Reference Manual
00809-0100-3565, Rev AB
July 2020

Rosemount™ Clarity II T56 Turbidmeter

ROSEMOUNT™

EMERSON™

Essential instructions

Read this page before proceeding!

Your instrument purchase from Emerson is one of the finest available for your particular application. These instruments have been designed and tested to meet many national and international standards. Experience indicates that its performance is directly related to the quailty of the installation and knowledge of the user in operating and maintaining the instrument. To ensure continued operation to the design specifications, read this Manual thoroughly before proceeding with installation, commissioning, operation, and maintenance of this instrument. If this equipment is used in a manner not specified by the manufacturer, the protection provided by it against hazards may be impaired.

- Failure to follow the proper instructions may cause any one of the following situations to occur: loss of life, personal injury, property damage, damage to this instrument, and warranty invalidation.
- Ensure that you have received the correct model and options from your purchase order. Verify that this Manual covers your model and options. If not, call 1-800-854-8257 or 949-757-8500 to request the corrrect Manual.
- For clarification of instructions, contact your Rosemount representative.
- Follow all warnings, cautions, and instructions marked on and supplied with the product.
- Use only qualified personnel to install, operate, program, and maintain the product.
- Inform and educate your personnel in the proper installation, operation, and maintenance of the product.
- Install equipment as specified in the installation section of this Manual. Follow appropriate local and national codes. Only connect the product to electrical and pressure sources specified in this Manual.
- Use only factory documented components for repair. Tampering or unauthorized substitution of parts can affect product performance and cause unsafe operation of your process.
- All equipment doors must be closed, and protective covers must be in place unless qualified personnel are performing maintenance.

⚠ WARNING

Risk of electrical shock

Installation and servicing of this product may expose personnel to dangerous voltages.

Equipment protected throughout by double insulation.

Disconnect main power wired to separate power source before servicing.

Do not operate or energize instrument with case open.

Signal wiring within this box must be rated at least 240 V.

Non-metallic cable strain reliefs do not provide grounding between conduit connections. Use grounding type bushings and jumper wires.

Unused cable conduit entries must be securely sealed by non-flammable closures to provide exposure integrity in compliance with personal safety and environmental protection requirements. Unused conduit openings must be sealed with Type 4X or IP66 conduit plugs to maintain the ingress protection rating (Type 4X).

Electrical installation must be in accordance with the National Electrical Code (ANSI/NFPA-70) and/or any other national or local codes.

Operate only with front panel fastened and in place.

Proper use and configuration is the operator's responsibility.

⚠ CAUTION

Radio interference

This product generates, uses, and can radiate radio frequency energy and thus can cause radio communication interference. Improper installation or operation may increase such interference. As temporarily permitted by regulation, this unit has not been tested for compliance within the limits of Class A computing devices, pursuant to Subpart J of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference.

Operation of this equipment in a residential area may cause interference, in which case the operator, at his own expense, will be required to take whatever measures may be required to correct the interference.

⚠ CAUTION

Industrial environments

This product is not intended for use in the light industrial, residential, or commercial environments per the instrument's certification to EN50081-2.

⚠ WARNING

Physical access

Unauthorized personnel may potentially cause significant damage to and/or misconfiguration of end users' equipment. This could be intentional or unintentional and needs to be protected against.

Physical security is an important part of any security program and fundamental to protecting your system. Restrict physical access by unauthorized personnel to protect end users' assets. This is true for all systems used within the facility.

Warranty

1. LIMITED WARRANTY: Subject to the limitations contained in Section 2 herein and except as otherwise expressly provided herein, Emerson ("Seller") warrants that the firmware will execute the programming instructions provided by Seller and that the Goods manufactured or Services provided by Seller will be free from defects in materials or workmanship under normal use and care until the expiration of the applicable warranty period. Goods are warranted for twelve (12) months from the date of initial installation or eighteen (18) months from the date of shipment by Seller, whichever period expires first. Consumables and Services are warranted for a period of 90 days from the date of shipment or completion of the Services. Products purchased by Seller from a third party for resale to Buyer ("Resale Products") shall carry only the warranty extended by the original manufacturer. Buyer agrees that Seller has no liability for Resale Products beyond making a reasonable commercial effort to arrange for procurement and shipping of the Resale Products. If Buyer discovers any warranty defects and notifies Seller thereof in writing during the applicable warranty period, Seller shall, at its option, promptly correct any errors that are found by Seller in the firmware or Services, or repair or replace F.O.B. point of manufacture that portion of the Goods or firmware found by Seller to be defective, or refund the purchase price of the defective portion of the Goods/Services. All replacements or repairs necessitated by inadequate maintenance, normal wear and usage, unsuitable power sources, unsuitable environmental conditions, accident, misuse, improper installation, modification, repair, storage or handling, or any other cause not the fault of Seller are not covered by this limited warranty, and shall be at Buyer's expense. Seller shall not be obligated to pay any costs or charges incurred by Buyer or any other party except as may be agreed upon in writing in advance by an authorized Seller representative. All costs of dismantling, reinstallation and freight, and the time and expenses of Seller's personnel for site travel and diagnosis under this warranty clause shall be borne by Buyer unless accepted in writing by Seller. Goods repaired and parts replaced during the warranty period shall be in warranty for the remainder of the original warranty period or ninety (90) days, whichever is longer. This limited warranty is the only warranty made by Seller and can be amended only in a writing signed by an authorized representative of Seller. Except as otherwise expressly provided in the Agreement, THERE ARE NO REPRESENTATIONS OR WARRANTIES OF ANY KIND, EXPRESSED OR IMPLIED, AS TO MERCHANTABILITY, FITNESS FOR PARTICULAR PURPOSE, OR ANY OTHER MATTER WITH RESPECT TO ANY OF THE GOODS OR SERVICES. It is understood that corrosion or erosion of materials is not covered by our guarantee.

2. LIMITATION OF REMEDY AND LIABILITY: SELLER SHALL NOT BE LIABLE FOR DAMAGES CAUSED BY DELAY IN PERFORMANCE. THE SOLE AND EXCLUSIVE REMEDY FOR BREACH OF WARRANTY HEREUNDER SHALL BE LIMITED TO REPAIR, CORRECTION, REPLACEMENT, OR REFUND OF PURCHASE PRICE UNDER THE LIMITED WARRANTY CLAUSE IN SECTION 1 HEREIN. IN NO EVENT, REGARDLESS OF THE FORM OF THE CLAIM OR CAUSE OF ACTION (WHETHER BASED IN CONTRACT, INFRINGEMENT, NEGLIGENCE, STRICT LIABILITY, OTHER TORT, OR OTHERWISE), SHALL SELLER'S LIABILITY TO BUYER AND/OR ITS CUSTOMERS EXCEED THE PRICE TO BUYER OF THE SPECIFIC GOODS MANUFACTURED OR SERVICES PROVIDED BY SELLER GIVING RISE TO THE CLAIM OR CAUSE OF ACTION. BUYER AGREES THAT IN NO EVENT SHALL SELLER'S LIABILITY TO BUYER AND/OR ITS CUSTOMERS EXTEND TO INCLUDE INCIDENTAL, CONSEQUENTIAL, OR PUNITIVE DAMAGES. THE TERM "CONSEQUENTIAL DAMAGES" SHALL INCLUDE, BUT NOT BE LIMITED TO, LOSS OF ANTICIPATED PROFITS, LOSS OF USE, LOSS OF REVENUE, AND COST OF CAPITAL.

Contents

1 Description and specifications

1.1 Features and applications

The Rosemount T56 turbidmeter is intended for the determination of turbidity in water. Low stray light, high stability, efficient bubble rejection, and a display resolution of 0.001 NTU make the turbidmeter ideal for monitoring the turbidity of filtered drinking water. You can also use the turbidmeter in applications other than drinking water treatment. Examples are monitoring wastewater discharges, condensate returns, and clarifiers.

Currently, new ISO 7027 systems are available, with replacement EPA 180.1 sensors available for current install base. USEPA 180.1 sensors use a visible light source. ISO 7027 sensors use a near infrared light emitting diode (LED). For regulatory monitoring in the United States, you must use USEPA 180.1 sensors. Regulatory agencies in other countries may have different requirements.

The turbidmeter consists of a transmitter, which accepts either one or two sensors, the sensors themselves, and a debubbler/measuring chamber and cable for each sensor. The cable plugs into the sensor and the transmitter, making setup fast and easy. Sensors can be located as far as 50 ft. (15.2 m) away from the transmitter.

The turbidmeter incorporates the popular and easy to use Rosemount 1056 transmitter. Menu flows and prompts are so intuitive that you practically do not need a manual. Analog outputs are fully scalable. Alarms are fully programmable for high/low logic and dead band. To simplify programming, the transmitter automatically detects whether an EPA 180.1 or ISO 7027 sensor is being used.

The turbidmeter is available in an optional configuration in which the transmitter, sensor(s), and debubbling flow cell(s) are mounted on a single back plate. The sensor cables are pre-wired to the transmitter, so setup is exceptionally fast and easy. Simply mount the unit on a wall, bring in power and sample, and provide a drain. To order this option, consult the factory.

1.2 Specifications

Note
Specifications subject to change without notice.

1.2.1 General specifications

Enclosure	Polycarbonate. Type 4X/CSA 4X IP66
Dimensions	6.2 x 6.2 x 5.2-in. (157 x 157 x 132 mm)
Conduit openings	Accepts ½-in. or PG 13.5 conduit fittings.
Display	Large 3.76 x 2.2-in. (95.3 x 55.9 mm) high resolution color LCD display for large process variables and user-definable display of diagnostic parameters. Back-lighting is user adjustable. You can customize the main display to meet your requirements.

Measurement character height	0.5-in. (13 mm)
Security code	Three-digit code prevents accidental or unauthorized changes in instrument settings and calibration.
Languages	• English • French • German • Italian • Spanish • Portuguese • Chinese • Russian • Polish
Units	Turbidity • NTU • FTU • FNU Total suspended solids • mg/L • ppm • No units
Display resolution: turbidity	Four digits; decimal point moves from x . xxx to xxx . x
Display resolution: TSS	Four digits; decimal point moves from x . xxx to xxx . x
Calibration methods	User-prepared standard, commercially prepared standard, or grab sample. For total suspended solids, you must provide a linear calibration equation.
Ambient temperature and humidity	32 to 131 °F (0 to 55 °C)
Altitude	For use up to 6562 ft. (2000 m).
Storage temperature	-4 to 140 °F (-20 to 60 °C)
Real time clock backup	24 hours
Power	85 to 265 Vac, 47.5 to 65.0 Hz, 20 W min. input power Equipment protected by double insulation.

Inputs One or two isolated sensor inputs.

Outputs Four 4-20 mA or 0-20 mA isolated current outputs. Fully scalable. Maximum load: 550 ohm. Output 1 has superimposed HART® signal.

Output dampening 0-999 seconds

Current output accuracy ±0.05 mA at 77 °F (25 °C)

Alarms Four process alarm relays for turbidity or temperature. You can also program relays for timer, TPC, or fault alarm operation instead of as process alarms. You can configure each relay independently. Alarm logic (high or low activation) and deadband are user-programmable.

Terminal connections rating Power connector (3 leads): 24-12 AWG wire size.
Signal board terminal blocks: 26-16 AWG wire size.
Current output connectors (2 leads): 24-16 AWG wire size.
Alarm relay terminal blocks: 24-12 AWG wire size.

RFI/EMI EN 61326 CE

LVD EN-61010-1 CE

Relays Form C, single pole, double throw, epoxy sealed

Table 1-1: Maximum Relay Current

Supply voltage	Resistive
28 Vdc 5.0 A	5.0 A
115 Vac 5.0 A	5.0 A
230 Vac 5.0 A	5.0 A

Field wiring terminals Removable terminal blocks for power, analog outputs, and sensors.

Transmitter hazardous location approvals

CSA approvals

Class 1, Division 2, Groups A, B, C, and D
Class II, Division 2, Groups E, F, and G
Class III T4A Tamb = 50 °C
Evaluated to the ANS/UL standards. The C and US indicators adjacent to the CSA mark signify that the product has been evaluated to the applicable CSA and ANSI/UL standards for use in Canada and the US respectively.

FM approvals

Class I, Division 2, Groups A, B, C, and D
Class II, Division 2, Groups E, F, and G
T4 Tamb = -10 °C to 60 °C

1.2.2 Sensor

Method	ISO 7027 (using 860 nm LED source).
LED life	Three years (ISO 7027)
Wetted materials	Delrin[1], glass, EPDM
Accuracy after calibration at 20.0 NTU	0 - 1 NTU: ±2 percent of reading or ±0.015 NTU, whichever is greater. 0 - 20 NTU: ±2 percent of reading
	Note The sensor can measure turbidity values of 2-200 NTU, but frequent cleaning may be required to maintain turbidity measurements.
Cable	20 ft. (6.1 m) or 50 ft (15.2 m). Connector is IP65.
Maximum pressure	30 psig (308 kPa abs)
Temperature	40 to 95 °F (5 to 35 °C)
Sensor body rating	IP65 when cable is connected.

1.2.3 Debubbler and flow chamber

Dimensions	18.1 x 4.1-in. (460 mm x 104 mm) diagram (approximately)
Wetted materials	ABS, EPDM, Delrin®, polypropylene, nylon
Inlet	Compression fitting accepts ¼-in. OD tubing; fitting can be removed to provide ¼-in. FNPT.
Drain	Barbed fitting accepts ⅜-in. ID tubing; fitting can be removed to provide ¼-in. female national pipe thread (FNPT). Must drain to atmosphere.
Sample temperature	40 to 95 °F (5 to 35 °C)
Minimum inlet pressure	3.5 psig (308 kPa abs). 3.5 psig will provide about 0.01 oz./min (250 mL/min) sample flow.
Maximum inlet pressure	30 psig (308 kPa abs). Do not block drain tube.
Recommended sample flow	0.01 to 0.03 oz./min (250 to 750 mL/min)

1.2.4 Miscellaneous

Weight/shipping weight

Sensor	1 lb./2 lb. (0.5 kg/1.0 kg)
Transmitter	2 lb./3 lb. (1.0 kg/1.5 kg)
Debubbler	3 lb./4 lb. (1.5 kg/2.0 kg) (rounded to the nearest lb. or 0.5 kg)

1.3 Ordering information

Ordering example with codes: T56-01-10-20-30

Table 1-2: Accessories

Part number	Description
23554-00	Cable gland kit for models 54e, XMT, 1055, and 1056 (quantity 5)
23820-00	Pipe/wall mounting bracket for models 1056, 1057, 5081, 6081, and XMT
23820-01	2-in. (51 mm) pipe mounting bracket, stainless steel
9240048-00	Stainless steel tag (specify marking)
24103-00	Flowmeter kit, includes valved rotameter and fittings
24101-00	Calibration cup
8-0108-0002-EPA	Turbidity sensor EPA 180.1 compliant
8-0108-0003-ISO	Turbidity sensor ISO 7027 compliant
1-0901-0010-ISO	Replacement lamp, ISO
24097-00	Sensor cable, turbidity, 20 ft. (6.1 m)
24098-00	Sensor cable, turbidity, 50 ft. (15.2 m)
24138-00	3 ft. (0.1 m) turbidity sensor cable for Clarity II
24170-00	Molded debubbler with integral flow chamber
9550145	O-ring for sensor, external, fits molded debubbler
9550322	O-ring for upper and lower debubbler caps

Table 1-3: Calibration Standards

Part number	Description
060-761855	Premixed 4000 NTU formazin calibration kit
905-761854	Replacement solution for 4000 NTU premixed kit

2 Install

2.1 Unpack and inspect

Consult the table to verify that you have received the parts for the option you ordered.

Table 2-1: Rosemount T56 Turbidmeter Parts

Item	Model/part number
Single input turbidity transmitter with HART®	56-03-27-38-HT
Dual input turbidity transmitter with HART	56-03-27-37-HT
Sensor - EPA standards	8-0108-0002-EPA
Sensor - ISO standard	8-0108-0003-ISO
Cable - 3 ft. (0.9 m)	2413800
Cable - 20 ft. (6.1 m)	2409700
Cable - 50 ft. (15.2 m)	2409800
Calibration cup	2410100
Molded chamber/debubbler	24170-00

2.2 General installation information

1. Although the transmitter is suitable for outdoor use, do not install it in direct sunlight or in areas of extreme temperatures.
2. Install the transmitter in an area where vibration and electromagnetic and radio frequency interference are minimized or absent.
3. Keep the transmitter and sensor wiring at least one foot (0.3 m) from high voltage conductors. Be sure there is easy access to the transmitter.
4. The transmitter is suitable for panel, pipe, or surface mounting. Refer to the figures below.

⚠ WARNING

Electrical shock

Electrical installation must be in accordance with the National Electrical Code (ANSI/NFPA-70) and/or any other applicable national or local codes.

Do not operate or energize instrument with case open.

Note

Dimensions are in inches (millimeters).

1. Panel supplied by others. Maximum thickness: 3.75 in. (9.52 mm)
2. 4X mounting brackets and screws provided with instrument

Figure 2-1: Panel Mount Front View

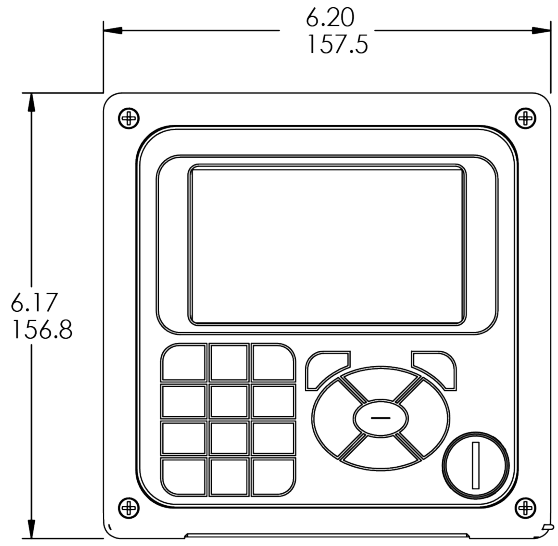
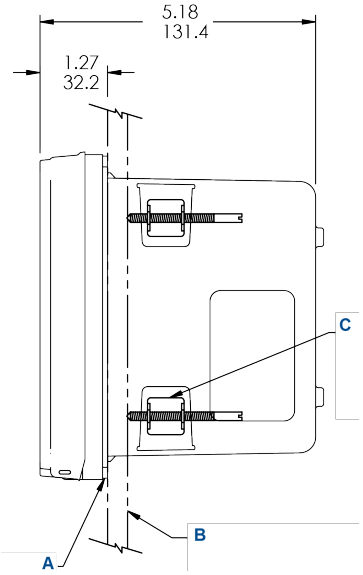
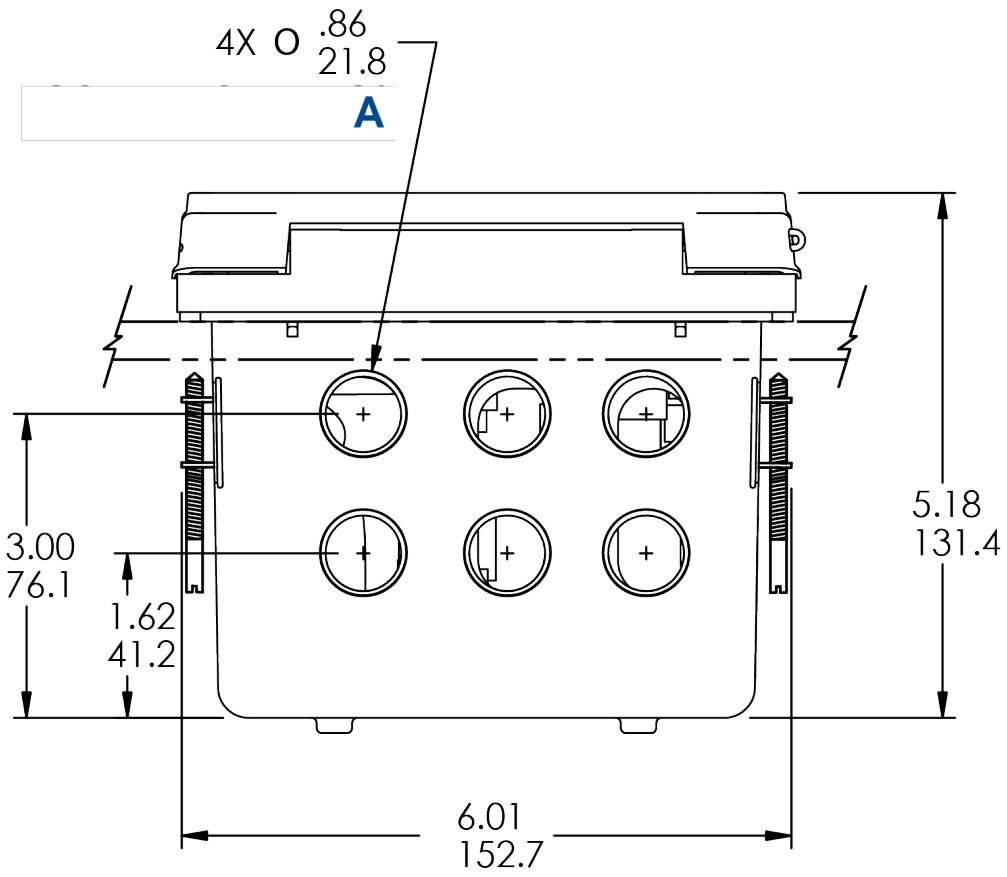


Figure 2-2: Panel Mount Side View



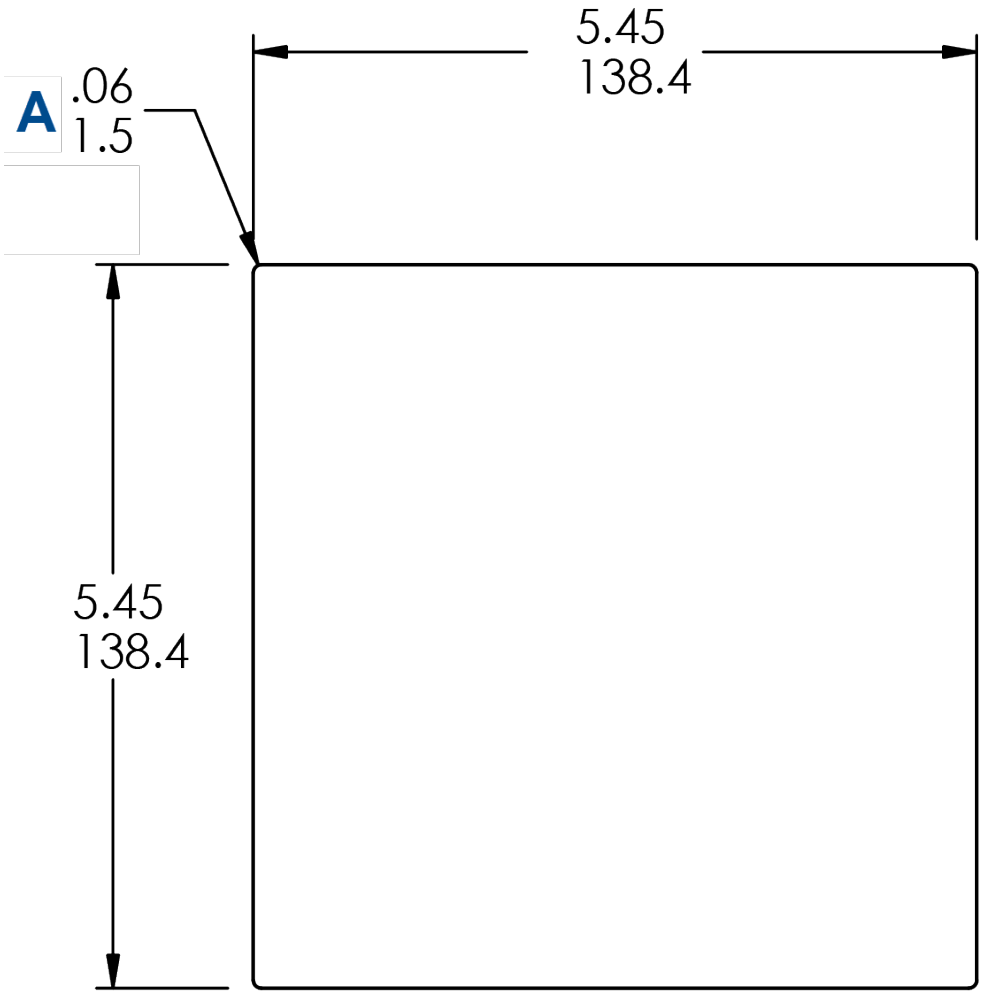
A. Panel mount gasket
B. Panel supplied by others. Maximum thickness: 0.375 in. (9.52 mm)
C. 4X mounting brackets and screws provided with instruments

Figure 2-3: Panel Mount Bottom View



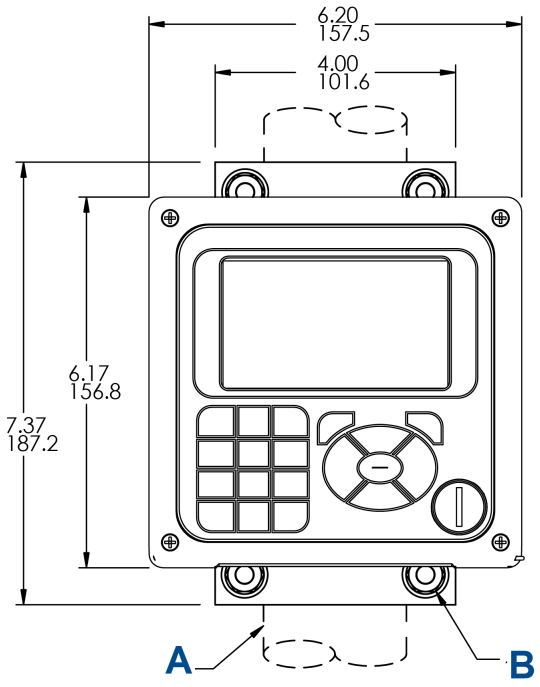
A. Conduit openings

Figure 2-4: Panel Cut-Out



A. Maximum

Figure 2-5: Wall/Surface Mount Front View



A. *2-in. pipe supplied by customer.*
Vertical pipe mounting shown. For horizontal pipe, rotate brackets and U-bolts 90 °.

Note
Unless otherwise specified.

B. *4X cover screw*

Figure 2-6: Wall/Surface Mount Side View

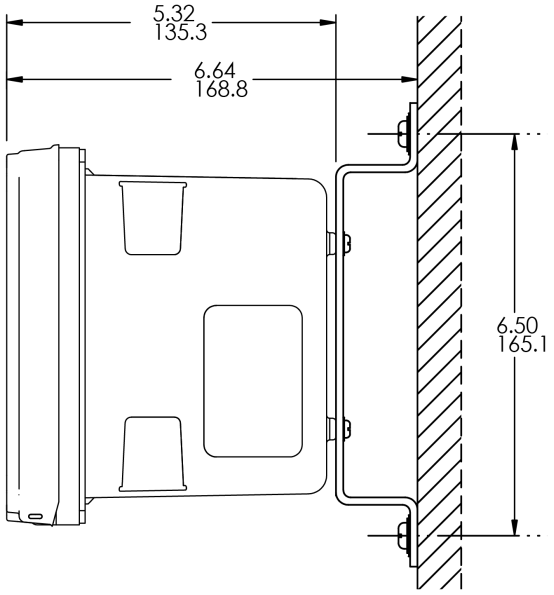
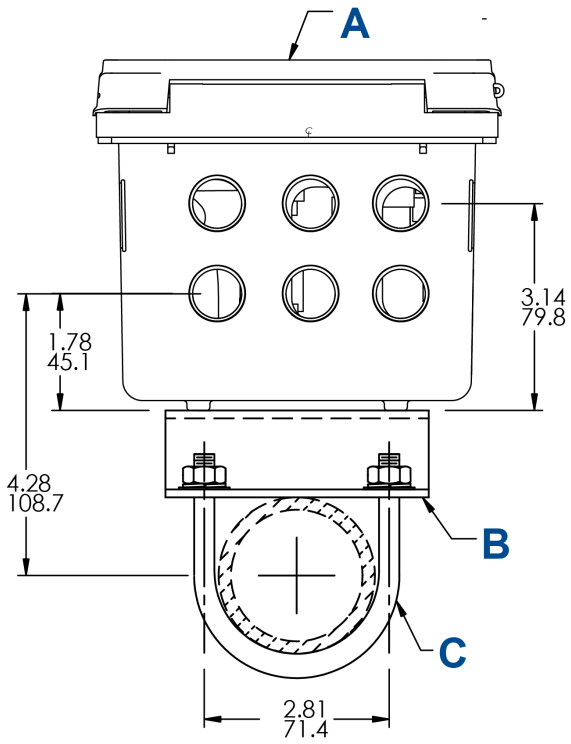
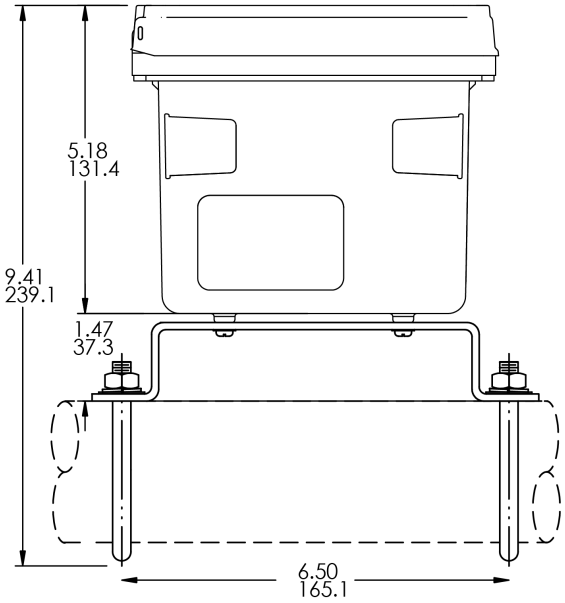


Figure 2-7: Pipe Mount Bottom View



A. Front panel
B. 2-in. pipe mount bracket
C. 2X set U-bolts for 2-in. pipe in kit PN 23820

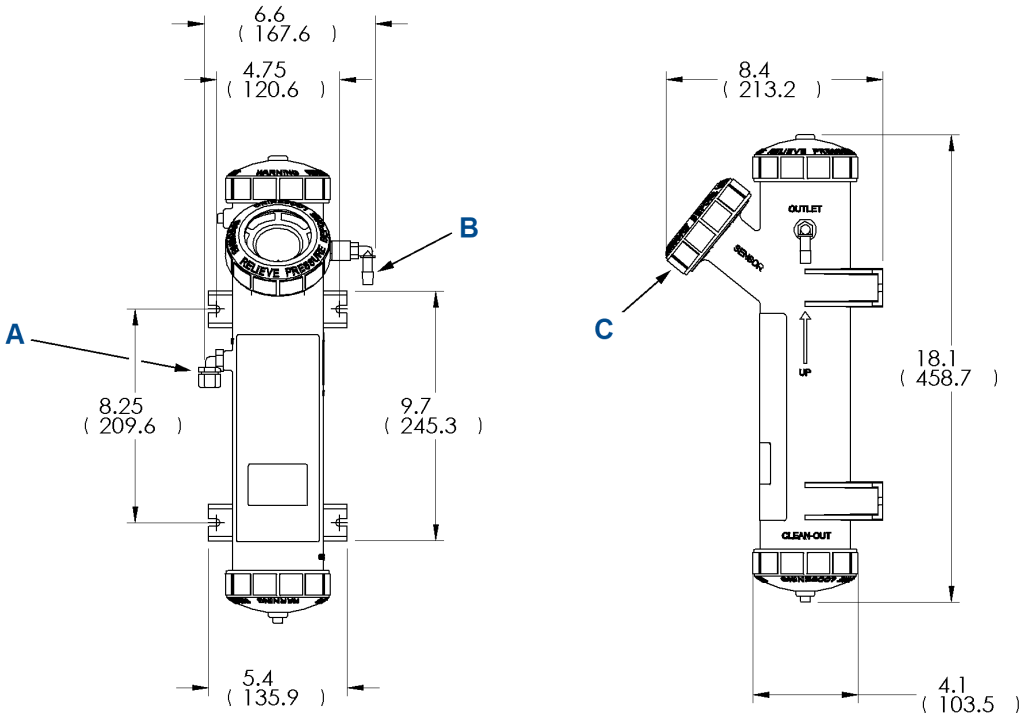
Figure 2-8: Pipe Mount Side View



2.3 Install debubbler assembly

See Figure 2-9 for installation.

Figure 2-9: Debubbler and Flow Chamber



A. Inlet
B. Outlet
C. Sensor port

Procedure

1. Connect the sample line to the inlet fitting.
   The fitting accepts ¼-in. OD tubing.
2. Attach a piece of ⅜-in. ID soft tubing to the drain fitting.
   The debubbler must drain to atmosphere.

⚠ WARNING

High pressure and temperature

Before removing the sensor, be absolutely certain that the process pressure is reduced to 0 psig and the process temperature is lowered to a safe level!

⚠ CAUTION

Reading errors

During operation, the debubbler is under pressure. A 0.040 in. (1 mm) orifice in the outlet provides the pressure. Back pressure helps prevent outgassing, which can lead to bubbles accumulating on the sensor face, resulting in erroneous readings.

Do not exceed 30 psig (308 kPa abs) inlet pressure.

The amount of pressure in the debubbler can be estimated from the flow rate. See Table 2-2.

Table 2-2: Approximate Debubbler Pressure as a Function of Flow (0.040 Inch Outlet Orifice)

gph	psig	mL/min	kPa abs
2	1	100	110
4	3	200	120
6	8	300	140
8	14	400	160
10	21	500	190
11	26	600	240
12	31	700	280
--	--	800	340

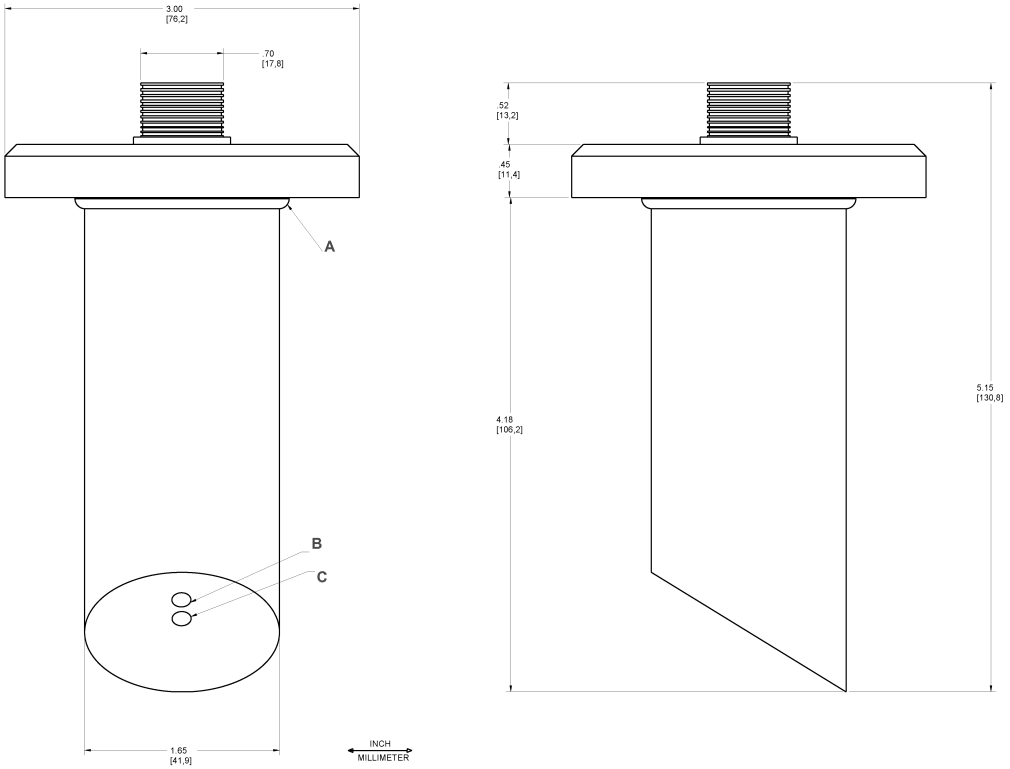
To control and monitor sample flow, a valved rotameter with fittings is available (PN 24103-00).

3. Attach the rotameter to the debubbler outlet.

   You can also use the rotameter to increase back pressure on the debubbler if additional pressure is needed to prevent outgassing.

2.4 Install sensor

Figure 2-10: Sensor



A. O-ring PN 9550145
B. Light source
C. Detector

Procedure

1. Unscrew the nut on the side of the debubbler.
2. Insert the sensor in the mouth of the measuring chamber.
   Be sure the pin on the debubbler lines up with the hole in the sensor.
3. Replace the nut.
4. Remove the protective cap from the sensor.
5. Screw the cable onto the receptacle.
   The plug and receptacle are keyed for proper alignment.

The sensor is rated to IP65 when properly connected to the cable.

Postrequisites

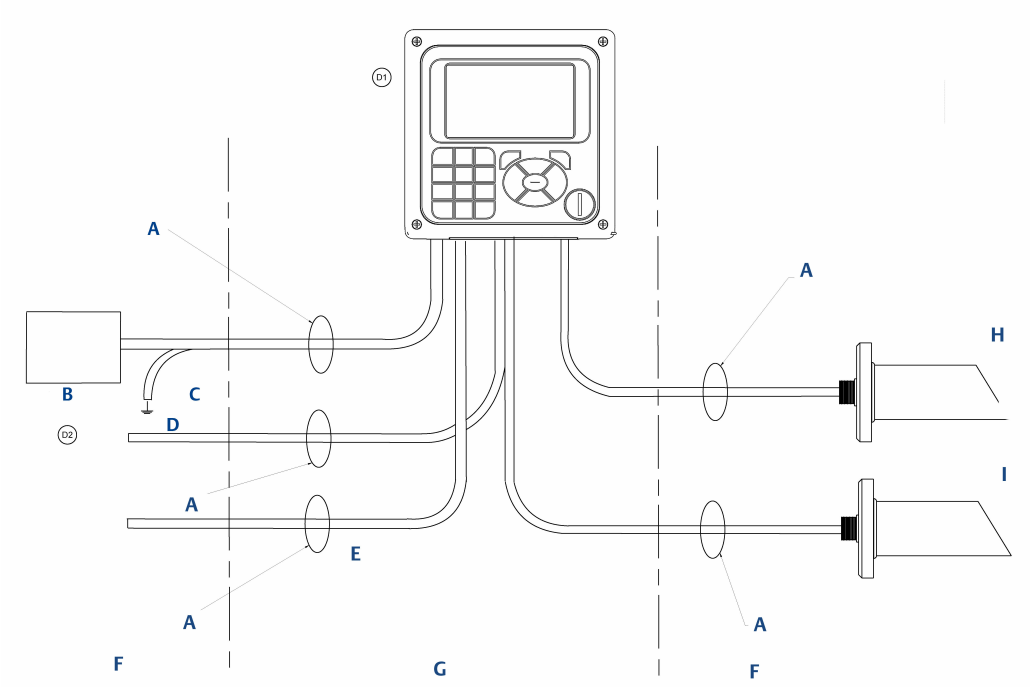
To prevent possible water damage to the connector contacts, be sure the cable receptacle and the connector on the back of the sensor are dry when connecting or disconnecting the cable.

2.5 Install Rosemount 56 transmitter

⚠ WARNING

Use with non-flammable process media only.

Figure 2-11: Non-Incendive Field Wiring Installation for the Rosemount 56-27-37 Transmitter



A. Metal conduit
B. Power supply
C. Ground connection may be made in hazardous areas.
D. Analog output
E. Alarm wiring (Vac) optional
F. Unclassified area
G. Hazardous area
H. Clarity II turbidity sensor #2 (optional)
I. Clarity II turbidity sensor #1 (optional)

- For FM installation, refer to installation drawing number 1400667.
- For CSA installation, refer to drawing number 1400668.

3 Wire

3.1 General wiring information

The transmitter is easy to wire.

The front panel is hinged at the bottom. The panel swings down for easy access to the wiring locations.

3.1.1 Removable connectors and signal input boards

The transmitter uses removable signal input boards and communication boards for ease of wiring and installation.

You can remove each of the signal boards either partially or completely from the enclosure for wiring. The transmitter has three slots for placement of up to two signal input boards and one communication board.

Slot 1 - left	Slot 2 - center	Slot 3 - right
Profibus® board	Signal board 1	Signal board 2

3.1.2 Signal input boards

Slots 2 and 3 are for signal input measurement boards.

Procedure

1. Wire the sensor leads to the measurement board following the lead locations marked on the board.
2. Carefully slide the wired board fully into the enclosure slot and take up the excess sensor cable through the cable gland.
3. Tighten the cable gland nut to secure the cable and ensure a sealed enclosure.

Note
For the purpose of replacing factory-installed signal input boards, Rosemount is the sole supplier.

3.1.3 Digital communication boards

HART® digital communications is standard on this system. A Profibus® DP communication board is available as an option for the system's communication with a host. HART communication supports Bell 202 digital communications over an analog 4-20 mA current output. Profibus DP is an open communications protocol which operates over a dedicated digital line to the host.

3.1.4 Alarm relays

Emerson supplies four alarm relays with the switching power supply (85 to 264 Vac, 03 order code) and the 24 Vdc power supply (20 - 30 Vdc, 02 order code). You can use all relays for process measurement(s) or temperature. You can also configure any relay as a fault alarm instead of a process alarm. In addition, you may configure any relay independently and program it to activate pumps or control valves.

All process alarms, alarm logic (high or low activation or USP*), and deadband are user-programmable. Customer-defined failsafe operation is supported as a programmable menu function to allow all relays to be energized or not energized as a default condition upon powering the transmitter. You may program the USP* alarm to activate when the conductivity is within a user-selectable percentage of the limit. USP* alarming is available only when a contacting conductivity measurement board is installed.

3.2 Prepare conduit openings

The transmitter enclosure has six conduit openings. Four conduit openings are fitted with conduit plugs.

Conduit openings accept ½-in. conduit fittings or PG 13.5 cable glands. To keep the case watertight, block unused openings with NEMA® 4X or IP65 conduit plugs.

Note
Use watertight fittings and hubs that comply with your requirements. Connect the conduit hub to the conduit before attaching the fitting to the transmitter.

3.3 Prepare sensor cable

The Rosemount T56 is intended for use with all Rosemount sensors. Refer to the sensor installation instructions for details on preparing sensor cables.

3.4 Power, output, and sensor connections

3.4.1 Power wiring

Emerson offers two power supplies for the Rosemount T56:

1. 24 Vdc (20-30 V) power supply (02 ordering code)
2. 85-265 Vac switching power supply (03 ordering code)

AC mains (115 or 230 V) leads and 24 Vdc leads are wired to the power supply board which is mounted vertically on the left side of the main enclosure cavity. Each lead location is marked clearly on the power supply board. Wire the power leads to the power supply board using the lead markings on the board.

The grounding plate is connected to the earth terminal of the -03 (85 to 265 Vac) power supplyu. The green colored screws on the grounding plate are intended for connection to some sensors to minimize radio frequency interference. The green screws are not intended to be used for safety purposes.

3.4.2 Current output wiring

Emerson ships all instruments with two 4-20 mA current outputs. Wiring locations for the outputs are on the main board which is mounted on the hinged door of the instrument.

Wire the output leads to the correct position on the main board using the lead markings (+/positive, -/negative) on the board. Emerson provides male mating connectors with each unit.

3.4.3 Alarm relay wiring

Emerson supplies four alarm relays with the switching power supply (85 to 265 Vac, 03 order code) and the 24 Vdc power supply (20-30 Vdc, 02 order code).

Wire the relay leads on each of the independent relays to the correct position on the power supply board using the printed lead markings (NO/Normally open, NC/Normally closed, or Com/Common) on the board. .

3.4.4 Sensor wiring to signal boards

Plug the pre-terminated sensor cable connector directly into the turbidity signal board mating connector.

⚠ WARNING

Electrical shock

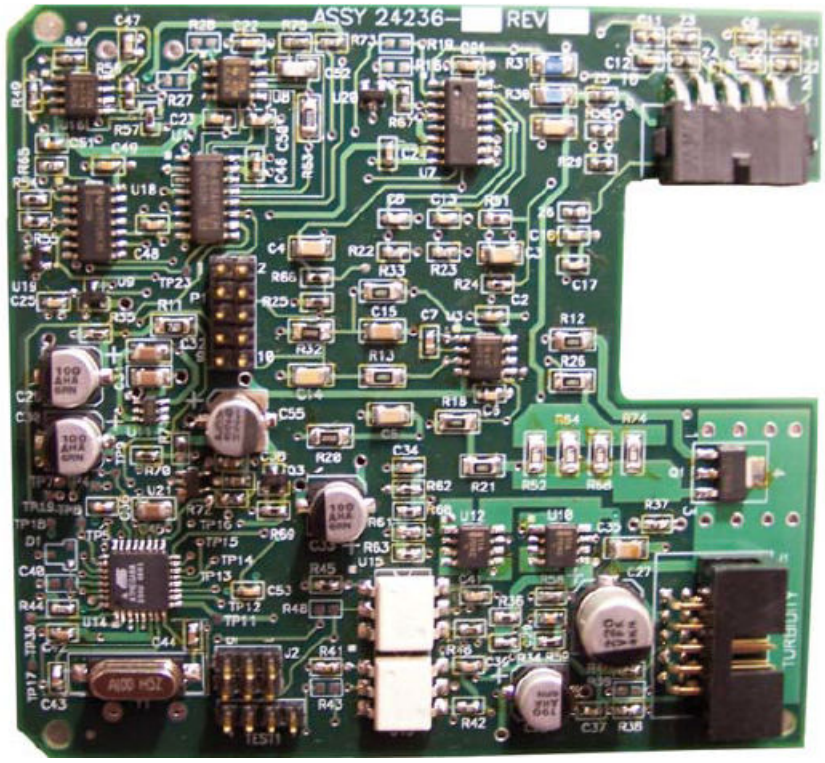
Electrical installation must be in accordance with the National Electrical Code (ANSI/NFPA-70) and/or any other applicable national or local codes.

3.4.5 Wire sensor cable

The sensor cable is pre-wired to a plug that inserts into a receiving socket on the signal board.

See Figure 3-1.

Figure 3-1: Turbidity Signal Board with Plug-in Sensor Connection



The cable also passes through a strain relief fitting. To install the cable:

Procedure

1. Remove the wrenching nut from the strain relief fitting.
2. Insert the plug through the hole in the bottom of the enclosure nearest the sensor socket. Seat the fitting in the hole.
3. Slide the wrenching nut over the cable plug and screw it onto the fitting.
4. Loosen the cable nut so the cable slides easily.
5. Insert the plug into the appropriate receptacle. To remove the plug, squeeze the release clip and pull straight out.
6. Adjust the cable slack in the enclosure and tighten the cable nut.

   Be sure to allow sufficient slack to avoid placing stress on the cable and connections.
7. Plug the cable into the back of the sensor.

   The sensor is rated to IP65 when properly connected to the cable. To prevent possible water damage to the connector contacts, be sure the cable receptacle and the connector on the back of the sensor are dry when connecting or disconnecting the cable.
8. Place the sensor in either the measuring chamber or the calibration cup.

   Important
   The sensor must be in a dark place when power is first applied to transmitter.

Note
If `S1 Warning` appears, check sensor cable connection and confirm sample water flow at debubbler drain outlet.

Important
When using EPA/incandescent sensors (P 8-0108-0002-EPA):

- Do not power up the instrument without the sensor connected.
- Do not disconnect and reconnect a sensor while a transmitter is powered.

If this is inconvenient or cannot be avoided:

- Cycle power to the instrument after connecting to the sensor or
- Perform a slope calibration or standard calibration routine after connecting the sensor.

Following these guidelines will extend the life of the incandescent lamp and avoid premature warnings and faults due to reduced lamp life.

4 Display and operate

4.1 User interface

The Rosemount™ T56 has a large display which shows two live measurement readouts in large digits and up to six additional process variables or diagnostic parameters concurrently.

The display is back-lit, and you can customize the format to meet your requirements. Use the **ENTER/MENU** key to access calibration, hold (of current outputs), programming, display, data, and HART® functions. In addition, you can use a dedicated **INFO** key to access useful diagnostic and instrument information regarding installed sensor(s) and any problematic conditions. The display flashes a red banner to indicate a Fault condition and a yellow banner for a Warning condition. The transmitter displays ***Help*** screens for fault and warning conditions to guide you in troubleshooting. During calibration and programming, key presses guide you step-by-step through procedures. An alpha-numeric keypad similar to a cell phone keypad is available to allow you to enter data during programming and calibration or lengthy tags to describe process points, sensors, or instrumentation.

4.2 Instrument keypad

There are three function keys, four navigation keys, and an alpha-numeric keypad on the instrument keypad.

Function keys

Use the key to access menus for programming and calibrating the instrument as well as retrieving sorted data. Eight top-level menu items appear when you press **ENTER/MENU**.

- ***Calibrate***: Calibrate the attached sensor(s) and analog output(s).
- ***Hold***: Suspend current outputs.

- ***Display Setup***: Program graphic trend display, brightness, main display format, tags, language, and warnings.
- ***Data storage and retrieval***: Enable data and event storage, download data, and view events.
- HART® or Profibus®: Program HART and Profibus communication parameters.
- ***Time and Date***: Set and view real-time clock settings.
- ***Reset***: Reset all instrument settings, calibration settings, or current outputs to factory defaults.

You can also use the **ENTER/MENU** key to enter selections or enable programming and calibration steps.

Use the **EXIT** key to return to the previous menu level.

Use the **INFO** key to display detailed instructions and explanations during programming and calibration procedures. You can also use it to see troubleshooting tips for all faults and warnings that may occur during calibration or continuous operation in process.

Navigation keys

The four navigation keys arranged around the **ENTER/MENU** key operate in an intuitive manner similar to the navigation keys on a computer keyboard. During menu operation, use these keys to move the highlighted screen selection to another adjacent screen item. During tag entry, use the **Left** key is used to delete entries during active alpha-numeric character entry.

Alpha-numeric keypad

The alpha-numeric keypad has 12 keys as outlined below.

- Nine keys are alpha-numeric.
- One key is a dedicated **1** key.
- One key is a dedicated **0** key.
- One key is a dedicated "**.**" (decimal point) key.

The alpha-numeric keypad operates the same as entries on a mobile phone. The nine alpha-numeric keys have multiple characters that you can use for tag entries or during programming and calibration steps. Make character selections by pressing the key multiple times to toggle the characters that are available on each key.

4.3 Main display

The transmitter displays one or two primary measurement values, up to six secondary measurement values, a fault and warning banner, alarm relay flags, and a digital communications icon.

4.3.1 Process measurements

If two signal boards are installed, the transmitter displays two process variables. If one signal board is installed with one sensor, the transmitter displays one process variable and process temperature.

The upper display area shows the Sensor 1 process reading. The center display area shows the Sensor 2 process reading. For dual conductivity, you can assign the upper and center display areas to different process variables.

For single input configurations, the upper display area shows the live process variable, and you can assign the center display area to Temperature or blank.

4.3.2 Secondary values

The display quadrants at the bottom half of the screen show up to six secondary values.

You can program all six secondary value positions to any display parameter available.

4.4 Menu system

The menu system is similar to a computer. Press the **ENTER/MENU** key at any time to open the top-level menu including Calibration, Hold, Programming, Display, Data, and HART® functions. To find a menu item, use the directional navigation keys to highlight a menu item. Press **ENTER/MENU**, direct the cursor to the desired operation, and follow the screen prompts. Press the **BACK** screen control available on some menu screens to revert to the immediate previous menu screen. Press the **EXIT** key to return to the previous hierarchical menu level.

Fault and Warning banners

If the transmitter detects a problem with itself or the sensor, the ***Fault*** banner (red) and/or ***Warning*** banner (yellow) appears at the bottom of the main display. A fault requires immediate attention. A warning indicates a problematic condition or an impending failure. For detailed troubleshooting assistance, press **INFO**.

5 Program the transmitter

5.1 General programming information

Typical programming steps include the following listed procedures. You can easily and quickly accomplish each of these programming functions using the intuitive menu system.

- Configure and assign values to the current outputs.
- Set a security code for two levels of security access.
- Access menu functions using a security code.
- Enable and disable Hold mode for current outputs.
- Choose the frequency of the AC power (needed for optimum noise rejection).
- Reset all factory defaults, calibration data only, or current output settings only.

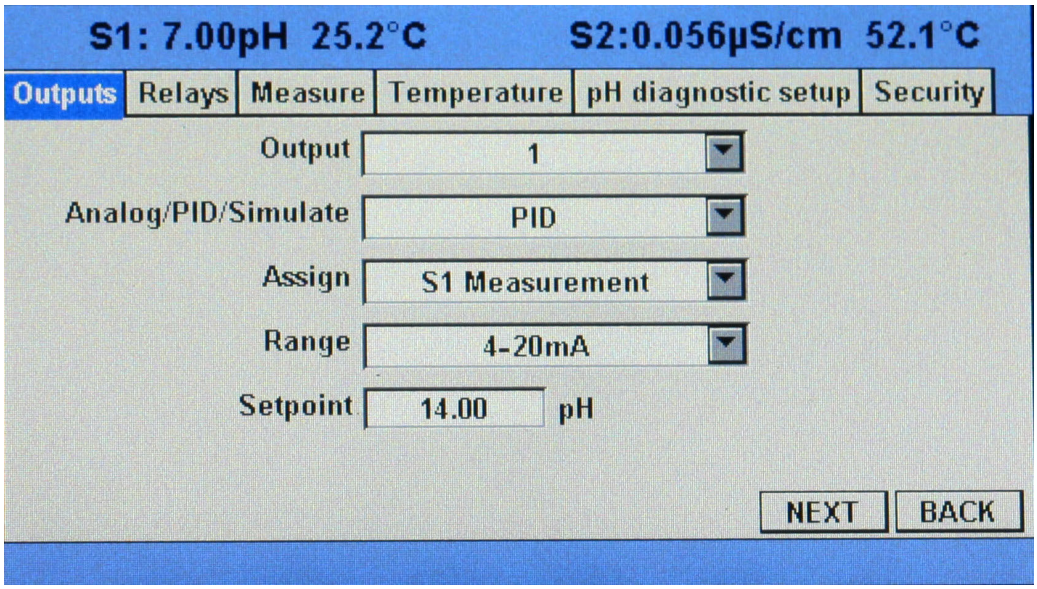
5.2 Configuring and ranging current outputs

The transmitter accepts inputs from two sensors and has four analog current outputs. Ranging the outputs means assigning values to the low (0 or 4 mA) and high (20 mA) outputs.

Important
Always configure the outputs first.

To configure the outputs, press **ENTER/MENU** to go to **Program** → **Outputs**. You can set Outputs 1 - 4 to Analog, PID, or Simulation. You can also set output assignments, scaling the range, linear or logarithmic outputs, output dampening, output setpoints, and output fault levels for each output if desired.

Figure 5-1: Rosemount™ 56 Outputs Screen



5.3 Use a security code

Security codes prevent accidental or unwanted changes to program settings, displays, and calibration. The Rosemount™ 56 has two levels of security code to control access and use of the instrument to different types of users.

The two levels of security are:

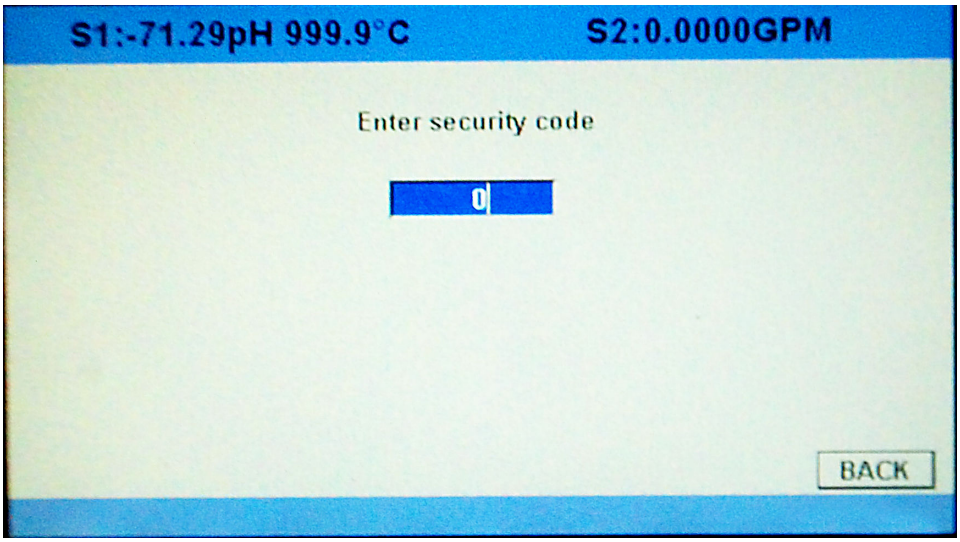
- All: This is the supervisory security level. It allows access to all menu fuctions, including programming, calibration, hold, and display.
- Calibration/Hold: This is the operator or technician level menu. It allows access to only calibration and hold of the current outputs.

To set security codes:

Procedure

1. Press **ENTER/MENU** from the main screen to access the ***Security*** screen.

   If you have programmed a security code, selecting the Calibrate, Hold, or Display menu items also causes the ***Security*** screen to appear.



2. Enter the three-digit security code for the appropriate security level.
   If the entry is correct, the appropriate menu screen appears. If the entry is incorrect, the ***Invalid Code*** screen appears. The ***Enter security code*** screen reappears after two seconds.

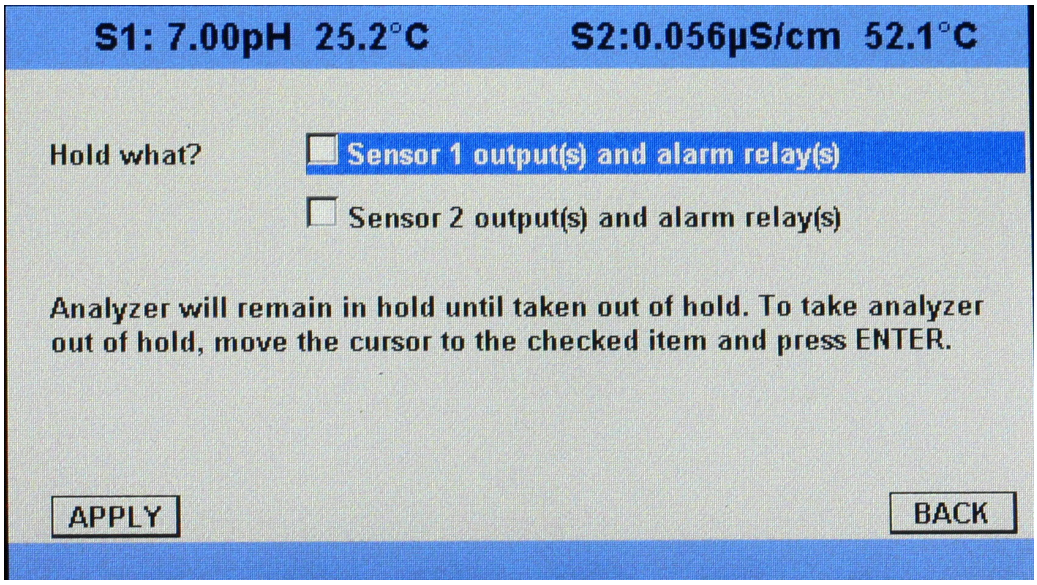
5.4 Use hold

To prevent improper operation of systems or pumps that are controlled directly by the current output, place the transmitter in hold before removing the sensor for calibration and maintenance.

During hold, all outputs remain at the last value.

Important
Once in hold, all current outputs remain on hold indefinitely.

Figure 5-2: Hold Screen



To hold the outputs and alarm relays:

Procedure

1. Press **ENTER/MENU** from the main screen to access the ***Hold*** screen.
2. Be sure to remove the transmitter from hold once calibration is complete.

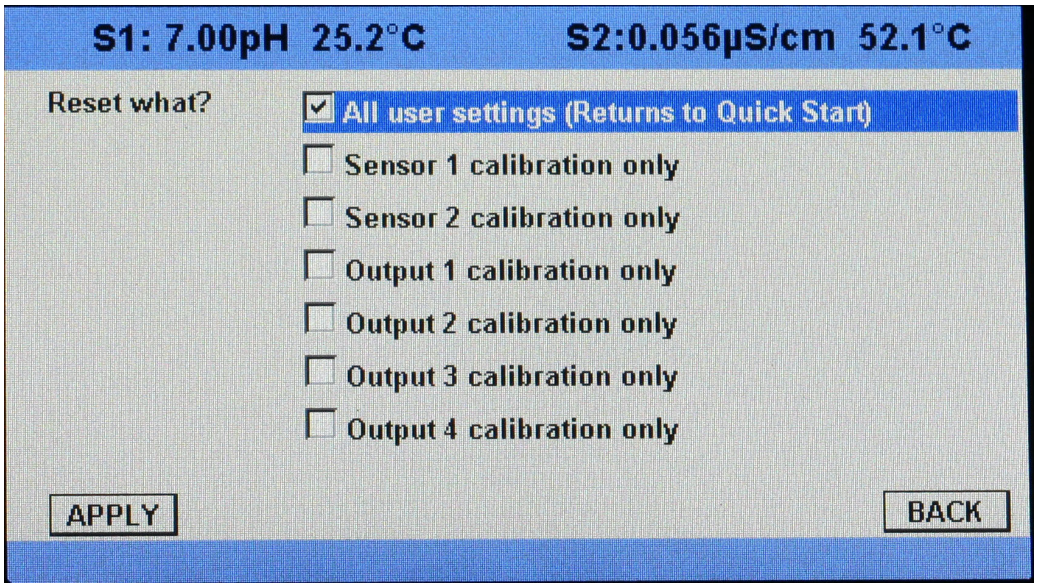
5.5 Reset factory default settings

Resetting factory default settings clears all fault messages and returns the display to the first ***Quick Start*** screen.

The Rosemount™ T56 offers three options for resetting factory defaults:

- Reset all settings to factory defaults.
- Reset sensor calibration data only.
- Reset analog output settings only.

Figure 5-3: Reset Screen



To reset settings, press **ENTER/MENU** from the main screen to access the ***Reset*** screen.

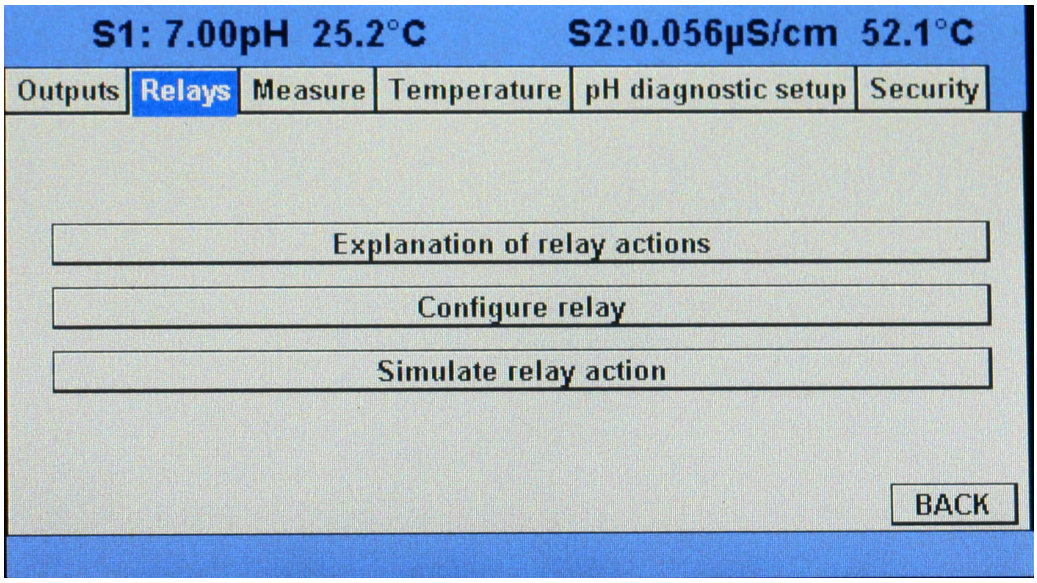
5.6 Program alarm relays

The Rosemount™ T56 24 Vdc (-02 order code) and the AC switching power supply (-03 order code) provide four alarm relays for process measurement or temperature. You can program each relay independently as an interval timer or one of four advanced timer functions.

You can program the following relay functions to any relay from the ***Relays*** screen.

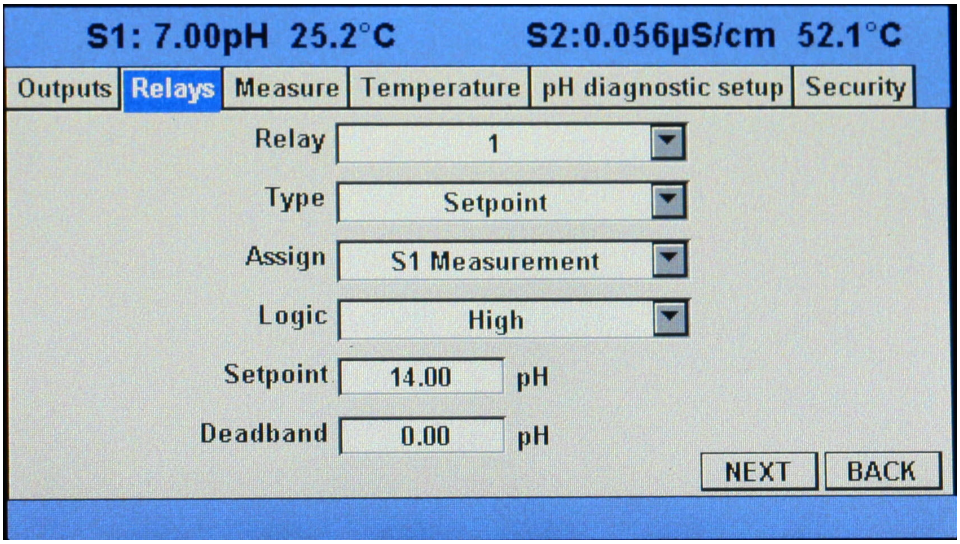
- Assign a relay.
- Define a relay function.
- Assign a measurement.
- Set relay logic.
- Enter setpoints.
- Set deadband.
- Set normal state.
- Set USP safety level (contacting conductivity).

Figure 5-4: Relays Tab



Procedure

1. Press **ENTER/MENU** from the main screen.
2. Select the ***Relays*** tab.
3. Click **Configure relay**.



4. To assign a relay, highlight the desired Relay (1 - 4) and press **ENTER/MENU**.
5. To define a relay function, select from the following:
   - Setpoint
   - Interval Timer
   - TPC

- Bleed and Feed
- Water Meter
- Display timer
- Date and Time
- Fault
- None

6. Press **ENTER/MENU**.
7. To set relay logic to activate alarms at a high reading or a low reading, select High or Low and press **ENTER/MENU**.
8. To enter setpoints for relays, enter the desired value for the process measurement or temperature at which to activate an alarm event and press **ENTER/MENU**.
9. To set deadband as a measurement value, enter the change in the process value needed after the delay deactivates to return to normal and press **ENTER/MENU**.

   This prevents repeated alarm activation.
10. To set the Normal alarm condition, select Open or Closed and press **ENTER/MENU**. Program the Normal state to define the desired alarm default state to normally open or normally closed upon power up.
11. To set USP Safety, enter the percentage below the limit at which to activate the alarm and press **ENTER/MENU**.

Note
USP Safety only appears if a contacting conductivity board is installed.

5.7 Simulate relay action

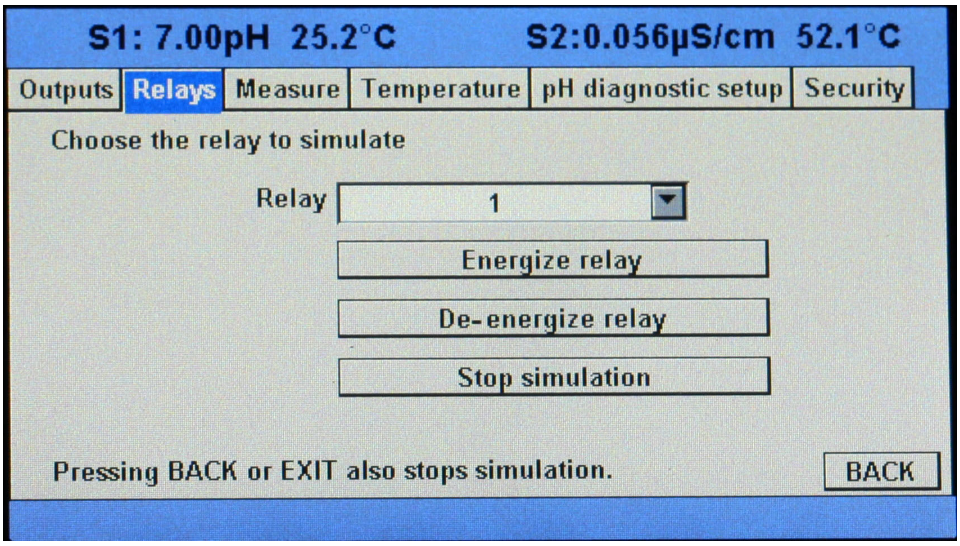
To simulate relays:

Procedure

1. Press **ENTER/MENU** from the main screen to access the ***Program*** screen.
2. Select the ***Relay*** tab.
   See Figure 5-4.
3. Select Simulate relay action.

   You can manually set alarm relays in order to check devices, such as valves or pumps.

   Under the ***Alarms Settings*** menu, the following screen appears to allow manual forced activation of alarm relays.



4. Select the desired alarm condition to simulate.

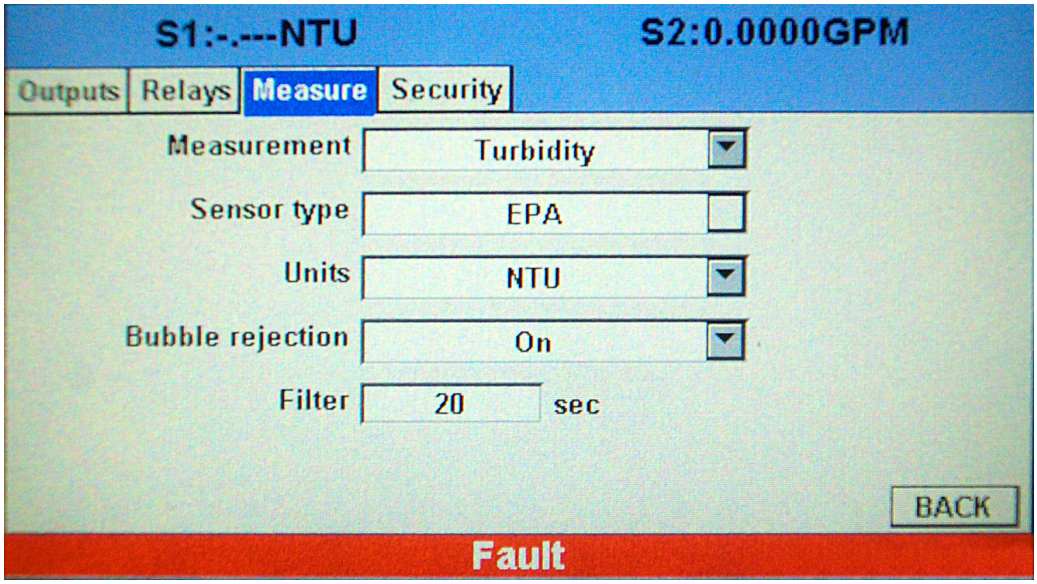
6 Program turbidity

The Rosemount™ T56 automatically recognizes each installed measurement board each time you power up the transmitter. Upon first power-up, completing ***Quick Start*** screens enables measurements, but you may need to complete additional steps to program the transmitter for the desired measurement application.

The following programming and configuration functions are covered:

- Measurement
- Sensor type
- Units
- Bubble rejection
- Filter

Figure 6-1: Measure Tab



Procedure

1. To program the Measurement type, select Turbidity or TSS calculation (estimated TSS) and press **ENTER/MENU**.
2. To program the Sensor type, select EPA or ISO and press **ENTER/MENU**.
3. To program Units, select NTU, FTU, or FNU and press **ENTER/MENU**.
4. To program Bubble rejection, select On or Off and press **ENTER/MENU**.
5. To override the default input Filter, enter 0 - 999 seconds and press **ENTER/MENU**.

7 Calibrate

7.1 Introduction to calibration

Calibration is the process of adjusting or standardizing the transmitter to a lab test or a calibrated laboratory instrument or standardizing to some known reference.

Completing Quick Start upon first power-up enables live measurements but does not ensure accurate readings in the lab or in process. Calibrate each attached sensor to ensure accurate, repeatable readings.

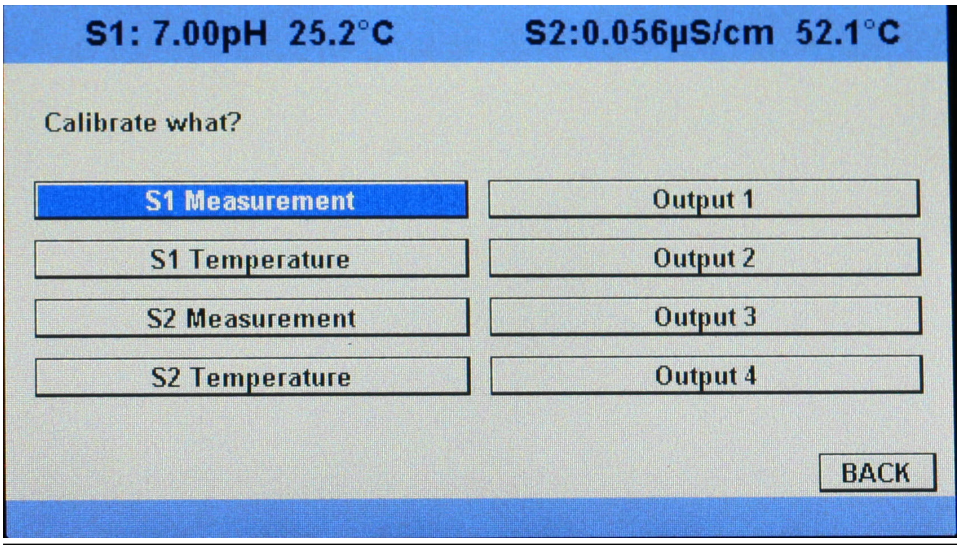
7.2 Turbidity

This section describes how to calibrate the turbidity sensor against a user-prepared standard as a two-point calibration with deionized water, against a 20 NTU user-prepared standard as a single point calibration, and against a grab sample using a reference turbidmeter.

To calibrate the turbidity sensor:

1. Press **ENTER/MENU** from the main screen to access the ***Calibration*** screen.

Figure 7-1: Calibration Screen



2. Select S1 Measurement or S2 Measurement and press **ENTER/MENU**.
3. Press **INFO** at any time to learn more about this procedure. When you press **INFO**, a yellow screen appears with detailed instructions and information.

The following calibration routines are covered:

- Slope Calibration: Slope calibration with pure water and a standard of known turbidity.

- Standardize Calibration: Standardizing the sensor to a known turbidity.
- Grab Calibration: Standardizing the sensor to a known turbidity based on a reference turbidmeter.

7.2.1 Calibrate slope

Conduct a two-point calibration of the turbidity sensor against a user-prepared nephelometric turbidity unit (NTU) standard.

Procedure

1. Immerse the sensor in filtered water having very low turbidity and measure the sensor output.
2. Increase the turbidity of the filtered water by a known amount, typically 20 NTU, and measure the sensor output again.
   The transmitter takes the two measurements, applies a linear correction (if necessary), and calculates the sensitivity.

Sensitivity is the sensor output (in mV) divided by turbidity. A typical new sensor has a turbidity of about 10 mV/NTU. As the sensor ages, the sensitivity decreases. Dark current is the signal generated by the detector when no light is falling on it. The transmitter substracts the dark current from the raw scattered light signal and converts the result to turbidity. In highly filtered samples, which scatter little light, the dark current can be a substantial amount of the signal generated by the detector.

7.2.2 Calibrate against a standard

You can calibrate the turbidity sensor against a commercial standard.

Stable 20.0 nephelometric turbidity unit (NTU) standards are available from a number of sources. Calibration using a commercial standard is simple. Filtered deionized water is not required.

Prerequisites

Before beginning the calibration, the transmitter does a dark current measurement. Dark current is the signal generated by the detector even when no light is falling on it.

Procedure

1. Select **Standard Calibration**.
2. Press **ENTER/MENU**.
   The transmitter subtracts the dark current from the raw scattered light signal and converts the result to turbidity. In highly filtered samples, which scatter little light, the dark current can be a substantial amount of the signal generated by the sensor.

7.2.3 Calibrate against a grab sample

If you want, you can calibrate the turbidity sensor against the turbidity reading from another instrument.

The transmitter treats the value you entered as though it were the true turbidity of the sample. Therefore, grab sample calibration changes the sensitivity; it does not apply an offset to the reading.

8 Maintenance

8.1 Maintenance overview

The Rosemount™ 56 transmitter used in the Rosemount Clarity II turbidmeter needs little routine maintenance.

Clean the transmitter case and front panel by wiping it with a clean soft cloth dampened with water only.

⚠ CAUTION

Solvents

Solvents like alcohol might cause a buildup of static charge.

Do not use solvents to clean the transmitter.

A few of transmitter's components are replaceable. See Replacement parts.

⚠ WARNING

Explosions

Do not connect equipment when a flammable or combustible atmosphere is present.

8.2 Sensor

8.2.1 Clean the sensor

Clean the sensor by rinsing it thoroughly with water and then wiping it with a soft tissue. If water is inadequate, wash with a mild detergent solution and then thoroughly rinse it with water.

⚠ CAUTION

Equipment damage

Do not scratch the lamp or photodiode windows.
Do not use abrasive cleaners or solvents.

If mineral scale is present, apply a dilute acid solution with a cotton swab to clean away the deposit. Rinse thoroughly with water.

8.2.2 Replace the lamp/light-emitting diode (LED) board

The US EPA-compliant sensor uses a tungsten filament lamp (PN 1-0901-0004-EPA) as the light source. The lamp has an expected life of about one year. The ISO-compliant version uses an infrared LED (PN 1-0901-0005-ISO). Its expected life is five years. The transmitter

continuously monitors the source intensity and corrects for changes in source intensity caused by age. When the source intensity becomes too low, the transmitter warns you. Replace the lamp as soon as possible.

To replace the lamp/LED board:

Procedure

1. Turn off power to the transmitter.

   ⚠ WARNING

   Explosion

   Do not disconnect equipment when a flammable or combustible atmosphere is present.

2. Remove the sensor from the measuring chamber and disconnect the cable.

   ⚠ WARNING

   High pressure and temperature

   Before removing the sensor, be absolutely certain that the process pressure is reduced to 0 psig and the process temperature is at a safe level.

   Note
   If you have a dual input transmitter, you can reapply power at this point. The initial reading from the other sensor will momentarily be zero. After about 60 seconds, the reading will reach its final value.

3. Using a small Phillips screwdriver, remove the two screws holding the top flange of the sensor to the body.

4. Using a slight back and forth twisting motion, carefully pull the flange from the sensor body.

⚠ CAUTION

Equipment damage

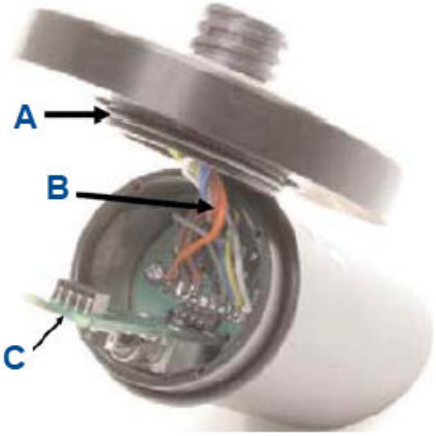
Wires are short. Pulling too hard will damage connections.

Don't pull too hard.

a. Don't pull too hard.

b. O-ring

5. Using your thumb and forefinger, remove the lamp/LED circuit board from the sensor.



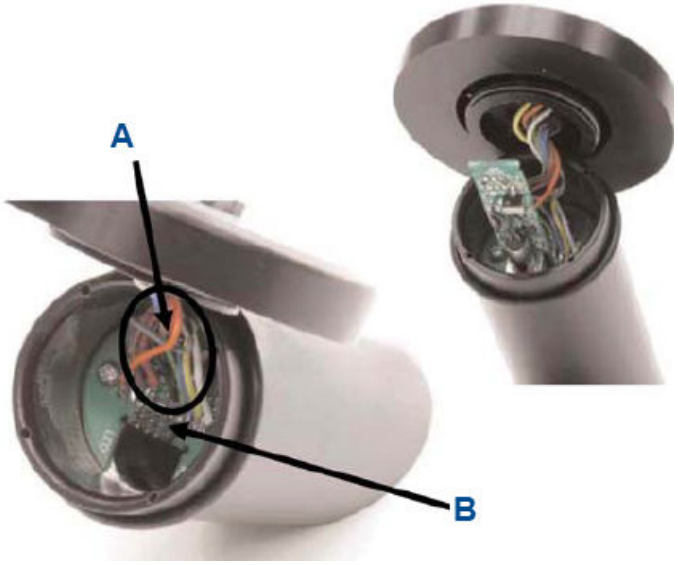
A. O-ring
B. Connecting wires
C. Lamp board

6. Insert the replacement board in the sensor and push the socket on the replacement board into the mating pins in the sensor.

⚠ CAUTION

Equipment damage

Keep wires pushed away from lamp board when replacing the flange.



A. Wires and flange
B. Mating pins

7. Place the dessicant package in the sensor body.
8. Orient the flange so that the screw holes line up with the holes in the sensor body. Push the flange back on the sensor body and replace the screws.

   Don't let wires push on lamp board. You may need to turn the flange a small amount until the holes line up.
9. Place the sensor in the calibration cup and reconnect the cable.
10. Calibrate the sensor using either slope or standard calibration.

    See Calibrate slope or Calibrate against a standard. Do not use grab calibration. Failure to calibrate the sensor may reduce the life of the sensor.

8.3 Maintaining the debubbler and measuring chamber

8.3.1 Clean the debubbler and measuring chamber

Procedure

1. Turn off the sample supply to the debubbler.

⚠ WARNING

High pressure and temperature

Before disconnecting the sample and drain lines or removing the sensor, be absolutely certain the process pressure is reduced to 0 psig and the process temperature is at a safe level.

2. Remove the sensor and put it in a safe place.
   The calibration cup is a good place to store the sensor.
3. Loosen the small drain plug in the base plug and allow the sample in the debubbler to drain out.
   See Figure 8-1.
4. Replace the drain plug.
5. Unscrew the upper and lower caps.
   Be careful not to lose the O-rings.
6. Use a stream of water, a brush, or a rag to flush and clean out the inside of the debubbler and measuring chamber.
7. Inspect the O-rings for signs of damage and replace if necessary.
   The part number for the O-ring (one each) is 9550316.
8. Replace the upper and lower caps.
9. Replace the sensor.

8.3.2 Clean the debubbler orifice

Procedure

1. Turn off the sample to the debubbler.
2. Disconnect the drain line. Unscrew the drain fitting from the orifice; then unscrew the orifice from the debubbler body.
   See Figure 8-1.
3. Use a stream of water to flush out any residue accumulated in the orifice. Direct the stream of water counter to the normal flow through the orifice.

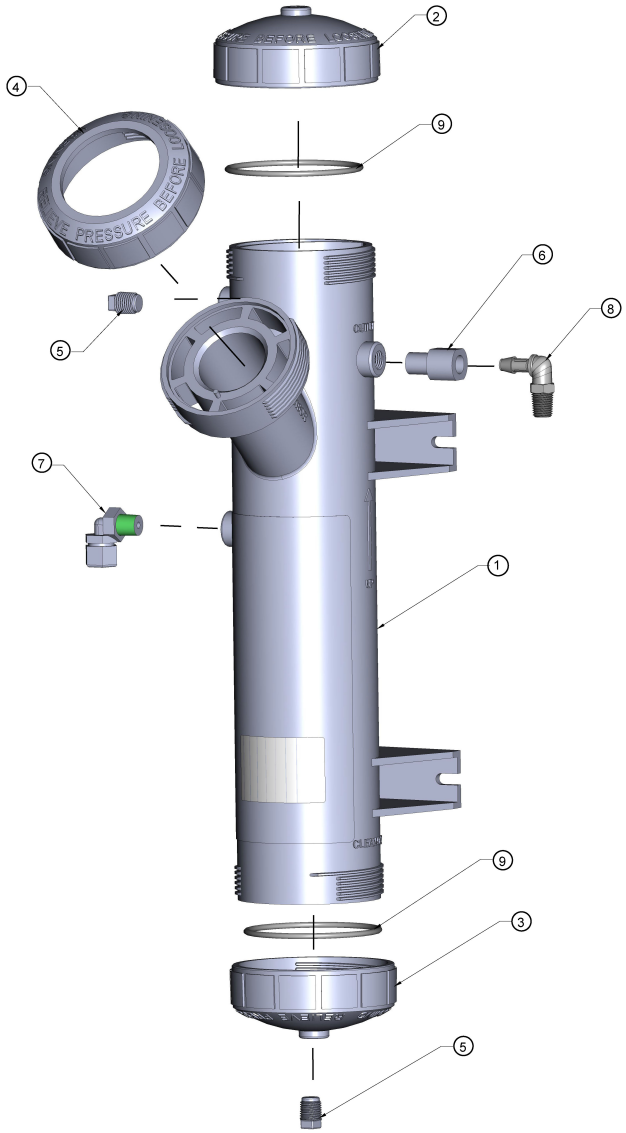
4. If the material plugging the orifice cannot be removed with flushing, use a toothpick or stiff wire to push out the obstruction. Push counter to the normal flow through the orifice.
5. Reinstall the orifice and reconnect the drain line. Turn on the sample flow.

Postrequisites

If the blockage cannot be removed or the orifice is damaged during cleaning, replace the orifice (PN 33947-00).

8.4 Replacement parts

Figure 8-1: Molded Debubbler Assembly



Location in Figure 8-1	Description	Part number
---	Replacement lamp board assembly, ISO-compliant sensor	109010010ISO
---	Replacement sensor, USEPA-complaint	801080002EPA
---	Replacement sensor, ISO-compliant	801080003ISO
1	Debubbler housing	3401500
2	Upper cap for debubbler	3401400
3	Lower cap for debubbler	3401401
4	Sensor nut	3401402
5	Pipe plug, ¼-in. male national pipe thread (MNPT), 2 places	3000854
6	Orifice assembly	3394700
7	Sample inlet elbow, ¼-in. compression fitting x ¼-in. MNPT	9321010
8	Sample drain elbow, ⅜-in. barb x ¼-in. MNPT	9322036
9	O-ring, one each, for upper and lower caps	9550322
not shown	O-ring, one each, for sensor	9550145

9 Return of material

9.1 General return information

To expedite the repair and return of instruments, proper communication between the customer and factory is important. Before returning a product for repair, call +1-855-724-2638 for a Return Materials Authorization (RMA) number.

9.2 Warranty repair

The following is the procedure for returning instruments still under warranty.

1. Call Rosemount™ for authorization.
2. To verify warranty, supply the factory sales order number of the original purchase order number. In the case of individual parts or sub-assemblies, you must supply the serial number on the unit.
3. Carefully package the materials and enclose your *Letter of Transmittal*. If possible, pack the materials in the same manner as they were received.
   See Warranty.
4. Send the package prepaid to:
   Emerson Automation Solutions
   8200 Market Boulevard
   Chanhassen, MN 55317, USA
   Attn: Factory Repair
   RMA No._____
   Mark the package: `Returned for Repair`
   Model No._____

9.3 Non-warranty repair

The following is the procedure for returning instruments that are no longer under warranty for repair.

1. Call Rosemount™ for authorization.
2. Supply the purchase order number and make sure to provide the name and telephone number of the individual to be contacted should additional information be needed.
3. Do steps 3 and 4 in Warranty repair.

Note
Consult the factory for additional information regarding service or repair.

A Verify linearity

This procedure describes how to verify linearity between turbidity and TSS.

Procedure

1. Collect a sample of the process liquid.

   You may need 10 L or more if you use the Rosemount™ Clarity II for measuring turbidity. If you uses a laboratory turbidmeter, you will need less volume. The Rosemount Clarity II requires about 500 mL for the measurement; laboratory turbidmeters require 50 mL or less. Verify that the turbidity of the sample is less than 200 NTU. Store in a clean bottle.

2. Filter a portion of the sample to obtain at least 5 L of dilution liquid.

   The filtrate is needed to dilute the sample in subsequent steps. Verify that the turbidity of the dilution water is low. If filtering the sample is impractical, use deionized water for dilution.

3. Measure the total suspended solids (TSS) in the sample obtained in Step 1. Thoroughly mix the sample before withdrawing liquid.

   A magnetic stirrer is best, but inverting the sample repeatedly for about a minute works too. Avoid violent shaking or mixing. Refer to any standard reference work on water and wastewater testing for the procedure for determining TSS.

4. Dilute the sample from Step 1 by a factor of 0.9, 0.7, 0.5, 0.3, and 0.1.

   See the table for recommended volumes. Measure TSS and turbidity for each dilution. For lower TSS values, use a larger volume of sample.

Dilution factor	Volume of stock, mL	Final volume, mL	Volume for Rosemount Clarity II, mL	Volume for TSS, mL
1.00	--	--	500	50 - 250
0.9	900	1000	500	50 - 250
0.7	700	1000	500	50 - 250
0.5	500	1000	500	50 - 250
0.3	300	1000	500	50 - 250
0.1	100	1000	500	50 - 250

5. Plot the data obtained in Step 4, with turbidity on the Y-axis and TSS on the X-axis. Fit the best straight line to the data.
6. Locate two points (P1 and P2) on the line separated as much as possible. Read the ppm and NTU value for each point and enter these into the transmitter.

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