adjust the filtering. Set Up > Calibration > Flow > *mDmp* can be adjusted from 1…99%.

Symptom	Possible Cause	Recommended Action
Density reading appears to be incorrect	**Installation issues** **Process loop issues** **Incorrect parameter settings**	Check process loop for entrained air and concentration of mix fluids which will impact the density.
		Run HealthTrack, the advanced function in RCT Console configuration software, to record critical measurements. Multiple, vital parameters can be viewed in a single snapshot to assist with diagnosing issues.
		Check for mechanical vibrations. Impact of mechanical vibrations might be visible in the parameters. System > Sensor > *DrvOut* and *Freq* (tube frequency) readings. *DrvOut* should be between 10…95% and *Freq* should be between: • 90…115 Hz (RCS005) • 170…220 Hz (RCS008) • 80…110 Hz (RCS018…050) • 40…90 Hz (RCS100…300) **NOTE:** The frequency stability should be better than ± 0.01 Hz for a good measurement
		Verify that the calibration factors on the sensor are entered correctly to the transmitter: • Set Up > Calibration > Flow > *FloFct* (Flow Factor) • Set Up > Calibration > Density parameters: *DAlpha* and *DBeta*
Volumetric flow reading appears to be incorrect	**Mass or density readings are incorrect**	Volumetric flow rate is calculated the mass flow rate divided by the density: vFlo = mFlo/Dens
Sensor temperature (Temp1) reading appears to be incorrect	**Incorrect wiring** **Cable issue** **RTD not functioning**	Verify sensor RTD is properly wired to transmitter (pins 2, 3 and 4).
		At the transmitter, disconnect the sensor wiring. Measure the resistance between brown and yellow/gray sensor wires. The resistance should be approximately 110 Ohms at 77° F (25° C). The resistance will vary depending on the fluid temperature. The resistance between the yellow and gray sensor wires should be less than 5 Ohms.
		If there appears to be an open or short at the transmitter end of the cable, remove the sensor cable from the sensor and measure the resistance from pin J to pins G/H on the sensor. The resistance should be 80…100 Ohms for temperatures less than 32° F (0° C) and 100…180 for temperatures greater than 32° F (0° C). Depending on the fluid temperature, the resistance between pins G and H should be less than 1 Ohm.
		Check the RTD Calibration constants in *Set Up* > *Calibration* > *Temperature*. *RTD1Of* should be 0 (± 5). *RTD1Sl* should be 1.00 (± 0.1).
		If there appears to be an open or short at the pins, replace the sensor.
		If the sensor measurements are in the acceptable range, replace the sensor cable.
Current, frequency, pulse or PWM outputs do not match the readings	**Incorrect parameter settings** **Wiring configuration issues** **Control system configuration issues**	See *"Output Configuration" on page 32* for parameter settings.
		Check that the ID parameter for the output matches the parameter of the desired reading.
		Verify that the minimum and maximum parameters for the output are set properly.
		Verify the device reading the output is set up correctly. The current and frequency outputs have a test output (*TstOut*) that can be used to troubleshoot system issues.

Table 3: Troubleshooting symptoms/resolution

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