Manual
LIQ-MAN-TCL-56, Rev B
July 2017

Rosemount™ TCL

Total Chlorine System with Rosemount 56 Transmitter

ROSEMOUNT™

EMERSON™

Essential instructions

Read this page before proceeding!

Rosemount designs, manufactures, and tests its products to meet many national and international standards. Because these instruments are sophisticated technical products, you must properly install, use, and maintain them to ensure they continue to operate within their normal specifications. The following instructions must be adhered to and integrated into your safety program when installing, using, and maintaining Rosemount products. 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.

- Read all instructions prior to installing, operating, and servicing the product. If this Instruction Manual is not the correct manual, call 1 800 999 9307, and Rosemount will provide the requested manual. Save this Instruction Manual for future reference.
- If you do not understand any of the instructions, contact your Rosemount representative for clarification.
- Follow all warnings, cautions, and instructions marked on and supplied with the product.
- Inform and educate your personnel in the proper installation, operation, and maintenance of the product.
- Install your equipment as specified in the installation instructions of this manual and per applicable local and national codes. Connect all products to the proper electrical and pressure sources.
- To ensure proper performance, use qualified personnel to install, operate, update, program, and maintain the product.
- When replacement parts are required, ensure that qualified people use replacement parts specified by Rosemount. Unauthorized parts and procedures can affect the product's performance and place the safe operation of your product at risk. Look alike substitutions may result in fire, electrical hazards, or improper operation.
- Ensure that all equipment doors are closed and protective covers are in place, except when maintenance is being performed by qualified people, to prevent electrical shock and personal injury.

⚠ DANGER!

HAZARDOUS AREA INSTALLATION

Installations near flammable liquids or in hazardous area locations must be carefully evaluated by qualified on site safety personnel. This device is not intrinsically safe or explosion proof.

To secure and maintain an intrinsically safe installation, the certified safety barrier, transmitter, and sensor combination must be used. The installaiton system must comply with the governing approval agency (FM, CSA, or BASEEFA/CENELEC) hazardous area classification requirements. Consult your transmitter instruction manual for details.

Proper installation, operation, and servicing of this device in a hazardous area installation is entirely your responsibility.

⚠ WARNING!

ELECTRICAL SHOCK HAZARD
Making cable connections to and servicing this instrument require access to shock hazard level voltages which can cause death or serious injury.

Be sure to disconnect all hazardous voltage before opening the enclosure.

Relay contacts made to separate power sources must be disconnected before servicing.

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

Unused cable conduit entries must be securely sealed by non-flammable closures to provide enclosure integrity in compliance with personal safety and environmental protection requirements.

The unused conduit openings need to be sealed with NEMA 4X or IP65 conduit plugs to maintain the ingress protection rating (IP65).

For safety and proper performance, this instrument must be connected to a properly grounded three-wire power source.

Proper relay use and configuration is your responsibility.

No external to the instrument of more than 69 Vdc or 43 V peak allowed with the exception of power and relay terminals. Any violation will impair the safety protection provided.

Do not operate this instrument without the front cover secured. Refer installation, operation, and servicing to qualified personnel.

⚠ WARNING!

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

⚠ WARNING!

HAZARDOUS VOLTAGE
Can cause severe injury or death. Disconnect power before servicing.

⚠ CAUTION!

SENSOR/PROCESS APPLICATION COMPATIBILITY

Wetted materials may not be compatible with process composition and operating conditions. Application compatibility is entirely your responsibility.

About this document

This manual contains instructions for installation and operation of the Model TCL56 Total Chlorine Transmitter.

The following list provides notes concerning all revisions of this document.

Rev. level	Date	Notes
A	5/11	This is the initial release of the product manual. This manual has been reformatted to reflect the Emerson documentation style and updated to reflect any change in the product offering.
B	7/17	All instances of *analyzer* have been replaced with *transmitter*. The manual has been reformatted to reflect new Emerson branding guidelines.

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1 Description and Specifications

1.1 Features

Rosemount TCL Sample Conditioning System

The sample conditioning system permits a single sensor to measure total chlorine in water. The sample conditioning system continuously injects a solution of acetic acid (vinegar) and potassium iodide into the sample. The acid lowers the pH to between 3.5 and 4.5 and allows total chlorine in the sample to quantitatively react with the potassium iodide to produce iodine. The sensor measures the iodine concentration, and the transmitter displays the total oxidant concentration in ppm as Cl_2.

Rosemount 56 Transmitter

The Rosemount 56 Transmitter measures total chlorine when used with the TCL and 499ACL-02 sensor.

The transmitter is housed in a corrosion resistant NEMA 4X enclosure. It is suitable for panel, pipe, or wall mounting. The large, high resolution, full color display shows total chlorine concentration and temperature in 0.5 in. (13 mm) high characters. Six other user-selectable variables can be shown in smaller characters. Operation of the transmitter is through the membrane keypad.

Menu screens for calibration and programming screens are simple and intuitive. Plain language prompts in nine languages guide you. Information about program settings and calibration, as well as troubleshooting guidance, is available on-screen at the press of a button.

The transmitter has four fully programmable analog outputs, with HART digital communication superimposed on output 1. Profibus DP digital communication is available as an option. PID control is standard.

Four fully programmable relays are available. Relays can be configured as simple high/low setpoint alarms or can be used to perform a number of timer functions as well as time proportional control (TPC). For more information about relay actions, refer to the Rosemount 56 Product Data Sheet.

A data and event logger are standard. The data logger stores up to 30 days of data, and the event logger stores up to 300 events. Events can be viewed on screen, and data can be shown in a full color dual graphics display. Data and events can also be downloaded through a USB port on the front panel of the transmitter.

Rosemount 499ACL-02 Total Chlorine Sensor

The Rosemount 499ACL-02 Total Chlorine Sensor is used in the TCL sample conditioning system. Although the sensor is called a chlorine sensor, it really measures iodine. The iodine comes from the reaction between oxidants in the sample and the acetic acid/ potassium iodide reagent added by the sample conditioning system.

The sensor consists of a gold cathode and a silver anode in an electrolyte solution. A silicone membrane, permeable to iodine, is stretched over the cathode. The transmitter applies a voltage to the cathode sufficiently negative to reduce all the iodine reaching it. Because the concentration of iodine in the sensor is always zero, a concentration gradient continuously forces iodine from the sample through the membrane into the sensor.

The reduction of iodine in the sensor generates a current directly proportional to the diffusion rate of iodine through the membrane, which is directly proportional to the concentration of iodine in the sample. Because the iodine concentration depends on the amount of total chlorine in the sample, the sensor current is ultimately proportional to the total chlorine concentration.

The permeability of the membrane to iodine is a function of temperature. A Pt100 RTD in the sensor measures the temperature, and the transmitter uses the temperature to compensate the total chlorine reading for changes in membrane permeability.

Sensor maintenance is fast and easy. Replacing the membrane requires no special tools or fixtures. Simply place the membrane assembly on the cathode and screw the retainer in place. Installing a new membrane and replenishing the electrolyte takes only a few minutes.

1.2 Specifications

Table 1-1: Sample Conditioning System

Physical characteristics	Specifications
General	
Enclosure	Fiberglass reinforced polyester, NEMA 3 (IP53) suitable for marine environments
Dimensions	14.5 x 13.0 x 8.6 in. (369 x 329 x 218 mm)
Mounting	Wall
Ambient temperature	0 to 50 °C (32 to122 °F)
Ambient humidity	0 to 90% (non-condensing)
Power	115 Vac, 6.9 W, 50/60 Hz 230 Vac, 7.0 W, 50/60 Hz
Hazardous location	The TCL Sample Conditioning System has no hazardous location approvals.
Pumps	EN 809:1998 CE
Weight/shipping weight	14 lb/16 lb (6.5 kg/7.5 kg)
Sample requirements	
Inlet connection	Compression fitting, accepts 1/4 in. OD tubing
Drain connection	3/4 in. barbed fitting (must drain to open atmosphere)
Inlet pressure	<100 psig (791 kPa abs)

Table 1-1: Sample Conditioning System *(continued)*

Physical characteristics	Specifications
Flow	At least 0.25 gph (15 mL/min)
Temperature	0 to 50 °C (32 to122 °F)
Total alkalinity	<300 mg/L as $CaCO_3$. For samples containing <50 mg/L alkalinity, consult the factory.
Sample conditioning system	
Reagent	Potassium iodide in vinegar
Reagent usage	5 gallons last approximately 60 days.
Reagent pump	Fixed speed peristaltic pump, about 0.2 mL/min
Sample pump	Fixed speed peristaltic pump, about 11 mL/min

Table 1-2: Rosemount 56 Transmitter

Physical characteristics	Specifications
Case	Polycarbonate
Display	Full color LCD, 3.75 x 2.20 in. (95 x 56 mm); you can customaize the display.
Languages	English, French, German, Italian, Spanish, Portuguese, Chinese, Russian, and Polish
Ambient temperature and humidity	-10 to 60 °C (14 to 140 °F); relative humidity 5 to 95% (non-condensing). Between -5 and 55 °C (23 and 131 °F) there is no visible degradation in display response or performance.
Storage temperature	-20 to 60 °C (-4 to 140 °F)
Power	85 to 265 Vac, 47.5 to 65.0 Hz, 20 W
RFI/EMI LVD	EN-61326 EN-6101-01 CE
Outputs	Four 4-20 or 0-20 mA isolated current outputs; assignable to measurement or temperature; fully scalable; maximum load 550 Ω. HART digital signal is superimposed on output 1.
Alarms and timers	Four relays, fully configurable as a setpoint alarm, interval timer, TPC, bleed and feed timer, delay timer, date and time timer, and fault alarm.
Relays	Form C, SPDT, epoxy sealed
Relay contact ratings	 5 A at 28 Vdc or 300 Vac (resistive) 1/8 HP at 120/240 Vac
Control features	PID control (analog output) and time proportional control or TPC (relays) are standard.

Table 1-2: Rosemount 56 Transmitter *(continued)*

Physical characteristics	Specifications
Data logger	Data automatically stored every 30 seconds for 20 days; older data removed to make room for new data. The following data are automatically stored: date and time, ppm, temperature, and raw sensor current.
Event logger	Stores up to 300 events with date and time stamps: faults, warnings, calibration data, calibration results (pass or fail), power on/off cycles, and hold on/off. Alarm relay activation and deactivation can also be stored. Older events are automatically removed to make room for new events.
Data and event downloading	Through USB port on front panel.
Graphical display	Dual graphical display shows measurement data on the Y-axis and time on the X-axis. The Y-axis is fully assignable and scalable. The X-axis can be set to 1 hour, 1 day, 7 days, or 30 days.
Digital communications	HART digital communications is standard. Profibus DP is optional.
Weight/shipping weight (rounded up to nearest 1 lb or 0.5 kg)	3 lb/4 lb (1.5 kg/2.0 kg)

Table 1-3: Rosemount 499ACL-02 Total Chlorine Sensor

Physical characteristics	Specifications
Wetted parts	Gold, Noryl®(1) (PPO), Viton®(2), EPDM, and silicone
Dimensions	1.0 x 5. 6 in. (25.4 x 143 mm)
Cable	25 ft (7.6 m) standard
Pressure rating	0 to 65 psig (101 to 549 kPa)
Temperature rating	0 to 50 °C (32 to 122 °F)
Electrolyte capacity	Approximately 25 mL
Electrolyte life	Approximately 4 months
Weight/shipping weight	1 lb/3 lb (0.5 kg/1.5 kg)

(1) Noryl is a registered trademark of General Electric.

(2) Viton is a registered trademark of DuPont Performance Elastomers.

Table 1-4: Performance Specifications - Complete System

Physical characteristics	Specifications
Linear range	0 to 20 ppm (mg/L) as Cl_2 (for higher ranges, consult factory)
Linearity (per ISO 15839)	0 to 10 ppm: 2%; 0 to 20 ppm: 3%
Response time	Following a step change in concentration, the reading reaches 90% of final value within 7 minutes at 25 °C (77 °F)
Drift	At about 1.5 ppm in clean water and constant temperature, drift is typically less than 0.05 ppm over two weeks.
Detection limit (per ISO 15839)	0.02 ppm (mg/L) in clean water at room temperature

1.3 Ordering information and accessories

Rosemount TCL Reagent-Based Chlorine System

The TCL is used for the continuous determination of total chlorine in water. The TCL consists of a sample conditioning system, a reagent carboy, a sensor, and a transmitter.

Important

Reagent kits must be ordered separately. Reagent kits for 0-5 ppm and 0-10 ppm chlorine are available. For higher ranges, consult the factory.

See *Table 1-5*.

Table 1-5: Rosemount TCL Total Chlorine System Ordering Information

Model	Sensor type
TCL	Total Chlorine System
Power input	
11	115 Vac 50/60 Hz
12	230 Vac 50/60 Hz
Transmitter	
-	No selection - no transmitter
280	Rosemount 56-03-24-38-HT, relays, analog/HART
281	Rosemount 56-03-24-38-DP, relays, analog/Profibus DP
Sensor	
-	No selection - no sensor
30	Rosemount 499ACL-02-54 Total Chlorine Sensor with standard cable

Table 1-5: Rosemount TCL Total Chlorine System Ordering Information *(continued)*

31	Rosemount 499ACL-02-54-60 Total Chlorine Sensor with optimum EMI/RFI cable
32	Rosemount 499ACL-02-54-VP Total Chlorine Sensor with VP cable connector(1)
Typical model number: TCL-11-280-32	

(1) Interconnecting VP cable sold separately.

Accessories

Table 1-6: Sample Conditioning System Accessories

Part number	Description
24134-00	Air pump, 115 Vac, 50/60 Hz
24134-01	Air pump, 230 Vac, 50/60 Hz
9160578	Air pump repair kit
9322052	Check valve for air injection line
24153-00	Carboy for reagent, 5 gal/19 L, includes cap
9100204	Fuse, 0.25 A, 250 V, 3 AG, slow blow for option-11 (115 Vac)
9100132	Fuse, 0.125 A, 250 V, 3 AG, slow blow for option -12 (230 Vac)
9380094	Reagent pump, 115 Vac, 50/60 Hz
9380095	Reagent pump, 230 Vac, 50/60 Hz
9380091	Reagent pump replacement tubing
24151-00	Reagent tubing replacement kit
24135-00	Reagent uptake tubing, 6 ft (1.8 m), includes weight
9380090	Sample pump, 115 Vac, 50/60 Hz
9380093	Sample pump, 230 Vac, 50/60 Hz
9380092	Sample pump replacement tubing
24152-00	Sample tubing replacement kit
24164-00	Potassium iodide, 25 g, sufficient for 5 gallons (19 L) of vinegar (0-5 ppm total chlorine)
24164-01	Potassium iodide, 50 g, sufficient for 5 gallons (19 L) of vinegar (0-10 ppm total chlorine)
24165-00	Acetic acid, 2 x 2.5 gal (9.5 L) bottles/case, with 25 g potassium iodide (0-5 ppm total chlorine)
24165-01	Acetic acid, 2 x 2.5 gal (9.5 L) bottles/case, with 50 g potassium iodide (0-10 ppm total chlorine)

Table 1-7: Rosemount 1056 and 56 Transmitters Accessories

Part number	Description
23554-00	Cable glands (qty 5 of PG 13.5)
23820-00	Wall and 2 in. pipe mounting kti
240048-00	Stainless steel tag (specify marking)

Table 1-8: Sensor Accessories

Part number	Description
23501-02	Total chlorine membrane, includes 1 membrane assembly and 1 O-ring
23502-02	Total chlorine membrane kit, includes 3 membrane assemblies and 3 O-rings
9210438	Total chlorine sensor fill solution, 4 oz (120 mL)

Table 1-9: For First Time Variopol Installations

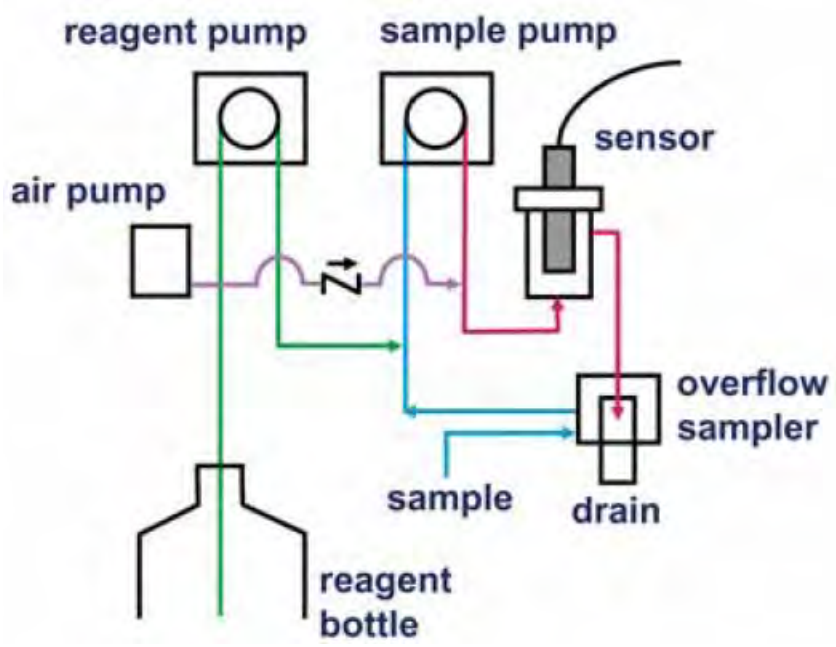
Part number	Description
23747-06	Interconnecting cable, VP 6, 2.5 ft (0.8 m)
23747-04	Interconnecting cable, VP 6, 4 ft (1.2 m)
23747-02	Interconnecting cable, VP 6, 10 ft (3.0 m)
23747-07	Interconnecting cable, VP 6, 15 ft (4.6 m)
23747-08	Interconnecting cable, VP 6, 20 ft (6.1 m)
23747-09	Interconnecting cable, VP 6, 25 ft (6.1 m)
23747-10	Interconnecting cable, VP 6, 30 ft (9.1 m)
23747-03	Interconnecting cable, VP 6, 50 ft (15.2 m)
23747-11	Interconnecting cable, VP 6, 100 ft (30.5 m)

2 Principles of operation

Total chlorine by definition is the iodine produced in a sample when it is treated with potassium iodide at a pH between 3.5 and 4.5. Typically, acetic acid (or vinegar) is used to adjust the pH.

The total chlorine system consists of a sample conditioning system, which injects the reagent into the sample, and a sensor and transmitter, which measure the amount of iodine produced. *Figure 2-1* shows the sample conditioning system. The sample enters the sample conditioning enclosure and flows to an overflow sampler from which the sample pump takes suction. Excess sample drains to waste. At the same time, the reagent pump draws reagent, a solution of potassium iodide in vinegar, from the reagent carboy and injects it into the suction side of the sample pump. The sample and reagent mix as they pass through the pump, and total chlorine in the sample is converted to the chemically equivalent amount of iodine. The flow rates are 11 mL/min for the sample and 0.2 mL/min for the reagent.

Figure 2-1: Schematic of Sample Conditioning System and Transmitter



The treated sample next enters the flow cell. Bubbles injected into the flow cell produce turbulence, which improves the stability of the reading. A membrane-covered amperometric sensor in the flow cell measures the concentration of iodine. The transmitter receives the raw signal from the sensor and displays the concentration of total chlorine. Display units are ppm (mg/L) chlorine as Cl_2. The treated sample leaves the flow cell and drains to waste along with the excess sample.

3 Installation

3.1 Unpacking and inspection

Complete the following steps when you unpack your instrument.

1. Inspect the shipping containers. If there is damage, contact the shipper immediately for instructions.
2. Save the box.
3. If there is no apparent damage, unpack the containers.
4. Ensure that all items shown on the packing list are present. If items are missing, notify Rosemount immediately.

3.2 Installation

3.2.1 General information

1. Although the transmitter and sample conditioning system are suitable for outdoor use, do not install them in direct sunlight or in areas of extreme temperature.

⚠ CAUTION!

HAZARDOUS AREAS

The TCL Total Chlorine Sample Conditioning System is not suitable for use in hazardous areas.

2. Install the transmitter and sample conditioning system in an area where vibrations and electromagnetic and radio frequency interference are minimized or absent.
3. The transmitter is suitable for panel, pipe, or wall mounting. The sample conditioning enclosure must be mounted on a wall. Provide adequate room beneath the enclosure for the 5-gallon reagent carboy.
4. Be sure that the distance between the transmitter and sample conditioning cabinet does not exceed the length of the sensor cable.

3.2.2 Install the sample conditioning enclosure

Follow the steps below to install the sample conditioning enclosure.
Refer to *Figure 3-1*, *Figure 3-2*, and *Figure 3-3* for installation details.

Figure 3-1: Installing the Sample Conditioning Enclosure

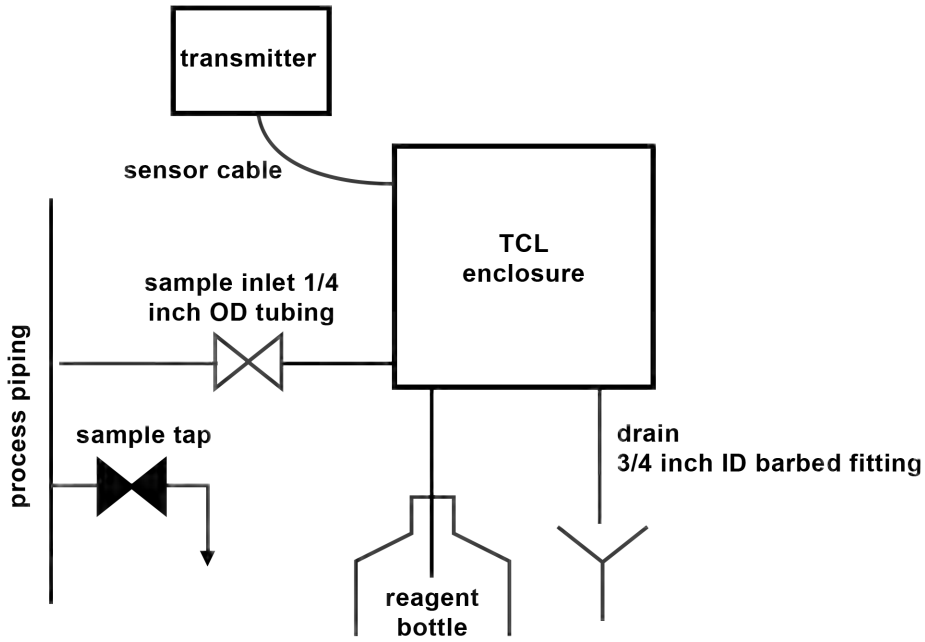


Figure 3-2: TCL Case Dimensions

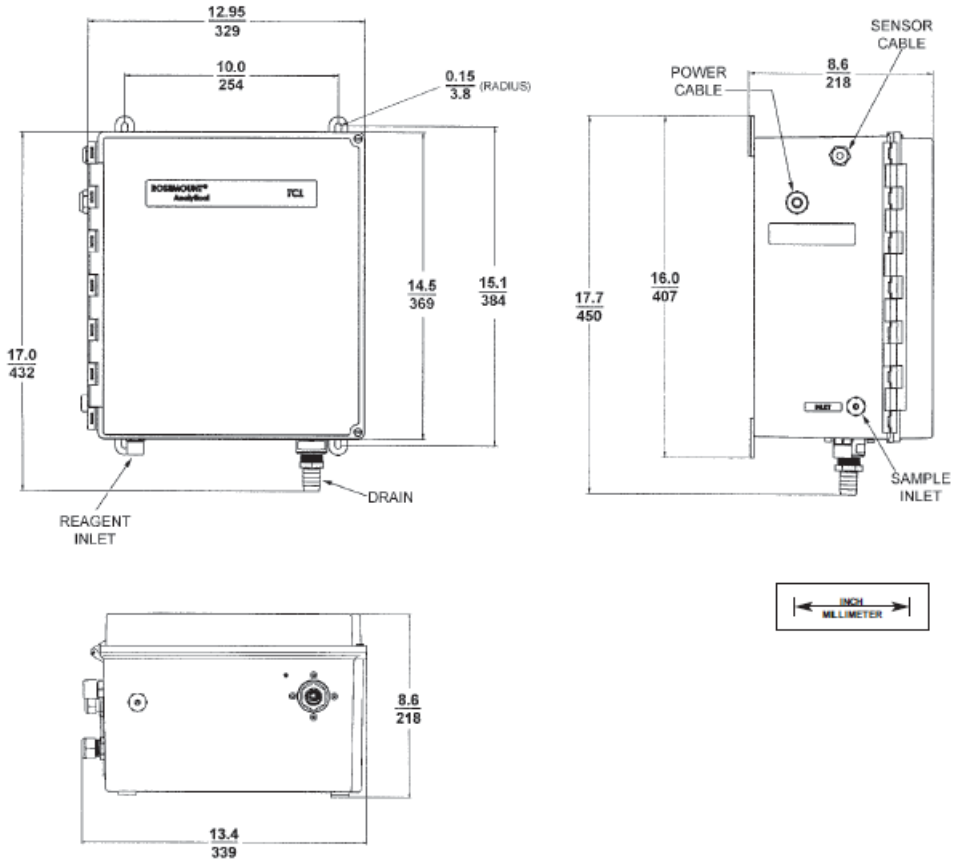
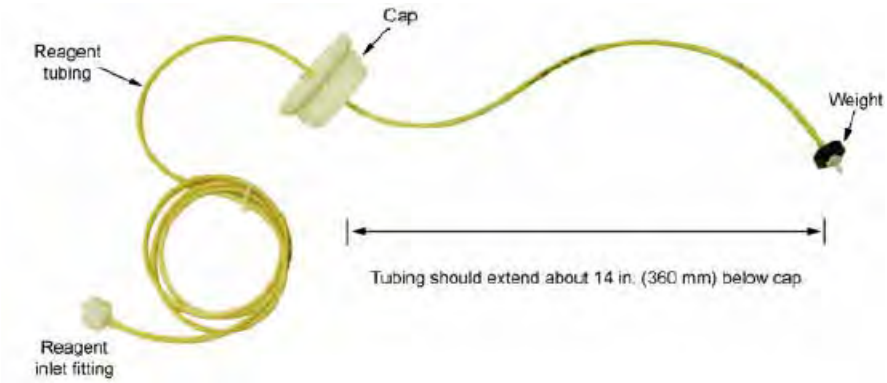


Figure 3-3: Reagent Tubing Assembly



Procedure

1. Connect the sample line to the sample conditioning system. Use 1/4 in. OD hard plastic or stainless steel tubing. If dechlorinated water is being measured, provide a way for occasionally substituting a chlorinated water sample for the dechlorinated sample.

   Chlorinated water is needed to calibrate the sensor and to check its response.
2. If a grab sample is not already available, install one in the process piping. Choose a point as close as possible to the sample line supplying the TCL.

   Be sure that opening the sample valve does not appreciably alter the flow of sample to the instrument.
3. Connect the drain to a length of 3/4 in. ID flexible plastic tubing.

   Important
   The sample must drain to open atmosphere.
4. Find the reagent tubing and fitting in the plastic bag taped to the inside of the enclosure door. Screw the reagent fitting onto the bulkhead fitting at the bottom left of the enclosure. Pass the reagent tubing through the hole in the carboy cap. Be sure the plastic weight will be inside the carboy when the cap is in place. Attach the reagent tubing to the barbed connector.

   See *Figure 3-3*.
5. Place the blue plastic carboy beneath the enclosure. Screw the cap and tubing assembly on the carboy.

   To prepare reagent, see *Section 5.1*.

3.2.3 Install the sensor

Complete the following steps to install the Rosemount 499ACL-02 Sensor in the TCL system.

1. From inside the sample conditioning enclosure, thread the sensor cable or VP cable through the gland on the upper left side.

   Leave about one foot of cable inside the enclosure.
2. Wire the cable to the transmitter.

   Refer to *Section 4.4*.
3. Remove the nut and adapter from the flow cell.
4. Slip the nut over the end of the sensor.
5. Thread the adapter onto the sensor. Hand-tighten only.
6. If you are using a VP cable, connect the cable to the sensor.

   The connector and receptacle are keyed to ensure proper mating.

7. Once the key has slid into place, tighten the connection by turning the knurled ring clockwise.
8. Remove the protective cap from the end of the sensor.
9. Insert the sensor in the flow cell. Hand tighten the nut.

4 Wiring

4.1 Prepare transmitter conduit openings

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

Conduit openings accept 1/2 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 the requirements of UL514B. Connect the conduit hub to the conduit before attaching the fitting to the transmitter (UL508-26 16).

4.2 Provide power to the sample conditioning system

Complete the following steps to power the sample conditioning system.

⚠ WARNING!

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

Note

Provide a switch or breaker to disconnect the sample conditioning cabinet from the main power supply. Install the switch or breaker near the unit and identify it as the disconnecting device for the sample conditioning system.

Procedure

1. Be sure the pump switches on the wiring access panel are in the **Off** position.
2. Remove the four screws securing the wiring access panel. Pull the panel out of the way to reveal the power terminal strip.
3. Insert the power cable through the strain relief connection labeled *Power*.

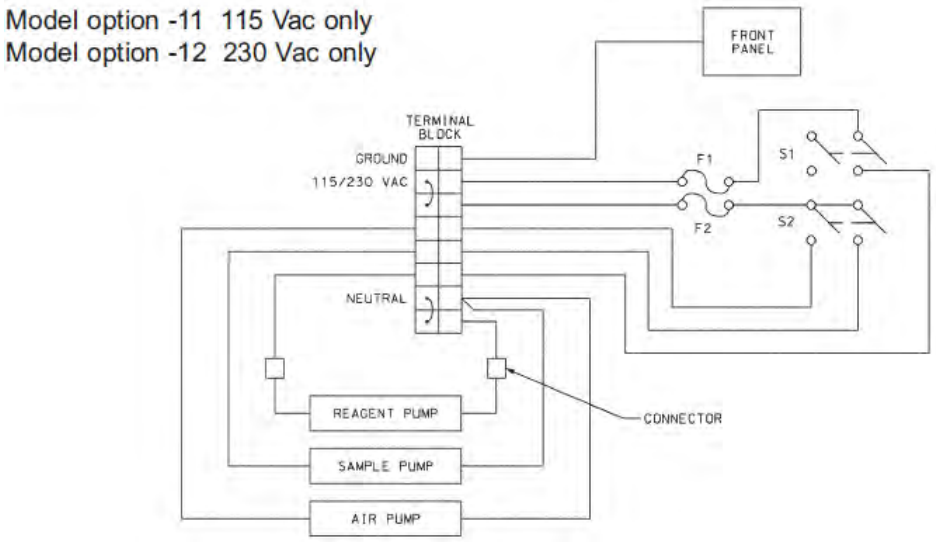
   See *Figure 3-2*.
4. Wire the power cable to the terminal strip as shown in *Figure 4-1*.

⚠ CAUTION!

EQUIPMENT DAMAGE

Do not apply 230 Vac power to a 115 Vac TCL (Model option -11). Doing so will damage the instrument.

Figure 4-1: Power wiring



Important

Leave the pump power switches off until ready to start up the unit.

See *Chapter 5*.

4.3 Make power, alarm, output, and sensor connections in the transmitter

⚠ WARNING!

RISK OF 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.

4.3.1 Power

Wire AC mains power supply to the power supply board, which is mounted vertically on the left hand side of the transmitter enclosure beneath the gray plastic cover.

1. To remove the cover, grab it by the upper edges and pull straight out.

The power connector is at the bottom of the board. See *Figure 4-3*.

2. Bring the power cable through the conduit opening just below the connector.
3. Unplug the connector from the board and wire the power cable to it.

   Lead connections are marked on the connector. (*L* is live or hot; *N* is neutral; the ground connection has the standard symbol.)
4. Replace the cover.

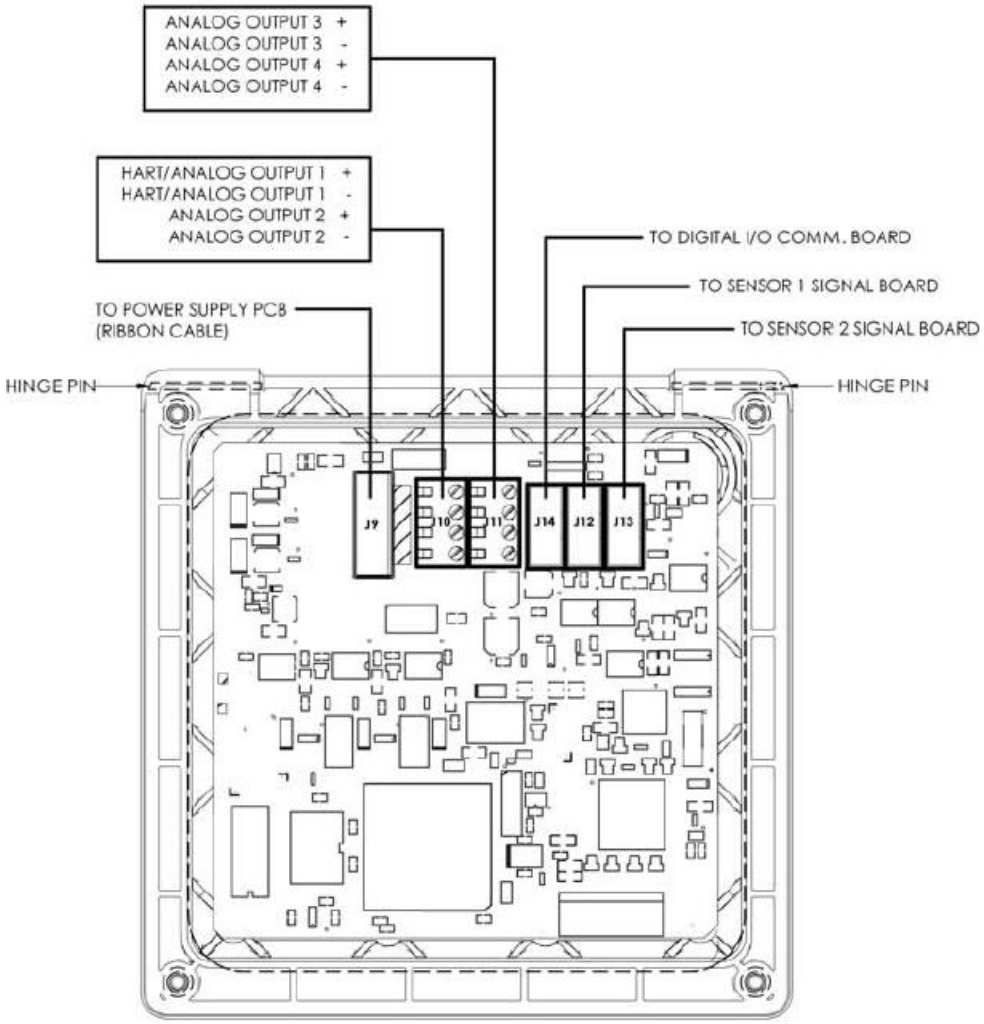
   The two tabs at the back edge of the cover fit into slots at the rear of the enclosure, and the three small slots in the front of the cover snap into the three tabs next to the relay terminal strip. See *Figure 4-3*.
5. Once the tabs are lined up, push the cover to snap it into place.
6. AC power wiring should be 14 gauge or greater. Run the power wiring through the conduit opening nearest the power terminal.
7. Provide a switch or breaker to disconnect the transmitter from the main power supply.
8. Install the switch or breaker near the transmitter and label it as the disconnecting device for the transmitter.

4.3.2 Analog output wiring

Four analog current outputs are located on the main circuit board, which is attached to the inside of the enclosure door.

Figure 4-2 shows the location of the terminals, the outputs they are assigned to, and the polarity.

Figure 4-2: Analog output connections



The analog outputs are on the main board near the hinged end of the enclosure door.

For best EMI/RFI protection, use shielded output signal cable enclosed in earth-grounded metal conduit.

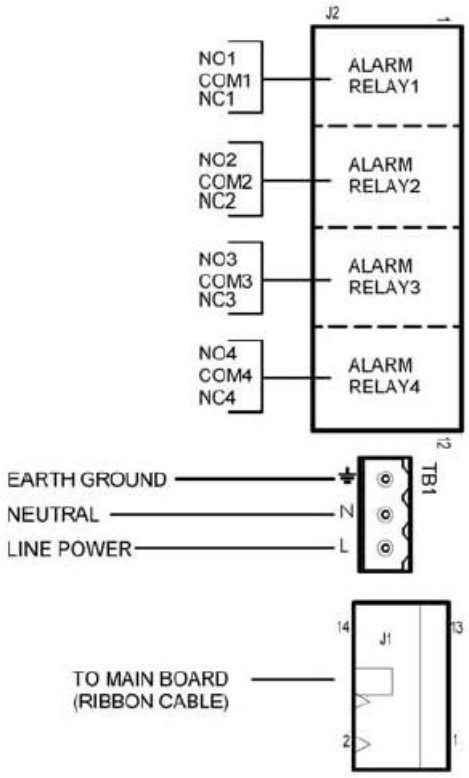
Keep output signal wiring separate from power wiring. Do not run signal and power or relay wiring in the same conduit or close together in a cable tray.

4.3.3 Alarm wiring

The alarm relay terminal strip is located on the power supply board, which is mounted on the left hand side of the enclosure beneath the gray plastic cover.

See *Figure 4-3*.

Figure 4-3: Alarm relay connections



1. To remove the cover, grab it by the upper edges and pull straight out. The relay terminal strip is at the top of the board.
2. Bring the relay wires through the rear conduit opening on the left hand side of the enclosure and make connections to the terminals strip.
3. Replace the cover. The two tabs on the back edge of the cover fit into slots at the rear of the enclosure, and the three small slots in the front of the cover snap into the three tabs next to the relay terminal strip. See *Figure 4-3*. Once the tabs are lined up, push the cover to snap it in place.

Keep alarm relay wiring separate from signal wiring. Do not run signal and power or relay wiring in the same conduit or close together in a cable tray.

4.4 Sensor wiring

If it is necessary to replace the sensor cable, refer to the instructions below.

1. Shut off power to the transmitter.
2. Locate the chlorine signal board.

Slot 1 (left)	Slot 2 (center)	Slot 3 (right)

communication	input 1 (chlorine)	input 2 (optional)

3. Insert the sensor cable through the conduit opening nearest the chlorine board.
4. Slide the board forward to gain access to the wires and terminal screws.
5. Connect the sensor to the chlorine board. Refer to *Figure 4-4* or *Figure 4-5*.

Figure 4-4: Wiring Sensor with Optimum EMI/RFI or Variopol Cable to Rosemount 56 Transmitter

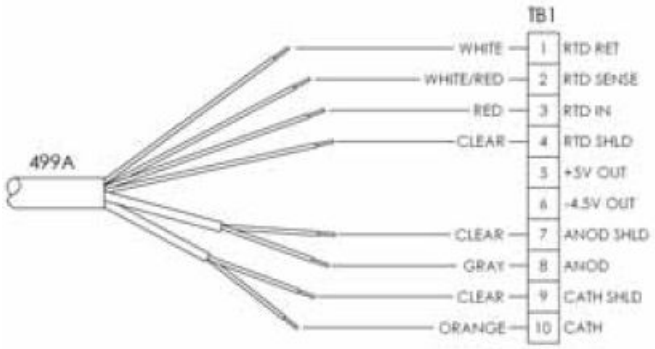
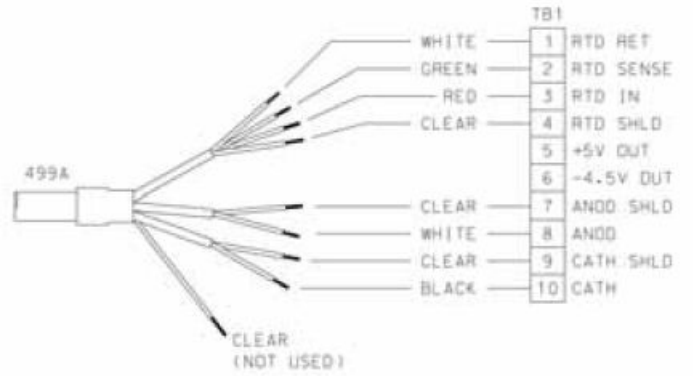


Figure 4-5: Wiring Sensor with Standard Cable to Rosemount 56 Transmitter



6. Once the cable has been connected, slide the board fully into the enclosure while taking up the excess cable through the conduit opening.
7. If you are using a cable gland, tighten the gland nut to secure the cable and ensure a sealed enclosure.

4.5 Apply power to the transmitter and complete Quick Start

For Rosemount Total Chlorine System with Rosemount 56 Transmitter

1. Once all wiring connections are secured and verified, apply power to the transmitter.

   When the transmitter is powered up for the first time, Quick Start screens appear. The first quick start screen has two control boxes, one for language and the other for temperature units.

   a. The cursor, shown by dark blue backlighting, is on the language control box. To change the language, press the **ENTER/MENU** key. A list of available languages, shown two at a time, appears. Using the **Up** and **Down** keys, scroll (see *Section 6.2*) to display the choices. Press **ENTER/MENU** to select the desired language. Press **Down** to move the cursor to the temperature control box. To change units, press **ENTER/MENU** and scroll to either °F or °C. Press **ENTER/MENU** to store the selection.

   b. To move to the next screen, use the navigation keys to move the cursor to **NEXT** and press **ENTER/MENU**.

2. The next screen lists navigation rules. Press **ENTER/MENU** for the next screen.
3. The next step is to configure sensor 1. Sensor 1 is the total chlorine sensor. The screen has two control boxes.

   a. For measurement, choose Total chlorine.

   b. Choose the desired units, mg/L or ppm.

4. Move the cursor to NEXT and press **ENTER/MENU**.

   The display changes to show some basic keypad operation guidelines.

5. Press **ENTER/MENU** to show the main display.

   The outputs, alarms, display configuration, and data logging are all assigned to default values. The default value for data logging is disabled.

6. To change the settings, refer to *Section 6.5*, *Chapter 7*, and *Chapter 9*.

5 Startup

Complete *Chapter 4* before starting this section.

5.1 Prepare the reagent

Complete the following steps to prepare the potassium iodide reagent.

⚠ WARNING!

HAZARDOUS SUBSTANCE
The reagent contains potassium iodide dissolved in distilled vinegar or 5% acetic acid. Avoid contact with skin and eyes. Wash thoroughly after using.

Important
Do not prepare the solution until ready to use.

Procedure

1. Position the blue plastic carboy under the sample conditioning cabinet. Unscrew the cap and reagent tube assembly.
2. Add the potassium iodide reagent to the carboy.

   See the table.

Expected range, ppm as Cl_2	Amount of KI needed per 5 gal (19 L) of vinegar	Part number
0-5 ppm	25 grams	24164-00
0-10 ppm	50 grams	24164-01
0-20 ppm	2 x 50 grams	24164-01

3. Add 5 gallons (19 L) of distilled white vinegar one gallon (4 L) at a time. Swirl the carboy after each addition.
4. Screw the cap on the carboy. Be sure the reagent uptake tube extends to the bottom of the carboy.
5. If it hasn't already been connected, connect the reagent tube to the small fitting on the bottom left hand side of the enclosure.

Note
The shelf life of the potassium iodide vinegar solution is at least two months if stored in the blue carboy. Do not store the reagent in a container other than the blue carboy. The reagent is sensitive to sunlight, which the blue carboy effectively blocks.

5.2 Zero the sensor

Complete the following steps to zero the 499ACL-02 Total Chlorine Sensor.

1. Place the sensor in a beaker of deionized water or simply place the sensor in air.
2. Let the sensor operate until the current is stable.
3. Zero the sensor.

   See *Section 8.4*.

5.3 Start sample flow

Adjust the sample flow until a slow stream of liquid is running down the inside tube of the sampling cup.

5.4 Begin operation and calibrate the sensor

Complete the following steps to start operating the Rosemount TCL and calibrate the 499ACL-02 Sensor.

1. Turn on the reagent and sample pump switches.

   Observe that liquid begins to fill the flow cell. The sample flow is about 11 mL/min, so the flow cell fills rather slowly. Also observe that the air pump is operating.

   The pump produces very vigorous bubbling in the flow cell. Once the flow of reagent starts, it takes about two minutes for the reagent to reach the flow cell. If the concentration of total chlorine in the sample is greater than about 0.5 ppm, the treated sample in the flow cell will be pale yellow. Sample containing more chlorine will be dark yellow.

2. Monitor the sensor current. Once the reading is stable, calibrate the unit.

   See *Section 8.4*. It may take thirty minutes or longer for the reading to stabilize when the sensor is first put in service.

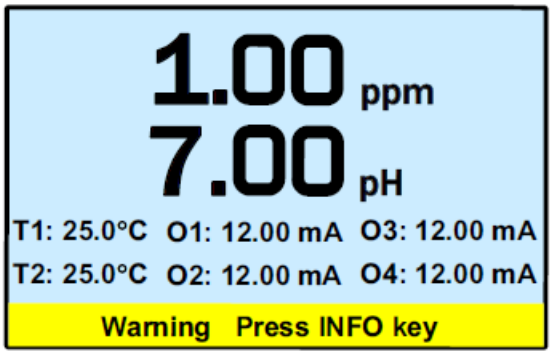
6 Display and operation

6.1 Main display

The transmitter has a four line display.

See *Figure 6-1*. The display can be customized to meet your requirements. See *Section 6.5*. Fault or warning messages, if appropriate, appear at the bottom of the screen. See *Section 13.1*.

Figure 6-1: Main display



The following abbreviations are used in the lower two lines of the display. The number following the display refers to the sensor, alarm relay, or output.

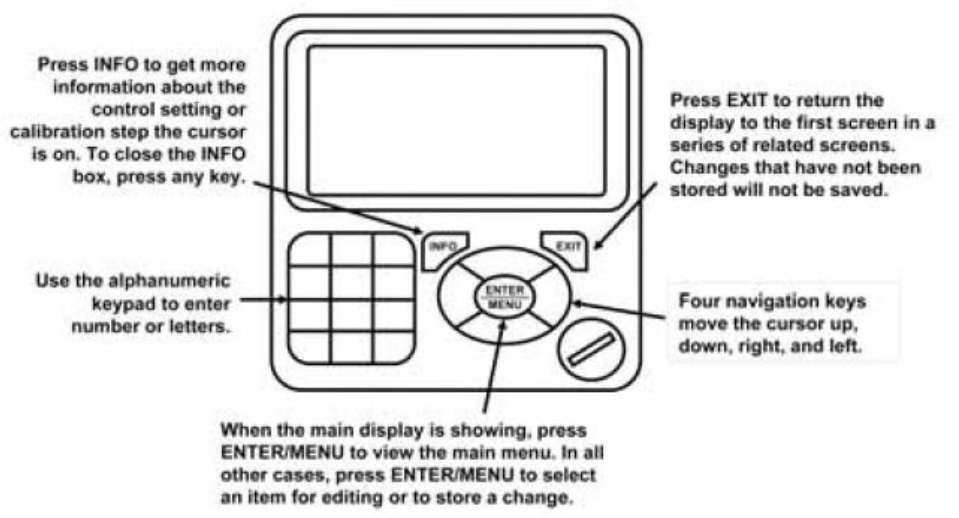
O	Output
T	Temperature (live)
Tm	Temperature (manual)
M	Measurement
AL	Alarm relay
I	Sensor current (chlorine)

6.2 Keypad

Local communication with the transmitter is through the membrane keypad.

See *Figure 6-2*.

Figure 6-2: Transmitter Keypad



6.3 Operation

The operation of the Rosemount 56 Transmitter can best be understood from the following example.

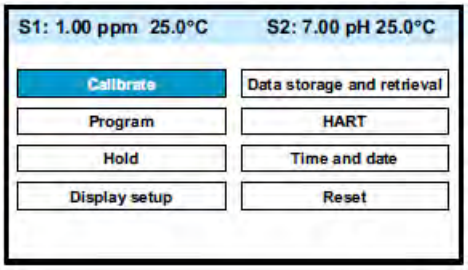
1. With the main display showing (*Figure 6-1*), press **ENTER/MENU**.

   The main Menu, shown below, appears.

   Important
   Pressing the **ENTER/MENU** key will bring up the main Menu only if the main display is showing.

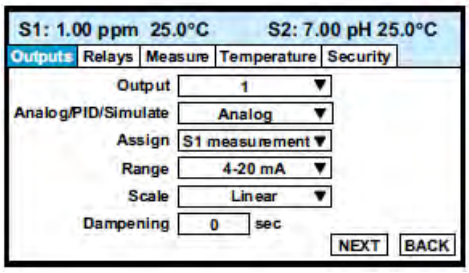
   Note that the current reading and temperature for sensor 1 (`S1`) and sensor 2 (`S2`), if applicable, always appear at the top of the screen.

   The cursor (dark blue backlit field) is on Calibrate.



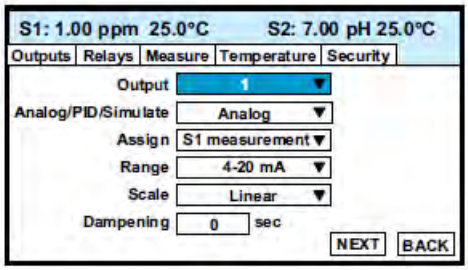
2. Press **Down** to move the cursor to Program.
3. Press **ENTER/MENU**.

   The cursor is on **Outputs**, and the first screen in the **Outputs** submenu is showing.



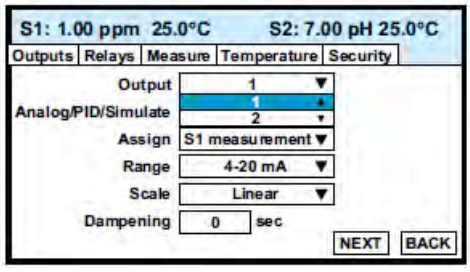
4. To select a different program submenu, use **Right** to move the cursor to the desired tab and press **ENTER/MENU**.
5. To enter the **Outputs** submenu, press **Down**.

   The cursor moves to the first control box, Output. The 56 has four analog outputs, and this control lets you select which output to configure. The default is output 1.



6. To select a different output, press **ENTER/MENU**.

   A list of the available outputs, shown two at a time, appears.

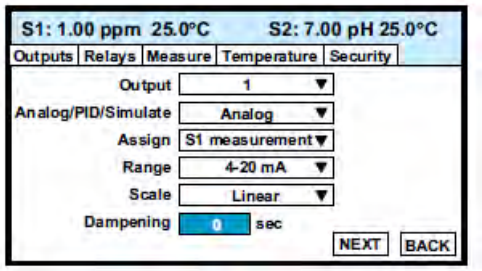


7. To view the list, press and hold **Up** or **Down**. To select and store the highlighted selection, press **ENTER/MENU**. To move from one control box to another, press **Up** or **Down**.

   Some controls require you to select an item from a list. Others, like Dampening, require you to enter a number.

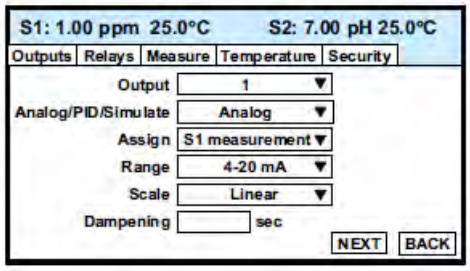
8. Move the cursor to Dampening at the bottom of the screen.

   The default Dampening value is 0 seconds.



9. To change the value, press **ENTER/MENU**.

   The dark blue back-lighting disappears, indicating that a number can be entered.

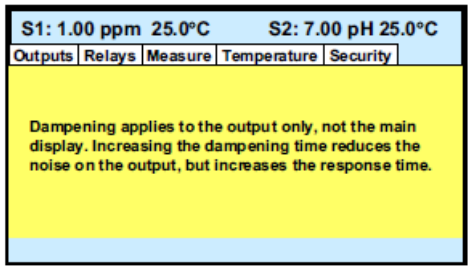


10. Use the numeric keypad to enter the desired number. If you make an error, press **Left** to erase the digit last entered. To store the number, press **ENTER/MENU**.

    Every control box has an information or help screen associated with it.

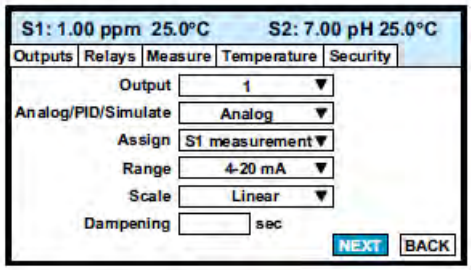
11. To view the information screen for the control box the cursor is on, press **INFO**.

    The information screen for Dampening is shown below.



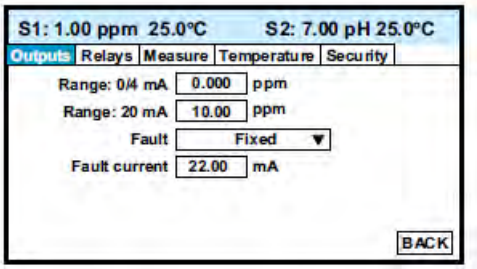
12. To close the information screen, press any key.

    A **NEXT** and **BACK** button are at the bottom of the screen. **NEXT** means that additional control boxes are available on at least one or more screen.



13. To view the next screen, use the navigation keys (either **Down** or **Right**) to move the cursor to **NEXT** and press **ENTER/MENU**.

    The next screen in the **Outputs** submenu appears. The cursor is on the Outputs tab.



14. To enter the screen, press **Down**.
15. To return to the previous screen, move the cursor to **BACK** and press **ENTER/MENU**.
16. To return to the main menu, press **EXIT**.

6.4 Hold

6.4.1 Purpose

To prevent unwanted alarms and improper operation of control systems or dosing pumps, place the alarm relays and outputs assigned to the sensor in hold before removing the sensor for maintenance.

Hold is also useful if calibration, for example, buffering a pH sensor, will cause an out of limits condition. During hold, outputs assigned to the sensor remain at the last value, and alarms assigned to the sensor remain in their present state.

6.4.2 Using the Hold function

The Hold function uses certain programming features not discussed in *Section 6.3*.

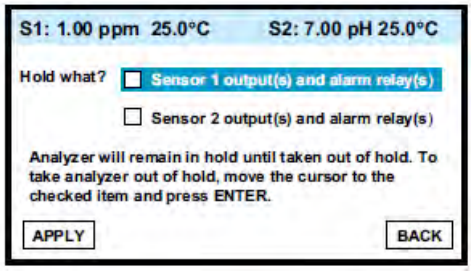
Procedure

1. With the main display showing, press **ENTER/MENU**.

   The main menu appears.

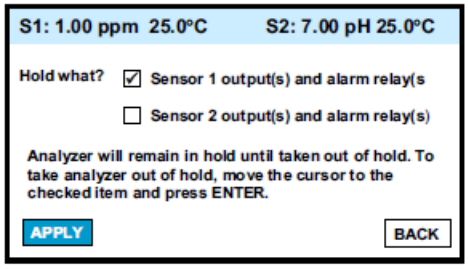
2. Choose Hold.

   The screen below appears. The cursor is on the first checkbox.



3. To hold outputs and relays associated with sensor 1, press **ENTER/MENU**. A check appears in the checkbox. To put sensor 2 on hold also, move the cursor to the sensor 2 line and press **ENTER/MENU** to select the sensor 2 checkbox.
4. To activate Hold, move the cursor to the APPLY button at the bottom left of the screen and press **ENTER/MENU**.

   The selected sensor outputs and alarm relays remain on hold until taken out of hold. However, if power is lost and then restored, hold will automatically be turned off.

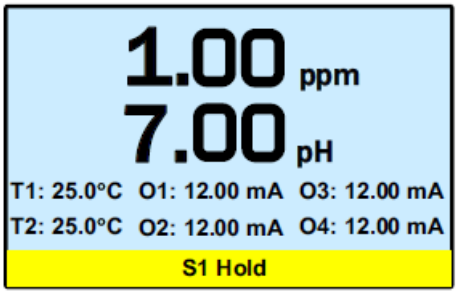


The screen describes how to take the transmitter out of hold.

Important

Be sure to press **APPLY** once the box has been unchecked.

A message stating which sensors are in hold appears in the fault/warning banner at the bottom of the display.



6.5 Main display

6.5.1 Configuring the main display

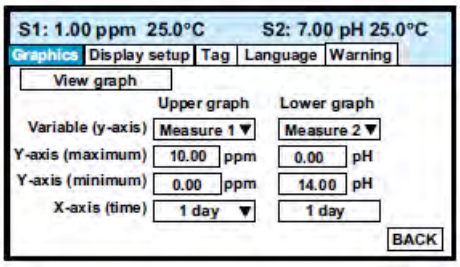
The main display can be configured to meet your specific requirements.

1. With the main display showing, press **ENTER/MENU**.

   The main menu appears.

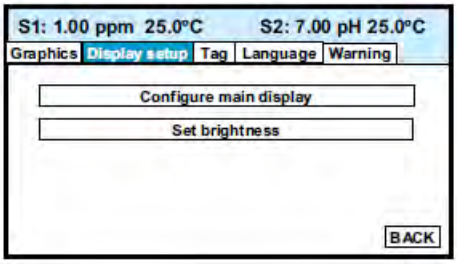
2. Choose **Display Setup**.

   The screen below appears.



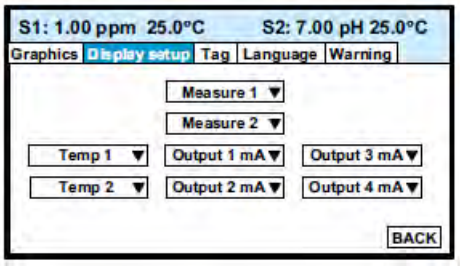
3. Move the cursor to Display setup and press **ENTER/MENU**.

   The screen below appears.



4. Choose Configure main display.

   The screen below appears. The position of each control box corresponds to the position of the variable in the main display.



5. Move the cursor to the control box and press **ENTER/MENU**. Use **Up** and **Down** to scroll through the list of variables and press **ENTER/MENU** to select the desired variable for display.

6.5.2 Setting brightness

Complete the following steps to the set the brightness on the 56 Transmitter screen.

1. Move the cursor to the Set brightness button shown in step 3 in *Section 6.5.1* and press **ENTER/MENU**.
2. Then move the cursor to Display brightness and select the desired brightness.

   The information screen gives recommendations about setting the brightness level especially in areas where the ambient temperature exceeds 50 °C (121 °F).

6.6 Security

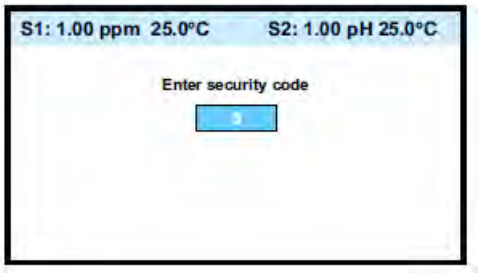
6.6.1 How the security code works

Security codes prevent accidental or unwanted changes to program settings or calibrations.
There are three levels of security:

1. A user can view the main display and diagnostic screens only.
2. A user has access to the **Calibration** and **Hold** menus only.
3. A user has access to all menus.

Procedure

1. If a security code has been programmed, pressing a submenu button (see *Section 6.3*) causes the security screen shown below to appear.



2. Enter the three digit security code.

   If the entry is correct, the requested submenu appears, and you have access to all the submenus the code entitles you to.

   If the entry is wrong, the Invalid code screen appears.

6.6.2 Assigning security codes

See *Section 7.6*

6.6.3 Bypassing security codes

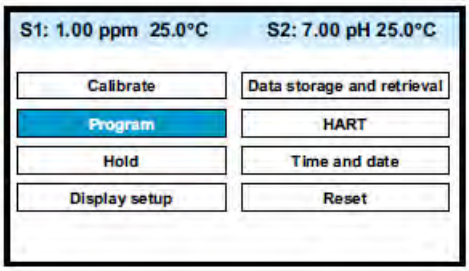
Call the factory.

7 Programming the transmitter

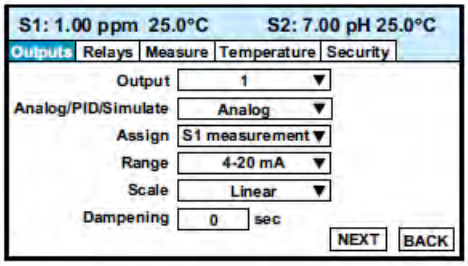
7.1 Entering the Program menus

Complete the following steps to access the **Program** menus on your 56 Transmitter.

1. With the main display showing, press **ENTER/MENU** to display the main menu.



2. Move the cursor to Program and press **ENTER/MENU**.



3. Move the cursor to the tab showing the desired submenu and press **ENTER/MENU**.

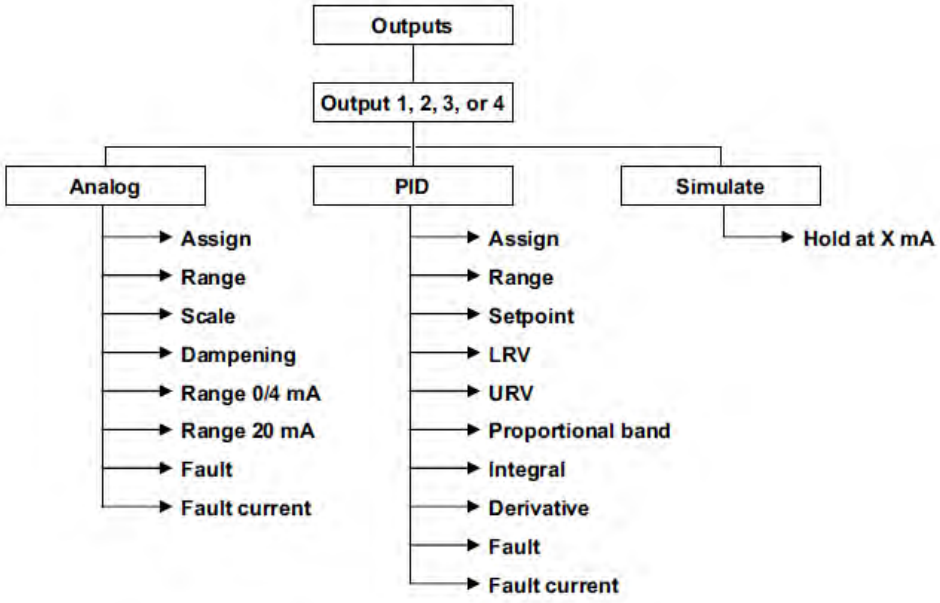
   A fifth tab, not shown, labeled pH diagnostics setup, will be present if one of the sensors is a pH sensor.

7.2 Outputs

7.2.1 Menu tree

Figure 7-1 is the **Outputs** menu tree.

Figure 7-1: Menu tree for the Outputs submenu



7.2.2 Settings

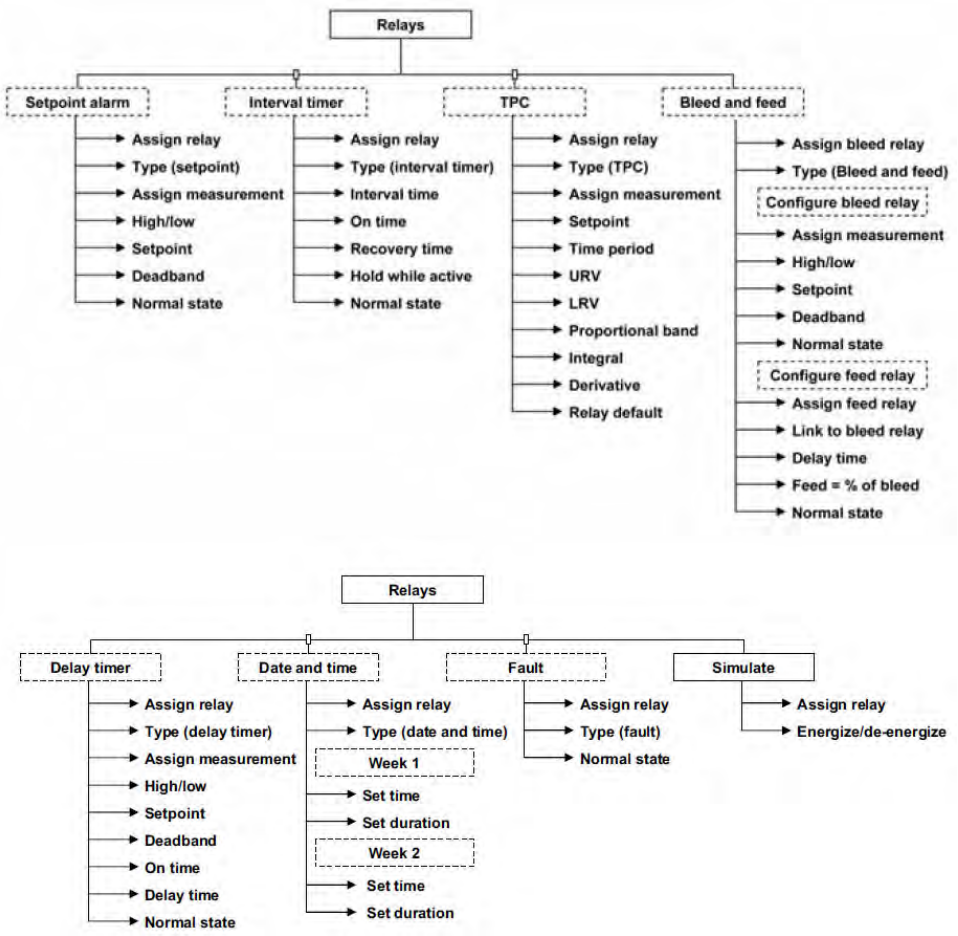
Move the cursor to the appropriate control box and press the desired setting. For more information about the control box the cursor is on, press **INFO**. To close the information screen, press any key.

7.3 Relays

7.3.1 Menu tree

Figure 7-2 is the **Relays** menu tree.

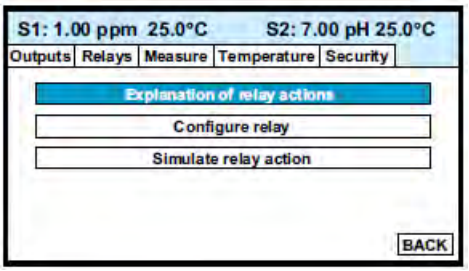
Figure 7-2: Menu tree for the Relays submenu



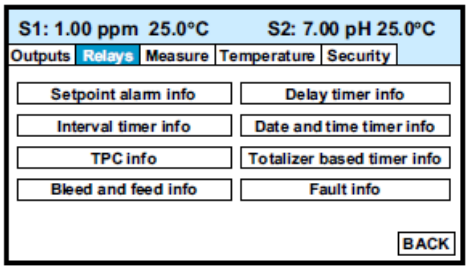
7.3.2 Settings

A large number of relay actions are available in the Model 56.

1. For more information about a relay action, move the cursor to the Explanation of relay actions button and press **ENTER/MENU**.



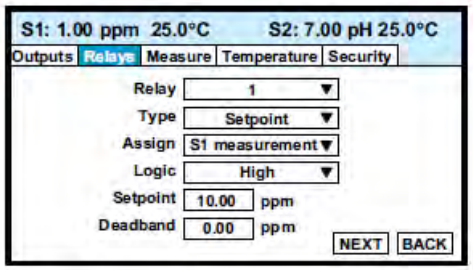
The screen below appears.



2. Select the desired relay action and press **INFO** to display the information screen.
3. To close the information screen, press any key.

   The totalizer-based relay timer is not available with the model 56 offered as standard options with the TCL. It is available only if one of the measurements is flow.
4. To configure a relay, press **EXIT** to return to the first screen.
5. Move the cursor to the Configure relay button and press **ENTER/MENU**.

   A screen similar to the one below appears.



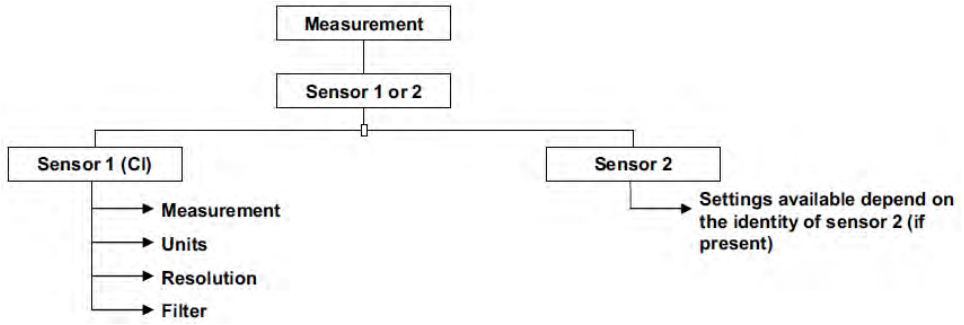
6. Move the cursor to the appropriate control box and make the desired setting.
7. For more information about the control the cursor is on, press **INFO**.
8. To close the information screen, press any key.

7.4 Measurement

7.4.1 Menu tree

Figure 7-3 is the **Measurement** menu tree.

Figure 7-3: Menu tree for the Measurement submenu



7.4.2 Settings

Complete the following steps to change the measurement settings on your 56 Transmitter.

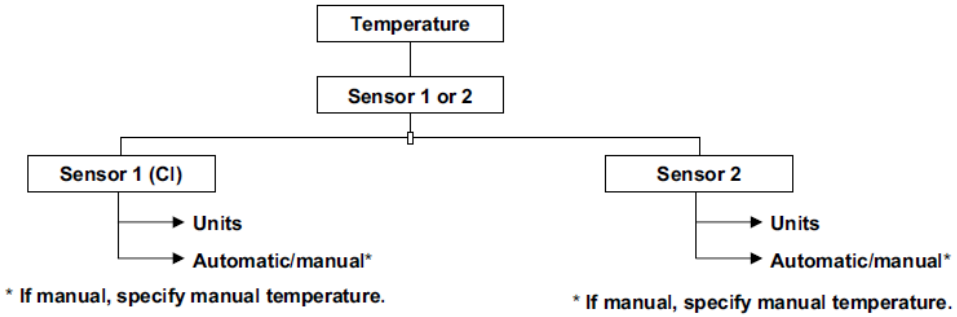
1. Move the cursor to the appropriate control box and make the desired setting.
2. For more information about the control the cursor is on, press **INFO**.
3. To close the information screen, press any key.

7.5 Temperature

7.5.1 Menu tree

Figure 7-4 is the **Temperature** menu tree.

Figure 7-4: Menu tree for the Temperature submenu



7.5.2 Settings

Complete the following steps to change the temperature settings on your 56 Transmitter.

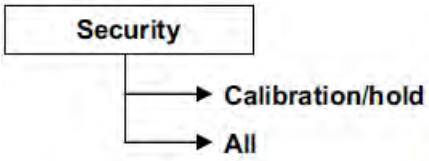
1. Move the cursor to the appropriate control box and make the desired setting.
2. For more information about the control the cursor is on, press **INFO**.
3. To close the information screen, press any key.

7.6 Security

7.6.1 Menu tree

Figure 7-5 is the Security menu tree.

Figure 7-5: Menu tree for the Security submenu



7.6.2 Settings

Complete the following steps to change the security settings on your 56 transmitter.

1. Move the cursor to the appropriate control box and make the desired setting.
2. For more information about the control the cursor is on, press **INFO**.
3. To close the information screen, press any key.

7.6.3 Restoring default settings

See *Section 8.6*.

8 Calibration

8.1 Introduction

The **Calibrate** menu allows you to do the following:

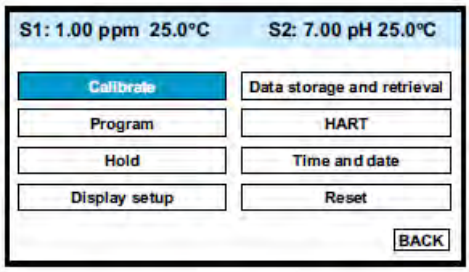
1. Calibrate the RTD (temperature sensing element) in the chlorine and pH sensors.
2. Calibrate the chlorine sensor.
3. Calibrate the analog outputs.

8.2 Entering the Calibration menus

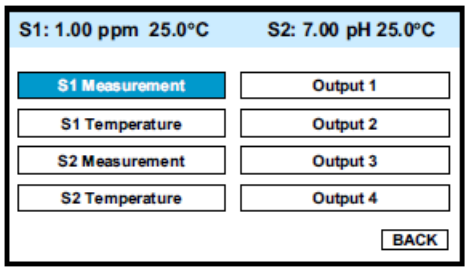
Complete the following steps to enter the **Calibration** submenus on your 56 Transmitter.

1. With the main display showing, press **ENTER/MENU** to display the main menu.

   The cursor is on Calibrate.



2. Press **ENTER/MENU**.



3. Choose the sensor (measurement or temperature) or output to be calibrated.

   Sensor 1 (S1) is the free chlorine sensor; sensor 2 (S2) is the pH sensor (if present).

8.3 Calibrating temperature

Complete the following steps to calibrate the temperature on your 56 Transmitter.

1. To calibrate the temperature device in the sensor, choose S1 temperature or S2 temperature and follow the prompts.

   If you want more information about a calibration step, press **INFO**.

   Once the calibration is correct, the screen shows the results of the calibration. The screen also shows some acceptance criteria to help you determine whether to accept the calibration.

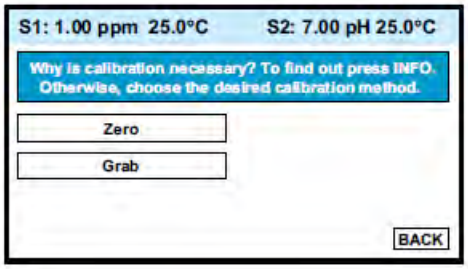
2. Press **INFO** for an information screen to aid with troubleshooting if the calibration results are not acceptable.

8.4 Calibrating the free chlorine sensor

Complete the following steps to calibrate the free chlorine sensor.

1. Choose sensor 1 (total chlorine) in *Section 8.2*.

   The screen below appears.



   There are two steps to calibrating a free chlorine sensor, measuring the zero current (Zero) and determining the slope of the calibration curve (Grab). Because stable total chlorine standards do not exist, the sensor must be calibrated against the results of a laboratory test run on a grab sample.

2. To zero the sensor, select Zero and follow the prompts.

   For more information about preparing the zero solution and measuring the zero current, press **INFO** when prompted.

   If the zero step is successful, the transmitter displays the Zero complete screen and the measured zero current. The screen also shows the typical zero current for the sensor and the recommended acceptance criterian. You are asked to accept the zero current. Press **INFO** for an information screen to aid with troubleshooting if the results are not acceptable.

   If the zero current is badly in error, the transmitter displays the Zero failed screen. Press **INFO** for troubleshooting.

3. To calibrate the sensor response in chlorinated water, select Grab and follow the prompts.

   Be sure the sensor is installed in the flow cell in the TCL and the sample is flowing down the inside tube of the overflow sampler. Also verify that reagent is being delivered to the sample and that the air pump is working.

   If the calibration is successful, the transmitter displays the Calibration complete screen and the sensitivity (nA/ppm). The screen also shows the typical sensitivity range for the sensor and the recommended acceptance criterion. You are asked to accept the calibration. Press INFO for an information screen to aid with troubleshooting if the calibration is not acceptable.

   If the sensitivity is badly in arror, the transmitter displays the Calibration failed screen. Press INFO for troubleshooting.

8.5 Calibrating the analog outputs

Complete the following steps to calibrate the analog outputs in your 56 Transmitter.

1. Choose the appropriate output in *Section 8.2* and follow the prompts to trim the selected output.

   If you want more information about a calibration step, press INFO.

   Once the calibration is complete, the screen shows the results of the calibration. The screen also shows some acceptance criteria to help you determine whether to acccept the calibration.

2. Press INFO for an information screen to aid with troubleshooting if the calibration results are not acceptable.

8.6 Reset

8.6.1 Purpose

There are three resets.

1. Reset all user settings, including calibration and program settings, to the factory default values. The transmitter will return to Quick Start.

   Important
   The event logger and data logger will be unaffected.

2. Reset sensor calibration to the default value. The transmitter will clear all user-entered calibration data for the selected sensor. It will leave all other user-entered data unaffected.

3. Reset the analog output calibration for the selected output to the default value. The transmitter will leave all other user-entered settings unchanged.

8.6.2 Procedure

Complete the following steps to reset your 56 Transmitter.

1. With the main display showing, press **ENTER/MENU** to display the main menu.
2. Move the cursor to Reset and press **ENTER/MENU**.
3. Check the desired boxes and press **APPLY**.

9 Data and event logging and retrieval

9.1 Overview

Data and event logging is a standard feature in the Rosemount 56 Transmitter. However, the feature must be enabled.

When data and event logging is enabled, the Rosemount 56 Transmitter will automatically store the following events with date and time stamp: faults warnings, calibration data, calibration results (pass or fail), power on/off cycles, hold on/off, and new sensor board detected. At your discretion, the transmitter will also store alarm activation and deactivation as events. The event logger holds 300 events. When the capacity of the logger is reached, the oldest events are removed to make room for new events.

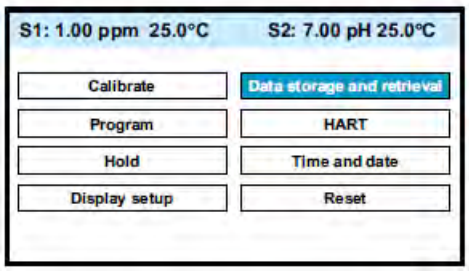
When data/event logging is enabled, the transmitter will automatically store the following measurement data for total chlorine: date and time, ppm chlorine, temperature, and sensor current.

The transmitter can store up to 30 days of data. When the capacity of the logger is reached, the oldest data are removed to make room for new data. Data storage frequency is every 30 seconds.

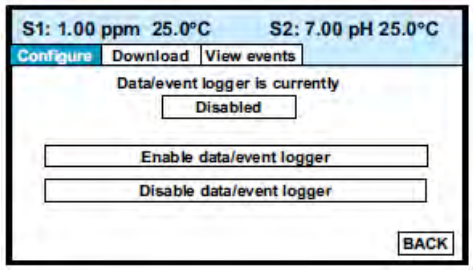
9.2 Configuration

Complete the following steps to configure data and event logging and retrieval on your 56 Transmitter.

1. With the main display showing, press **ENTER/MENU**. Choose Data storage and retrieval.



The screen below appears. The data logger is currently disabled (default).



2. To enable the data lotter, move the cursor to Enable data/event logger and press **ENTER/MENU**.
3. Make the appropriate date and time settings and choose which alrm relay activations and deactivations to record as events.

Note

Setting the date or time to an earlier value than the one currently showing will cause data to be lost form the data/event logger. Download data before resetting time or date. See *Section 9.3*.

9.3 Downloading data and events

Complete the following steps to download data and events from your 56 Transmitter to a USB flash drive.

1. To download data or events, move the cursor to the **Download** tab and press **ENTER/MENU**.
2. Unscrew the USB port cover in the lower right hand corner of the front panel and insert a USB flash drive in the port.
3. Press the appropriate button to download data or events.

   Downloading may take as long as 20 minutes. During download, the display and keypad are frozen, but all other transmitter functions continue.

Downloaded data and events are stored in a spreadsheet. There is a separate spreadsheet for every day of data. The finename for downoloaded data is *dl mmddyy* or *dl ddmmyy* depending on the date and time format you select. The filename for downloaded events is *el mmddyy* or *el ddmmyy*.

9.4 Date and time

To reset the date and time from the main Menu, press the **Time and Date** button.

Note

Setting the date and time to an earlier value than the one showing will cause data to be lost from the data/event logger. See *Section 9.3*.

10 Graphical display

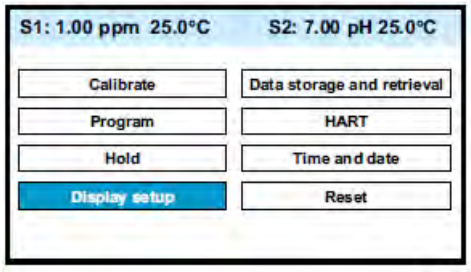
10.1 Overview

The Rosemount 56 Transmitter has a dual graphical display. Each graph can be configured to meet your requirements, although the time axis on both graphs must be the same. The time scale can be set to one hour, one day, seven days, or thirty days.

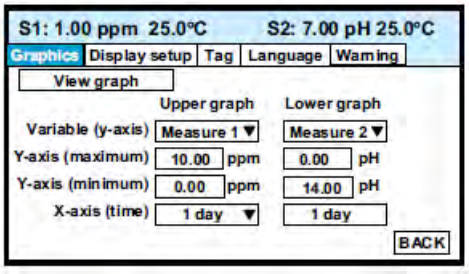
10.2 Configuration

Complete the following steps to configure the graphical display on your 56 Transmitter.

1. With the main display showing, press **ENTER/MENU**. Choose Display setup.

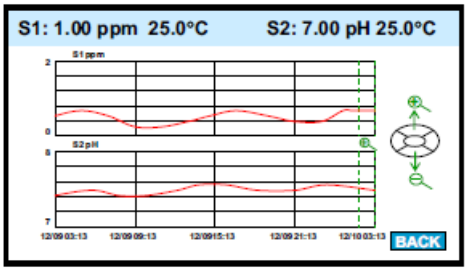


The screen shown below appears.



2. Configure the displayed variable, the maximum and minimum values for the Y-axis, and the time scale.

3. To view the graphs, move the cursor to the **View graph** button and press **ENTER/ MENU**.



The time axis can be expanded or shrunk.

4. To expand the time scale, use **Left** or **Right** to move the pair of dotted green lines to the area of interest. Press **Up** to expand the graph. To shrink the time axis, press **Down**.

11 Digital communications

The Rosemount 56 Transmitter has HART communications as a standard feature and Profibus DP as an option. For more information, refer to the Rosemount 56 HART or Profibus DP Addendum manuals.

12 Maintenance

12.1 Transmitter

The Rosemount 56 Transmitter used with the TCL requires little routine maintenance. Clean the transmitter case and front panel by wiping with a clean soft cloth dampened with water only. Do not use solvents, like alcohol, that might cause a buildup of static charge.

The sensor circuit board (PN 24203-01) is replaceable. If you have a dual input transmitter, consult the Rosemount 56 instruction manual for the part number of the other board.

To replace the board:

⚠ WARNING!

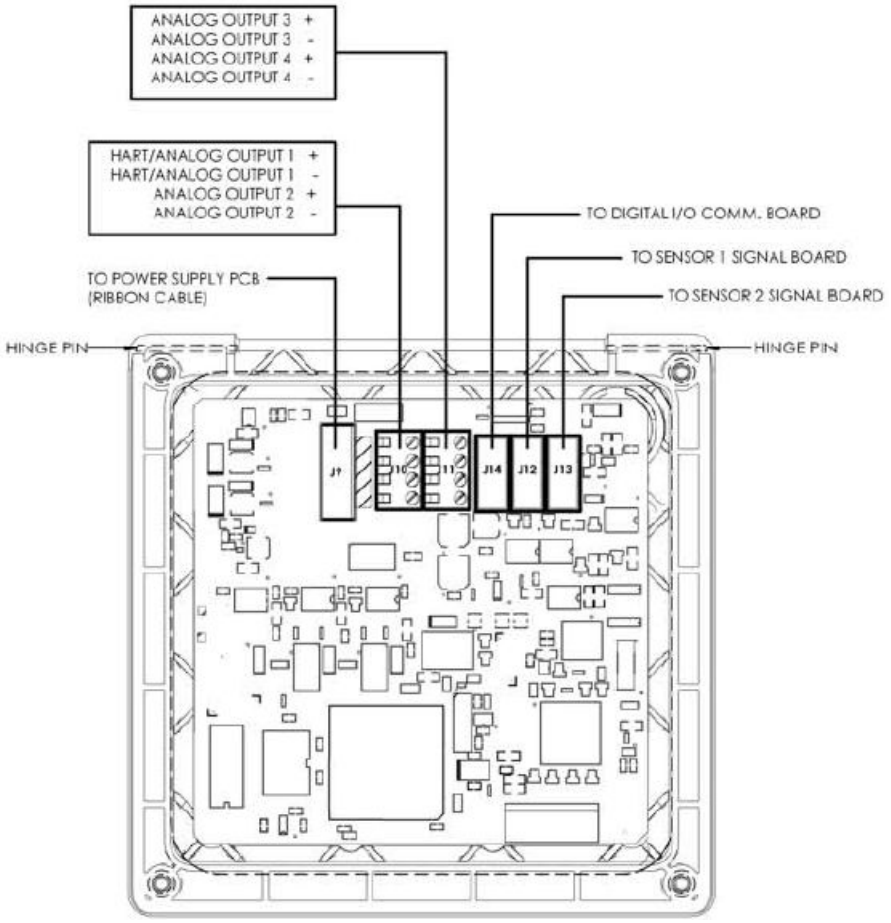
RISK OF ELECTRICAL SHOCK
Disconnect main power and relay contacts wired to separate power source before servicing.

Procedure

1. Turn off power to the transmitter.
2. Loosen the four screws holding the front panel in place and let the front panel drop down.
3. Loosen the gland fitting and carefully push the sensor cable up through the fitting as you pull out the circuit board.
4. Once you have access to the terminal strip, disconnect the sensor.
5. Unplug the sensor board from the main board.

   See *Figure 12-1*.

Figure 12-1: Main Board Showing Connections to Sensor Board(s)



6. Slide the replacement board partially into the board slot. Plug the sensor board into the main board and reattach the sensor wires.
7. Carefully pull the sensor cable through the gland fitting as you push the sensor board back into the enclosure. Tighten the cable glands.
8. Close the front panel.
9. Turn on power.

12.2 Total chlorine sensor

12.2.1 General

When used in clean water, the total chlorine sensor requires little maintenance. Generally, the sensor needs maintenance when the response becomes sluggish or noisy or when readings drift following calibration. Maintenance frequency is best determined by experience. For a sensor used in potable water, expect to clean the membrane every

month and replace the membrane and electrolyte solution every three months. Sensors used in dirty water require more frequent maintenance and calibration. However, if experience shows the sensor is holding calibration and not drifting appreciably between calibration intervals, the maintenance interval can be extended.

12.2.2 Cleaning the membrane

Keep the membrane clean.

Clean the membrane with water sprayed from a wash bottle. Use a soft tissue to gently wipe the membrane.

12.2.3 Replacing the membrane

Complete the following steps to replace the membrane on the total chlorine sensor.

1. Hold the sensor with the membrane facing up.
2. Unscrew the membrane retainer. Remove the membrane assembly and O-ring.

   See *Figure 12-2*.
3. Inspect the cathode. If it is tarnished, clean it by gently rubbing in the direction of the existing scratches (do not use a circular motion) with 400-600 grit silicon carbon finishing paper. Rinse the cathode thoroughly with water.
4. Prepare a new membrane. Hold the membrane assembly with the cup formed by the membrane and membrane holder pointing up. Fill the cup with electrolyte solution. Set aside.
5. Put a new O-ring in the groove.
6. Place a drop of electolyte solution on the cathode. Invert the membrane assembly and place it over the cathode stem.
7. Screw the membrane retainer back in place.
8. Hold the sensor with the membrane pointing down. Shake the sensor a few times, as though shaking down a clinical thermometer.

12.2.4 Replacing the electrolyte solution and membrane

⚠ WARNING!

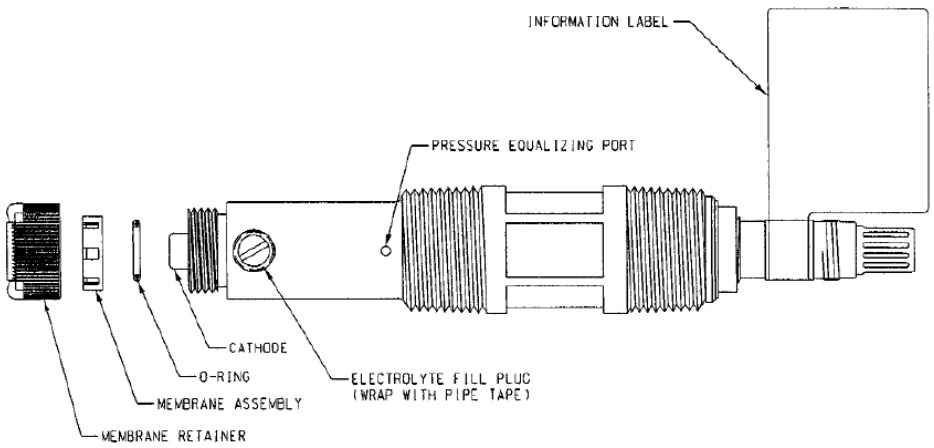
HARMFUL SUBSTANCE
Fill solution may cause irritation. Avoid contact with skin and eyes. May be harmful if swallowed..

Procedure

1. Unscrew the membrane retainer.
2. Remove the membrane assembly and O-ring.

   See *Figure 12-2*.

Figure 12-2: Sensor Parts



3. Hold the sensor over a container with the cathode pointing down.
4. Remove the fill plug.
5. Allow the electrolyte solution to drain out.
6. Remove the old pipe tape from the plug.
7. Wrap the plug with two turns of pipe tape and set aside..
8. Prepare a new membrane.
   a. Hold the membrane assembly with the cup formed by the membrane and membrane holder pointing up.
   b. Fill the cup with electrolyte solution.
   c. Set it aside.
9. Hold the sensor at about a 45° angle with the cathode end pointing up.
10. Add electrolyte solution (PN 9210438) through the fill hole until the liquid overflows.
11. Tap the sensor near the threads to release trapped air bubbles.
12. Add more electrolyte solution if necessary.
13. Place the fill plug in the electrolyte port and begin screwing it in.
14. After several threads have engaged, rotate the sensor so that the cathode is pointing up and continue tightening the fill plug.

    Do not overtighten.
15. Place a new O-ring in the groove around the cathode post.
16. Cover the holes at the base of the cathode stem with several drops of electrolyte solution.
17. Insert a small blunt probe, like a toothpick with the end cut off, through the pressure equalizing port.

    See *Figure 12-2*.

⚠ CAUTION!

EQUIPMENT DAMAGE

Do not use a sharp probe. It will puncture the bladder and destroy the sensor.

18. Gently press the probe against the bladder several times to force liquid through the holes at the base of the cathode stem. Keep pressing the bladder until no air bubbles can be seen leaving the holes. Be sure the holes remain covered with electrolyte solution.
19. Place a drop of electrolyte solution on the cathode; then place the membrane assembly over the cathode.
20. Screw the membrane retainer in place.

    The sensor may require several hours operating at the polarizing voltage to equilibrate after the electrolyte solution has been replenished.

Table 12-1: Spare Parts

Part number	Description
33523-00	Electrolyte fill plug
9550094	O-ring, Viton 2-014
33521-00	Membrane retainer
23501-02	Total chlorine membrane assembly: includes one membrane assembly and one O-ring
23502-02	Total chlorine membrane kit: includes three membrane assemblies and three O-rings.
9210438	Total chlorine sensor fill solution , 4 oz (120 mL)

12.3 Sample conditioning system

12.3.1 Reagent

The sample conditioning reagent lasts about two months.

Before putting fresh reagent in the carboy, discard any small amount of remaining reagent. To prepare the reagent refer to the procedure in *Section 5.1*. See *Table 12-2* for ordering information.

12.3.2 Sample and reagent tubing

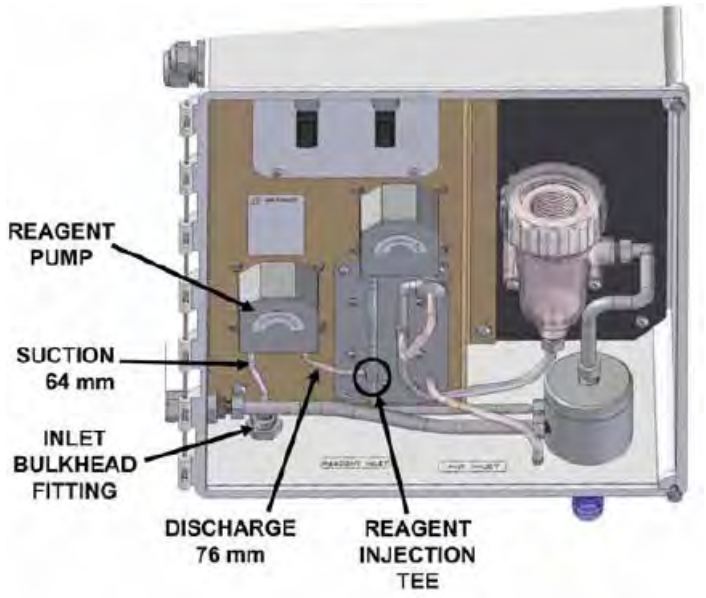
Periodically inspect sample and reagent tubing for cracks and leaks. Replace tubing if it is damaged.

After a period of time, the sample tubing becomes plugged with suspended matter. The tubing is flexible and difficult to clean mechanically. Plugged sample tubing is best replaced.

Replacement tubing kits are available. See *Table 12-2*.

Reagent tubing is shown in *Figure 12-3*.

Figure 12-3: Replacing Reagent Tubing



To replace reagent tubing:

Procedure

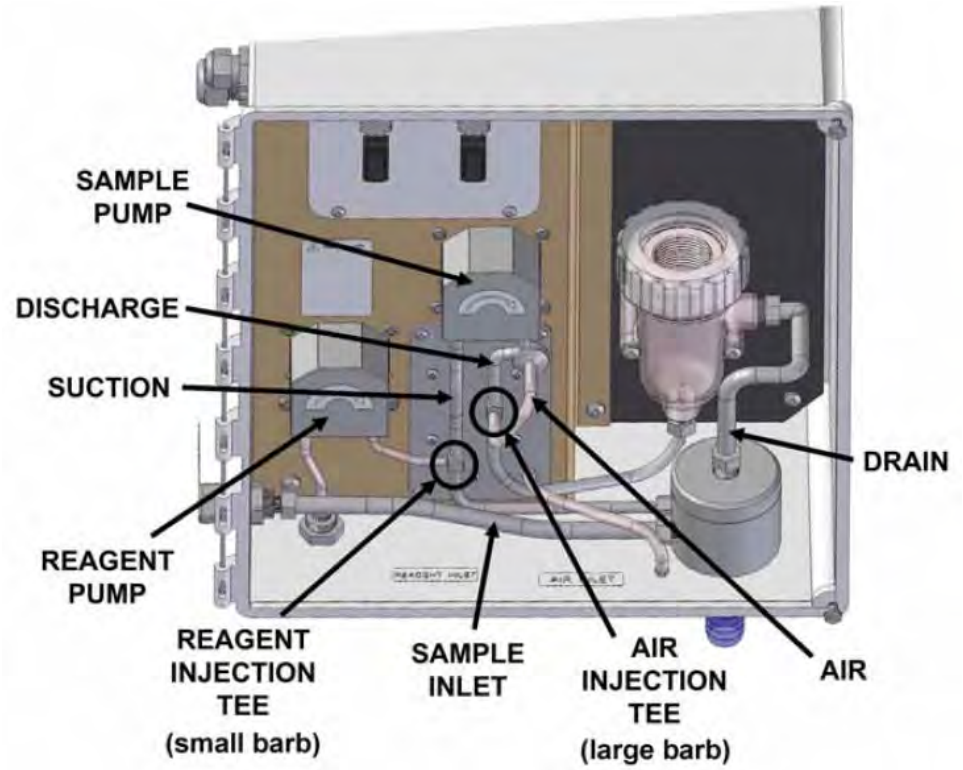
1. Turn off sample and reagent pumps.
2. Luer fittings connect the reagent tubing to the pump. Disconnect the tubing by turning the fitting in the direction of the arrows shown in *Figure 12-5*.
3. Disconnect the other end of the suction tubing from the barb on the reagent inlet fitting in the bottom of the enclosure. Disconnect the other end of the discharge tubing from the reagent injection tee.
4. Install the replacement tubing.

   Note that the discharge tubing is longer than the suction tubing.

12.3.3 Replacing sample tubing

To replace sample tubing:
Sample tubing and tees are shown in *Figure*.

Figure 12-4: Replacing sample tubing



Procedure

1. Turn off the sample and reagent pumps.
2. Luer fittings connect the sample tubing to the pump. Disconnect the tubing by turning the fitting in the direction of the arrows shown in *Figure 12-5*.
3. Disconnect the other end of the sample pump suction tubing from the overflow sampler. Pull the reagent injection tubing off the reagent injection tee.
4. Disconnect the other end of the sample pump discharge tubing from the flow cell. Pull the air injection tubing off the air injection tee.
5. Disconnect the sample inlet and drain tubing.
6. Install the replacement sample pump suction and discharge tubing assemblies.

   The assemblies look similar. To tell the difference, note the air injection tee in the discharge tubing assembly has a larger diameter barb than the reagent injection tee in the suction tubing assembly.
7. Install replacement sample inlet and drain tubing.

   The sample inlet tubing is longer than the drain tubing.

12.3.4 Peristaltic pump tubing

The expected life of the peristaltic pump tubing is one year.
To replace pump tubing:

Procedure

1. Turn off the sample and reagent pumps.
2. The reagent and sample tubing is connected to the pump tubing with luer fittings. Disconnect the fittings from the pump by turning the fitting in the direction of the arrow.

   See *Figure 12-5*.

Figure 12-5: Luer Fittings

3. Using your thumb and forefinger, gently pinch the sides of the pump cover. Slide the cover upwards to remove it.

   See *Figure 12-6*.

Figure 12-6: Pump Cover

4. Using your thumb as shown in *Figure 12-7*, push the tubing fitting straight outward until the fitting slides out of the socket.

Figure 12-7: Pushing the Tubing Fitting Out

5. Remove and discard the pump tubing.
6. Insert the new tubing one end at a time. Tongues on the sides of the gray fittings at the end of the tube fit into receiving grooves in the pump casing. Push the fitting in place until it clicks. Gently stretch the tubing over the rollers and insert the other fitting into the receiving socket on the other side of the pump.

   See *Figure 12-8*.

Figure 12-8: Inserting New Tubing

7. Replace the pump cover.
   a. Place the cover on the pump casing.

      See *Figure 12-9*.

Figure 12-9: Replacing the Pump Cover

b. Be sure the pins at the bottom of the cover (*Figure 12-10*) ride on the tracks in the pump casing.

Figure 12-10: Pins

c. The position of the track is outlined in *Figure 12-11*. The pins on the pump cover must ride in these tracks as the cover is pushed into place. Gently squeeze the ends of the cover to guide the pins.

Figure 12-11: Track

d. Push down until the cover snaps into place.

8. Reconnect the tubing.

12.3.5 Replacing the air pump

Complete the following steps to replace the air pump on your total chlorine system.

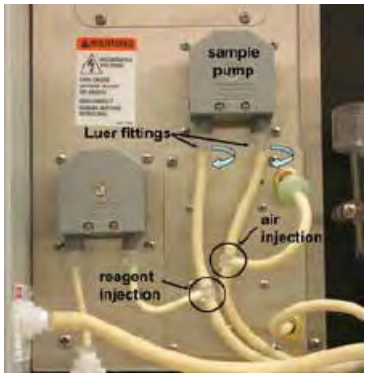
⚠ WARNING!

HAZARDOUS VOLTAGE
Can cause severe injury or death. Disconnect power before servicing.

Procedure

1. Disconnect power to the transmitter.
2. Refer to *Figure 12-12*. Disconnect the reagent and air injection tubes. Disconnect the suction and discharge tubing by turning the Luer fitting in the direction shown in the figure. Disconnect the air pump inlet tubing from the barbed tubing in the bottom of the enclosure.

Figure 12-12: Replacing the Air Pump



3. Remove the four screws (circled in *Figure 12-12* and *Figure 12-13*) holding the air pump access panel. Pull out the pump and panel.

Figure 12-13: Air Pump Access Panel

4. Disconnect the air inlet and outlet tubing from the air pump.

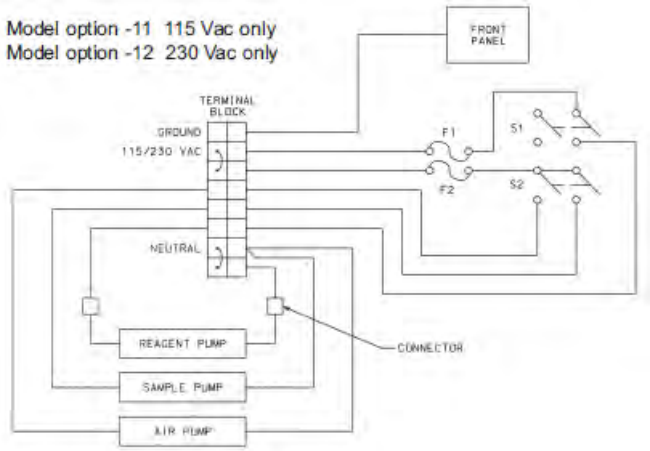
See *Figure 12-14*.

Figure 12-14: Air Inlet and Outlet Tubing

5. Remove the five screws (surrounded by squares in *Figure 12-13*) holding the air pump to the access panel.
6. Remove the four screws holding the wiring access panel.
7. Disconnect the air pump power wires from the terminal strip. Discard the old air pump.

   See *Figure 12-15*.

Figure 12-15: Terminal Strip



8. Remove the five screws holding the rubber base of the replacement air pump to the body.
9. Using the five screws removed in step 6, attach the replacement air pump to the access panel.
10. Connect the air pump power wires to the terminal strip.
11. Replace the wiring access panel.
12. Connect the air inlet and outlet tubing to the air pump.

See *Figure 12-14*. The conical end of the check valve points in the direction of the air flow.

13. Replace the air pump access panel.
14. Connect the sample pump tubing to the pump. Connect the reagent and air injection tubing. Connect the air inlet tubing to the barbed fitting at the bottom of the enclosure.

12.3.6 Replacing the air pump diaphragm and check valves

Complete the following steps to replace the air pump diaphragm and check valves on your total chlorine system.

⚠ WARNING!

HAZARDOUS VOLTAGE
Can cause severe injury or death. Disconnect power before servicing.

Procedure

1. Disconnect power to the transmitter.
2. Refer to *Figure 12-12*. Disconnect the reagent and air injection tubes. Disconnect the suction and discharge fitting by turning the Luer fitting in the direction shown in the figure. Disconnect the air pump inlet tubing from the barbed fitting at the bottom of the enclosure.
3. Remove the four screws (circled in *Figure 12-13*) holding the air pump access panel. Pull out the pump and panel.
4. Disconnect the air inlet and outlet tubing from the air pump.

   See *Figure 12-14*.
5. Remove the five screws (surrounded by squares in *Figure 12-13*) holding the air pump to the access panel.
6. Pull the rubber base off the pump.
7. Using needle nose pliers, remove the air inlet fitting from the side of the air pump.

   See *Figure 12-16*.

Figure 12-16: Inlet Fitting

8. Slide the pump assembly out of the air pump body.

   See *Figure 12-17*.

Figure 12-17: Pump Assembly

9. Following instructions on the package (PN 9160518), replace the diaphragm and check valves.
10. Slide the pump assembly back into the pump body and replace the barbed inlet fitting.
11. Replace the rubber base and screw the pump access panel back onto the air pump.
12. Connect the air inlet and outlet tubing to the air pump.

    See *Figure 12-14*. The conical end of the check valve points in the direction of the air flow.
13. Replace the air pump access panel.
14. Connect the sample pump tubing to the pump. Connect the reagent and injection tubing. Connect the air inlet tubing to the barbed fitting at the bottom of the enclosure.

Table 12-2: Replacement Parts and Reagent for Sample Conditioning System

PN	Description
24134-00	Air pump, 115 Vac, 60 Hz
24134-01	Air pump, 230 Vac, 50 Hz
9160578	Air pump repair kit
9322052	Check valve for air injection line
24153-00	Carboy for reagent, 5 gal/19 L, includes cap
9100204	Fuse, 0.25 A, 250 V, 3 AG, slow blow for option -11 (115 Vac)
9011132	Fuse, 0.125 A, 250 V, 3 AG, slow blow for option -12 (230 Vac)
9380094	Reagent pump, 115 Vac, 50/60 Hz
9380095	Reagent pump, 230 Vac, 50/60 Hz
9380091	Reagent pump replacement tubing
24151-00	Reagent tubing replacement kit (see *Section 12.3.2*)
24135-00	Reagent uptake tubing, 65 ft (1.8 m), includes weight

Table 12-2: Replacement Parts and Reagent for Sample Conditioning System *(continued)*

PN	Description
9380090	Sample pump, 115 Vac, 50/60 Hz
9380093	Sample pump, 230 Vac, 50/60 Hz
9380092	Sample pump replacement tubing
24152-00	Sample tubing replacement kit (includes tees, see *Section 12.3.2*)
24165-00	Acetic acid, 2 x 2.5 gal (9.5 L) bottles/case, with 25 g potassium iodide
24165-01	Acetic acid, 2 x 2.5 gal (9.5 L) bottles/case, with 50 g potassium iodide
24164-00	Potassium iodide, 25 g, sufficient for 5 gallons (19 L) of vinegar (for 0 - 5 ppm total chlorine)
24164-01	Potassium iodide, 50 g, sufficient for 5 gallons (19 L) of vinegar (for 0 - 10 ppm total chlorine)

13 Troubleshooting

13.1 Overview

The transmitter continuously monitors itself and the sensor for problems. When the transmitter identifies a problem, the word `warning` or `fault` appears intermittently at the bottom of the display. To read a fault or warning message and troubleshooting information, press **INFO**.

See *Section 13.2*.

Warning The instrument or sensor is usable, but you should take steps as soon as possible to correct the condition causing the warning. Warning messages can be turned off. To turn off warning messages, go to the main menu and choose Display setup. Scroll to the Warning tab and turn off warning messages.

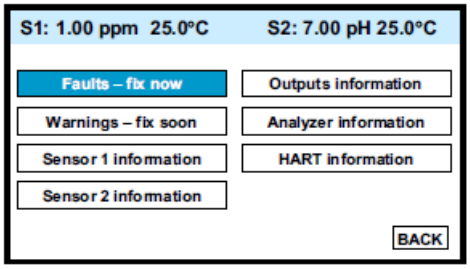
Fault The measurement is seriously in error and is not to be trusted. A fault condition might also mean that the transmitter has failed. Correct fault conditions immediately. When a fault occurs, the analog output goes to 22.00 mA or to the value programmed in *Section 7.2*. Fault messages cannot be turned off.

13.2 Reading and troubleshooting Fault and Warning messages

Complete the following steps to access Fault and Warning messages and determine what they mean.

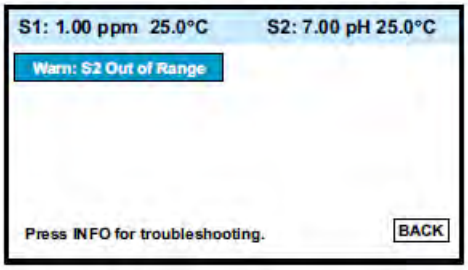
1. With the main display showing, press **INFO**.

   The screen below appears.



2. Move the cursor to the appropriate button and press **ENTER/MENU**.

   A screen like the one below appears showing all fault or warning messages.

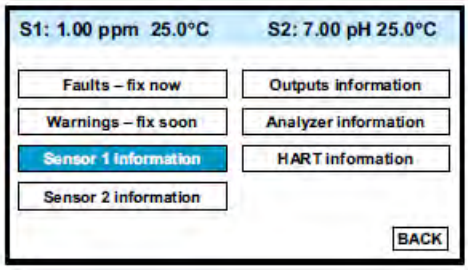


3. For troubleshooting information, press **INFO**.

13.3 Sensor diagnostics

Sensor diagnostic readings are often useful in troubleshooting measurement problems.

1. With the main display showing, press **INFO**.



2. Move the cursor to the Sensor 1 information or Sensor 2 information button and press **ENTER/MENU**.

   A list of sensor diagnostics appears.

3. For more information about a specific diagnostic measurement, move the cursor to the diagnostic of interest and press **INFO**.

13.4 Troubleshooting calibration problems

If a calibration attempt results in an error or a likely error, the transmitter displays the appropriate warning screen. For troubleshooting suggestions, press **INFO**.

13.5 Other troubleshooting

Problem	See Section
Readings are too low.	*Section 13.5.1*
Process readings are erratic or wander.	*Section 13.5.2*
Readings drift.	*Section 13.5.3*
Readings are too high.	*Section 13.5.4*

13.5.1 Readings are low.

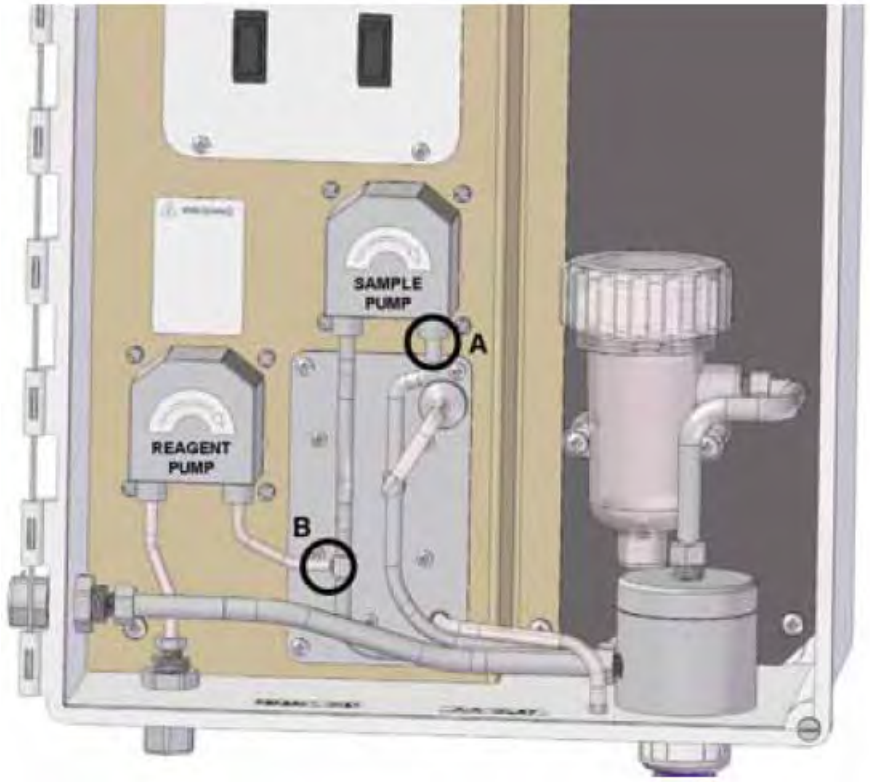
1. Does the reagent carboy contain reagent? Is the reagent uptake tubing below the level of the reagent? Has potassium iodide been added to the acetic acid (vinegar) reagent?
2. Is there adequate flow to the overflow sampler? Excess sample should be flowing down the inside tube of the overflow sampler.
3. Does the reagent contain the correct amount of potassium iodide? See the table.

Expected range, ppm as Cl_2	Amount of KI needed per 5 gallons of vinegar	Part number
0 - 5 ppm	25 grams	24164-00
0 - 10 ppm	50 grams	24164-01
0 - 20 ppm	2 x 50 grams	24164-01

4. Was the comparison or calibration sample tested as soon as it was taken? Chlorine solutions can be unstable. Test the sample immediately after collecting it. Avoid exposing the sample to sunlight.
5. Is the membrane fouled or coated? A dirty membrane inhibits diffusion of iodine through the membrane, reducing sensor current. Clean the membrane by rinsing it with a stream of water from a wash bottle. Wipe gently with a soft tissue.
6. Are the reagent and sample pumps running? If a pump is not running, check the fuse and replace it if necessary. See *Table 12-2* for part numbers. If the fuse is okay, replace the pump.
7. Are all the tube fittings tight? Pay particular attention to the Luer fittings that connect the tubing to the pumps.
8. Does the pump tubing element need replacing? Remove the tubing from the pump and inspect it. If the tubing appears permanently pinched or deformed, replace the tubing. Refer to *Section 12.3.4* for instructions on how to remove and replace the tubing elements. The expected life of a tubing element is about one year.

9. Is the sample flow to the sensor about 11 mL/min? If the sample flow is too low, the total chlorine reading will be low. If the flow is too high, the ratio between the sample flow and reagent flow will be too high, and there might be insufficient reagent to properly react with the total chlorine in the sample. To check sample flow:
   a. Turn off the reagent and sample pumps.
   b. Disconnect the reagent tubing at the injection tee. See B in *Figure 13-1*.
   c. Place the end of the tubing in a 5 mL graduated cylinder.
   d. Start the reagent pump and collect reagent for ten minutes.
   e. Note the volume of reagent collected in the graduated cylinder. After ten minutes, the volume should be about 2 mL.
10. Is the reagent flow about 0.2 mL/min? If the reagent flow is too low, there might be insufficient acetic acid to lower the sample pH and insufficient potassium iodide to react with total chlorine in the sample. To check reagent flow:
   a. Turn off the reagent and sample pumps.
   b. Disconnect the reagent tubing at the injection tee. See B in *Figure 13-1*.
   c. Place the end of the tubing in a 5 mL graduated cylinder.
   d. Start the reagent pump and collect reagent for ten minutes.
   e. Note the volume of reagent collected in the graduated cylinder. After ten minutes, the volume should be about 2 mL.

Figure 13-1: Disconnecting Sample (A) and Reagent (B) Tubing Prior to Checking Flow



13.5.2 Process readings are erratic or wander.

1. Is the sensor properly wired to the transmitter? See *Section 4.3*. Verify that all connections are tight.
2. Readings can be erratic when a new sensor is first placed in service. Readings usually stabilize after about an hour.
3. Is the air pump working? There should be a vigorous stream of bubbles in the flow cell. The bubbles help mix the sample and keep carbon dioxide bubbles off the membrane. Carbon dioxide forms when bicarbonate alkalinity in the sample reacts with acetic acid. The bubbles accumulate in the membrane and eventually break away, causing the total chlorine reading to wander.
4. Is the membrane damaged or loose? Replace the membrane if necessary.
5. Is the space between the membrane and cathode filled with electrolyte solution, and is the flow path between the electrolyte reservoir and membrane clear? Often the flow of electrolyte can be started by simply holding the sensor with the membrane end pointing down and sharply shaking the sensor a few times as though shaking down a clinical thermometer. If shaking does not work, try clearing the holes around the cathode stem. Hold the sensor with the membraned end pointing up. Unscrew the membrane retainer and remove the membrane assembly. Use the end of a straightened paper clip to clear the holes at the base of the cathode stem.

13.5.3 Readings drift.

1. Is the sample temperature changing? Membrane permeability is a function of temperature. The time constant for the 499ACL-01 sensor is about five minutes. Therefore, the reading may drift for a while after a sudden temperature change.
2. Is the membrane clean? For the sensor to work properly, iodine must diffuse freely through the membrane. A coating on the membrane will interfere with the passage of iodine, resulting in a gradual downward drift in readings. The coating will also slow the response on the sensor to step changes. Clean the membrane by rinsing with a stream of water from a wash bottle. Wipe the membrane with a soft tissue.
3. Is the sensor new or has it been recently serviced? New or rebuilt sensors may require several hours to stabilize.
4. Is the flow of sample past the sensor about 11 mL/min? See *Section 13.5.1* step 9 for more information.
5. Is the reagent flow about 0.2 mL/min? See *Section 13.5.1* step 10 for more information.

13.5.4 Readings are too high

1. Is the sample conditioning reagent clear and colorless? If the reagent is pale yellow, results will be high. The pale yellow color is caused by iodine, which comes from the reaction between atmospheric oxygen and potassium iodide. The reaction is catalyzed by sunlight. The purpose of the blue carboy is to protect the reagent from sunlight.
2. Is the sensor fill solution fresh? An old,discolored fill solution may produce a high reading.

13.6 Other troubleshooting - general

Problem	See Section
Current output is too low.	*Section 13.6.1*
Alarm relays do not operate properly.	*Section 13.6.2*

13.6.1 Current is output too low.

Load resistance is too high. Maximum load is 600 Ω.

13.6.2 Alarm relays do not operate properly.

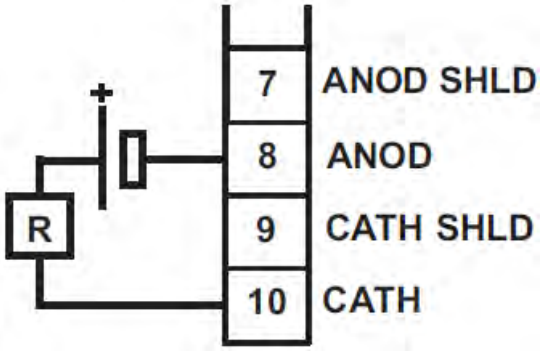
1. Verify the relays are properly wired.
2. Verify the relays are properly configured.

13.7 Simulating inputs - chlorine

To check the performance of the transmitter, use a decade box and 1.5 V battery to simulate the current from the sensor. The battery, which opposes the polarizing voltage, is necessary to ensure that the sensor current has the correct sign.

1. Disconnect the anode and cathode leads from terminals 8 and 10 on TB1 and connect a decade box and 1.5 V battery as shown in *Figure 13-2*.

Figure 13-2: Simulating Chlorine



It is not necessary to disconnect the RTD leads.

2. Set the decade box to 1.4 MΩ.
3. Note the sensor current.

   It should be about 960 nA. The actual value depends on the voltage of the battery. To view the sensor current, go to the main display and press **INFO**. Choose sensor 1 information. The input current is the second line in the display.

4. Change the decade box resistance and verify that the correct current is shown. Calculate current from the equation:

$$\text{current (nA)} = \frac{V_{\text{battery}} - 250 \text{ (voltages in mV)}}{\text{resistance (m}\Omega\text{)}}$$

The voltage of a fresh 1.5 volt battery is about 1.6 volt (1600 mV).

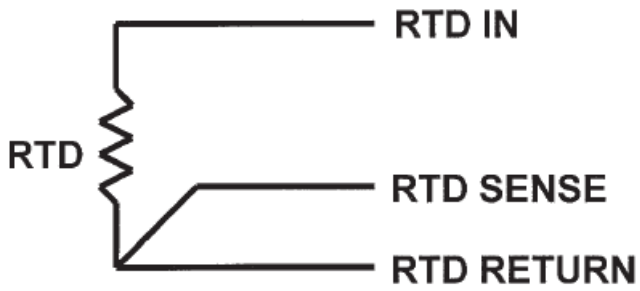
13.8 Simulating inputs - temperature

13.8.1 General

The Rosemount 56 Transmitter accepts a Pt100 RTD. The Pt100 RTD is a three-wire configuration.

See *Figure 13-3*.

Figure 13-3: Three-Wire RTD Configuration

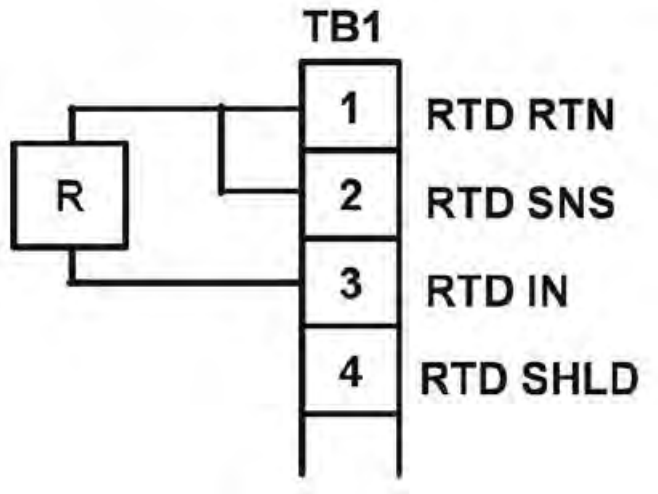


Although only two wires are required to connect the RTD to the transmitter, using a third (and sometimes fourth) wire allows the transmitter to correct for the resistance of the lead wires and for changes in the lead wire resistance with temperature.

13.8.2 Simulating temperature

To simulate the temperature input, wire a decade box to the transmitter as shown in *Figure 13-4*.

Figure 13-4: Simulating RTD Inputs



To check the accuracy of the temperature measurement, set the resistor simulating the RTD to the values indicated in the table and note the temperature readings. The measured temperature might not agree with the value in the table. During sensor calibration, an offset might have been applied to make the measured temperature agree with a standard thermometer. The offset is also applied to the simulated resistance. The transmitter is measuring temperature correctly if the difference between measured temperatures equals the difference between the values in the table to within ±0.1 °C.

For example, start with a simulated resistance of 103.9 Ω, which corresponds to 10.0 °C. Assume the offset from the sensor calibration was -0.3 Ω. Because of the offset, the transmitter calculates temperature using 103.6 Ω. The result is 9.2 °C. Now change the resistance to 107.8 Ω, which corresponds to 20.0 °C. The transmitter uses 107.5 Ω to calculate the temperature, so the display reads 19.2 °C. Because the difference between the displayed temperatures (10.0 °C) is the same as the difference between the simulated temperatures, the transmitter is working correctly.

Temp. (°C)	**Pt 100 (Ω)**
0	100.0
10	103.9
20	107.8
25	109.7
30	111.7
40	115.5
50	119.4
60	123.2
70	127.1
80	130.9
85	132.8
90	134.7
100	138.5

14 Return of material

For any repair, warranty, and return of instrument requests, please contact the factory.

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