Coriolis
Mass Flow Meters

Coriolis Flow Meter

RCT1000

Badger Meter

CRL-QS-00156-EN-04 March 2015

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 RCT1000 User Manual,* which can be found on the USB memory stick included with the meter. You can also download the manual at *www.badgermeter.com*.

SAFETY

Safety Symbol Explanations

⚠DANGER

INDICATES A HAZARDOUS SITUATION, WHICH, IF NOT AVOIDED IS ESTIMATED TO BE CAPABLE OF CAUSING DEATH OR SERIOUS PERSONAL INJURY.

⚠WARNING

INDICATES A HAZARDOUS SITUATION, WHICH, IF NOT AVOIDED COULD RESULT IN SEVERE PERSONAL INJURY OR DEATH.

⚠CAUTION

INDICATES A HAZARDOUS SITUATION, WHICH, IF NOT AVOIDED IS ESTIMATED TO BE CAPABLE OF CAUSING 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

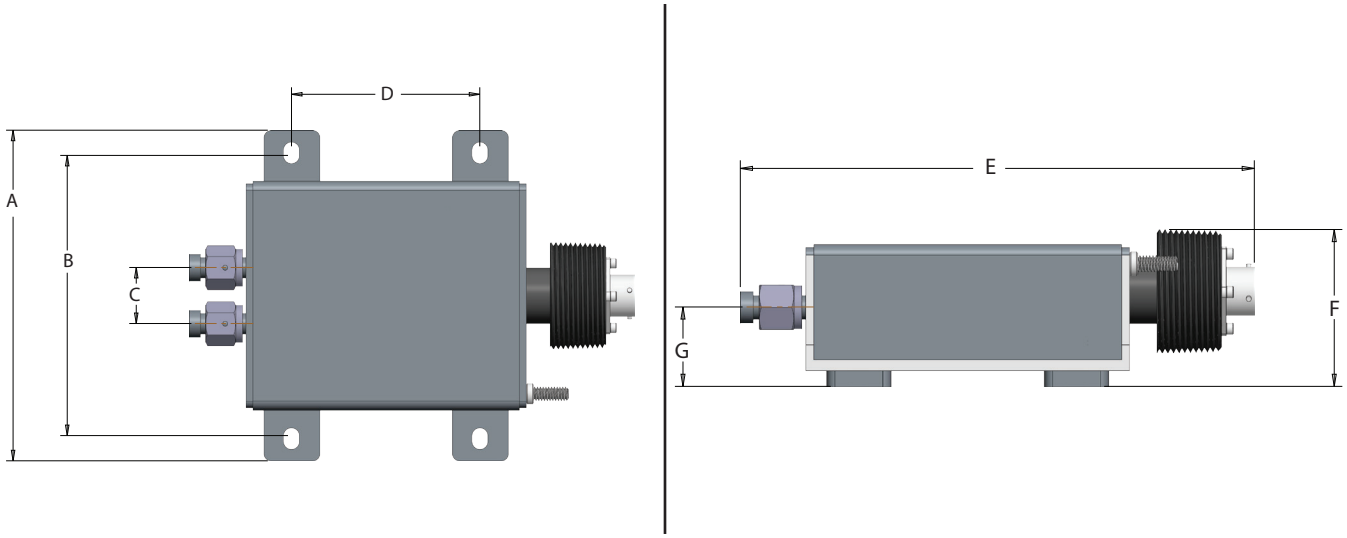
THE POWER SUPPLY BOARD CAN HAVE LINE VOLTAGES APPLIED TO IT. DISCONNECT ELECTRICAL POWER BEFORE OPENING THE INSTRUMENT ENCLOSURE. USE WIRING PRACTICES THAT CONFORM TO LOCAL AND NATIONAL CODES WITHIN THE REGION WHERE THE PRODUCT IS INSTALLED. [FOR EXAMPLE: THE NATIONAL ELECTRICAL CODE® HANDBOOK IN THE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

RCS SENSOR DIMENSIONS

Sensor Dimensions, RCS005



Sensor	Nominal Size	A	B	C	D	E	F	G
RCS005	1/4 in.	5.90 in. (149.9 mm)	5.00 in. (127 mm)	1.00 in. (25.4 mm)	3.60 in. (85.3 mm)	7.93 in. (201.7 mm)	2.42 in. (61.6 mm)	1.23 in. (31.2 mm)

Sensor Dimensions, RCS008

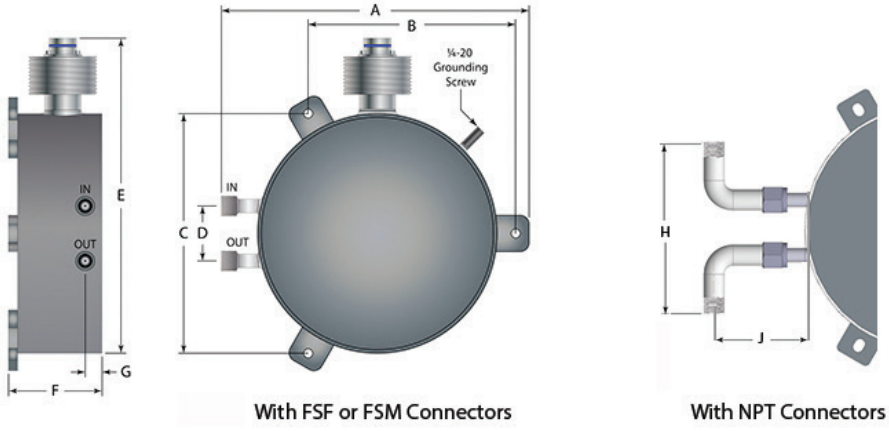


Figure 1: RCS008 dimensions

Sensor	Nominal Size	A	B	C	D	E	F	G	H	J
RCS008	1/4 in.	8.48 in. (215.3 mm)	5.72 in. (145.3 mm)	6.60 in. (167.7 mm)	1.50 in. (38.1 mm)	8.70 in. (221 mm)	2.67 in. (67.8 mm)	0.98 in. (24.9 mm)	4.65 in. (118 mm)	2.48 in. (63 mm)

Sensor Dimensions, RCS018…RCS300

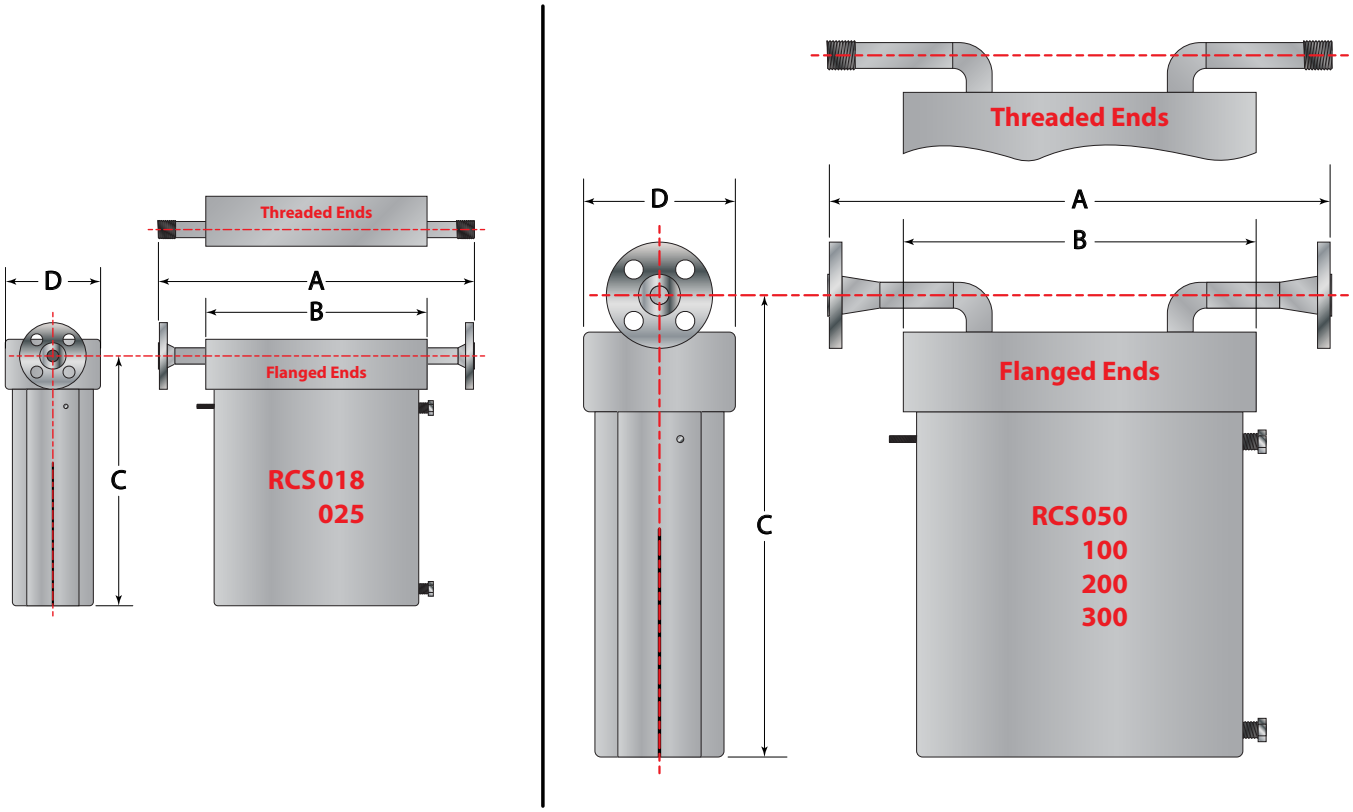


Figure 2: Large sensor dimensions

Sensor	Nominal Size	A[1]	B	C	D
RCS018	1/2 in.	13.5 in. (344 mm)	7.1 in. (180 mm)	8.5 in. (216 mm)	4.3 in. (110 mm)
RCS025	1/2 in.	16.0 in. (406 mm)	9.0 in. (228 mm)	9.9 in. (252 mm)	4.3 in. (110 mm)
RCS050	1/2 in.	18.5 in. (470 mm)	11.4 in. (290 mm)	15.5 in. (393 mm)	5.0 in. (128 mm)
RCS100	1 in.	23.2 in. (590 mm)	16.8 in. (426 mm)	27.6 in. (700 mm)	6.3 in. (160 mm)
RCS200	2 in.	26.4 in. (670 mm)	18.3 in. (466 mm)	28.6 in. (726 mm)	7.9 in. (200 mm)
RCS300	3 in.	40.9 in. (1040 mm)	28.7 in. (728 mm)	42.5 in. (1079 mm)	9.4 in. (240 mm)

[1] ± 0.16 in (4 mm)

RCTN TRANSMITTER DIMENSIONS

NOTE: Mounting hardware included. (wall mount bracket, pipe mount bracket and transmitter/bracket fasteners)

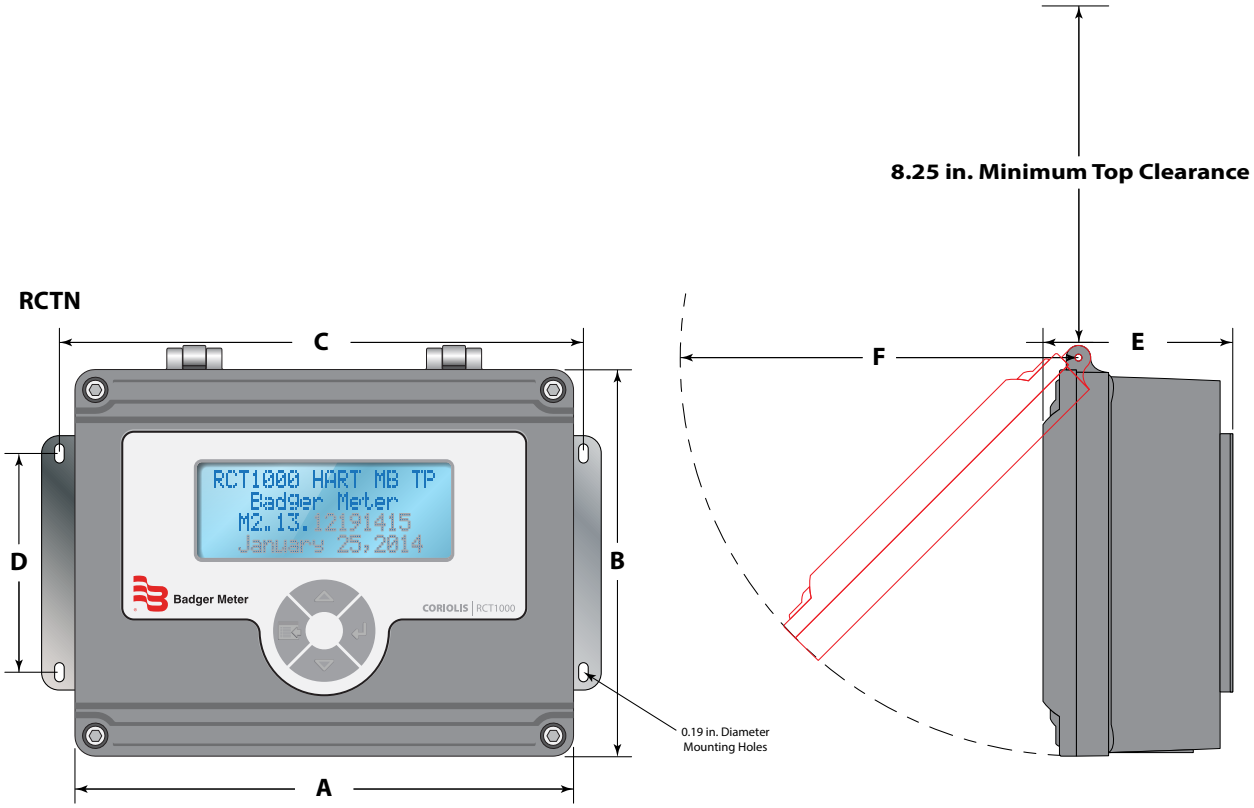


Figure 3: Transmitter mounting dimensions

A	B	C	D	E	F
9.80 in. (249.9 mm)	8.00 in. (203.2 mm)	10.30 in. (261.6 mm)	4.30 in. (109.2 mm)	3.66 in. (93.0 mm)	8.32 in. (211.2 mm)

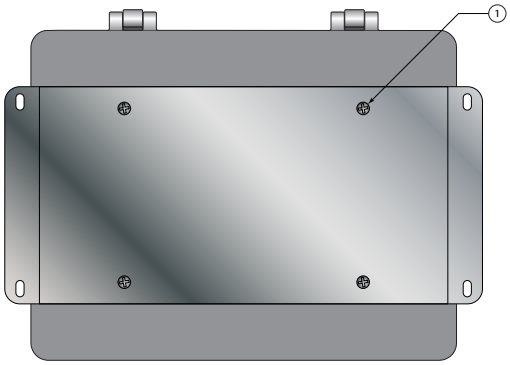


Figure 4: Back plate mounting

1	Screw	#8-32 UNC-2B

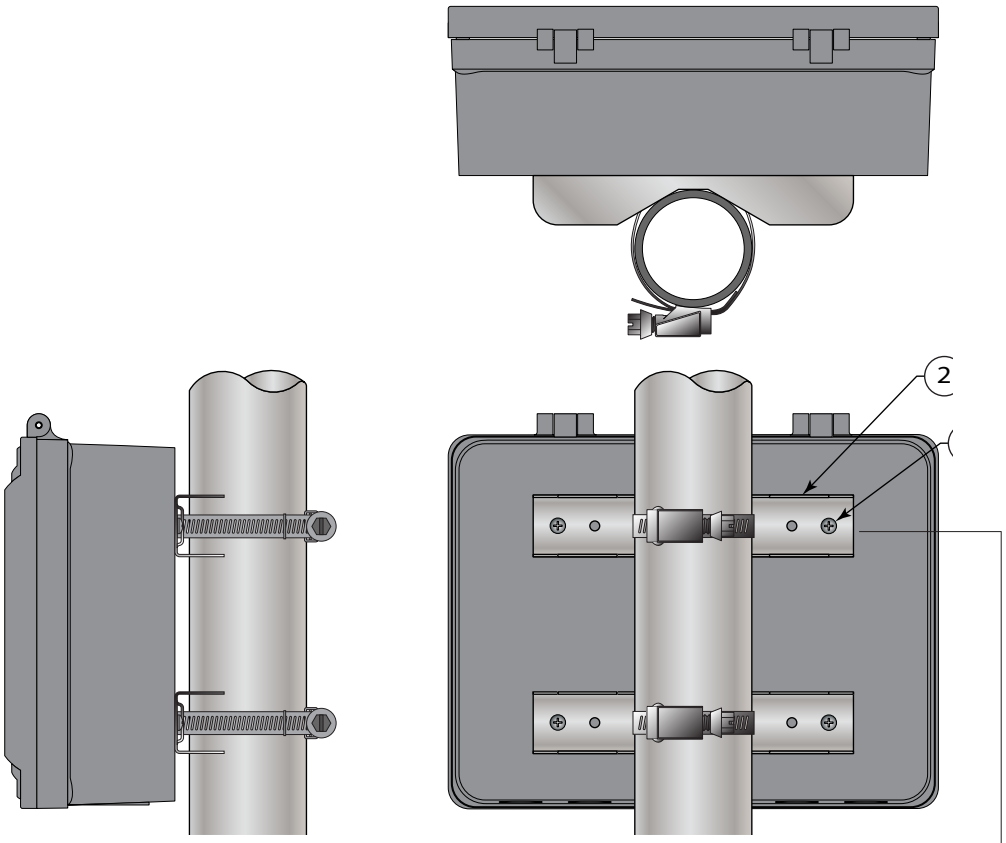
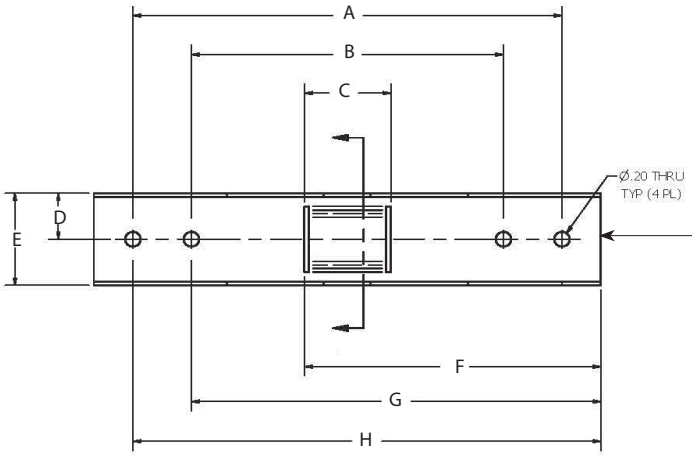


Figure 5: Pipe mounting

1	Screw	#8-32 UNC-2B
2	Bracket	Pipe mounting



A	B	C	D	E	F	G	H
5.50 in. (139.7 mm)	4.00 in. (101.6 mm)	1.11 in. (28.2 mm)	.625 in. (15.9 mm)	1.25 in. (31.8 mm)	3.80 in. (96.5 mm)	5.25 in. (133.6 mm)	6.00 in. (152.4 mm)

INSTALLATION

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.
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 unpacking and 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.

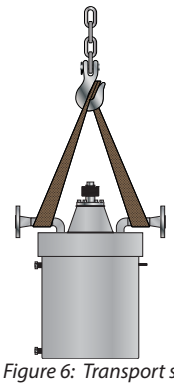


Figure 6: Transport sling

SENSOR INSTALLATION

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

All RCS Sensors

IMPORTANT

Remove all process connection caps and ensure process connections are open.

1. Support and align piping connections to prevent side loading of the mating surfaces.
2. RCS018 and larger sensors are designed to be supported by the process flange connection. No additional supports are needed for meter housing.
3. To reduce the influence of pipe vibration on RCS018 and larger meters, Stauff style clamps are suggested to help with supporting process piping. RCS005 and RCS008 sensors must be securely mounted to a heavy, rigid surface, such as a concrete floor or wall.
4. Full port ball valves should be mounted on either side of meter for zero calibration purposes.
5. Control valves should be mounted downstream of the flow meter to prevent possible cavitation especially when measuring liquids with low boiling points (see *Figure 8*).
6. The meter should be installed in a section of the piping where it always remains full unless the application is designed to drain with no flow.
7. Vertical piping installations should have the flow going up through the meter (see *Figure 10*).
8. When using hose connections a short section of rigid pipe should be used on each side of the meter for proper support. The meter should not hang from hose connections (see *Figure 11* and *Figure 12*).
9. Caution should be used for fluids that harden or solidify at rest. Do not pass fluids that react together through the same flow sensor.
10. If heat tracing is used, be aware of the maximum temperature limits of the meter.
11. Use of armored hoses, as sensor vibration isolators may be required when a high amount of ambient vibration is present (see *Figure 11 on page 14* and *Figure 12 on page 14*).
12. Ensure particulate matter is small enough to pass through the flow sensor. A filter should be added to the system if necessary.
13. Ensure 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 8 on page 12*, *Figure 9 on page 12* and *Figure 10 on page 13*).
14. High sources of EMF should be avoided. These 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.

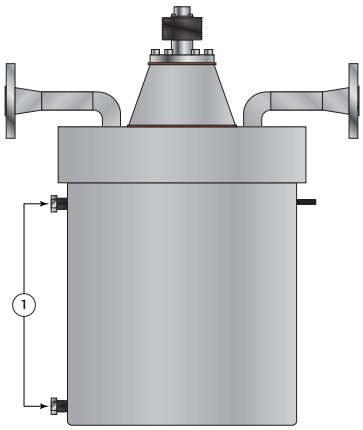


Figure 7: Purge ports

1	Port	Nitrogen purge

Sensor Pipeline Mounting Recommendations

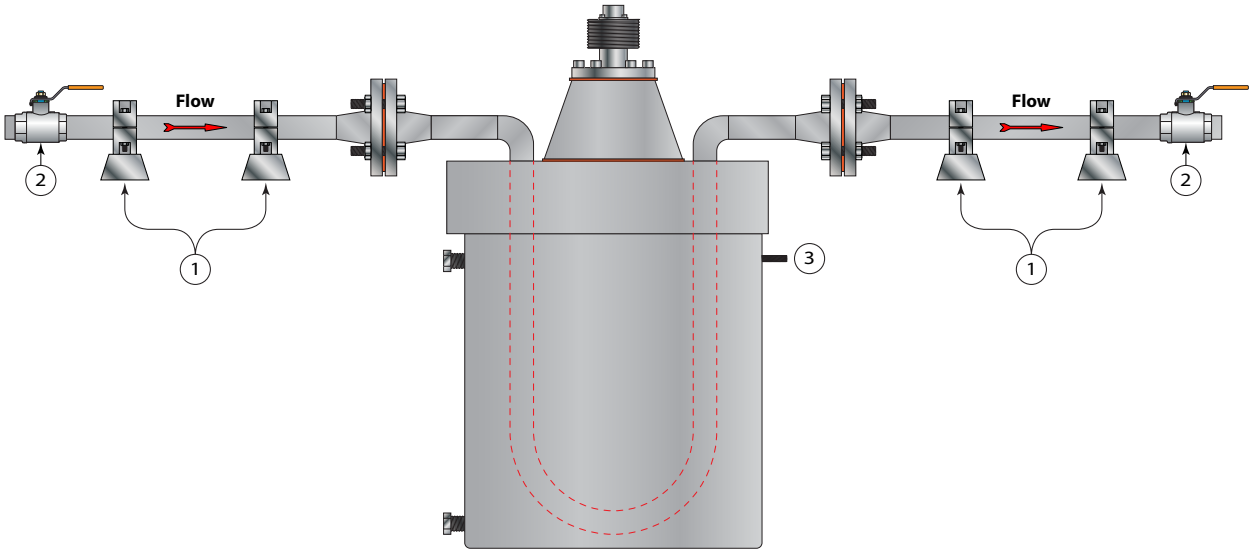


Figure 8: Tubes down (liquids)

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

Vibration reducing pipe supports should be used in all applications. The mounting orientation shown in *Figure 8* is recommended for liquid applications.

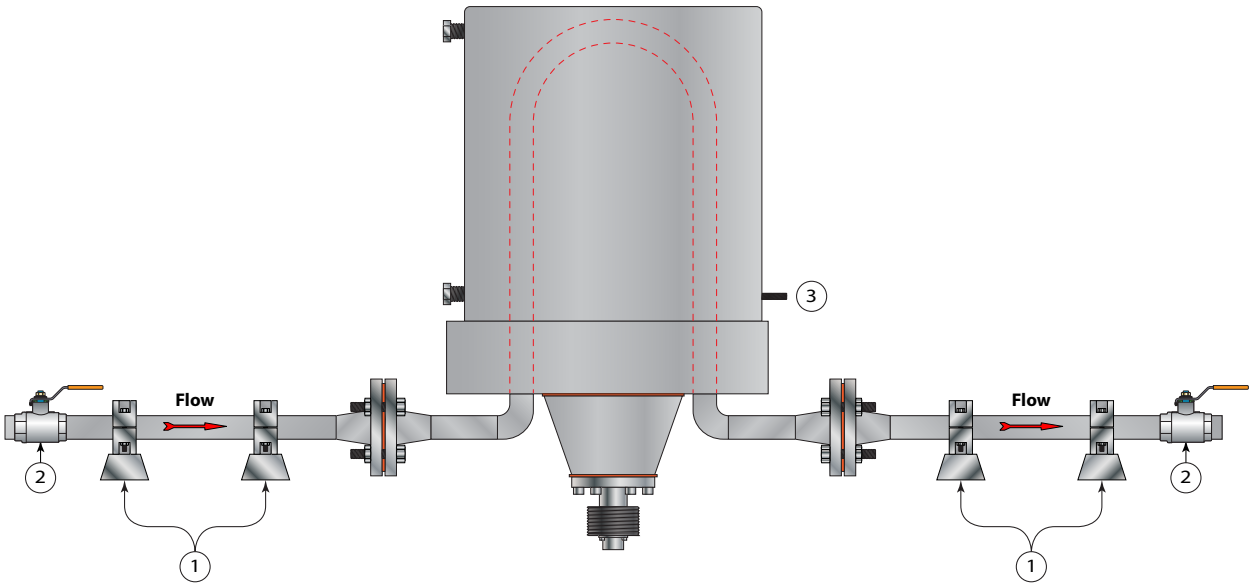


Figure 9: Tubes up (gases)

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

For gas or slurry applications where condensate may be present, mount the sensor as shown in *Figure 9*.

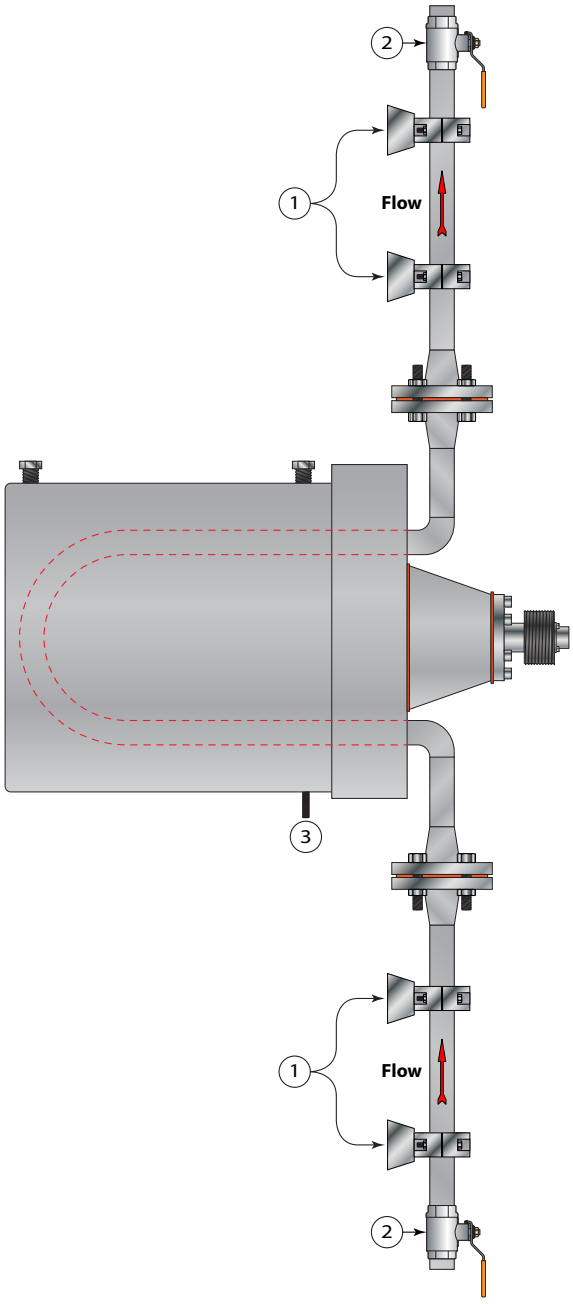


Figure 10: Tubes to the side with flow going up (self-draining)

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

For self-draining configurations, mount the RCS sensors in vertical pipelines as shown in *Figure 10*.

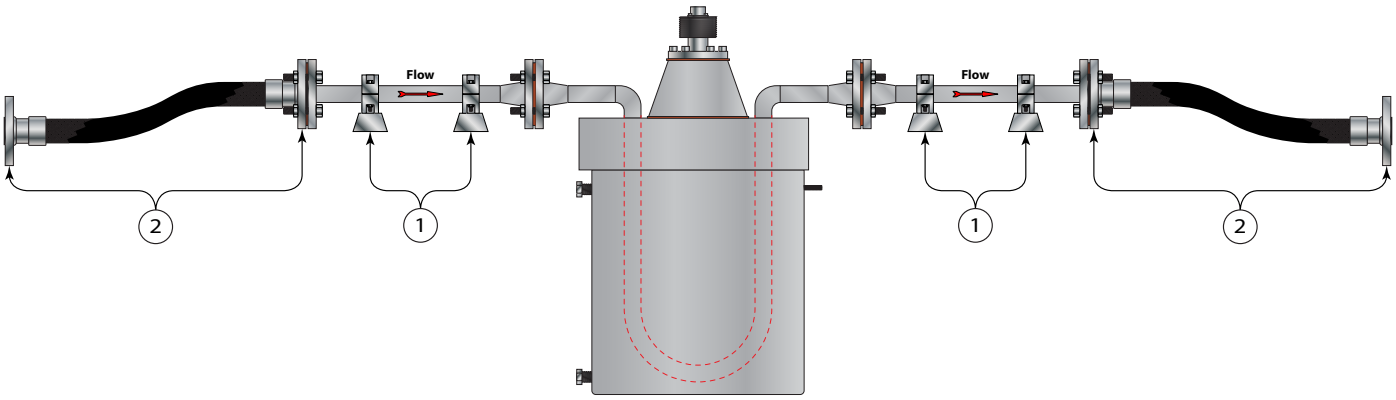


Figure 11: Flexible armored hoses

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

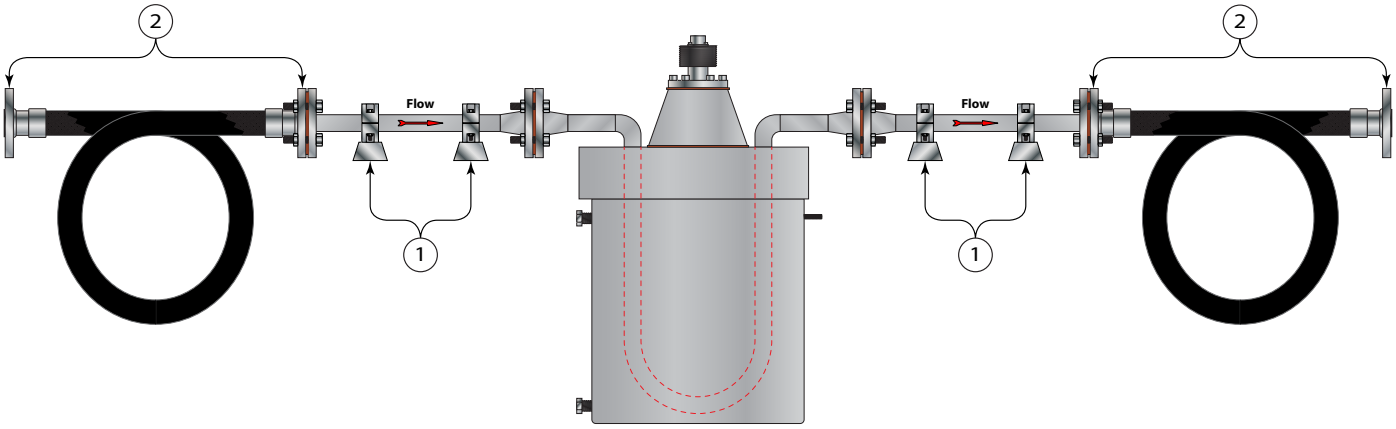


Figure 12: Flexible armored hose loops

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

RCS005 and RCS008 Sensor Installation

The mounting orientation for the RCS005 and RCS008 sensors is identical. The RCS008 is shown below for illustration.

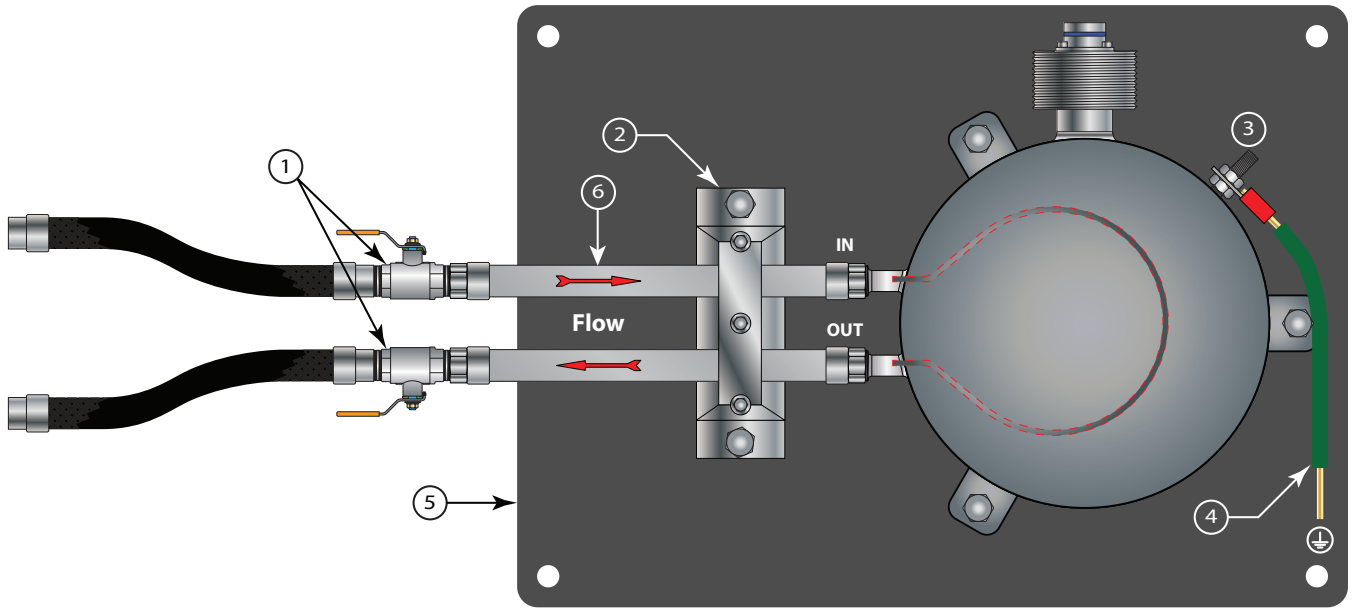


Figure 13: RCS008 mounting

1	Valves—**Customer supplied**	Full port ball
2	Clamp—**Customer supplied**	Pipe
3	Screw	Grounding 1/4–20
4	Ground—**Customer supplied**	Protective (earth), 10 AWG (4 mm^2) minimum
5	Plate—**Customer supplied**	Mounting
6	Pipe or hose—**Customer supplied**	Mounting

NOTE: Vibration isolators are recommended on the mounting feet.

TRANSMITTER INSTALLATION

The enclosure should be mounted in an area convenient for observation of the LCD readout, programming and servicing.

1. Locate the transmitter within the length of sensor cable supplied. If this is not possible, the cable should be exchanged for one that is of proper length. In order to increase cable length to an RCS sensor, the cable used must be the same type as used by the manufacturers and must be one continuous piece (no cable splices).
2. Mount the transmitter:
    - In a location known to be non-hazardous
    - Where little vibration exists
    - In an upright position (conduit holes on the bottom) to help avoid fluid ingress
    - Protected from corrosive fluids
    - Within the transmitter's ambient temperature limits 14…160° F (–10…70° C)
    - Out of direct sunlight. Direct sunlight may increase transmitter temperature above the maximum limit.
3. Make sure enough room is available to allow for door swing, maintenance and conduit entrances. Secure the mounting bracket to a flat surface, 2 inch (50 mm) pipe or frame post with the hardware provided. Refer to *Figure 3 on page 8* and *Figure 5 on page 9* for enclosure and mounting dimension details.
4. Cable should be routed into the transmitter via the conduit holes located at the bottom of the sensor unit. Holes not used for cable entry should be sealed with plugs (RC820428). Optional cable glands (RC820389) are available for inserting sensor and power cables. These parts can be ordered directly from the manufacturer.

NOTE: Use NEMA 4 (IP66) rated fittings/plugs to maintain the watertight integrity of the enclosure. Generally, the right conduit hole (viewed from front) is used for power, the left conduit hole for sensor connections, and the center holes for I/O wiring.

Grounding/Earthing

IMPORTANT

All wiring must be suitable for a temperature of at least 203° F (95° C).

NOTE: To access terminal strips for wiring, loosen the four screws in the enclosure door and open.

NOTE: The sensor cable carries low voltage, high sensitivity signals. It is not recommended to add additional length to the cable supplied with the transducers. If additional cable is required, contact the factory to arrange an exchange for a transducer cable with the appropriate length. Cables up to 300 ft (91 meters) are available.

Earthing Using Rigid Pipe

⚠WARNING

THE POWER CONNECTIONS MUST USE THE CONDUIT HOLE ON THE FAR RIGHT AND 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

1. General
   a. 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.
   b. Connecting or disconnecting devices:
      i. Ensure the supply voltage is switched off and the RCTN is in a non-hazardous area.
   c. Connecting cables shall be rated for a continuous service temperature of –10…95° C (Tamb max +20° C).
   d. Only use certified (conforming to IEC 60079–14 Electrical Installations in Hazardous Areas) cable glands and conduit hole plugs.
   e. 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 RCTN meet this requirement and are compliant to both standards.
2. Potential equalization (earth bonding)
   a. As a condition of safe use, both an internal and external earth bond are required.
      i. Internal earth bond is made at the protective earth terminal on terminal block TB1. Earth bond conductors must be the same gauge or larger than the power supply conductors.
      ii. The external bond:
         3. Is satisfied by either connecting the enclosure chassis through hard conduit. See *Figure 15 on page 18* or *Figure 16 on page 19*.
         4. Via armored cable and the use of a cable gland designed to allow a bonding jumper to be run between the gland and protective earth (see *Figure 14*).

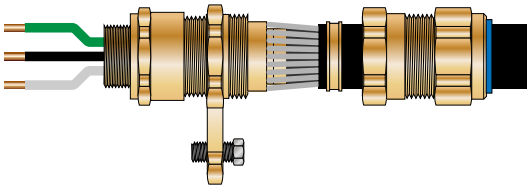


Figure 14: Typical earth bonding connector

POWER CONNECTIONS

RCTN AC Power Connections

1. Verify that switch S1, the AC power selection switch, is set to the appropriate line voltage. The RCTN can be set for either 115V AC or 230V AC. See *Figure 15*.
2. The RCTN is shipped with a fuse installed that is designed for 115V service and contains a 0.25 A fuse. If the RCTN is to be operated at 230V AC, replace the fuse in F1 with a 0.125 A slow blow fuse 5 x 20 mm (a 0.125 A fuse is included with the meter).
3. Connect power to the screw terminal block TB1 in the RCT1000 transmitter using the conduit hole on the right side of the enclosure. Connect 115 or 230V AC, AC neutral and protective ground to the TB1 terminals referenced in *Figure 15*. Do not operate without a protective (earth) ground connection. Install using wiring practices that conform to regional, local and national codes. (For example The National Electrical Code Handbook in the U.S.; Canadian Electric (CE) Code in Canada.)
4. See *Figure 15* for AC connection schematic. Terminal blocks in the RCT1000 accommodate wire gauges up to 14 AWG.
5. A switch or circuit breaker is required in the installation.
6. The switch or circuit breaker must be in close proximity of the RCT1000 and within easy reach of the operator.
7. The switch or circuit breaker must be marked as the disconnect device for the RCT1000.

⚠WARNING

- ***AS A CONDITION OF SAFE USE, AN EARTH BONDED METAL CONDUIT MUST BE USED ON A MINIMUM OF ONE WIRE ENTRANCE HOLE.***
- ***DO NOT OPEN ENCLOSURE WHEN ENERGIZED.***
- ***DO NOT REMOVE OR REPLACE FUSE WHEN ENERGIZED.***

⚠CAUTION

ANY OTHER WIRING METHOD MAY BE UNSAFE OR CAUSE IMPROPER OPERATION OF THE INSTRUMENT.

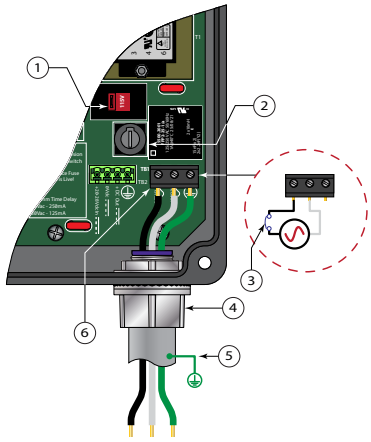


Figure 15: NEMA 4 AC power connections

1	Switch	S1–AC Power selection	4	Connector	Grounding
2	Fuse	F1–For 115V AC input use 0.250 A	5	Ground	External
		F1–For 230V AC input use 0.125 A	6	Terminal block	TB1–AC Power connections
3	Disconnect	Switch or circuit breaker			

NOTE: This instrument requires clean electrical line power. Do not operate this unit on circuits with electrically noisy components such as fluorescent lights, relays, compressors or variable frequency drives and similar devices. Do not use a step down transformer from high voltage, high amperage sources. Do not run signal wires with line power conductors within the same wiring tray or conduit.

RCTN DC Power Connections

The RCT1000 operates from a 20…28V DC Class 2 source, as long as the source is capable of supplying a minimum of 7W.

1. Connect a 20…28V DC Class 2 power source as illustrated in the schematic in *Figure 16*. Terminal blocks in the RCT1000 accommodate wire gauges up to 14 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 RCTN and within easy reach of the operator.
   b. The switch or circuit breaker must be marked as the disconnect device for the RCTN.

NOTE: DC powered connections are protected by an automatically resetting fuse. This fuse does not require replacement.

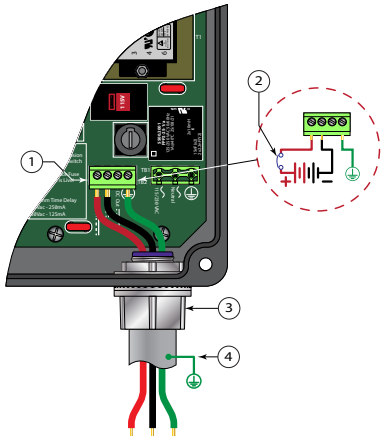


Figure 16: NEMA 4 DC power connections

1	Terminal block	TB2–DC power connections	3	Connector	Grounding
2	Disconnect	Switch or circuit breaker	4	Ground	External

SENSOR CONNECTIONS

1. Plug the cable connector into the sensor, then rotate the connectors locking ring clockwise until it seats.
2. Slide the protective cable cover over the sensor connections and thread the cover hand tight. See *Figure 17*.
3. Tighten the cable grip tight enough to hold the sensor cable firmly.
4. Route the sensor cable back to the transmitter avoiding spurious signal producing sources.
5. Insert the sensor cable through the weather resistant connector.
6. Guide the sensor cable and weather resistant connector through the transmitter conduit hole located in the bottom left of the RCTN enclosure.
7. Secure the weather resistant connector with hardware supplied.
8. Remove any protective covers from the interface board.
9. Unplug the ten-pin connector on the interface board and attach the sensor cable to the appropriate wire color codes. See *Figure 18*.
10. If an external, PT100 RTD is used, connect the RTD to the three-pin plug adjacent to the Coriolis sensor plug.
11. Replace any protective covers and close the enclosure.
12. All RCS sensors are equipped with a 1/4 in. threaded ground stud. Connect this stud to a protective (earth) ground with a minimum of a 10 AWG conductor. See *Figure 13 on page 15* and *Figure 18*.

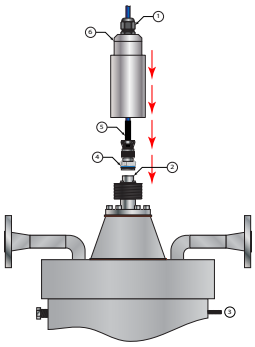


Figure 17: Protective cable cover installation

1	Grip	Cable	4	Connection	Cable (female)
2	Connection	Sensor (male)	5	Cable	Interconnect
3	Ground	Protective (earth), 10 AWG (4 mm^2) minimum	6	Cover	Cable (protective)

RCTN for General Safety Areas

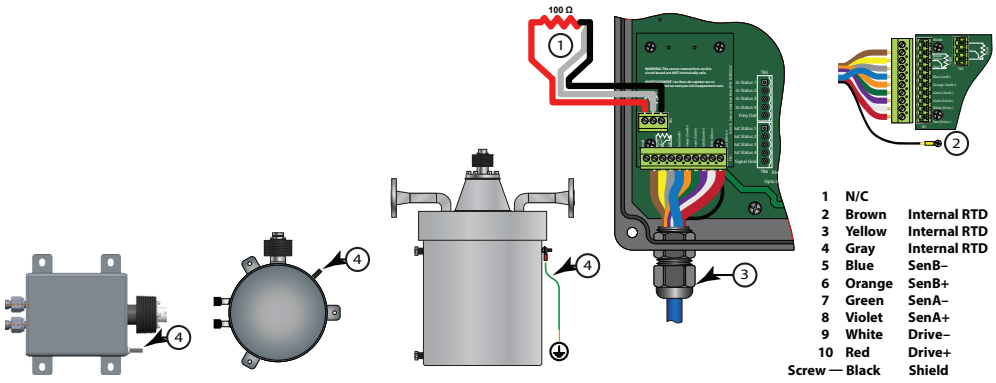


Figure 18: RCTN sensor connections

1	RTD	100 Ω RTD number 2 (optional)	**3**	Connector	Weather resistant
2	Ground	Shield wire connected to case*	**4**	Ground	Protective (earth), 10 AWG (4 mm^2) minimum

*With the transmitter oriented as shown in *Figure 20*, the correct landing for the shield wire is the screw located on the furthest bottom left area of the main board, closest to the sensor wire entry point of the transmitter.

INPUTS / OUTPUTS

The RCTN has three analog outputs available to send signals to peripheral devices (such as loop–powered remote indicators, controllers and similar equipment). Using the keypad or the RCT Console software for any range between 0…22 mA, the user may independently set these outputs. The default is 4…20 mA. The maximum load (loop) impedance for each output is 500 Ω.

Normally the Iout1 output is set for mass flow. However, this output can represent other parameters. In these cases, the units of measure are (appropriately) different.

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

The frequency/pulse output signal is available as an open collector. This channel is user selected to operate as either a straight frequency output, a pulse output or a PWM output suitable for totalizing.

NOTE: The maximum current-sinking capacity of the outputs is 100 mA.

NOTE: The open collector output requires a DC voltage of 5…28V DC and a pullup resistor to form a positive voltage pulse. It is preferable to make this connection in the users' equipment since the preferred voltage should be available there.

Outputs	Qty	Labeled	Use
4-20 mA	**3**	Iout1 Iout2 Iout3	The current output reports the configured process variable. The current output parameters control how the process variable reports. Sends signals to peripheral devices such as loop-powered remote indicators, controllers and similar equipment.
Frequency	**1**	Freq Out	The frequency output can be configured for frequency, pulse or PWM and reports a process variable to counters or totalizers.
Status	**4**	Out Status 1 Out Status 2 Out Status 3 Out Status 4	An output status event is used to provide notification of process changes and, optionally, to perform specific transmitter actions if the event occurs. An output status event occurs if the real-time value of a user-specified process variable moves above a high setpoint or below a low setpoint. Output status events can also be programed to occur when a process is within a user-defined range or out of a user-defined range with respect to two user-defined setpoints.
DC Out	**1**	+DC Out	Unregulated DC supply that can be used to internally power frequency out and status I/O outputs.

Inputs	Qty	Labeled	Use
Status	**4**	In Status 1 In Status 2 In Status 3 In Status 4	Status inputs are digital signals used to initiate many of the transmitters advanced functions.
Analog In	**2**	Analog In Analog In 2	Used to form ratio between the analog input and an analog signal from other devices such as flow, temperature, density, pressure and others.

Table 1: RCTN Input/Output listing

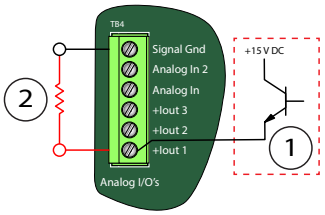


Figure 19: 4 –20 mA current output

1		Representation of internal I/O circuit
2	Load	500 Ω maximum

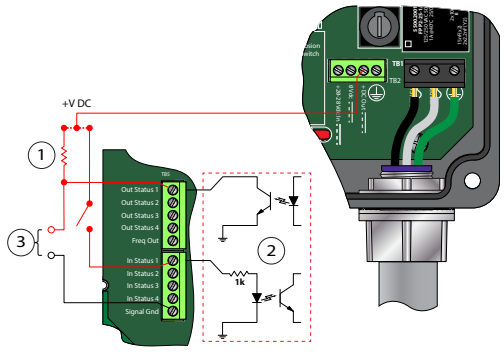


Figure 20: Status inputs and outputs internally powered

1	Resistor	Pullup
2		Representation of internal I/O circuit
3	External device	PLC, pulse counter or other compatible inputs

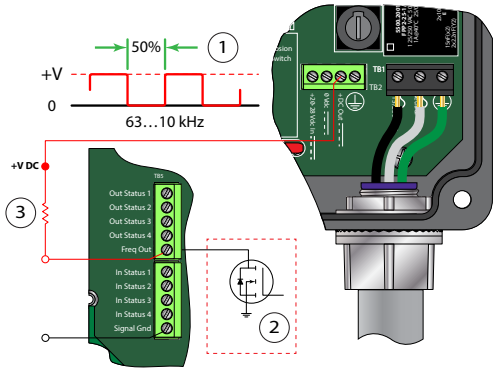


Figure 21: Frequency output internally powered

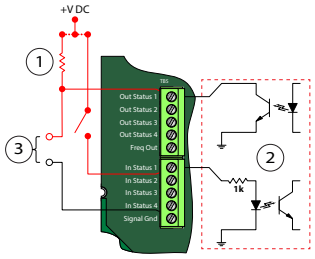


Figure 22: Status inputs and outputs externally powered

1	Output representation	50% duty cycle, 63…10k Hz maximum frequency
2		Representation of internal I/O circuit
3	Load	External frequency input device

1	Resistor	Pullup
2		Representation of internal I/O circuit
3	External device	PLC, pulse counter or other compatible inputs

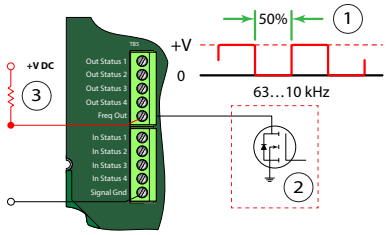


Figure 23: Frequency output externally powered

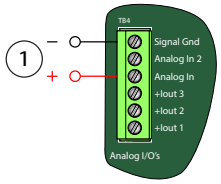


Figure 24: 0…5 Volt input

1	Output representation	50% duty cycle, 63…10k Hz maximum frequency
2		Representation of internal I/O circuit
3	Load	External frequency input device

1	Input	0…5V DC

To preserve environmental sealing of the RCTN, a specific fastener tightening pattern and torque setting is required. Tighten the captive fasteners to a torque setting of 20 in-lb. Follow the pattern in *Figure 25.*

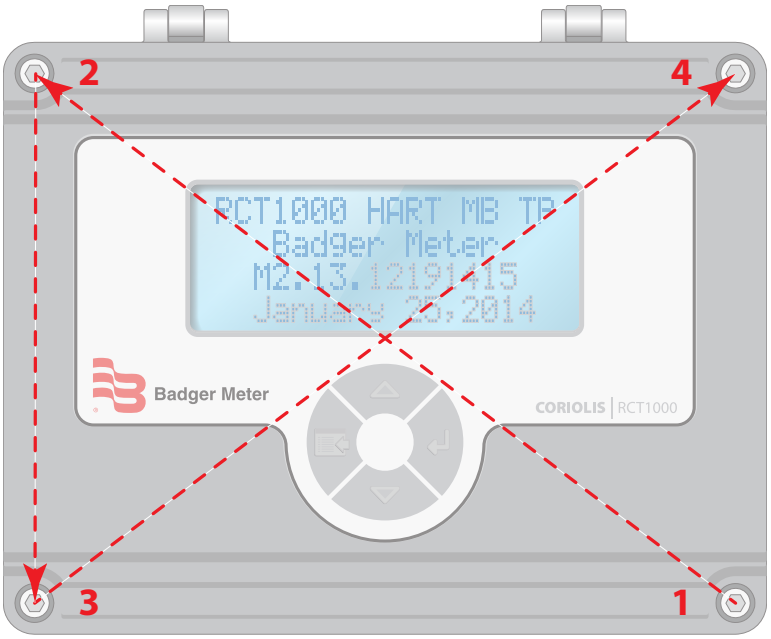


Figure 25: Fastener tightening pattern

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 provided on the provided USB thumb drive.

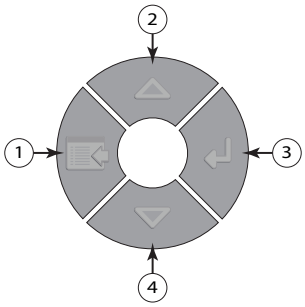
The following procedure outlines the commissioning of the system via the keypad on the transmitter.

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 is accomplished when any button is pressed and held for a time greater than two seconds.



1	Button	Menu/Exit
2	Button	Up arrow
3	Button	Enter
4	Button	Down arrow

Figure 26: RCT1000 keypad

Conventions

Button Name	Button 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 2: Keyboard icons

The Active Line

The RCT1000 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, respectively.

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

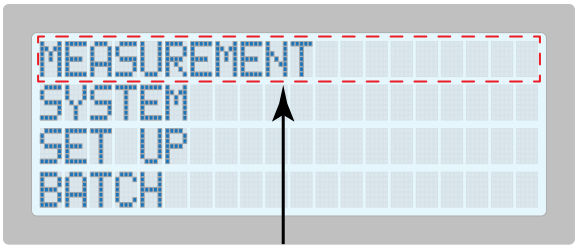


Figure 27: The active line

Button Functions Based on Location In Menus

Keypad Functions from the Home Screen (Without Warnings)			
Button	**Press Duration**	**Function**	**Notes**
	Press	Steps into the top level menu screen.	
	Long Press		
	Press	Scrolls the user defined parameters upward.	
	Long Press		
	Press	Scrolls the user defined parameters downward.	
	Long Press		
	Press	Performs no action.	
	Long Press	Edits parameter in active line assuming password access allows it.	

Keypad Functions from the Home Screen (With Warnings)			
Button	**Press Duration**	**Function**	**Notes**
	Press	Shows the warnings screen.	
	Long Press	Steps into the top level menu system.	
	Press	Scrolls the user defined parameters upward.	If not within warning screen.
	Long Press		
	Press	Scrolls the user defined parameters downward.	If not within warning screen.
	Long Press		
	Press	Performs no action.	
	Long Press	Edits parameter in active line assuming password access allows it.	

Keypad Functions from the Top Level Menu Screen (Without Warnings)			
Button	**Press Duration**	**Function**	**Notes**
	Press	Returns user to *Home* screen.	
	Long Press		
	Press	Scrolls the list of available menus upward.	
	Long Press		
	Press	Scrolls the list of available menus downward.	
	Long Press		
	Press	Steps into the menu shown on the active line.	
	Long Press		

Keypad Functions from the Top Level Menu Screen (With Warnings)			
Button	**Press Duration**	**Function**	**Notes**
	Press	Shows the warning screen.	
	Long Press	Returns the user to the home screen.	
	Press	Scrolls the list of available menus upward.	If not within warning screen.
	Long Press		
	Press	Scrolls the list of available menus downward.	If not within warning screen.
	Long Press		
	Press	Steps into the menu shown on the active line.	
	Long Press		

Keypad Functions from Submenus (Without Warnings)			
Button	**Press Duration**	**Function**	**Notes**
	Press	Returns user to the parent menu.	
	Long Press		
	Press	Scrolls the list of available submenus upward.	
	Long Press		
	Press	Scrolls the list of available submenus downward.	
	Long Press		
	Press	Steps into the menu shown on the active line.	
	Long Press		

Keypad Functions from Submenus (With Warnings)			
Button	**Press Duration**	**Function**	**Notes**
	Press	Shows the warning screen.	
	Long Press	Returns user to the parent menu.	
	Press	Scrolls the user defined submenus upward.	If not within warning screen.
	Long Press		
	Press	Scrolls the user defined submenus downward.	If not within warning screen.
	Long Press		
	Press	Steps into the menu shown on the active line.	
	Long Press		

Keypad Functions from the Parameter Screens (Without Warnings)			
Button	**Press Duration**	**Function**	**Notes**
	Press	Returns user to the parent menu.	
	Long Press		
	Press	Scrolls the parameter list upward.	
	Long Press		
	Press	Scrolls the parameter list downward.	
	Long Press		
	Press	Performs no action.	
	Long Press	Initiates the editing function for the parameter in the active line.	

Keypad Functions from the Parameter Screens (With Warnings)			
Button	**Press Duration**	**Function**	**Notes**
	Press	Shows the warning screen.	
	Long Press	Returns user to the parent menu.	
	Press	Scrolls the parameters list upward.	If not within warning screen.
	Long Press		
	Press	Scrolls the parameters list downward.	If not within within warning screen.
	Long Press		
	Press	Performs no action.	
	Long Press	Initiates the editing function for the parameter in the active line.	

Keypad Functions from the Parameter Edit Screens (Without Warnings)			
Button	**Press Duration**	**Function**	**Notes**
	Press	Clears the edited value to +0.	
	Long Press	Cancels edit(s) and returns to the parameter screen.	
	Press	**Values:** Increment. **Resolution:** Increment. **Units:** Scrolls available list upward.	
	Long Press	Moves the cursor to the right if the value is being edited.	
	Press	**Values:** Decrement. **Resolution:** Decrement. **Units:** Scrolls available list downward.	
	Long Press	Moves the cursor to the left if the value is being edited.	
	Press	Cycles through editing areas (value, resolution and units).	Does nothing for list type parameters.
	Long Press	Saves any changes and returns user to the parent parameter screen.	

Keypad Functions from the Parameter Edit Screens (With Warnings)
Warnings cannot be handled when in editing mode.

Keypad Functions from the Parameter Edit Screens (List Type) (Without Warnings)			
Button	**Press Duration**	**Function**	**Notes**
	Press	Reverts to the first selection on the list.	
	Long Press	Cancels edit(s) and returns to the parameter screen.	
	Press	Scrolls the list options upward.	
	Long Press		
	Press	Scrolls the list options downward.	
	Long Press		
	Press	Performs no action.	
	Long Press	Saves any changes and returns user to the parent parameter screen.	

Keypad Functions from Warning Screen		
Button	**Press Duration**	**Function**
	Press	Returns to the screen from which the warning screen was called.
	Long Press	Clears all warnings and returns to the screen from which the warning screen was called.
	Press	Scrolls the list of available warnings upward.
	Long Press	
	Press	Scrolls the list of available warnings downward.
	Long Press	
	Press	Displays the timestamp of warning in the active line at the time and date of occurrence.
	Long Press	

Keypad Functions from Warning Details Screen		
Button	**Press Duration**	**Function**
	Press	Returns to the warning screen.
	Long Press	Clears the individual warning and returns to the warning screen.
	Press	Performs no action.
	Long Press	
	Press	Performs no action.
	Long Press	
	Press	Performs no action.
	Long Press	

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

FINAL 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. See *"Sensor Check" on page 31* for additional details.
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 *"Initial Zeroing Procedure" on page 32*.

Startup Screens

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

1. Example of startup splash screen.

Figure 28: 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.

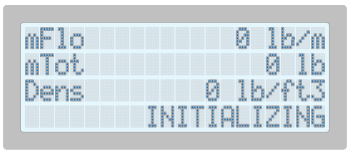


Figure 29: Transmitter initializing

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.

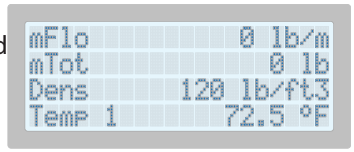


Figure 30: Sensor connected–no flow

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

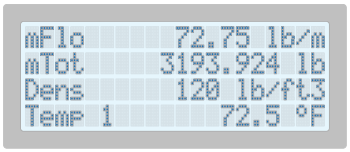


Figure 31: Sensor connected–with flow

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

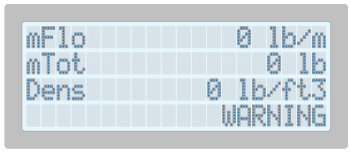


Figure 32: No sensor warning screen

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 User Manual.

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): Home Screen>Set Up>Calibration>Flow

DAlpha: Home Screen>Set Up>Calibration>Density

DBeta: Home Screen>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. This ensures there is no 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.

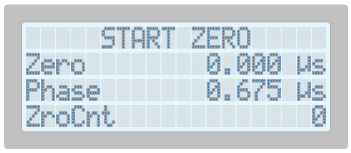


Figure 33: Start zero screen

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 *"Backing Up the Transmitter" on page 35*.
13. Open the blocking valves. The meter is now ready to use.

HOME SCREEN SETUP

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

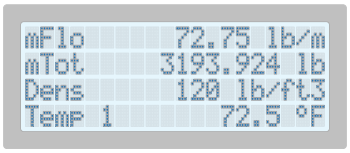


Figure 34: Home screen example

The RCT1000 has 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 edit which parameters are seen, 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**.
4. 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)
5. 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.
6. Press and hold **Enter**.
7. Use **Up** or **Down** to scroll through the available options (*Show menu* or *Hide menu*).
8. 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 35: Example of startup screen

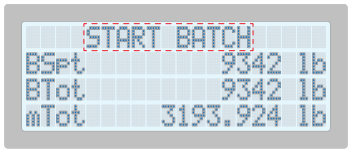


Figure 36: Example of a command

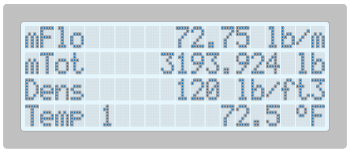


Figure 37: Home screen or base parameter level within a menu

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.

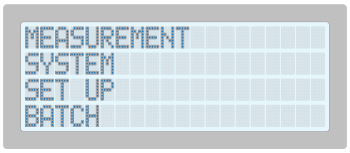


Figure 38: Example of transmitter being in menus or submenus

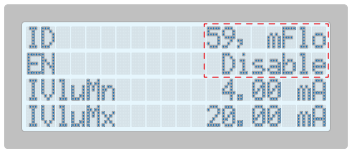


Figure 39: Example of parameters with enumerations

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.

BACKING UP THE TRANSMITTER

There are three ways to create backups:

- Automatically through flagged parameters (See the User Manual for a list of flagged parameters.)
- Manually through the HMI
- Through the RCT Console software

Automatic 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 40: Parameter change triggered backup

Manual 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 41*).

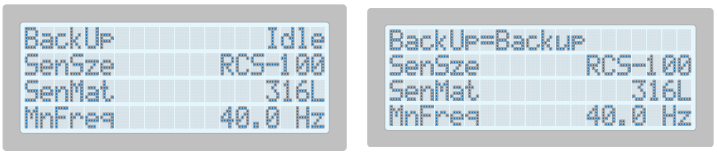


Figure 41: Backup triggered from menu

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.

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

RCT transmitters have three current outputs 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 *Home* screen>*SET UP*>*SYSTEM IO* menu contains three current output channels:

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

NOTE: *Table 3* describes Current Output 1 setup. The setup for Current Output 2 and Current Output 3 are similar.

Parameter	Description	Password Levels											
		Operator				Technician				Engineer			
		Read	Write			Read	Write			Read	Write		
			Vlu	Unt	Res		Vlu	Unt	Res		Vlu	Unt	Res
IOut1	Current output on current channel 1	X		X	X	X		X	X	X		X	X
ID	Parameter ID	X				X	—			X	—		
EN	Enable current channel 1	X				X	—			X	—		
IVluMn	Current value associated with minimum flow	X		X	X	X	X	X	X	X	X	X	X
IvluMx	Current value associated with maximum flow	X		X	X	X	X	X	X	X	X	X	X
VluMn	Parameter value associated with minimum flow	X		X	X	X	X	X	X	X	X	X	X
VluMx	Parameter value associated with maximum flow	X		X	X	X	X	X	X	X	X	X	X
TstOut	Tests current channel 1 output	X		X	X	X	X	X	X	X	X	X	X
+AltI1	Enables alternate current on current channel 1 output	X				X	—			X	—		

Table 3: Current output 1 setup

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 PWM output that varies the ratio of on time to a set period. The output can be configured for an 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 Home screen> *SET UP*> *SYSTEM I/O*> *FREQUENCY SETUP* menu.

Selecting *FREQUENCY SETUP* enters the frequency/pulse out menu which contains the items shown in *Table 4*.

NOTE: The availability of the items depends on the password level selected.

Parameter	Description	Password Levels											
		Operator				Technician				Engineer			
		Read	Write			Read	Write			Read	Write		
			Vlu	Unt	Res		Vlu	Unt	Res		Vlu	Unt	Res
FrqOut	Frequency output	X		X	X	X		X	X	X		X	X
FrqOEN	Enables frequency 1 output	X				X	—			X	—		
ID	Parameter ID for frequency 1 output	X				X	—			X	—		
EN	Enables frequency 1 output	X				X	—			X	—		
FrqMn	Frequency value associated with minimum flow	X		X	X	X	X	X	X	X	X	X	X
FrqMx	Frequency value associated with maximum flow	X		X	X	X	X	X	X	X	X	X	X
VluMn	Parameter value associated with minimum flow	X		X	X	X	X	X	X	X	X	X	X
VluMx	Parameter value associated with maximum flow	X		X	X	X	X	X	X	X	X	X	X
TstOut	Tests frequency 1 output	X		X	X	X	X	X	X	X	X	X	X
+AltFrq	Enables alternate frequency and PWM on frequency 1 output	X				X	—			X	—		
PlsOM	Pulse output mode	X				X	—			X	—		
PlsID	Pulse output item	X				X	—			X	—		
PlsSze	Pulse size	X		X	X	X	X	X	X	X	X	X	X
PlsWth	Pulse width	X				X	—			X	—		
PWMPer	Controls the period of PWM frequency in ms	X				X	—			X	—		
PWMAlt	Simulates an output based on percent of PWMPer	X		X	X	X	X	X	X	X	X	X	X

Table 4: Frequency/pulse/PWM outputs

COMMUNICATION WIRING AND SETUP

All RCT100 transmitters include EIA-485 and USB programming ports.

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 / USB Configuration

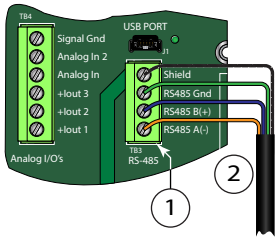


Figure 42: EIA-485 wiring diagram

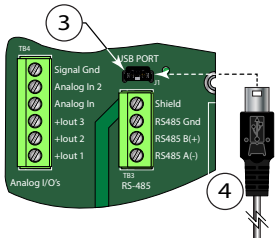


Figure 43: USB wiring diagram

1	Connector	TB3–RS485
2	Wiring	Field–RS485
3	Connector	USB Mini–B
4	Cable	USB Mini–B

Parameters are available to configure the EIA–RS485 and USB ports. Engineer (PW3) level access is required to change of the default settings.

Parameter selection is in menu *SET UP* > *SYSTEM IO* > *COM PORTS*

ComAdd is the parameter for the network device address.

1. To change the network device address, scroll to parameter *ComAdd* then press and hold **Enter** until the cursor starts flashing under the first digit of the address.
2. Press and hold **Up** to move the cursor to the correct digit.
3. Use **Up** or **Down** to increment the address number.
4. Press and hold **Enter** for a Long Press to save the change, or press and hold **Menu/Exit** to cancel the edit(s) and return to *COM PORTS* parameter screen.

ComPr1 is the parameter for the protocol selection.

1. To change the protocol selection, scroll to parameter *ComPr1* then press and hold **Enter**.
2. Press **Up** or **Down** to scroll to the appropriate option.
3. Press and hold **Enter** for a Long Press to save the change, or press and hold **Menu/Exit** for a Long Press to cancel the edit(s) and return to *COM PORTS* parameter screen.

BaudRate is the parameter for the baud rate setting. Valid baud rates are 1200, 2400, 4800, 9600, 19200 and 38400.

NOTE: The baud rate setting is common for all ports. If an optional communication card is used, then the baud rate must be set to 38400.

1. To change the network device address, scroll to *BaudRate* then press and hold **Enter**.
2. Press and hold **Up** to move the cursor to the correct digit.
3. Use **Up** or **Down** to increment the numbers in the baud rate parameter.
4. Press and hold **Enter** for a Long Press to save the change, or press and hold **Menu/Exit** to cancel the edit(s) and return to *COM PORTS* parameter screen.

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. See the *Coriolis RCT1000 Product Data Sheet* for ordering information.

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

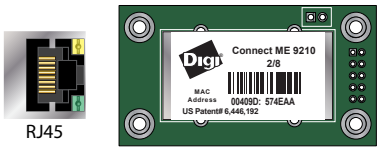


Figure 44: Ethernet card

TROUBLESHOOTING

⚠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

See user manual for a full description of LED diagnostics.

Troubleshooting Symptoms

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.

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. Ensure 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.

Symptom	Possible Cause	Recommended Action
Abnormal or Incorrect Mass Flow Readings	**Installation issues Flow instability**	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 Home Screen > 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%
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 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) **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 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**	Refer to Output Configuration 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.

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. PID output limits 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			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 5: Error messages

RCT Console Basics

See user manual for a description on the installation of RCT Console.

Control. Manage. Optimize.

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The Americas | Badger Meter | 4545 West Brown Deer Rd | PO Box 245036 | Milwaukee, WI 53224-9536 | 800-876-3837 | 414-355-0400
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Europe, Middle East and Africa | Badger Meter Europa GmbH | Nurtinger Str 76 | 72639 Neuffen | Germany | +49-7025-9208-0
Europe, Middle East Branch Office | Badger Meter Europe | PO Box 341442 | Dubai Silicon Oasis, Head Quarter Building, Wing C, Office #C209 | Dubai / UAE | +971-4-371 2503
Czech Republic | Badger Meter Czech Republic s.r.o. | Mařikova 2082/26 | 621 00 Brno, Czech Republic | +420-5-41420411
Slovakia | Badger Meter Slovakia s.r.o. | Racianska 109/B | 831 02 Bratislava, Slovakia | +421-2-44 63 83 01
Asia Pacific | Badger Meter | 80 Marine Parade Rd | 21-06 Parkway Parade | Singapore 449269 | +65-63464836
China | Badger Meter | 7-1202 | 99 Hangzhong Road | Minhang District | Shanghai | China 201101 | +86-21-5763 5412