

Rosemount™ TCL

Total Chlorine System with Rosemount 1056 Transmitter



Essential instructions

Read this page before proceeding!

Emerson 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. You must adhere to the following instructions and integrate them into your safety program when installing, using, and maintaining Emerson's 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 reference manual is not the correct one, call 1-800-854-8257 or 949-757-8500 to request the correct reference manual. Save this reference manual for future reference.
- If you do not understand any of the instructions, contact your Emerson 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 equipment as specified in the installation instructions of the appropriate Quick Start Guide 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 Emerson. Unauthorized parts and procedures can affect the product's performance, place the safe operation of your process at risk, and 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.

WARNING

Hazardous area installation

Qualified on-site safety personnel must carefully evaluate installations near flammable liquids or in hazardous areas.

This device is not Intrinsically Safe or Explosion Proof.

To secure and maintain intrinsically safe installation, use an appropriate transmitter/safety barrier/sensor combination. The installation system must be in accordance with the governing approval agency (FM, CSA, or BASEEFA/CENELEC) hazardous area classification requirements. Consult your transmitter Reference Manual for details.

Proper installation, operation, and servicing of this sensor in a hazardous area installation are entirely the operator's responsibility.

⚠ WARNING

Electrical shock

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 voltages before opening the enclosure.

Disconnect relay contacts made to separate power sources before servicing.

Electrical installation must be in accordance with the National Electrical Code (ANSI/NFPA-70) and/or any other 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 the operator's responsibility.

No external power to the instrument of more than 69 Vdc or 43 V peak is 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 environments per the instrument's certification to EN50081-2.

Hazardous voltage

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

⚠ CAUTION

Sensor/process application compatibility

The wetted sensor materials may not be compatible with process composition and operating conditions.

Application compatibility is entirely the operator's responsibility.

⚠ WARNING

Physical access

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

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

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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 is housed in a corrosion resistant NEMA 4X enclosure. It is suitable for panel, pipe, or wall mounting. You can operate the transmitter with a membrane keypad.

and programming screens are simple and intuitive. Plain language prompts in languages guide you.

Four fully programmable relays are available.

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

1.3 Ordering information and accessories

Refer to the [Rosemount TCL Total Chlorine System Product Data Sheet](#) for more information.

2 Principles of operation

3 Installation

3.1 Unpacking and inspection

Procedure

1. Inspect the shipping container(s). If there is damage, contact the shipper immediately for instructions.
2. If there is no apparent damage, unpack the container(s).
3. Ensure that all items shown on the packing list are present.
If items are missing, notify Emerson immediately.

3.2 General installation information

1. Although the system is suitable for outdoor use, do not install it in direct sunlight or in areas of extreme temperature.

⚠ CAUTION

Hazardous areas

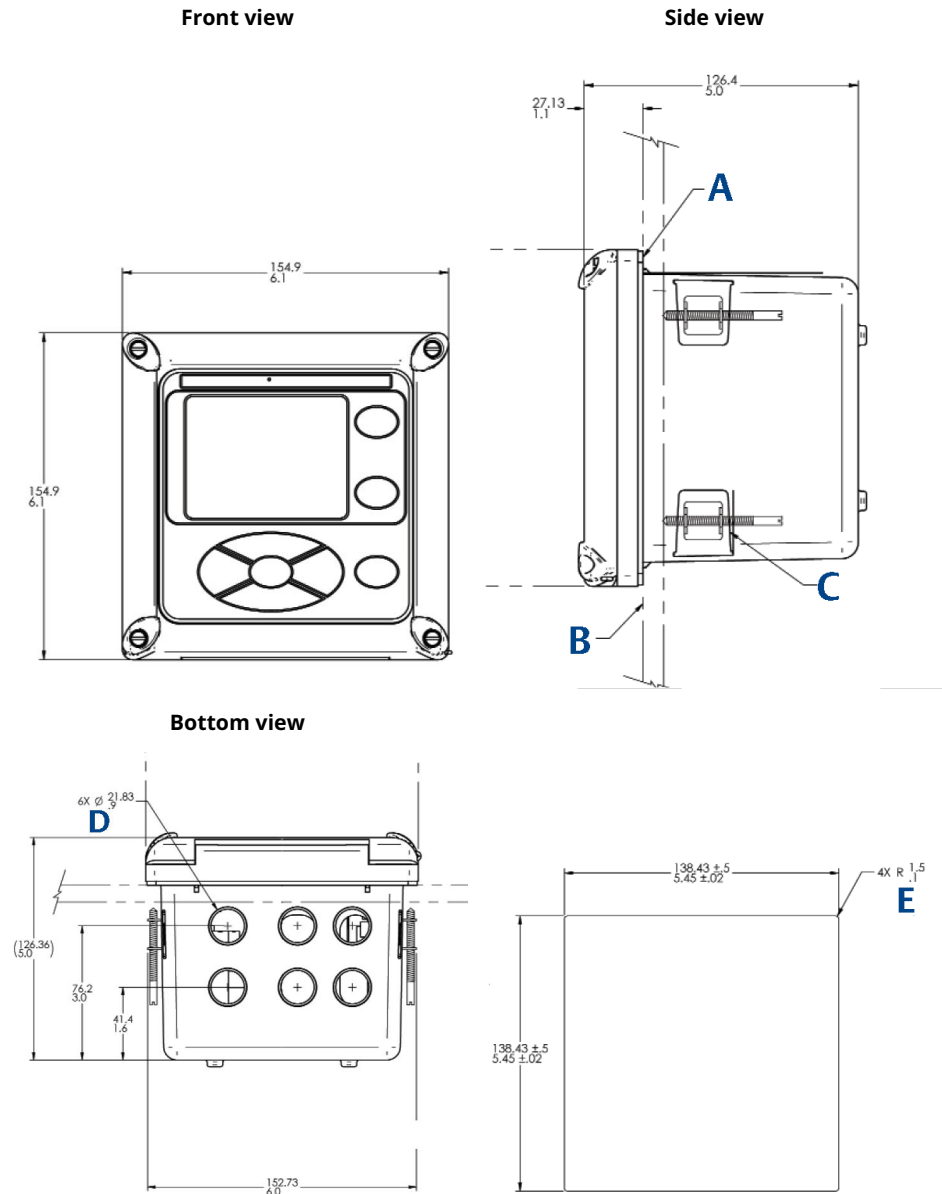
The system is not suitable for use in hazardous areas.

2. Install the system in an area where vibrations and electromagnetic and radio frequency interference are minimized or absent.
3. Keep the transmitter and sensor wiring at least 1 ft (0.30 m) from high voltage conductors. Be sure there is easy access to the transmitter and sample conditioning system.
4. 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.
5. Be sure that the distance between the transmitter and sample conditioning cabinet does not exceed the length of the sensor cable.

3.3 Install the transmitter

1. Refer to the appropriate figure for installation details.

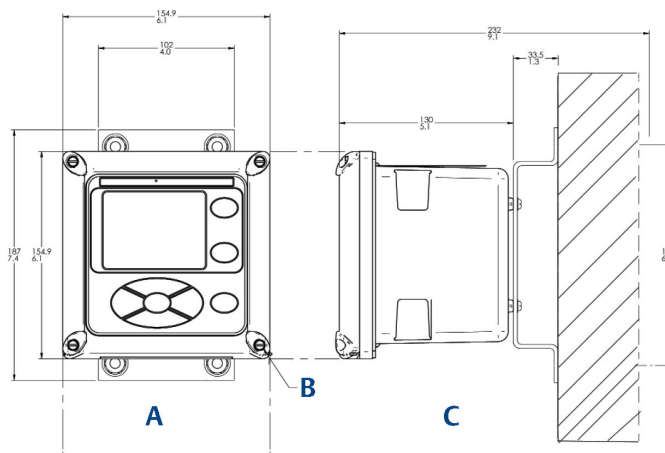
Figure 3-1: Panel Mount Dimensions



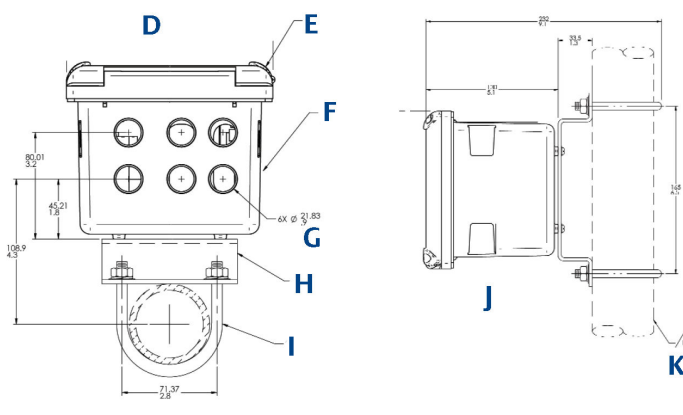
- A. Panel mount gasket
- B. Panel supplied by others maximum thickness .375-in.(9.52 mm)
- C. Four mounting brackets and screws provided with instrument
- D. Conduit openings
- E. Maximum radius

Figure 3-2: Pipe/Wall Mount Dimensions (Mounting bracket PN:2382000)

Wall/surface mount



Pipe mount



- A. Front view
- B. Four cover screws
- C. Side view
- D. Bottom view
- E. Front panel
- F. Panel and pipe mount enclosure
- G. Conduit openings
- H. 2-in. pipe mount bracket
- I. Two set U-bolts for 2-in. pipe in kit PN 23820-00
- J. Side view
- K. 2-in. pipe supplied by customer

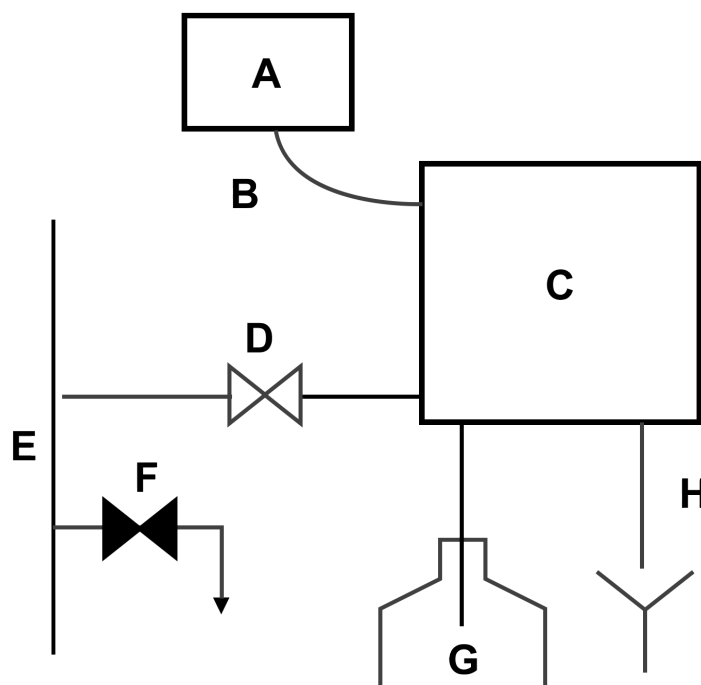
2. See [Prepare transmitter conduit openings](#) for more information about the conduit openings.
3. See [Provide power to the sample conditioning system](#) for wiring instructions.

3.4 Install the sample conditioning enclosure

Follow the steps below to install the sample conditioning enclosure.

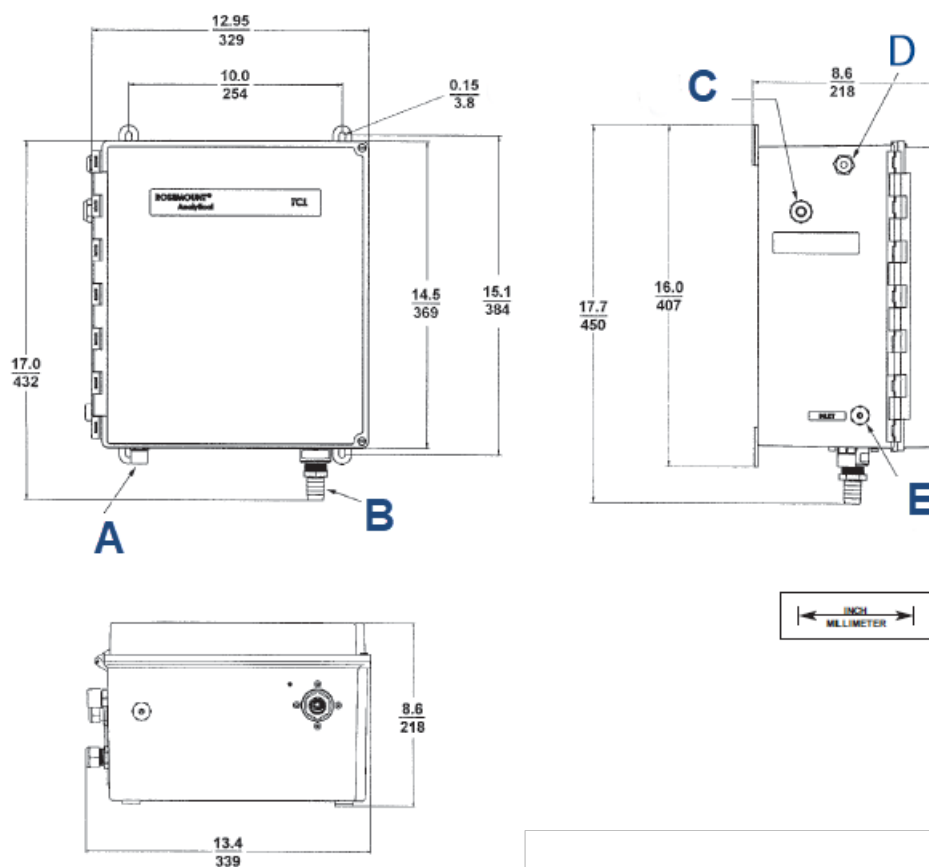
Refer to [Figure 3-3](#), [Figure 3-4](#), and [Figure 3-5](#) for installation details.

Figure 3-3: Installing the Sample Conditioning Enclosure



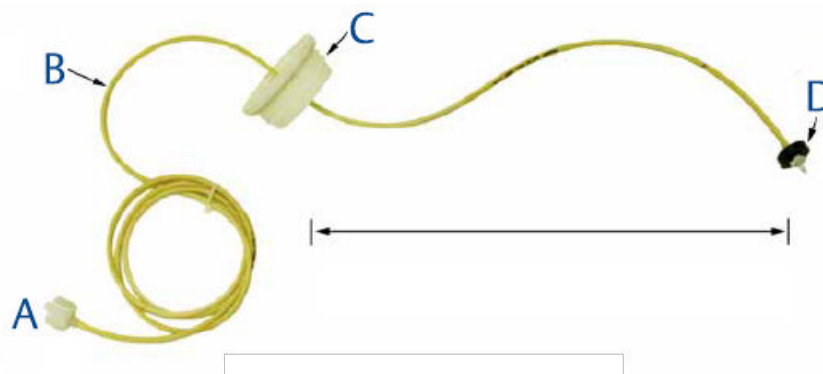
- A. Transmitter
- B. Sensor cable
- C. Rosemount™ TCL enclosure
- D. Sample inlet 1/4-in. OD tubing
- E. Process piping
- F. Sample tap
- G. Reagent bottle
- H. Drain 3/4-in. barbed fitting

Figure 3-4: TCL Case Dimensions



- A. Reagent inlet
- B. Drain
- C. Power cable
- D. Sensor cable
- E. Sample inlet

Figure 3-5: Reagent Tubing Assembly



Tubing should extend about 14-in. (360 mm) below cap.

- A. Reagent inlet fitting
- B. Reagent tubing
- C. Cap
- D. Weight

Procedure

1. Connect the sample line to the sample conditioning system. Use ¼-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 ¾-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 3-5](#).
5. Place the blue plastic carboy beneath the enclosure. Screw the cap and tubing assembly on the carboy.
To prepare reagent, see [Prepare the reagent](#).

3.5 Install the sensor

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

Procedure

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 [Sensor wiring](#).
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 ½-in. conduit fittings or PG 13.5 cable glands. To keep the case watertight, block unused openings with NEMA® 4X or IP65 conduit plugs.

Note

Use watertight fittings and hubs that comply with 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

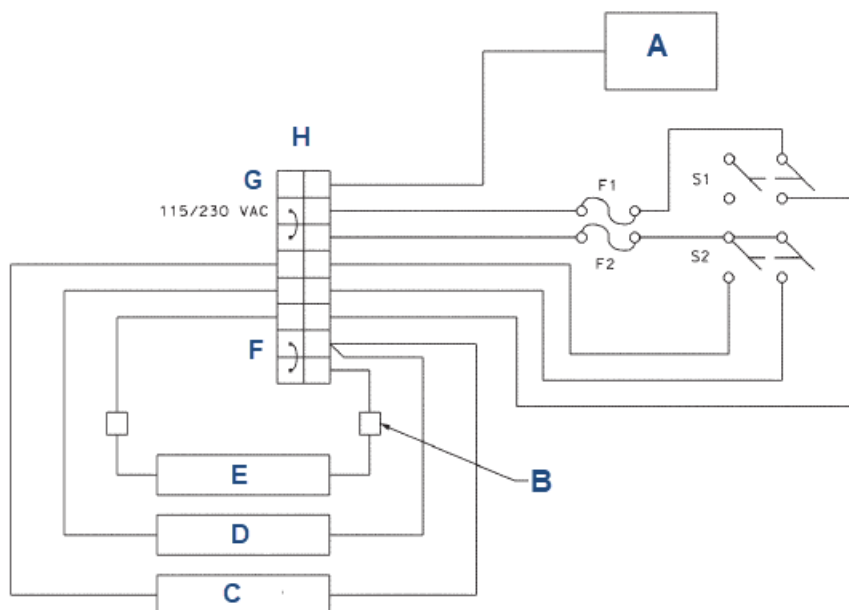
1. Be sure the pump switches on the wiring access panel are in the **Off** position.
2. Remove the four screws securing the wiring access panel. Pull the panel out of the way to reveal the power terminal strip.
3. Insert the power cable through the strain relief connection labeled *Power*.
See [Figure 3-4](#).
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



Model option -11: 115 Vac only

Model option -12: 230 Vac only

- A. Front panel
- B. Connector
- C. Air pump
- D. Sample pump
- E. Reagent pump
- F. Neutral
- G. Ground
- H. Terminal block

Important

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

See [Startup](#).

4.3 Power

Wire AC mains power to the power supply board, which is mounted vertically on the left hand side of the analyzer enclosure.

⚠ WARNING

Electrical shock

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

The power connector is at the top of the board.

Procedure

1. 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.)
2. Run the power wiring through the conduit opening nearest the power terminal.
AC power wiring should be 14 gauge or greater.
3. Provide a switch or breaker to disconnect the transmitter from the main power supply.
4. Install the switch or breaker near the transmitter and label it as the disconnecting device for the transmitter.

4.4 Analog output wiring

Two analog output currents are located on the main circuit board, which is attached to the inside of the enclosure door.

Figure 4-2 shows the locations of the terminals. The connectors can be detached for wiring. TB-1 is output 1. TB-2 is output 2. Polarity is marked on the circuit board.

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.

4.5 Alarm wiring

See [Alarm relay connections](#).

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.

4.6 Sensor wiring

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

Procedure

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

Slot 1 (left)	Slot 2 (center)	Slot 3 (right)
Power	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 4-3](#) or [Figure 4-4](#)

Figure 4-3: Wiring Sensor with Optimum EMI/RFI or Variopol Cable to Rosemount 1056 Transmitter

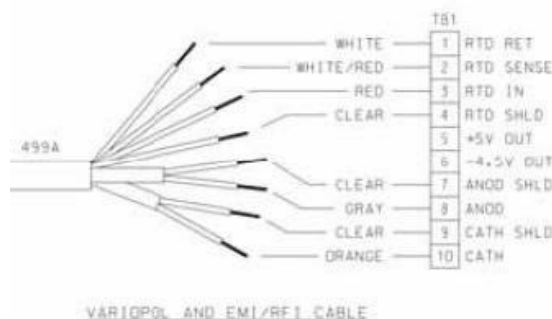
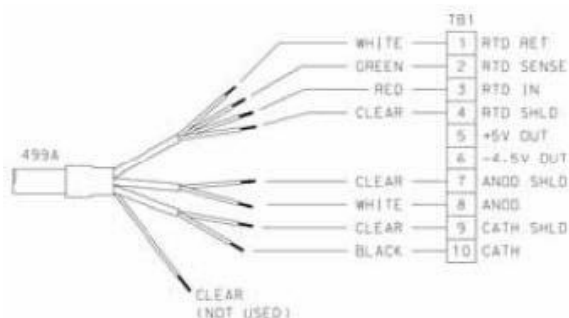


Figure 4-4: Wiring Power with Standard Cable to Rosemount 1056 Transmitter



6. Once the cable has been connected to the board, 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.

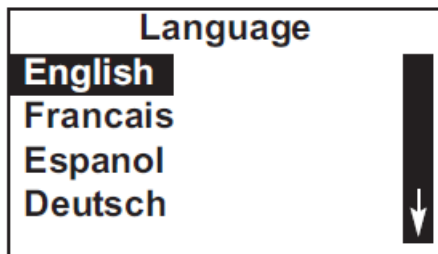
4.7 Apply power to the transmitter and complete Quick Start

Procedure

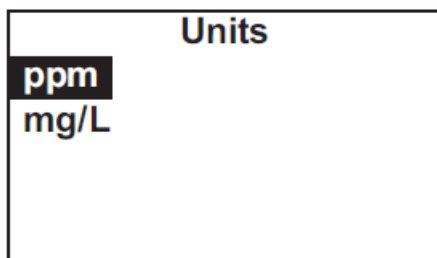
1. Once connections are secured and verified, apply power to the transmitter. When the transmitter is powered up for the first time, **Quick Start** screens appear. Using **Quick Start** is easy.
 - a. A backlit field shows the position of the cursor.
 - b. To move the cursor left or right, use the keys to the left or right of the **ENTER** key. To scroll up or down or to increase or decrease the value of a digit, use the keys above and below the **ENTER** key. Use the left and right keys to move the decimal point.
 - c. Press **ENTER** to store a setting. Press **EXIT** to leave without storing changes. Pressing **EXIT** also returns the display to the initial **Quick Start** screen.
 - d. A vertical black bar with a downward pointing arrow on the right side of the screen means there are more items to display. Continue scrolling down to

display all the items. When you reach the bottom of the list, the arrow points up.

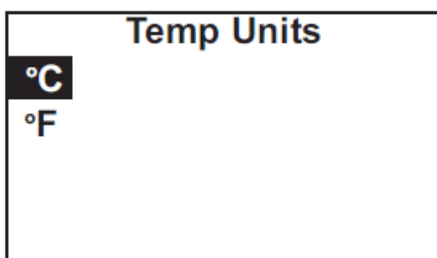
2. Choose the desired language. Scroll down to display more choices.



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. Choose Total Chlorine for sensor 1 (S1).
5. Choose the desired units for chlorine.



6. Choose the desired temperature units.

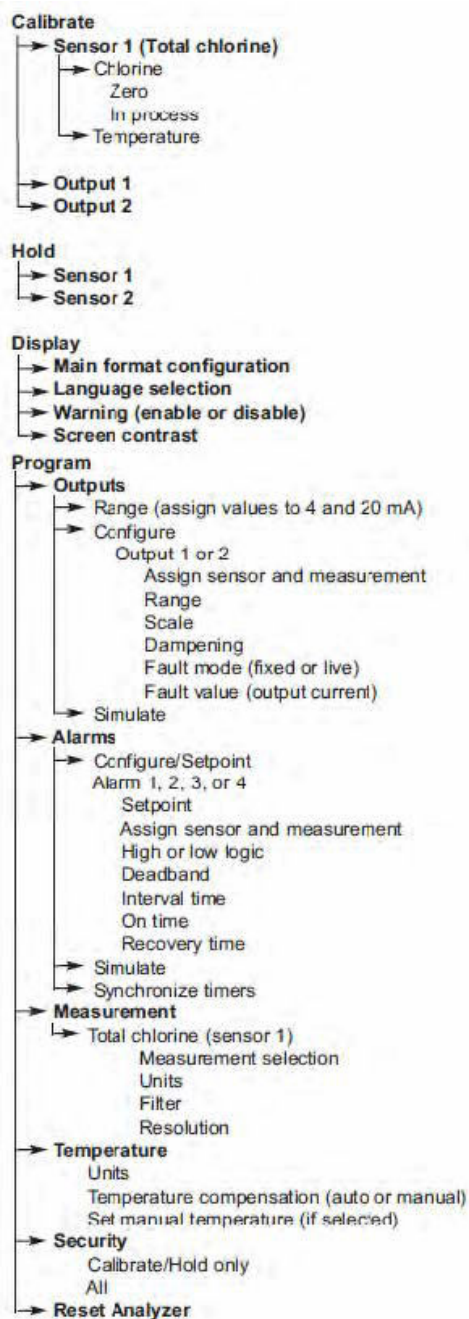


The main display appears. The outputs and alarms (if an alarm board is present) are assigned to default values.

7. To change outputs, alarms, and other settings, go to the **Main Menu** and choose Program. Follow the prompts.

A menu tree is on the following page. To calibrate the sensor, refer to [Calibrate](#).

Figure 4-5: Menu Tree



5 Startup

Complete [Wiring](#) 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.

Procedure

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.

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.

Procedure

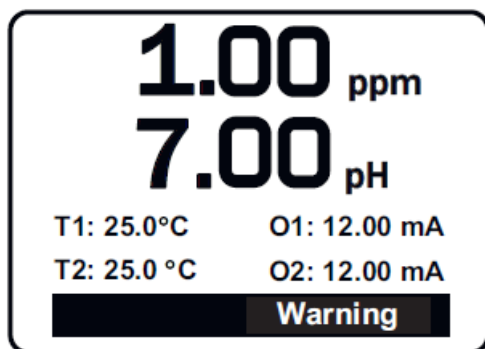
1. Turn on the reagent and sample pump switches.
Observe that liquid begins to fill the flow cell. The sample flow is about 11 mL/min, so the flow cell fills rather slowly. Also observe that the air pump is operating.
The pump produces very vigorous bubbling in the flow cell. Once the flow of reagent 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.
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 Display

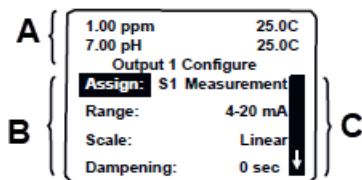
See [Figure 6-1](#). You can customize the display to meet your requirements. Refer to [Configure the main display](#).

Figure 6-1: Main Display



When the transmitter is being programmed or calibrated, the display changes to a screen similar to the one shown in [Figure 6-2](#). The live readings appear in small font at the top of the screen. The rest of the display shows programming and calibration information. Programming items appear in lists. The screen can only show four items at a time, and the arrow bar at the right of the screen indicates whether there are additional items in the list. See [Figure 6-3](#) for an explanation of the arrow bar.

Figure 6-2: Programming Screen Showing Item List



- A. Live measurement
- B. Item list
- C. Arrow bar

The position of the cursor is shown in reverse video. See [Keypad](#) and [Programming the transmitter - tutorial](#) for more information.

Figure 6-3: Arrow Bar



- A. You are at the top of the list. There are more items for viewing. Scroll down.
- B. You are at the bottom of the list. There are more items for viewing. Scroll up.
- C. You are in the middle of the list. There are more items for viewing. Scroll up or down.

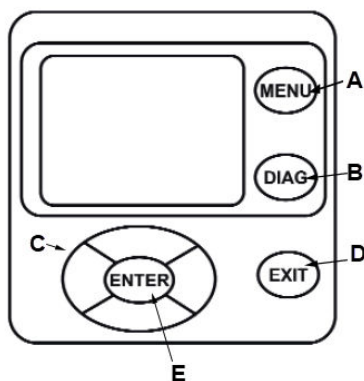
The arrow bar shows whether additional items in a list are available.

6.2 Keypad

Local communication with the transmitter is through the membrane keypad.

Figure 6-4 and Figure 6-5 explain the operation of the keys.

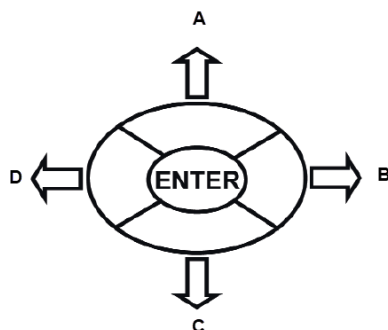
Figure 6-4: Transmitter Keypad



- A. Press **MENU**. The **Main Menu** screen appears.
- B. Press **DIAG**. The main diagnostic screen appears.
- C. Navigation keys move the cursor in the direction indicated in Figure 6-5.
- D. Press **EXIT** to leave a screen without storing changes. The display returns to the previous screen.
- E. Press **ENTER** to store a change or select an item. The display changes to the next screen.

Four navigation keys move the cursor around the screen. The position of the cursor is shown in reverse video. The navigation keys are used to increase or decrease the value of a numeral. Press **ENTER** to select an item and store numbers and settings. Press **EXIT** to return to the previous screen without storing changes. Pressing **MENU** always causes the main menu to appear.

Figure 6-5: Navigation Keys



- A. Moves cursor up or increases the value of the selected digit.
- B. Moves cursor to the right.
- C. Moves cursor down or decreases the value of the selected digit.
- D. Moves cursor to the left.

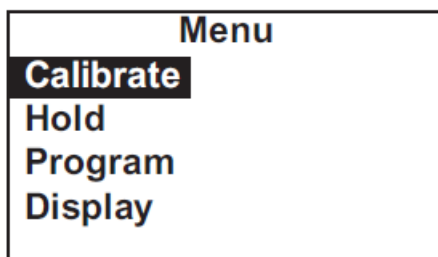
The operation of the navigation keys is shown. To move a decimal point, highlight it and then press **Up** or **Down**.

6.3 Programming the transmitter - tutorial

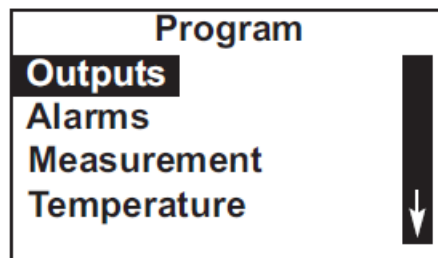
Setting up and calibrating the transmitter is easy. The following tutorial describes how to move around in the programming menus.

Procedure

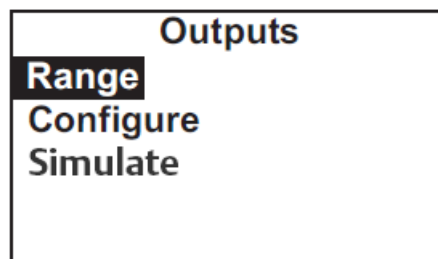
1. Press **MENU**.
The main **Menu** screen appears. There are four items in the main menu. Calibrate is in reverse video, meaning that the cursor is on Calibrate.



2. To assign values to the analog outputs, you must open the **Program** sub-menu. Use **Down** to move the cursor to Program. Press **ENTER**.
The **Program** menu appears. The screen displays four items at a time. The downward pointing arrow on the right of the screen shows there are more items available in the menu.



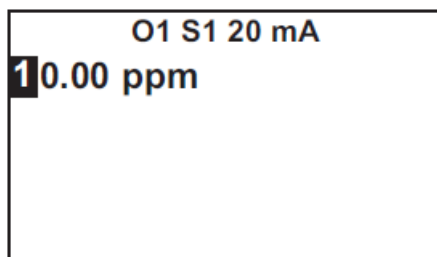
3. To view the other items, use **Down** to scroll to the last item shown and continue scrolling down. When you have reached the bottom, the arrow will point up. Move the cursor back to **Outputs** and press **ENTER**. The **Outputs** screen appears. The cursor is on **Range**. Output range is used to assign values to the low and high current outputs.



4. Press **ENTER**. The **Output Range** screen appears. The screen shows the present values assigned to output 1 (O1) and output 2 (O2). The screen also shows which sensors the outputs are assigned to. Outputs are freely assignable under the **Configure** menu.

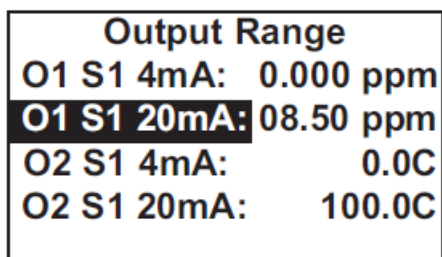
Output Range		
O1 S1 4mA		0.000 ppm
O1 S1 20mA:		10.00 ppm
O2 S1 4mA:		0.0C
O2 S1 20mA:		100.0C

5. For practice, change the 20 mA settings for output 1 to **8.5** ppm.
 - a) Move the cursor to the O1 S1 20 mA: 10.00 line and press **ENTER**. The screen below appears.



- b) Use the navigation keys to change **10.00** to **8.5** ppm. Use **Left** and **Right** to move from digit to digit. Use **Up** and **Down** to increase or decrease the numeral.
- c) To move the decimal point, press **Left** or **Right** until the decimal point is highlighted. Press **Up** to move the decimal point to the right. Press **Down** to move to the left.
- d) Press **ENTER** to store the setting.

Note that the 20 mA setting for output 1 has changed to **8.50** ppm.



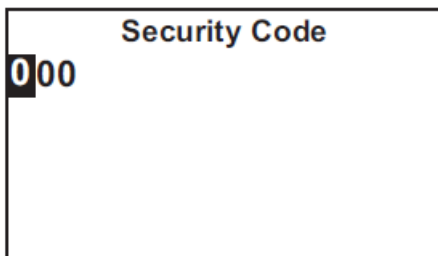
- 6. To return to the main menu, press **MENU**. To return to the main display, press **MENU** and then **EXIT**.

6.4 Security

6.4.1 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 default 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.



1. If a security code has been programmed, pressing **MENU** causes the security screen to appear.
2. Enter the three-digit security code.
3. If the entry is correct, the main **Menu** screen appears. The user has access to the sub-menus the code entitles him to.
4. If the entry is wrong, the **Invalid code** screen appears.

6.4.2 Assign security codes

See [Configuring security settings](#).

6.4.3 Bypassing security codes

Call the factory.

6.5 Using hold

6.5.1 Purpose

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

During hold, outputs assigned to the sensor remain at the last value, and alarms assigned to the sensor remain in their present state.

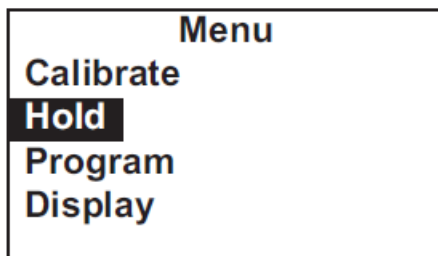
Once in hold, the sensor remains in hold until hold is turned off. However, if power is lost then restored, hold is automatically turned off.

6.5.2 Using the hold function

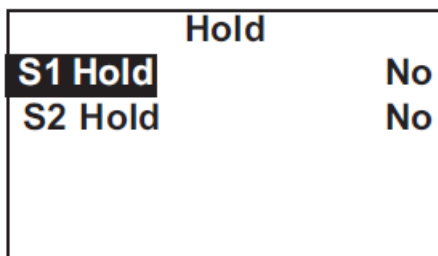
To put the transmitter in hold, complete the following steps.

Procedure

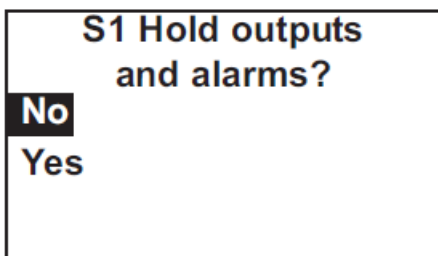
1. Press **MENU**.
The main **Menu** screen appears.



2. Select **Hold**.
The screen shows the current hold status for each sensor.



3. Select the sensor to be put in hold. Press **ENTER**.



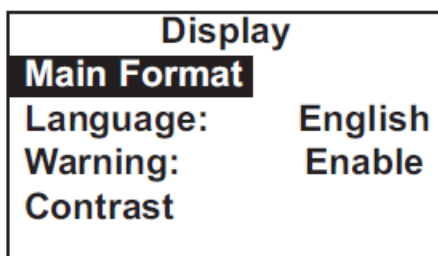
4. To put the sensor in hold, select **Yes**. To take the sensor out of hold, select **No**.

6.6 Configure the main display

You can configure the main display to meet your requirements.

Procedure

1. Press **MENU**.
The main **Menu** screen appears.
2. Move the cursor to **Display** and press **ENTER**.
The screen shows the present configuration. There are four items: Main Format, Language, Warning, and Contrast.



3. To make a change, move the cursor to the desired line and press **ENTER**.
A screen appears in which the present setting can be edited.
4. Press **ENTER** to store the setting.
5. Main Format lets you configure the second line in the main display as well as the four smaller items at the bottom of the display. Move the cursor to the desired place in the screen and press **ENTER**.
6. Scroll through the list of items and select the parameter you wish to be displayed.
7. Once you are done making changes, press **EXIT** twice to return to the Display menu.
8. Press **MENU** and then **EXIT** to return to the main display.

The following abbreviations are used in the quadrant display.

O	output
T	temperature (live)
Tm	temperature (manual)
M	measurement

9. Choose Language to change the language used in the display.
10. Choose Warning to disable or enable warning messages.
11. Choose Contrast to change the display contrast.
12. To change the contrast, choose either lighter or darker and press **ENTER**.
Every time you press **ENTER**, the display becomes lighter or darker.

7 Programming the transmitter

7.1 Overview

This section describes how to make the following program settings using the local keypad.

1. Configure and assign values to the analog current outputs.
2. Configure and assign values to the alarm relays (if the alarm board is installed).
3. Choose the type of chlorine measurement being made. This step is necessary because the transmitter used with the TCL can measure forms of chlorine other than total chlorine.
4. Choose temperature units or manual temperature correction.
5. Set two levels of security codes.
6. Reset the transmitter to factory default settings.

7.2 Default settings

The transmitter leaves the factory with the default settings shown in [Table 7-1](#). You can change the settings to any value shown in the column labeled **Choices**.

Table 7-1: Default settings

Item	Choices	Default
Outputs		
a. Output 1		
b. Output 2		Temperature
	0-20 or 4-20 mA	4-20 mA
a.	-9999 to +9999	0
b. Temperature	-999.9 to +999.9	0
a. Chlorine	-9999 to +9999	10
	-999.9 to +999.9	0
	0.00 to 22.0 mA	mA
	0 to 999 sec	0 sec
	0.00 to 22.00 mA	12.00 mA
Alarms		
1. Logic	high or low	AL1 low, AL2, 3, 4, high
2. Assignments		
a. AL1 and AL2		
b. AL3 and AL4		
3. Deadband	0 to 9999	0

Table 7-1: Default settings (continued)

Item	Choices	Default
4. Interval timer settings		
a. Interval time	0.0 to 999.9 hr	24.0 hr
b. On time	0 to 999 sec	10 sec
c. Recovery time	0 to 999 sec	60 sec
a. Units	ppm or mg/L	ppm
b. Resolution	0.01 or 0.001	0.001
c. Input filter	0 to 999 sec	5 sec
Temperature related settings		
1. Units	°C or °F	°C
2. Temperature compensation	Automatic or manual	Automatic
Security code		
1. Calibrate/Hold	000 to 999	000
2. Program/Display	000 to 999	000
Calibration - analog outputs		
1. 4 mA	0.000 to 22.000 mA	4.000 mA
2. 20 mA	0.000 to 22.000 mA	20.000 mA

7.3 Configuring, ranging, and simulating outputs

7.3.1 Purpose of configuration

This section describes how to configure, range, and simulate the two analog current outputs.

Important

Configure the outputs first.

1. Configuring an output means
 - a. Assigning a sensor and measurement (or temperature) to an output.
 - b. Selecting a 4-20 mA or 0-20 mA output.
 - c. Choosing a linear or logarithmic output.
 - d. Selecting the value the output current goes to if the transmitter detects a fault.
2. Ranging the output means assigning values to the low (0 or 4 mA) and high (20 mA) outputs.
3. Simulating an output means making the transmitter generate an output equal to the value you enter.

7.3.2 Definitions

Analog current output

Assigning an output

Linear output

Logarithmic output

Dampening Output dampening smoothes out noisy readings. It also increases response time. The time selected for output dampening is the time to reach 63 percent of the final reading following a step change. Output dampening does not affect the response time of the display.

Fault If the transmitter detects a fault, a fault message appears in the main display. At the same time, the output current goes to the value programmed in this section. There are two output fault modes: fixed and live. Fixed means the selected output goes to the previously programmed value (between 0.00 and 22.00 mA) when a fault occurs. Live means the selected output is unaffected when the fault occurs.

Ranging an output The outputs are fully rangeable, including negative numbers. If the output is logarithmic, assigned values must be positive.

7.3.3 Procedure - configure outputs

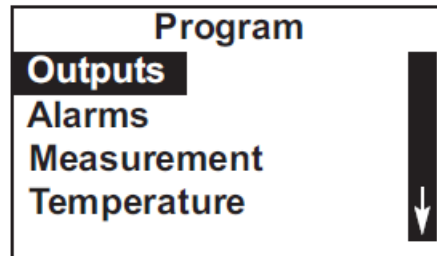
Complete the following steps to configure the analog current outputs.

Procedure

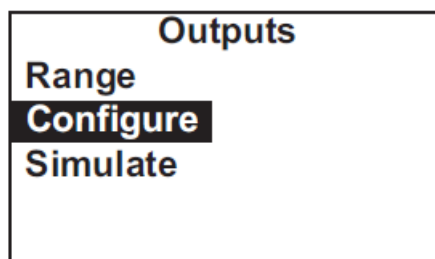
1. Press **MENU**.

The main **Menu** screen appears.

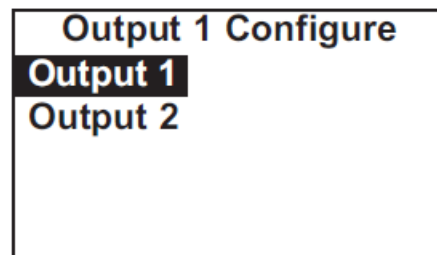
2. Move the cursor to Program and press **ENTER**.
The cursor is on Outputs.



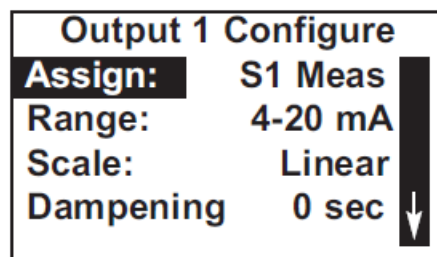
3. Press **ENTER**.



4. Choose **Configure**.



5. Choose **Output 1** or **Output 2**.
The screen shows the present configuration. To display the fifth and sixth items, scroll to the bottom of the screen and continue scrolling.



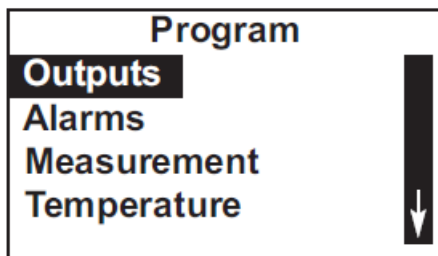
6. To make a change, move the cursor to the desired line and press **ENTER**.
A screen appears in which the present setting can be edited.
7. Press **ENTER** to store the setting.
For an explanation of terms, see [Purpose of configuration](#) and [Definitions](#).
8. To return to the main display, press **MENU** and then **EXIT**.

7.3.4 Procedure - ranging outputs

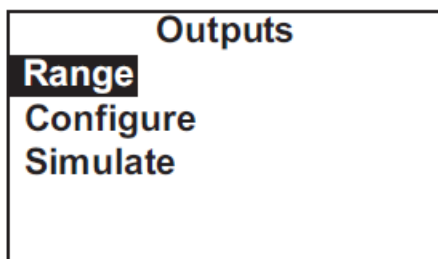
Complete the following steps to range the outputs by assigning values to the low and high outputs.

Procedure

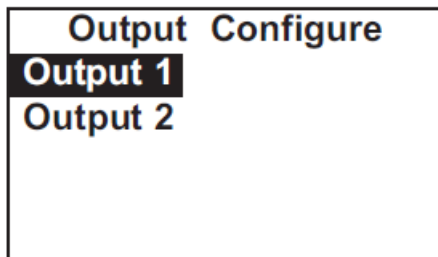
1. Press **MENU**.
The main **Menu** screen appears.
2. Move the cursor to **Program** and press **ENTER**.
The cursor is on Outputs.



3. Press **ENTER**.



4. Choose **Range**.



5. Choose **Output 1** or **Output 2**.
The screen shows the present settings for the outputs. .

Output Range	
O1 S1 4mA	0.000 ppm
O1 S1 20mA:	10.00 ppm
O2 S1 4mA:	0.0C
O2 S1 20mA:	100.0C

6. To make a change, move the cursor to the desired line and press **ENTER**.

A screen appears in which the present setting can be edited.

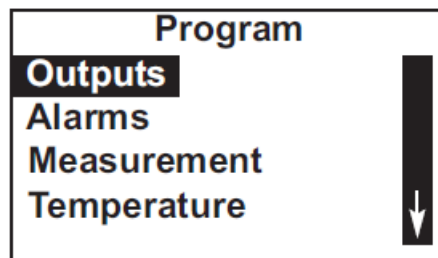
7. Press **ENTER** to store the setting.
For an explanation of terms, see [Purpose of configuration](#) and [Definitions](#).
8. To return to the main display, press **MENU** and then **EXIT**.

7.3.5 Procedure - simulating outputs

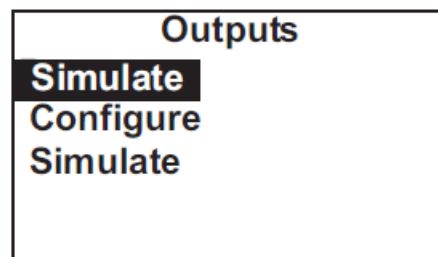
Complete the following steps to simulate an output by making the transmitter generate an output current equal to the value you enter.

Procedure

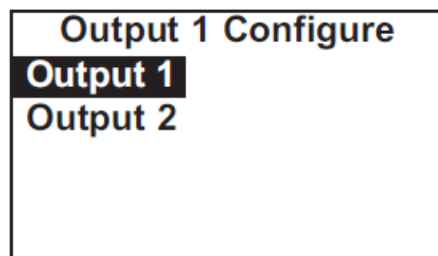
1. Press **MENU**.
The main **Menu** screen appears.
2. Move the cursor to **Program** and press **ENTER**.
The cursor is on Outputs.



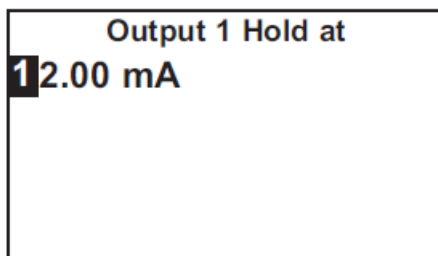
3. Press **ENTER**.



4. Choose **Simulate**.



5. Choose **Output 1** or **Output 2**.



6. Enter the desired simulated output current.
7. To end the simulated current, press **MENU** or **EXIT**.

7.4 Configuring alarms and assigning setpoints

7.4.1 Purpose

This section describes how to configure and assign setpoints to the alarm relays, simulate alarm action, and synchronize interval timers.

Important

Configure the alarms first.

1. Configuring an alarm means
 - a. An alarm relay can also be used as a timer.
 - b. Selecting high or low logic.
 - c. Choosing the deadband.
 - d. Setting the interval timer parameters.
2. Simulating an alarm means making the transmitter energize or de-energize an alarm relay.

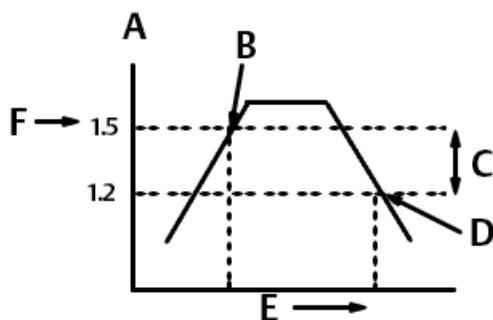
7.4.2 Definitions

Assigning alarms There are four alarm relays. . Alarm relays can also be assigned to operate as interval timers or as fault alarms. A fault alarm activates when the transmitter detects a fault in either itself or the sensor.

Fault alarm A fault condition exists when the transmitter detects a problem with the sensor or with the transmitter itself that is likely to cause seriously erroneous readings. If an alarm was programmed as a fault alarm, the alarm activates. At the same time, a fault message appears in the main display.

Alarm logic, setpoints, and deadbands See [Figure 7-1](#) and [Figure 7-2](#).

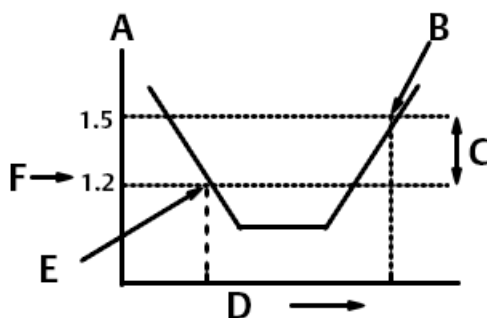
Figure 7-1: High Alarm Logic



- A. Chlorine, ppm
- B. Alarm activates
- C. Deadband = 0.3 ppm
- D. Alarm deactivates
- E. Time
- F. High alarm setpoint

The alarm activates when the chlorine concentration exceeds the high setpoint. The alarm remains activated until the reading drops below the value determined by the deadband.

Figure 7-2: Low Alarm Logic



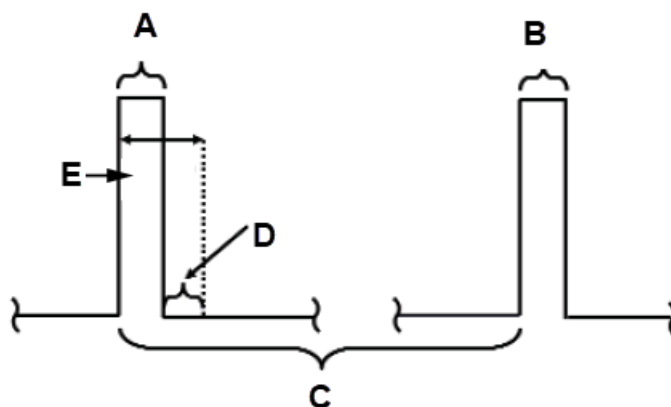
- A. Chlorine, ppm
- B. Alarm deactivates
- C. Deadband = 0.3 ppm
- D. Time
- E. Alarm activates
- F. Low alarm setpoint

The alarm activates when the chlorine concentration drops below the low setpoint. The alarm remains activated until the reading increases above the value determined by the deadband.

Interval timer

Any alarm relay can be used as an interval timer. [Figure 7-3](#) shows how the timer operates. During hold, the main display remains at the last value.

Figure 7-3: Operation of the Interval Timer



- A. On time duration (0 - 999 sec)
- B. On (relay activated)
- C. Timer interval (0 - 999.9 hr)
- D. Recovery (0 - 999 sec)
- E. Hold

The numbers in parentheses are the allowed values for each timer parameter.

Synchronize timer

If two or more relays are being used as interval timers, choosing synchronize timers will cause each timer to start one minute later than the preceding timer.

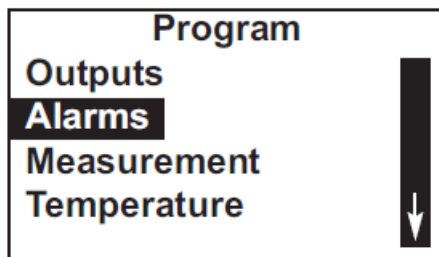
7.4.3

Procedure - configuring alarms and assigning setpoints

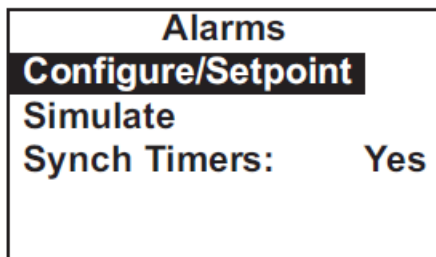
Complete the following steps to configure the alarms and assign setpoints.

Procedure

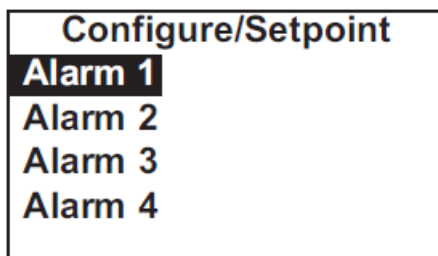
1. Press **MENU**.
The main **Menu** screen appears.
2. Move the cursor to **Program** and press **ENTER**.



3. Choose **Alarms**.



4. Choose **Configure/Setpoint**.

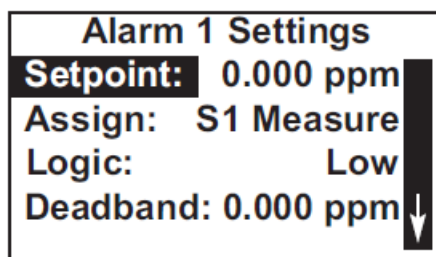


5. Choose **Alarm 1**, **Alarm 2**, **Alarm 3**, or **Alarm 4**.

The screens summarizes the present configuration and setpoints. There are eight items:

- Setpoint
- Logic
- Deadband
- Interval time
- On time
- Recover time
- Hold while active

The last four items describe the operation of the timer. Only four items are shown at a time. To view the remaining items, scroll to the bottom of the screen and continue scrolling.



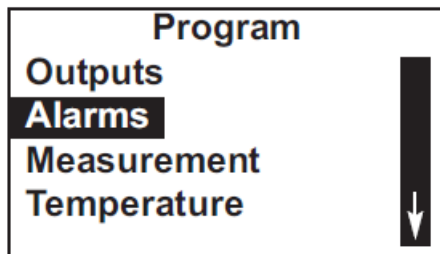
6. To make a change, move the cursor to the desired line and press **ENTER**.
A screen appears in which the present setting can be edited.
7. Press **ENTER** to store the setting.
For an explanation of terms, see [Purpose](#) and [Definitions](#).
8. To return to the main display, press **MENU** and then **EXIT**.

7.4.4 Procedure - simulating alarms

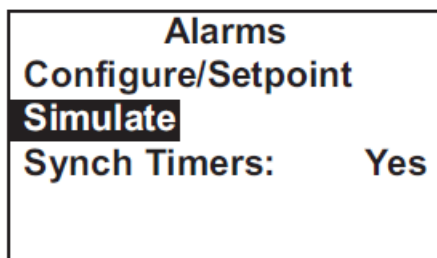
Complete the following steps to make the transmitter energize or de-energize an alarm relay.

Procedure

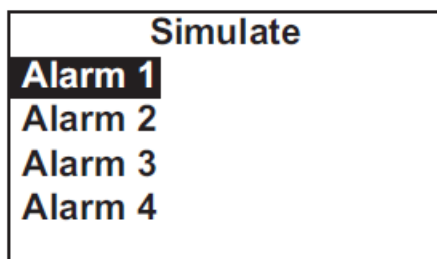
1. Press **MENU**.
The main **Menu** screen appears.
2. Move the cursor to **Program** and press **ENTER**.



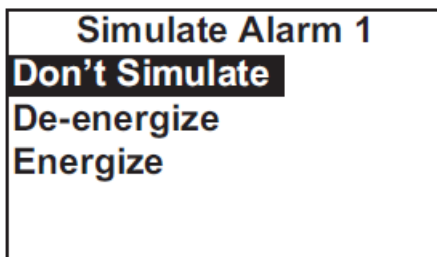
3. Choose **Alarms**.



4. Choose **Simulate**.



5. Choose **Alarm 1**, **Alarm 2**, **Alarm 3**, or **Alarm 4**.



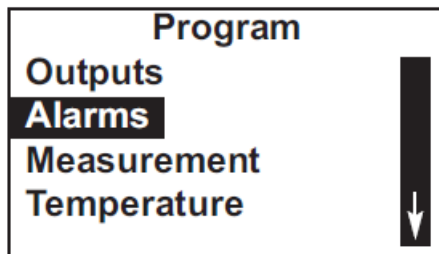
6. Choose **Don't simulate**, **De-energize**, or **Energize**.
7. Press **MENU** or **EXIT** to end simulation.

7.4.5 Procedure - synchronizing timers

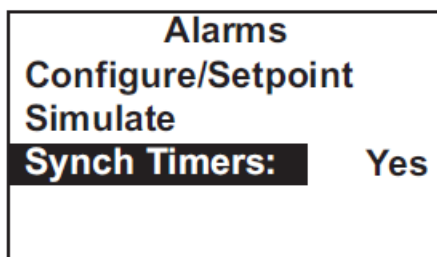
Synch timers is available only if two or more alarm relays have been configured as interval timers.

Procedure

1. Press **MENU**.
The main **Menu** screen appears.
2. Move the cursor to **Program** and press **ENTER**.



3. Choose **Alarms**.



The summary display shows the current **Synch timers** setting (Yes or No).

4. To make a change, choose **Synch timers** and press **ENTER**.
A screen appears in which the present setting can be edited.
5. Press **ENTER** to store the setting.
For an explanation of terms, see [Purpose](#) and [Definitions](#).
6. To return to the main display, press **MENU** and then **EXIT**.

7.5 Configuring the measurement

7.5.1 Purpose

This section explains how to do the following:

1. Program the transmitter to measure total chlorine. This step is necessary, because the transmitter can be used with other sensors to measure other chlorine oxidants.
2. Set the level of electronic filtering of the sensor current.
3. Set the display resolution.

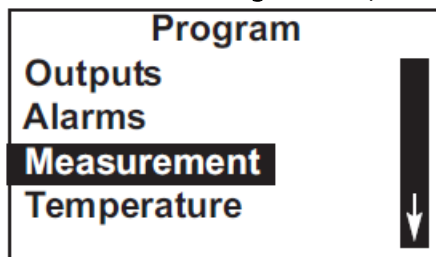
7.5.2 Definitions

Chlorine oxidants	Although the Rosemount™ TCL is used to measure total chlorine only, the Rosemount 1056 transmitter used with the Rosemount TCL can be used to measure other chlorine oxidants, for example, monochloramine and free chlorine.
Filter	The transmitter applies a software filter to the raw sensor current. The filter reduces noise but increases the response time. The available filter(s) depend on the time setting. If the filter is between 0 and 10 seconds, the transmitter applies a window filter. The window filter averages the measured value within the filter time. For example, if the filter is 5 seconds and a step increase is applied to the input, the displayed value increases linearly, reaching the final value after 5 seconds. If the filter is set to greater than 10 seconds, the transmitter applies either an adaptive filter or a continuous filter. An adaptive filter discriminates between noise and real process change. It filters changes below a fixed threshold value but does not filter changes that exceed the threshold. It is best used in situations where the noise is relatively low. A continuous filter dampens all changes. The filter timer setting is approximately equal to the time constant, the amount of time required for the reading to reach 63 percent of the final value following a step change.
Resolution	If the chlorine concentration is less than 1.00 ppm (mg/L), the display resolution can be set to 0.XX or 0.XXX .

7.5.3 Procedure - configuring measurement

Procedure

1. Press **MENU**.
The main **Menu** screen appears.
2. Move the cursor to **Program** and press **ENTER**.



3. Choose **Measurement**.
4. To make a change, move the cursor to the desired line and press **ENTER**.
A screen appears in which the present setting can be edited.
5. To store the setting, press **ENTER**.
 - a)
6. To return to the main display, press **MENU** and then **EXIT**.

7.6 Configuring temperature related settings

7.6.1 Purpose

This section describes how to do the following:

1. Choose temperature units.
2. Choose automatic or manual temperature correction for membrane permeability.
3. Enter a temperature for manual temperature compensation.

7.6.2 Definitions

**Automatic
temperature
correction**

The sensor is a membrane-covered amperometric sensor. As temperature increases, permeability increases. Thus, an increase in temperature will cause the sensor current and the transmitter reading to increase even though the remained constant. In automatic temperature correction, the transmitter uses the temperature measured by the sensor .

**Manual
temperature
correction**

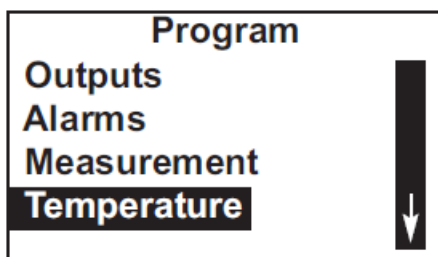
In manual temperature correction, the transmitter uses the temperature you enter for correction. It does not use the actual process temperature. Do not use manual temperature correction unless the measurement and calibration temperatures differ by no more than about 2 °C. Manual temperature correction is useful if the sensor temperature element has failed and a replacement sensor is not available.

7.6.3 Procedure - configuring temperature related settings

Complete the following steps to set the temperature units and to select automatic or manual temperature correction.

Procedure

1. Press **MENU**.
The main **Menu** screen appears.
2. Move the cursor to **Program** and press **ENTER**.



3. Choose **Temperature**.
The screen summarizes the present sensor configuration.
4. To make a change, move the cursor to the desired line and press **ENTER**.
A screen appears in which the present setting can be edited.
5. To store a setting, press **ENTER**.
6. To return to the main display, press **MENU** and then **EXIT**.

7.7 Configuring security settings

7.7.1 Purpose

This section describes how to set security codes. There are three levels of security.

1. A user can view the default 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.

The security code is a three digit number. The table shows what happens when different security codes (**XXX** and **YYY**) are assigned to Calibration/Hold and All. **000** means no security.

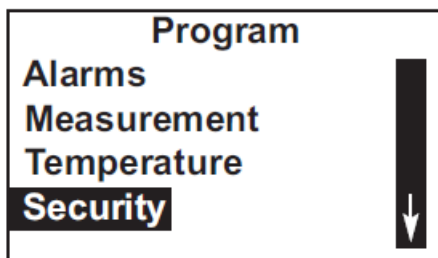
Calibration/Hold	All	What happens
000	XXX	User enters XXX and has access to all menus.
XXX	YYY	User enters XXX and has access to Calibration and Hold menus only. User enters YYY and has access to all menus.
XXX	000	User needs no security code to have access to all menus.
000	000	User needs no security code to have access to all menus.

7.7.2 Procedure - configuring security settings

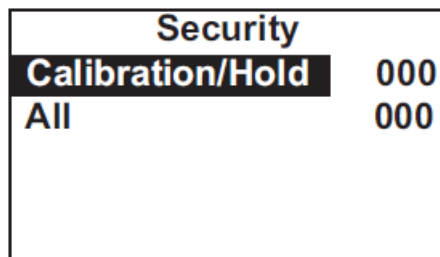
Follow the steps below to set security codes.

Procedure

1. Press **MENU**.
The main **Menu** screen appears.
2. Move the cursor to **Program** and press **ENTER**.



3. Scroll to the bottom of the screen and continue scrolling until Security is highlighted.
Press **ENTER**.
The screen shows the existing security codes.



4. To make a change, move the cursor to the desired line and press **ENTER**.
A screen appears in which the present setting can be edited.
5. Press **ENTER** to store a change.
The security code takes effect two minutes after pressing **ENTER**.
6. To return to the main display, press **MENU** and then **EXIT**.

7.8 Resetting the transmitter

7.8.1 Purpose

This section describes how to clear user-entered values and restore default settings. There are three resets:

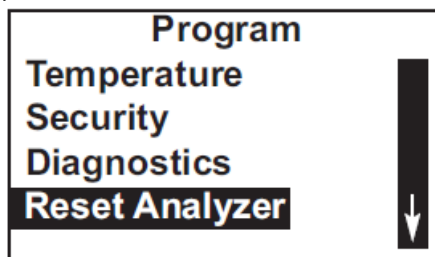
1. Resetting to factory default clears ALL user-entered settings, including sensor and analog output calibration, and returns ALL settings and calibration values to the factory defaults.
2. Resetting a sensor calibration to the default value clears user-entered calibration data for the selected sensor but leaves all other user-entered data unaffected.
3. Resetting the analog output calibration clears only the user-entered analog output calibration. It leaves all other user-entered settings unchanged.

7.8.2 Procedure - resetting the transmitter

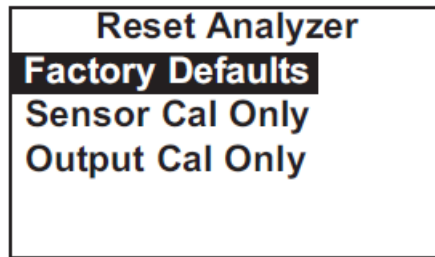
Complete the following steps to reset the transmitter.

Procedure

1. Press **MENU**.
The main **Menu** screen appears.
2. Move to **Program** and press **ENTER**.



3. Scroll to the bottom of the screen and continue scrolling until **Reset Analyzer** is highlighted. Press **ENTER**.



4. Choose whether to reset all user-entered values (**Factory Defaults**), sensor calibration (**Sensor Cal Only**), or output calibration (**Output Cal Only**). If you choose **Sensor Cal Only** or **Output Cal Only**, a second screen appears in which you can select which sensor or output calibration to reset.
5. To return to the main display, press **MENU** and then **EXIT**.

8 Digital communications

9 Calibrate

9.1 Introduction

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

1. Calibrate the temperature sensing element in the .
2. Calibrate the sensor.
3. Calibrate the analog outputs.

9.2 Calibrating temperature

9.2.1 Purpose

The sensor is a membrane-covered amperometric sensor. As the sensor operates, diffuses through the membrane and is consumed at an electrode immediately behind the membrane. The diffusion rate, in turn, depends on the concentration of and how easily it passes through the membrane (the membrane permeability). Because membrane permeability is a function of temperature, the sensor current changes if the temperature changes. To account for changes in sensor current caused by temperature alone, the transmitter automatically applies a membrane permeability correction. The membrane permeability changes about 3%/° C at 25 °C (77 °F), so a 1 °C error in temperature produces about a 3% error in the reading.

Without calibration, the accuracy of the temperature measurement is about ± 0.4 °C. Calibrate the sensor/transmitter unit if:

1. ± 0.4 °C accuracy is not acceptable.
2. The temperature measurement is suspected of being in error. Calibrate temperature by making the transmitter reading match the temperature measured with a standard thermometer.

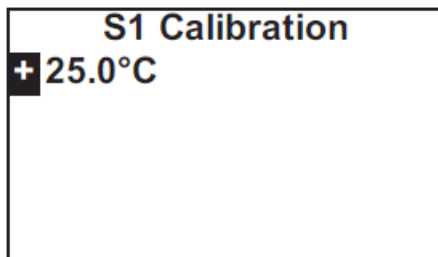
9.2.2 Procedure

Complete the following steps to calibrate the temperature in the transmitter.

Procedure

1. Remove the sensor from the flow cell. Place it in an insulated container of water along with a calibrated thermometer. Submerge at least the bottom two inches of the sensor.
2. Allow the sensor to reach thermal equilibrium.
The time constant for the sensor is about five minutes, so it may take as long as thirty minutes for equilibration.
3. Press **MENU**.
The main **Menu** screen appears. The cursor is on Calibrate.
4. Press **ENTER**.
5. Choose the sensor you wish to calibrate.

6. Choose **Temperature**.



7. Change the display to match the temperature read from the calibrated thermometer. Press **ENTER**.
If the present temperature is more than 5 °C different from the value entered, an error message appears.
8. To force the transmitter to accept the calibration, choose **Yes**. To repeat the calibration, choose **No**.
For troubleshooting assistance, see [Troubleshooting when no error message is showing](#).
9. To return to the main display, press **MENU** and then **EXIT**.

9.3 Calibrating total chlorine

9.3.1 Purpose

The continuous determination of total chlorine requires two steps.

The zero standard is necessary, because the sensor, even when no iodine is present, generates a small current called the residual current or zero current. The transmitter compensates for the residual current by subtracting it from the measured current before converting the result to a total chlorine value. New sensors require zeroing before being placed in service; zero sensors whenever the electrolyte solution is replaced. Deionized water makes a good zero standard.

The purpose of the full-scale standard is to establish the slope of the calibration curve. Because stable total chlorine standards do not exist, you must calibrate the sensor against a test run on a grab sample of the process liquid. Several manufacturers offer portable test kits for this purpose. Observe the following standards when taking and testing the grab sample.

- Take the grab sample from a point as close as possible to the inlet of the sample conditioning system.
- Total chlorine solutions are unstable. Run the test immediately after taking the sample. Try to calibrate the sensor when the chlorine concentration is at the upper end of the normal operating range.

9.3.2 Procedure - zeroing the sensor

Complete the following steps to calibrate the sensor with the zero standard.

Procedure

1. Remove the sensor from the flow cell and place it in the zero standard (a beaker of deionized water). Be sure no air bubbles are trapped against the membrane. Observe the sensor current.

The current drops rapidly at first and then gradually reaches a stable zero value.

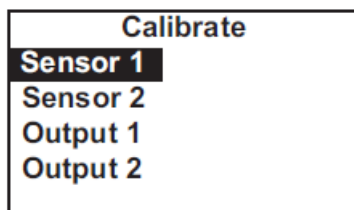
2. To monitor the sensor current, press **DIAG**.
3. Move the cursor to the chlorine sensor and press **ENTER**.

The input current is the first line in the display. Note the units: nA is nanoamps and μ A is microamps. The typical zero current for a Rosemount™ 499ACL-02 sensor is -10 to +50 nA. A new sensor or a sensor in which the electrolyte solution has been replaced may require several hours (occasionally as long as overnight) to reach a minimum zero current.

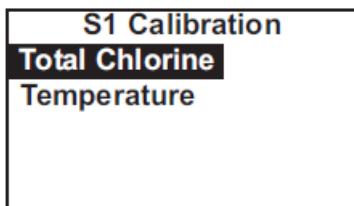
Important

Do not start the zero routine until the sensor has been in the zero solution for at least two hours.

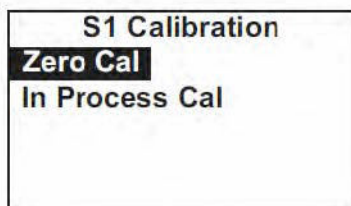
4. Press **MENU**.
The main **Menu** screen appears. The cursor is on Calibrate.
5. Press **ENTER**.



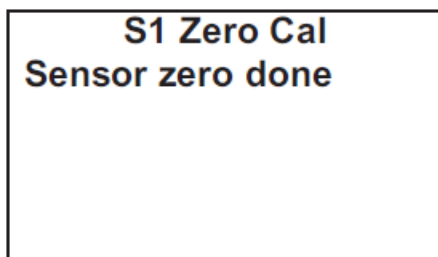
6. Choose the sensor you wish to calibrate.
Sensor 2 only appears if you have a dual input Rosemount 1056 transmitter.



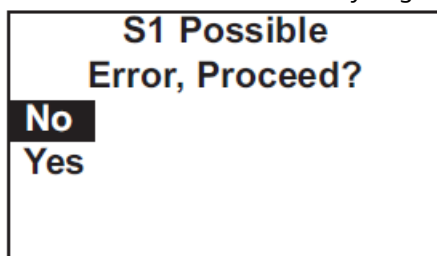
7. Choose Total Chlorine.



8. Choose **Zero Cal**.
The transmitter automatically starts the zero calibration.
If the zero calibration was successful, the following screen appears.

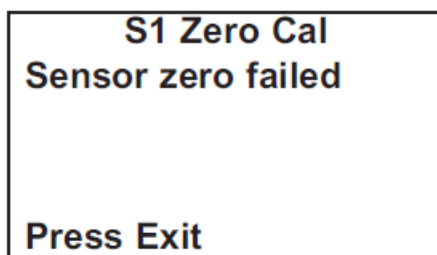


If the zero current is moderately larger than expected, an error message appears.



9. To force the transmitter to accept the zero current, choose **Yes**. To repeat the calibration, choose **No**. For troubleshooting information, see [Troubleshooting when no error message is showing](#)

If the zero current is much larger than expected, the **Sensor zero failed** screen appears.



The transmitter will not update the zero current.

10. To return to the main display, press **MENU** and then **EXIT**.

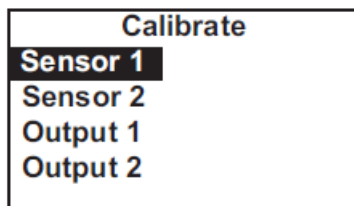
9.3.3 Procedure - calibrating the sensor

Complete the following steps to calibrate the total chlorine sensor with the full scale standard solution.

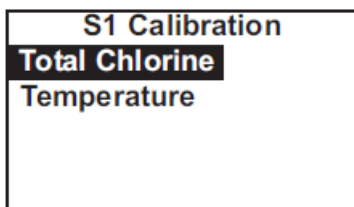
Procedure

1. If the sensor was just zeroed, place the sensor back in the flow cell. Confirm that excess 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.
2. Adjust the chlorine concentration until it is near the upper end of the operating range. Wait until the transmitter reading is stable before starting calibration.
When you first start up the system or put a new sensor into service, allow at least 30 minutes for the reading to stabilize.
3. Press **MENU**.
The main **Menu** screen appears. The cursor is on Calibrate.

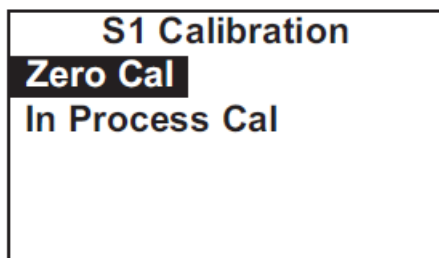
4. Press **ENTER**.



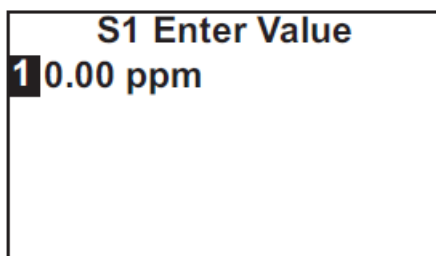
5. Choose the sensor you wish to calibrate.
Sensor 2 appears only if you have a dual input Rosemount™ 1056 Transmitter.



6. Choose Total Chlorine.

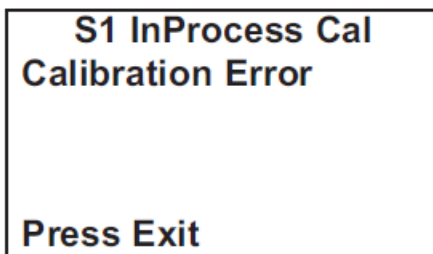


7. Choose In Process Cal.
8. Follow the screen prompts. Once the reading is stable, press **ENTER**. Take the sample and press **ENTER**.
At this point, the transmitter stores the present sensor current and temperature and uses those values in calibration.
9. Determine the total chlorine concentration in the sample and enter the value in the screen below.



See [Purpose](#) for sampling and testing precautions.

If the calibration was successful, the live reading changes to the value entered above, and the display returns to the screen in [Step 6](#). If the sensitivity is too far outside the range of expected values the following screen appears.



The transmitter doesn't update the calibration. For troubleshooting assistance, see [Troubleshooting when no error message is showing](#).

10. To return to the main display, press **MENU** and then **EXIT**.

9.4 analog outputs

9.4.1 Purpose

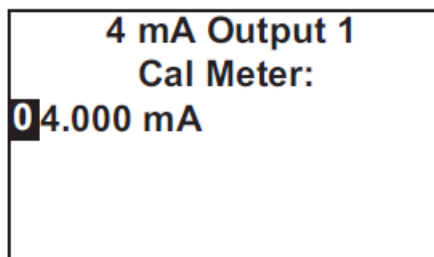
Although the transmitter analog outputs are calibrated at the factory, they can be trimmed in the field to match the reading from a standard milliammeter. Both the low (0 or 4 mA) and high (20 mA) outputs can be trimmed.

9.4.2 Procedure

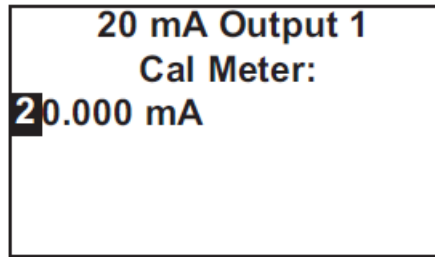
Complete the following steps to calibrate the transmitter's analog outputs.

Procedure

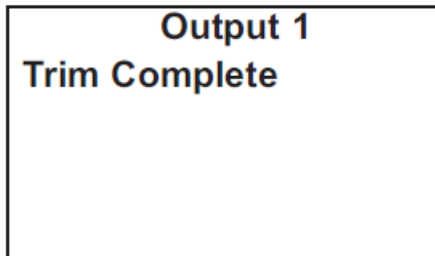
1. Connect a calibrated milliammeter across the output you wish to calibrate. If a load is already connected to the output, disconnect the load.
Do not put the milliammeter in parallel with the load.
2. Press **MENU**.
The main **Menu** screen appears. The cursor is on Calibrate.
3. Press **ENTER**.
4. Choose the output you wish to calibrate.
The transmitter simulates the low output current.



5. Change the value in the display to match the reading from the milliammeter.
The transmitter simulates the 20 mA output current.



6. Change the value in the display to match the reading from the milliammeter.
If the calibration was successful, the screen below appears.



If the user entered value is more than ± 1 mA different from the nominal value, a possible error screen appears.

7. To force the transmitter to accept the calibration, choose **Yes**.
8. To return to the main display, press **MENU** and then **EXIT**.

10 Maintenance

10.1 Transmitter

The Rosemount™ 1056 transmitter used with the Rosemount 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 chlorine sensor circuit board is replaceable. If you have a dual input transmitter, consult the Rosemount 1056 [Reference Manual](#) for the part number of the other board.

⚠ WARNING

Electrical shock

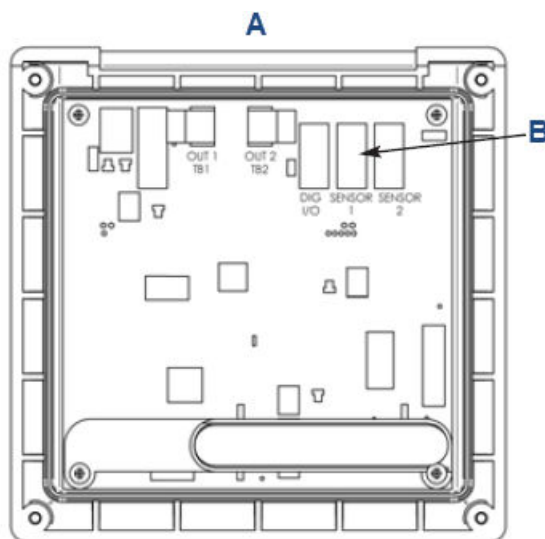
Disconnect main power and relay contacts to separate power source before servicing.

To replace the board:

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 10-1](#)

Figure 10-1: Sensor Board Connections



- A. Hinged end
B. Sensor board cable connection

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.
8. Close the front panel.
9. Turn on power.

10.2 Total chlorine sensor

10.2.1 General

When used in clean water, the 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.

10.2.2 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.

10.2.3 Replacing the membrane

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

Procedure

1. Hold the sensor with the membrane facing up.
2. Unscrew the membrane retainer. Remove the membrane assembly and O-ring. See [Figure](#).
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 electrolyte 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.

10.2.4 Replacing the electrolyte solution and membrane

Procedure

1. Unscrew the membrane retainer.

2. Remove the membrane assembly and O-ring.
See .
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. Wrap the plug with
7. 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 allowing the wood ring to soak up the electrolyte solution.
8. Hold the sensor at about a 45 degree angle with the cathode end pointing up.
9. Add electrolyte solution through the fill hole until the liquid overflows.
10. Tap the sensor near the threads to release trapped air bubbles.
11. Add more electrolyte solution if necessary.
12. Place the fill plug in the electrolyte port and begin screwing it in.
13. After several threads have engaged, rotate the sensor so that the cathode is pointing up and continue tightening the fill plug.
Do not overtighten.
14. Place a new O-ring in the groove around the cathode post.
15. Insert a small blunt probe, like a toothpick with the end cut off, through the pressure equalizing port. See .

CAUTION

Equipment damage

A sharp probe may puncture the bladder and destroy the sensor.

Do not use a sharp probe.

16. ; then place the membrane assembly over the cathode.
17. Screw the membrane retainer in place.

10.3 Sample conditioning system

10.3.1 Reagent

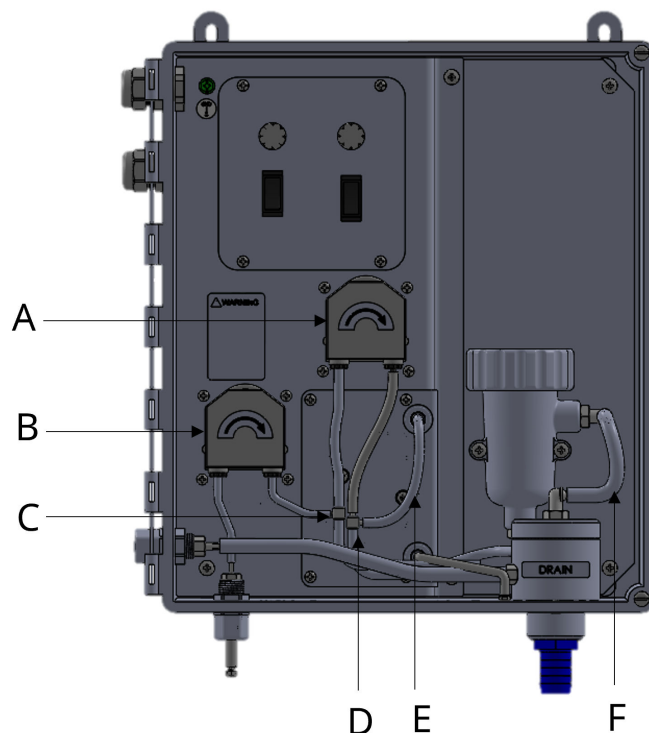
The sample conditioning reagent lasts about two months.

Before putting fresh reagent in the carboy, discard any small amount of remaining reagent. To prepare the reagent refer to the procedure in [Prepare the reagent](#).

10.3.2 Sample and reagent tubing

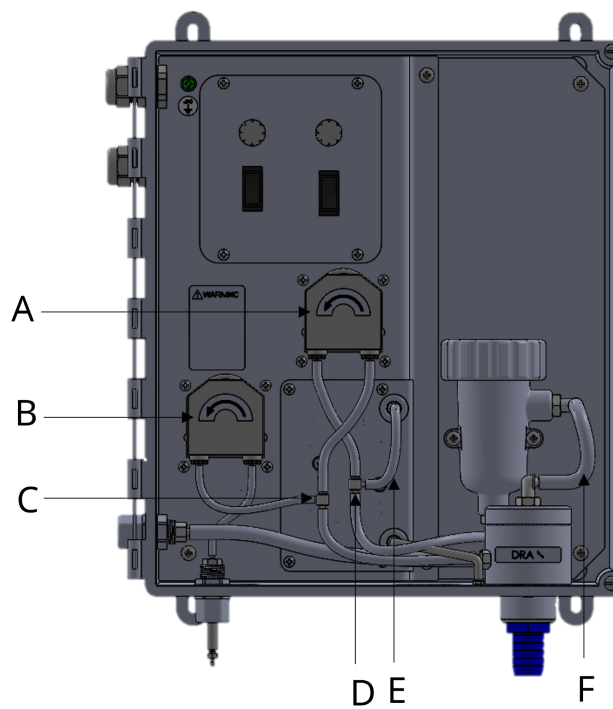
Periodically inspect sample and reagent tubing for cracks, leaks, and plugs. Replace tubing if it is damaged or plugged.

Figure 10-2: Tubing Layout for Units with Clockwise Flow Reagent and Sample Pumps



- A. Sample pump
- B. Reagent pump
- C. Reagent injection tee (small barb)
- D. Air injection tee (large barb)
- E. Air
- F. Drain

Figure 10-3: Tubing Layout for Units with Counter-clockwise Flow Reagent and Sample Pumps



- A. Sample pump
- B. Reagent pump
- C. Reagent injection tee (small barb)
- D. Air injection tee (large barb)
- E. Air
- F. Drain

10.3.3 Replacing reagent tubing

Depending on the TCL configuration and manufacturing date, the reagent pump may have either clockwise or counter-clockwise flow direction. It is important to use the right reagent tubing kit for your reagent pump flow direction. Refer to the product datasheet for reagent tubing kit ordering information.

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 10-4](#).
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.

10.3.4 Replacing sample tubing

Depending on the TCL configuration and manufacturing date, the sample pump may have either clockwise or counter-clockwise flow direction. The same sample tubing kit can be used for either sample pump flow direction. Refer to the product datasheet for sample tubing kit ordering information.

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 10-4](#).
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.

10.3.5 Replacing peristaltic pump tubing

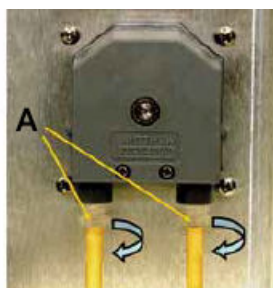
The expected life of the peristaltic pump tubing is one year.

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 10-4](#).

Figure 10-4: Luer Fittings

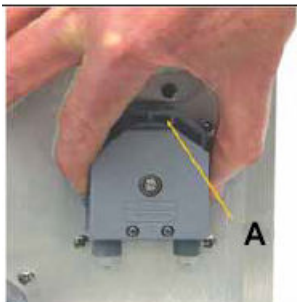


A. Luer fittings

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

See [Figure 10-5](#).

Figure 10-5: Pump Cover



A. Pump cover

4. Using your thumb as shown in [Figure 10-6](#), push the tubing fitting straight outward until the fitting slides out of the socket.

Figure 10-6: 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 10-7](#).

Figure 10-7: Inserting New Tubing



7. Replace the pump cover.
 - a) Place the cover on the pump casing.
See [Figure 10-8](#).

Figure 10-8: Replacing the Pump Cover



- b) Be sure the pins at the bottom of the cover ([Figure 10-9](#)) ride on the tracks in the pump casing.

Figure 10-9: Pins



- c) The position of the track is outlined in [Figure 10-10](#). 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 10-10: Track



- d) Push down until the cover snaps into place.
8. Reconnect the tubing.

10.3.6 Replacing the air pump

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

⚠ WARNING

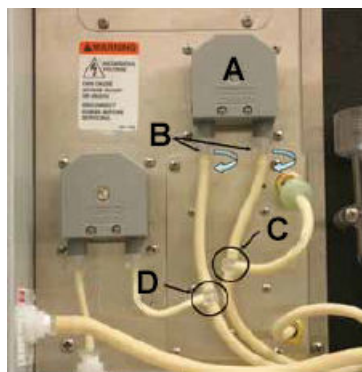
HAZARDOUS VOLTAGE

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

Procedure

1. Disconnect power to the transmitter.
2. Refer to [Figure 10-11](#). 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 10-11: Replacing the Air Pump



- A. Sample pump
- B. Luer fittings
- C. Air injection
- D. Reagent injection

3. Remove the four screws (circled in [Figure 10-11](#) and [Figure 10-12](#)) holding the air pump access panel. Pull out the pump and panel.

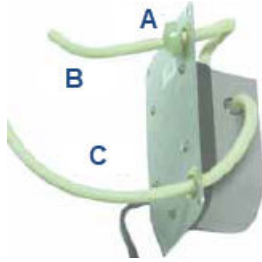
Figure 10-12: Air Pump Access Panel



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

See [Figure 10-13](#).

Figure 10-13: Air Inlet and Outlet Tubing

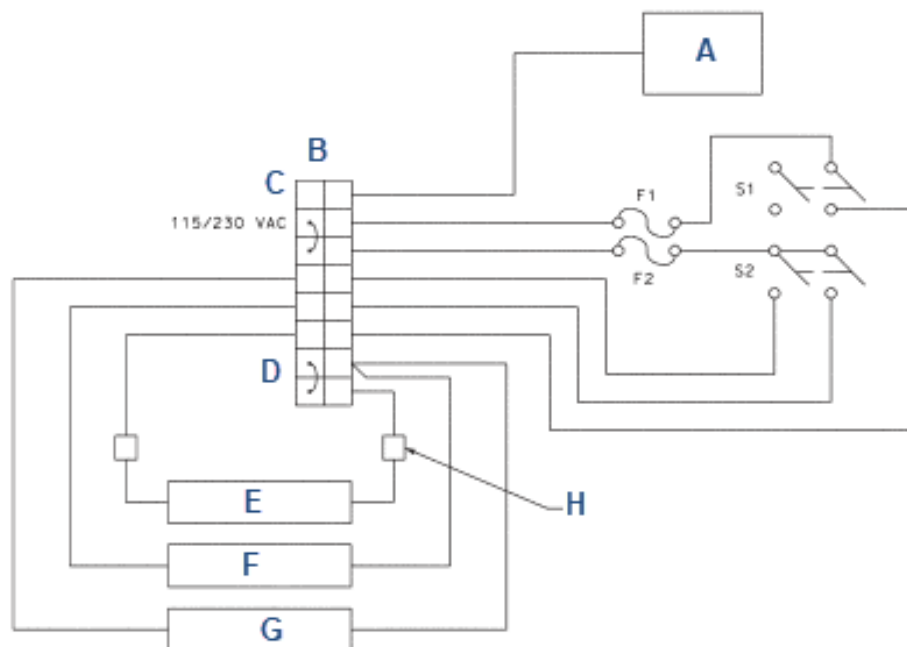


- A. Check valve*
- B. Air outlet*
- C. Air inlet*

5. Remove the five screws (surrounded by squares in [Figure 10-12](#)) 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 10-14](#).

Figure 10-14: Terminal Strip



Model option -11: 115 VAC only

Model option -12: 230 VAC only

- A. Front panel
- B. Terminal block
- C. Ground
- D. Neutral
- E. Reagent pump
- F. Sample pump
- G. Air pump
- H. Connector

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 10-13](#). 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.

10.3.7 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

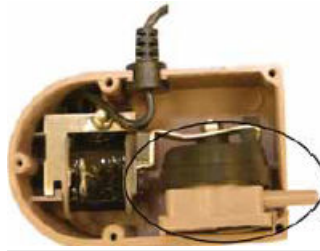
1. Disconnect power to the transmitter.
2. Refer to [Figure 10-11](#). Disconnect the reagent and air injection tubes. Disconnect the suction and discharge fitting by turning the Luer fitting in the direction shown in the figure. Disconnect the air pump inlet tubing from the barbed fitting at the bottom of the enclosure.
3. Remove the four screws (circled in [Figure 10-12](#)) 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 10-13](#).
5. Remove the five screws (surrounded by squares in [Figure 10-12](#)) 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 10-15](#).

Figure 10-15: Inlet Fitting



8. Slide the pump assembly out of the air pump body.
See [Figure 10-16](#).

Figure 10-16: 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 10-13](#). 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.

11 Troubleshoot

11.1 Overview

11.2 Use the diagnostic feature

Complete the following steps to troubleshoot your transmitter with the diagnostic feature.

Procedure

1. To read diagnostic messages, press **DIAG**.
The screen below appears.
2. To display fault messages, select Faults. To display warning messages, select Warnings. To read measurement information about the sensor, including raw sensor signal and calibration data, choose and press **ENTER**.
If you choose Faults or Warnings, a screen like the one below appears. S1 means sensor 1.
3. For additional troubleshooting information, select the desired message and press **ENTER**.
For more information, see [Troubleshooting when a Fault message is showing](#).
4. To return to the main display, press **MENU** and then **EXIT**.

11.3 Troubleshooting when a Fault message is showing

Fault message	Explanation
Main Board CPU, Main Board Factory Data, and Main Board User Data errors	Main board software is corrupted.
Main Board CPU, Main Board Factory Data, and Main Board User Data errors	Main board factory eeprom data is corrupted.
Main Board CPU, Main Board Factory Data, and Main Board User Data errors	Main board user eeprom data is corrupted.
Hardware error	Missing or bad hardware component.
Sensor Board Unknown, Sensor Board HW (Hardware) or SW (Software) Mismatch, or Sensor Board Not Communicating	Transmitter does not recognize sensor board.
Sensor Board Unknown, Sensor Board HW (Hardware) or SW (Software) Mismatch, or Sensor Board Not Communicating	Sensor board hardware and software do not match.
Sensor Board Unknown, Sensor Board HW (Hardware) or SW (Software) Mismatch, or Sensor Board Not Communicating	Sensor board software is not supported by main board software.
Sensor Board Unknown, Sensor Board HW (Hardware) or SW (Software) Mismatch, or Sensor Board Not Communicating	Sensor board is not communicating with main board.

Fault message	Explanation
Sensor CPU error	Sensor board software is corrupted.
Sensor RTD Open	Temperature measuring circuit is open.
Sensor 1 not detected	No sensor board is connected to sensor 1 terminal.
Sensor Factory Data, Sensor Board User Data, and Sensor EEPROM write errors	Sensor board factory eeprom data is corrupted.
Sensor Factory Data, Sensor Board User Data, and Sensor EEPROM write errors	Bad CPU on the sensor board.
Sensor Factory Data, Sensor Board User Data, and Sensor EEPROM write errors	Sensor board user eeprom data is corrupted.
Sensor ADC error	Bad component on the sensor board.
Sensor RTD out of range	RTD is improperly wired or has failed.

11.3.1 Main Board CPU, Main Board Factory Data, and Main Board User Data errors

These error messages mean the main board may be corrupted or the eeprom data on the main board may be corrupted.

Procedure

1. Cycle the power off and then on.
2. If cycling the power does not resolve the issue, call the factory.
3. If the fault message was Main Board User Data and a power cycle did not resolve the fault, reset the transmitter to factory defaults and repeat calibration, reset the transmitter to factory default, re-enter user settings, and repeat calibration.

11.3.2 Hardware error

Hardware error means that there is a missing or bad hardware component on the sensor board.

The board must be replaced.

11.3.3 Sensor Board Unknown, Sensor Board HW (Hardware) or SW (Software) Mismatch, or Sensor Board Not Communicating

These error messages mean the main board either does not recognize the sensor board or the sensor board and main board are no longer communicating.

Procedure

1. Verify that the ribbon cable connecting the main board (on the inside of the front panel) and the sensor board are properly seated.
2. Inspect the connecting cable for obvious tears or breaks.
3. If the ribbon cable is properly seated and appears undamaged, replace the sensor board.

11.3.4 Sensor incompatible

This error message means that the sensor board software is not supported by the main board software. Either the sensor board or the main board software is too old.

Replace the main board with one compatible with the sensor board. Call the factory for assistance. You will be asked for the main and sensor board revision numbers. To read the main board revision, press **DIAG** and scroll down until `Inst SW Ver` is showing. To view the sensor board software revision, press **DIAG**, choose the appropriate sensor, and scroll down until `Board SW Ver` is showing. The main board can be replaced only at the factory.

11.3.5 Sensor CPU error

This message means the sensor board software is corrupted.

Procedure

1. Cycle the power off and then on.
2. If cycling the power does not help, call the factory.
The sensor board must be replaced.

11.3.6 Sensor RTD open

There is an open circuit in the sensor RTD (resistance temperature device) or wiring.

Procedure

1. If the sensor is being installed for the first time, check the wiring connections.
See [Power](#).
2. Disconnect the sensor from the transmitter and measure the resistance between the RTD and return wires.
See [Figure 4-3](#) or [Figure 4-4](#).
3. If there is an open circuit, replace the sensor.
4. If there is no open circuit, check the transmitter.
See [Troubleshooting when no error message is showing](#).

11.3.7 Sensor 1 not detected

The ribbon cable from sensor 1 (chlorine) board must be plugged into the sensor 1 plug.

See [Figure 4-2](#) for the location of the sensor board connectors.

Procedure

1. Confirm that the ribbon cable connecting sensor 1 (chlorine) board to the main board is plugged into the Sensor 1 connector on the main board.
2. Confirm that the ribbon cable is seated at both ends.

11.3.8 Sensor Factory Data, Sensor Board User Data, and Sensor EEprom write errors

These messages mean factory eeprom data or user eeprom data on the sensor board is corrupted or the CPU on the sensor board is bad.

Procedure

1. Cycle power off and then on.
2. Replace the sensor board.

11.3.9 Sensor ADC error

There is a bad component on the sensor board. The sensor board must be replaced.

11.3.10 Sensor RTD out of range

The Rosemount™ 499ACL-02 chlorine sensor contains a Pt 100 RTD (resistance temperature device) for measuring temperature. If the measured resistance is outside of the expected range, the transmitter displays the `Out of Range` error message.

Recommended actions

1. Check wiring connections.
2. Disconnect the sensor from the transmitter and use an ohmmeter to check the resistance across the RTD.
See [Figure 4-3](#) or [Figure 4-4](#). The resistance should be about 110 Ω. If there is an open or short circuit, or if the resistance is more than about 5% different from 110 Ω, the sensor has failed and should be replaced.
3. If there is no open or short, check the transmitter.
See [Simulating temperature](#).

11.4 Troubleshooting when a Warning message is showing

Warning message	Explanation	Section
Sensor Need Factory Cal	The sensor was not calibrated at the factory.	Sensor needs Factory Cal
Sensor Negative Reading	The reading is less than -0.5 ppm.	Sensor negative reading
Sensor RTD Sense Open	RTD sensor line is broken or not connected.	Sensor RTD sense open
Sensor Temperature High	Temperature is greater than 155 °C (311 °F).	Sensor temperature high or low
Sensor Temperature Low	Temperature is less than -20 °C (-4 °F).	Sensor temperature high or low

11.4.1 Sensor needs Factory Cal

The sensor board was improperly calibrated at the factory. Call the factory for assistance.

11.4.2 Sensor negative reading

The transmitter converts the raw to ppm by subtracting the zero current from the raw current and multiplying the result by a conversion factor. If the zero current is larger than the raw current, the result will be negative.

Procedure

1. Check the zero current.
It should be less than about nA.
2. If it is greater than nA, repeat the zero step.
If the zero current is in the correct range, the negative reading might be the result of the raw current or the sensitivity being too low. A properly operating sensor should generate .
3. Recalibrate the sensor. If necessary, clean or replace the membrane and check the fill .
4. Replace the sensor.

11.4.3 Sensor RTD sense open

The transmitter measures temperature using a three-wire resistance temperature device (RTD). See [Figure 11-4](#). The transmitter uses the in and return leads to measure the resistance of the RTD. The third lead, called the sense line, is connected to the return lead at the sensor. The sense line allows the transmitter to correct for the resistance of the in and return leads and to compensate for changes in wire resistance caused by changes in ambient temperature.

Recommended actions

1. Check wiring.
2. Disconnect the sense and return wires and check the resistance between them.
It should be less than 1 Ω . Even though the sense line is open, the sensor is still usable.
3. Use a wire jumper to connect the sense and return terminals to the sensor terminal strip.
The temperature reading will no longer be corrected for the lead resistance, nor will the transmitter be able to compensate for changes in ambient temperature. The error could be several $^{\circ}\text{C}$ or more.
4. Replace the sensor.

11.4.4 Sensor temperature high or low

The sensor RTD is most likely miswired.

Procedure

1. Check wiring connections.
- 2.
3. Replace the sensor.

11.5 Troubleshooting when no error message is showing

Problem	See section
Zero current was accepted, but the current is outside the range -10 to 15 nA.	Zero current is too high.
Error or warning message appears while zeroing the sensor (zero current is too high).	Zero current is too high.
Zero current is unstable.	Zero current is unstable
Sensor can be calibrated, but the current is too low.	Sensitivity is low or readings are low.
Process readings are erratic or wander.	Process readings are erratic or wander
Readings drift.	Readings drift
Readings are too high.	Readings are too high
Readings are too low.	Sensitivity is low or readings are low.
Current output is too low.	Current output too low
Alarm relays do not operate when setpoint is exceeded or do not release when reading is below setpoint.	Alarm relays don't work

11.5.1 Zero current is too high

Recommended actions

1. Check to see if the sensor is properly wired to the transmitter.
See [Sensor wiring](#).
2. Check to see if the zero solution is chlorine free. Take a sample of the solution and test it for total chlorine.
The concentration should be less than about 0.05 ppm. Avoid using tap water for zeroing the sensor. Even though tap water contains no iodine, chlorine oxidants present in tap water may produce a sensor current as high as 100 nA.
3. Make sure that you have allowed adequate time for the sensor to reach a stable residual current.
It may take several hours, sometimes as long as overnight, for a new sensor to stabilize.
4. Make sure the sensor fill solution is fresh.
An old, discolored fill solution may produce a high zero current.
5. Check to see if the membrane is damaged. Inspect the membrane and replace it if necessary.

11.5.2 Zero current is unstable

Recommended actions

1. Make sure the sensor is properly wired to the transmitter. Verify that all connections are tight.
2. If the sensor is new, wait about an hour for readings to stabilize.

Readings can be erratic when a new sensor is first placed in service.

3. Make sure the space between the membrane and cathode is filled with electrolyte solution and the flow path between the electrolyte reservoir and membrane is clear. Try starting the electrolyte flow by holding the sensor with the membrane end pointing down and sharply shaking the sensor a few times as though shaking down a clinical thermometer.
4. If shaking does not work, try clearing the hole around the cathode stem.
 - a) Hold the sensor with the membrane end pointing up. Unscrew the membrane retainer and remove the membrane assembly.
 - b) Use the end of a straightened paper clip to clear the holes at the base of the cathode stem.
5. Verify that the sensor is filled with electrolyte solution.
Refer to [Total chlorine sensor](#) for details.

11.5.3 Sensitivity is low or 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.

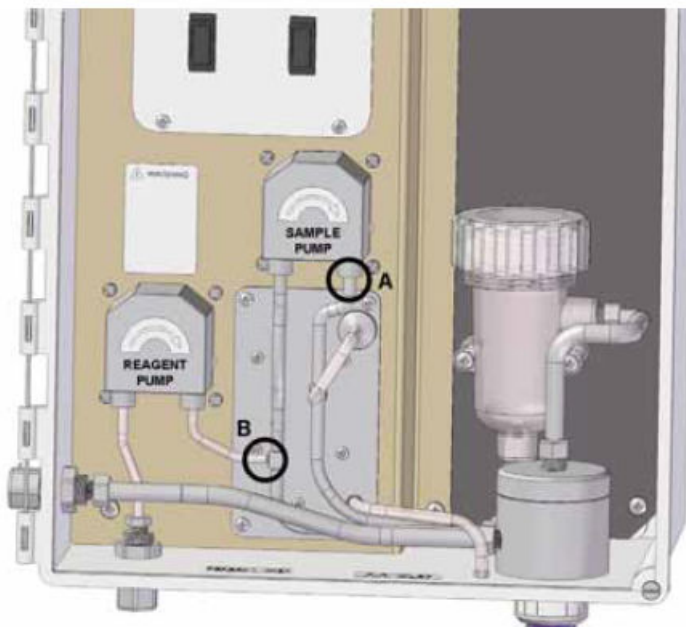
Expected range, ppm as Cl_2	Amount of KI needed per 5 gallons of vinegar	Part number
0-5 ppm	25 grams	24164-00
0-10 ppm	50 grams	24164-01
0-20 ppm	2 x 50 grams	24164-01

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. If the fuse is okay, replace the pump.
7. Are all 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 [Replacing peristaltic pump tubing](#) 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 luer fitting on the discharge of the sample pump. See A in [Figure 11-1](#).
 - c. Hold a small beaker under the discharge port.
 - d. Start the sample pump and collect sample for two minutes.
 - e. Measure the volume of sample collected in the beaker. After two minutes, the volume should be about 22 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 11-1](#).
 - 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 11-1: Disconnecting Sample and Reagent Tubing Prior to Checking Flow



- A. Sample tubing
B. Reagent tubing

11.5.4 Process readings are erratic or wander

Recommended actions

1. Make sure the sensor is properly wired to the transmitter. Verify that all connections are tight.
2. If the sensor is new, wait about an hour for readings to stabilize.
Readings can be erratic when a new sensor is first placed in service.
3. Make sure the air pump is 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. Check to see if the membrane is damaged or loose. Replace the membrane if necessary.
5. Make sure the space between the membrane and cathode is filled with electrolyte solution and the flow path between the electrolyte reservoir and membrane is clear. Try starting the electrolyte flow by holding the sensor with the membrane end pointing down and sharply shaking the sensor a few times as though shaking down a clinical thermometer.

11.5.5 Readings drift

Recommended actions

1. Check to see if the sample temperature is changing.
Membrane permeability is a function of temperature. The transmitter automatically corrects for changes in sensor current caused by temperature changes. The time constant for the Rosemount™ 499ACL-02 sensor is about five minutes. Therefore, the reading may drift for a while after a sudden temperature change.
2. Make sure the membrane is 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.
 - a) Clean the membrane by rinsing with a stream of water from a wash bottle.
 - b) Wipe the membrane with a soft tissue.
3. If the sensor is new or has been recently service, wait for it to stabilize.
New or rebuilt sensors may require several hours to stabilize.
4. Check to see if the flow of sample past the sensor is 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 luer fitting on the discharge of the sample pump.
See A in [Figure 11-1](#).

- c) Hold a small beaker under the discharge port.
 - d) Start the sample pump and collect sample for two minutes.
 - e) Measure the volume of sample collected in the beaker.
After two minutes, the volume should be about 22 mL.
5. Make sure the reagent flow is 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 11-1](#).
 - 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.

11.5.6 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.

11.5.7

1. Is the standard thermometer, RTD, or thermistor accurate? General purpose liquid-in glass thermometers, particularly ones that have been mistreated, can have surprisingly large errors.
2. Is the temperature element in the sensor completely submerged in the liquid?
3. Is the standard temperature sensor submerged to the correct level?

11.5.8 Current output too low

Load resistance is too high. Maximum load is .

11.5.9 Alarm relays don't work

Recommended actions

1. Verify the relays are properly wired.
2. Verify that deadband is correctly set.
See [Configuring alarms and assigning setpoints](#).

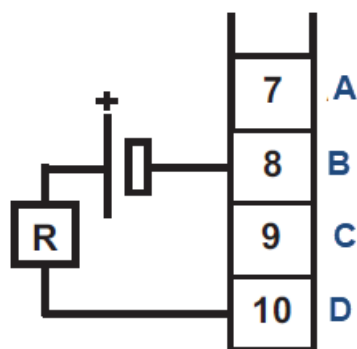
11.6 Simulating inputs

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.

Procedure

1. Disconnect the anode and cathode leads from terminals and connect a decade box and 1.5 V battery as shown in [Figure 11-2](#).

Figure 11-2: Simulating Chlorine



- A. Anode shield
- B. Anode
- C. Cathode shield
- D. Cathode

It is not necessary to disconnect the RTD leads.

2. Set the decade box to $M\Omega$.
3. Note the sensor current.
It should be about nA. The actual value depends on the voltage of the battery. To view the sensor current, go to the main display and press . Choose sensor 1. 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:
The voltage of a fresh 1.5 volt battery is about 1.6 volt (1600 mV).

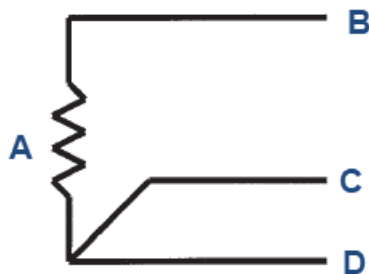
11.7 Simulating temperature

11.7.1 General

The transmitter accepts a Pt100 resistance temperature device. The Pt100 resistance temperature device is a three-wire configuration.

See [Figure 11-3](#).

Figure 11-3: Three-Wire RTD Configuration



- A. Resistance temperature device
- B. Resistance temperature device in
- C. Resistance temperature device sense
- D. Resistance temperature device return

Although only two wires are required to connect the resistance temperature device 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.

11.7.2 Simulating temperature

To simulate the temperature input, wire a decade box to the transmitter as shown in [Figure 11-4](#).

Figure 11-4: Simulating Resistance Temperature Device Inputs

- A. Resistance temperature device return
- B. Resistance temperature device sense
- C. Resistance temperature device in
- D. Resistance temperature device shield

To check the accuracy of the temperature measurement, set the resistor simulating the resistance temperature device 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.

Temperature (°C)	Pt 100 (Ω)
0	100.0
10	103.9
20	107.8

Temperature (°C)	Pt 100 (Ω)
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

12 Return of material

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

For more information: [Emerson.com](https://www.emerson.com)

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