Reference Manual
00809-0200-3412, Rev AB
October 2023

Rosemount™ FCL

Free Chlorine System with Rosemount 56 Transmitter

ROSEMOUNT™

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Essential instructions

Read this page before proceeding!

Your instrument purchase from Emerson is one of the finest available for your particular application. Emerson designs, manufactures, and tests its products to meet many national and international standards. Experience indicates that its performance is directly related to the quality of the installation and knowledge of the user in operating and maintaining the instrument. To ensure continued operation to the design specifications, read this Manual thoroughly before proceeding with installation, commissioning, operation, and maintenance of this instrument. If this equipment is used in a manner not specified by the manufacturer, the protection provided by it against hazards may be impaired. Failure to follow the proper instructions may cause any one of the following situations to occur: loss of life, personal injury, property damage, damage to this instrument, and warranty invalidation.

- Ensure that you have received the correct model and options from your purchase order. Verify that this Manual covers your model and options. If not, call 1-800-854-8257 or 949-757-8500 to request the correct Manual.
- For clarification of instructions, contact your Rosemount representative.
- Follow all warnings, cautions, and instructions marked on and supplied with the product.
- Use only qualified personnel to install, operate, program, and maintain the product.
- 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.
- Use only factory documented components for repair. Tampering or unauthorized substitution of parts and procedures can affect the performance and cause unsafe operation of your process.

⚠ 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.

Equipment protected throughout by double insulation.

Disconnect main power and relay contacts wired to separate power sources before servicing.

Do not operate or energize instrument with case open.

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

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 exposure integrity in compliance with personal safety and environmental protection requirements. Unused conduit openings must be sealed with NEMA 4X or IP65 conduit plugs to maintain the ingress protection rating (IP65).

Operate only with front and rear panels fastened and in place over terminal area.

Safety and performance require that this instrument be connected and properly grounded through a three-wire power source.

⚠ WARNING

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

⚠ CAUTION

Radio interference

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

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

⚠ 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 in protecting your system. Restrict physical access by unauthorized personnel to protect end users' assets. This is true for all systems used within the facility.

Contents

1 Installation

1.1 Unpacking and inspection

Procedure

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

   If items are missing, then notify Emerson immediately.

1.1.1 Rosemount FCL-01 (free chlorine without continuous pH correction)

The FCL-01 consists of the following items mounted on a back plate.

1. 56-03-24-38-HT Transmitter with sensor cable attached.
2. Constant head overflow sampler with flow cell for chlorine sensor.

The free chlorine sensor (499ACL-01-54-VP), three membrane assemblies, and a bottle of electrolyte solution are in a separate package.

1.1.2 Rosemount FCL-02 (free chlorine with continuous pH correction)

The FCL-02 consists of the following items mounted on a back plate:

1. 56-03-24-38-HT Transmitter with sensor cables attached.
2. Constant head overflow sampler with flow cells for pH and chlorine sensors.
3. Stand to hold pH buffer solution during calibration.

The free chlorine sensor (499ACL-01-54-VP), shipped with three membrane assemblies and a bottle of electrolyte solution, and the 3900VP-02-10 pH Sensor are in separate packages.

1.2 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.

   ⚠ WARNING

   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. Be sure there is easy access to the transmitter and sensor(s).

1.3 Sample requirements

Be sure the sample meets the following requirements:

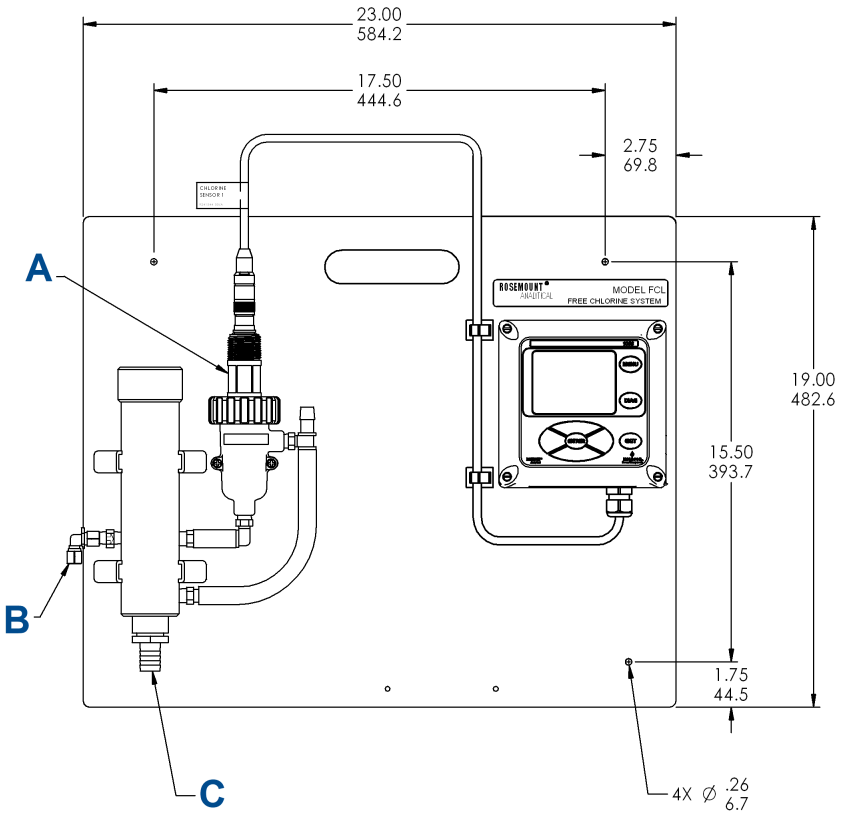
1. Temperature: +32 to +122 °F (0 to +50 °C)
2. Pressure: 3 to 65 psig (0.2 to 4.5 barg)
3. Minimum flow: 3 gal/hr (11 L/hr)

1.4 Mounting, inlet, and drain connections

The Rosemount FCL is intended for wall mounting only.

Refer to Figure 1-1 or Figure 1-2 for details. The sensor(s) screw into the flow cell adapters as shown in the figures. For FCL-02 (free chlorine with continuous pH adjustment), you must also install the pH sensor.

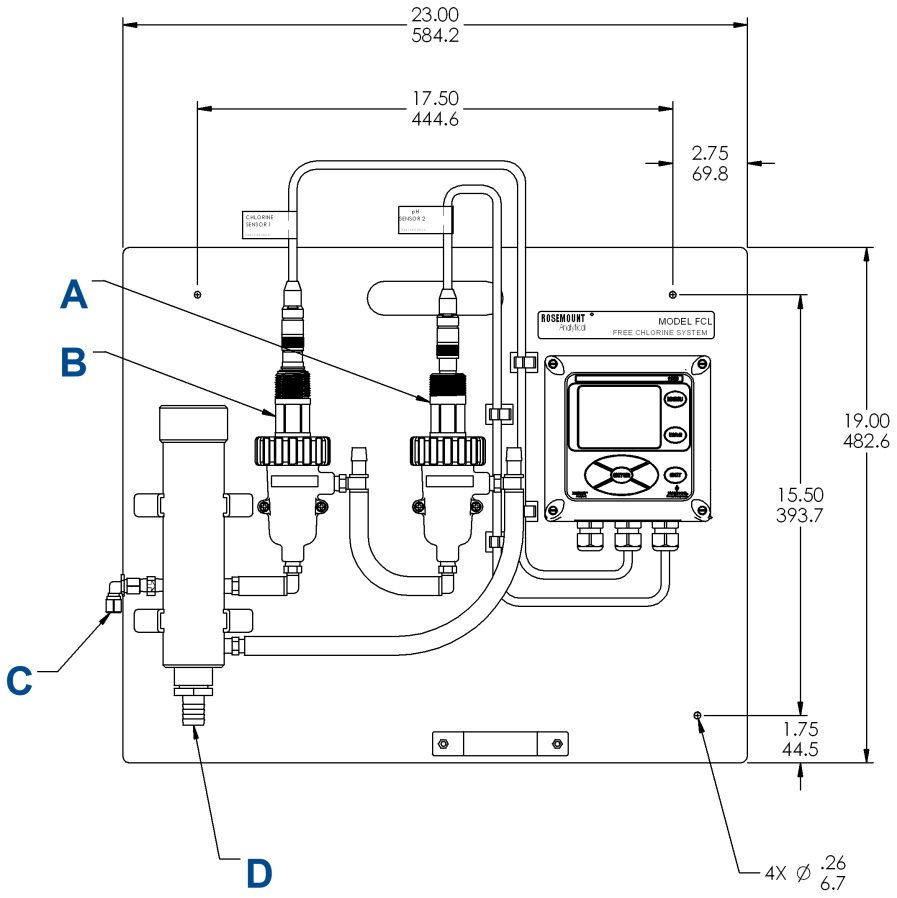
Figure 1-1: FCL-01



Dimensions are shown with inches above and millimeters below.

A. Chlorine sensor
B. Inlet
C. Drain

Figure 1-2: FCL-02



Dimensions are shown with inches above and millimeters below.

A. pH sensor
B. Chlorine sensor
C. Inlet
D. Drain

A ¼-in. outer dimension (OD) tubing compression fitting is provided for the sample inlet. If desired, you can remove the compression fitting and replace it with a barbed fitting. The fitting screws into a ¼-in. female NPT (FNPT) check valve. The check valve prevents the sensor flow cell from going dry if sample flow is lost.

The sample drains through a ¾-in. barbed fitting.

1. Attach a piece of soft tubing to the fitting and allow the waste to drain to open atmosphere.

NOTICE

Do not restrict the drain line.

2. Adjust the sample flow until the water level is even with the central overflow tube and excess water is flowing down the tube.
3. Confirm that sample is flowing through the flow cells.

1.5 Install the sensor(s)

Emerson provides the Rosemount FCL with the sensor cable pre-wired to the transmitter.

Procedure

1. Connect the chlorine sensor (499ACL-01-54-VP) to the cable labeled **CL**.
2. Connect the pH sensor (3900-VP-02-10) to the cable labeled **pH**.

   The terminal end of the sensor is keyed to ensure proper mating with the cable receptacle.
3. Once the key has slid into the mating slot, tighten the connection by turning the knurled ring clockwise.
4. Screw the sensor(s) into the plastic fitting(s), which are held in the flow cell(s) by the union nut.

   Do not remove the protective cap on the sensor(s) until ready to put the sensor(s) in service.

2 Wiring

2.1 Wire power

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

⚠ WARNING

Electrical shock

Electrical installation must be in accordance with the National Electrical Code (American National Standards Institute [ANSI]/National Fire Protection Association [NFPA]-70) and/or any other applicable national or local codes.

Procedure

1. Unplug the connector from the board and wire the power cable to it.

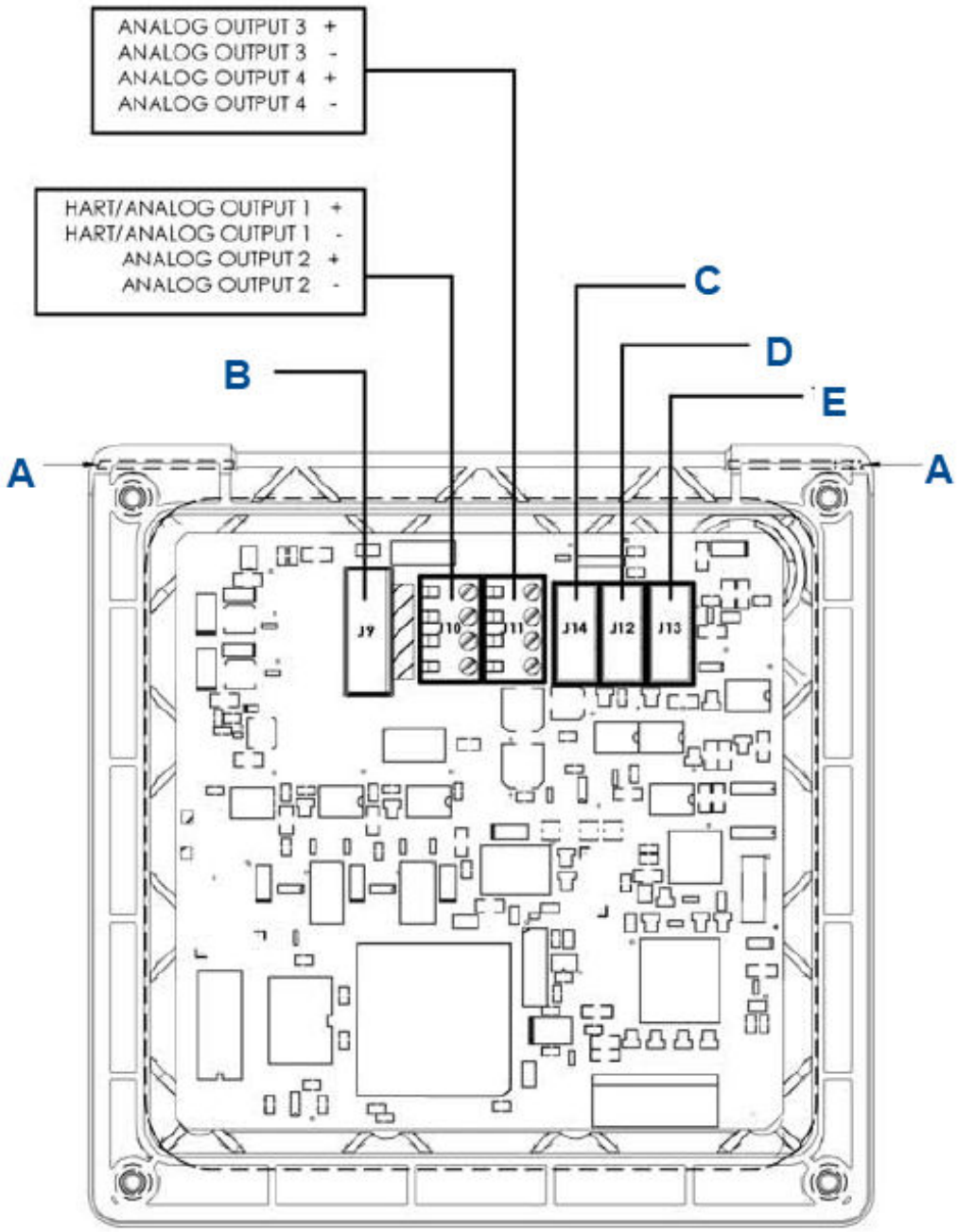
   Lead connections are marked on the connector. (**L** is live or hot; **N** is neutral; the ground connection has the standard symbol.)
2. Provide a switch or breaker to disconnect the transmitter from the main power supply.
3. Install the switch or breaker near the transmitter and label it as the disconnecting device for the transmitter.

2.2 Wire analog outputs

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

Figure 2-1 shows the locations of the terminals, the outputs they are assigned to, and the polarity.

Figure 2-1: Analog Output Connections



A. Hinge pin
B. To power supply PCB (ribbon cable)
C. To digital I/O communication board
D. To sensor 1 signal board
E. To sensor 2 signal board

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

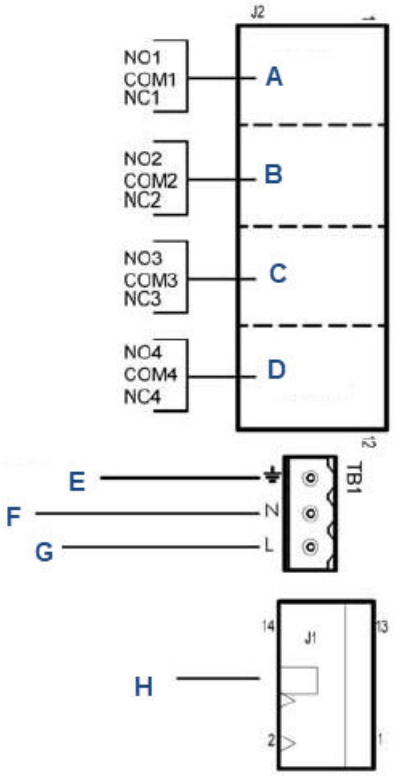
For best EMI/RFI protection, use shielded output signal cable enclosed in earth-grounded metal conduit.

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.

2.3 Wire alarm relays

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

Figure 2-2: Alarm Relay Connections



A. Alarm relay 1
B. Alarm relay 2
C. Alarm relay 3
D. Alarm relay 4
E. Earth ground
F. Neutral
G. Line power
H. To main board (ribbon cable)

Procedure

1. To remove the cover, grab it by the upper edges and pull straight out.
   The relay strip is at the top of the terminal board. See Figure 2-2.

2. Bring the relay wires through the rear conduit opening on the left hand side of the enclosure and make connections to the terminal strip.
3. Replace the cover.

   The two tabs on the back edge of the cover fit into slots at the rear of the enclosure, and the three small slots on the front of the cover snap into the three tabs next to the relay terminal strip. See Figure 2-2.

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

2.4 Wire sensor

The Rosemount FCL is provided with sensor cables pre-wired to the transmitter. If it is necessary to replace the sensor cable, refer to the instructions below.

Procedure

1. Shut off power to the transmitter.
2. Loosen the four screws holding the front panel in place and let it drop down.
3. Locate the appropriate signal board.

Slot 1 (left)	Slot 2 (center)	Slot 3 (right)
Communication	Input 1 (chlorine)	Input 2 (optional)

4. Loosen the gland fitting and carefully push the sensor cable up through the fitting as you pull the board forward to gain access to the wires and terminal screws.
5. Once the cable has been connected to the board, slide the board fully into the enclosure while taking up the excess cable through the cable gland.
6. Tighten the gland nut to secure the cable and ensure a sealed enclosure.

2.5 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.

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

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

2. The next screen lists navigation rules. Press **ENTER/MENU** for the next screen.
3. Configure sensor 1.

   Sensor 1 is the free chlorine sensor. The screen has three control boxes.

   a) For measurement, choose Free chlorine.

Important
Do not choose pH-independent free chlorine.

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

c) If you have a Rosemount™ FCL-02 (with pH sensor), the third control box lets you choose between live/continuous or manual pH correction.
If you choose live/continous (recommended), the transmitter will use the pH measured by the pH sensor to correct the chlorine reading for pH changes. If you choose manual (not recommended), a fourth control box appears to let you enter the manual pH, and the transmitter will use the entered value to correct the chlorine reading.

d) If you have a Rosemount FCL-01 (no pH sensor), enter the pH of the process liquid in the third control box.

e) Move the cursor to NEXT and press **ENTER/MENU**. If you have a Rosemount FCL-01, the display changes to show some basic keypad operation guidelines. Press **ENTER/MENU** to show the main display. If you have a Rosemount, go to the next step.

4. Configure sensor 2.

   Sensor 2 is the pH sensor. The screen has two control boxes.

   a) For measurement, choose pH.

   b) For pre-amplifier location, choose analyzer.

   c) Move the cursor to NEXT and press **ENTER/MENU**. The display changes to show some basic keypad operation guidelines. Press **ENTER/MENU** to show the main display.

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

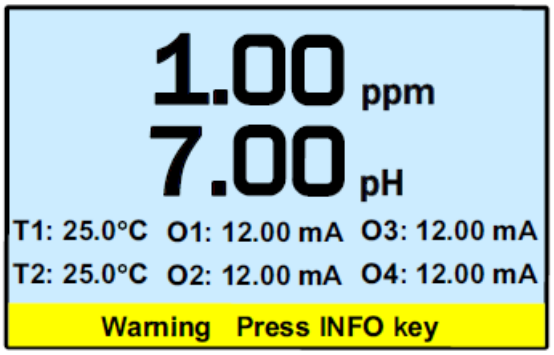
3 Display and operation

3.1 Main display

The transmitter has a four line display.

See Figure 3-1. The display can be customized to meet your requirements. Fault or warning messages, if appropriate, appear at the bottom of the screen. See Overview of troubleshooting.

Figure 3-1: Main display



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

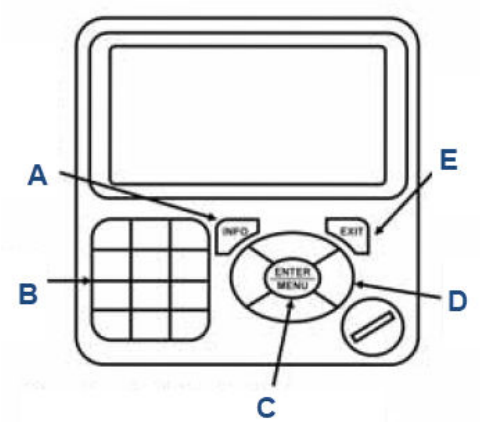
O	Output
T	Temperature (live)
Tm	Temperature (manual)
M	Measurement
AL	Alarm relay
I	Sensor current (chlorine)
mV	mV input (pH)
Slp	slope (pH)
R.Z.	reference impedance (pH)
Gl.Z.	glass impedance (pH)

3.2 Keypad

Local communication with the transmitter is through the membrane keypad.

See Figure 3-2.

Figure 3-2: Transmitter Keypad



A. *Press **INFO** to get more information about the control setting or calibration step the cursor is on. To close the **INFO** box, press any key.*
B. *Use the alphanumeric keypad to enter numbers or letters.*
C. *When the main display is showing, press **ENTER/MENU** to view the main menu. In other cases, press **ENTER/MENU** to select an item for editing or to store a change.*
D. *Four navigation keys move the cursor up, down, left, and right.*
E. *Press **EXIT** to return the display to the first screen in a series of related screens. Changes that have not been stored will not be saved.*

3.3 Operation

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

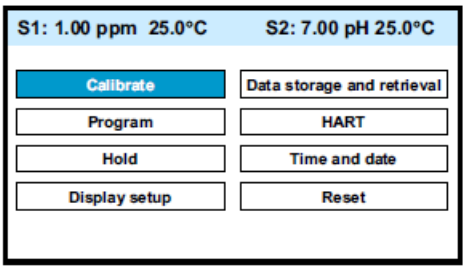
Procedure

1. With the main display showing (Figure 3-1), press **ENTER/MENU**.
   The main ***Menu***, shown below, appears.

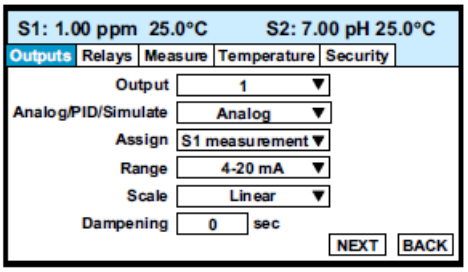
   Important
   Pressing the **ENTER/MENU** key will bring up the main ***Menu*** only if the main display is showing.

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

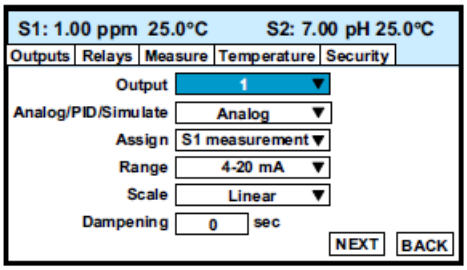
   The cursor (dark blue backlit field) is on Calibrate.



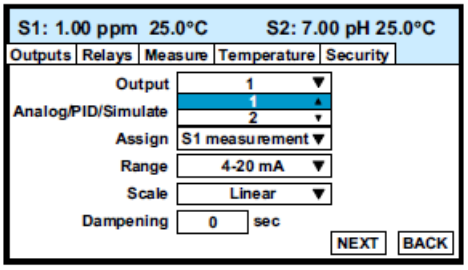
2. Press **Down** to move the cursor to Program.
3. Press **ENTER/MENU**.
   The cursor is on **Outputs**, and the first screen in the **Outputs** submenu is showing.



4. To select a different program submenu, use **Right** to move the cursor to the desired tab and press **ENTER/MENU**.
5. To enter the **Outputs** submenu, press **Down**.
   The cursor moves to the first control box, Output. The Rosemount 56 has four analog outputs, and this control lets you select which output to configure. The default is output 1.



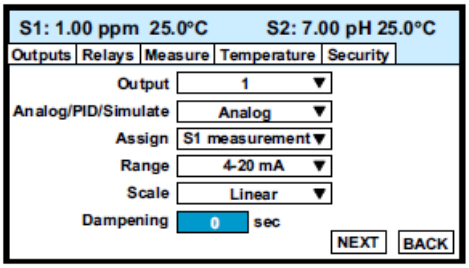
6. To select a different output, press **ENTER/MENU**.
   A list of the available outputs, shown two at a time, appears.



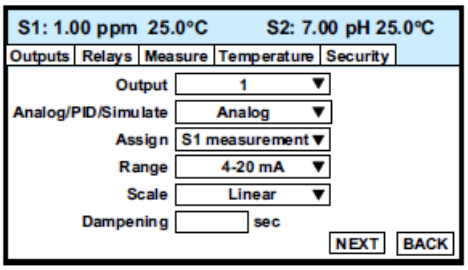
7. To view the list, press or press and hold **Up** or **Down**. To select and store the highlighted selection, press **ENTER/MENU**. To move from one control box to another, press **Up** or **Down**.

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

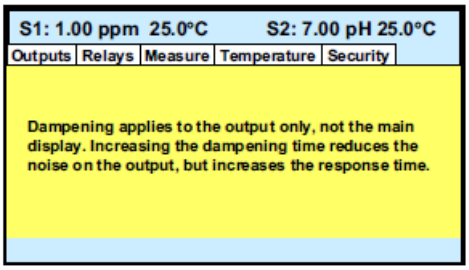
8. Move the cursor to Dampening at the bottom of the screen.
   The default Dampening value is 0 seconds.



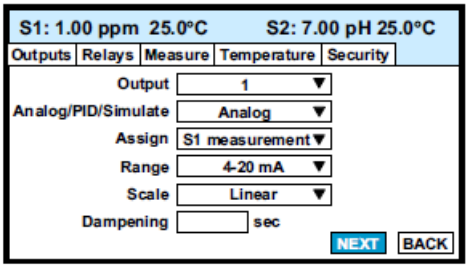
9. To change the value, press **ENTER/MENU**.
   The dark blue back-lighting disappears, indicating that a number can be entered.



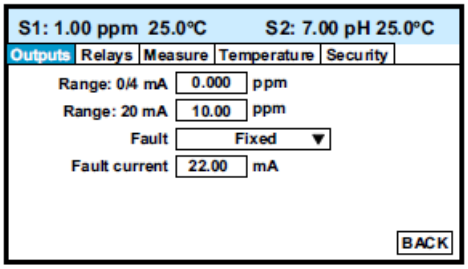
10. Use the numeric keypad to enter the desired number. If you make an error, press **Left** to erase the digit last entered. To store the number, press **ENTER/MENU**.
    Every control box has an information or help screen associated with it.
11. To view the information screen for the control box the cursor is on, press **INFO**.
    The information screen for Dampening is shown below.



12. To close the information screen, press any key.
    A **NEXT** and **BACK** button are at the bottom of the screen. **NEXT** means that additional control boxes are available on at least one or more screen.



13. To view the next screen, use the navigation keys (either **Down** or **Right**) to move the cursor to **NEXT** and press **ENTER/MENU**.
    The next screen in the **Outputs** submenu appears. The cursor is on the Outputs tab.



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

3.4 Hold

3.4.1 Putting sensor in hold

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

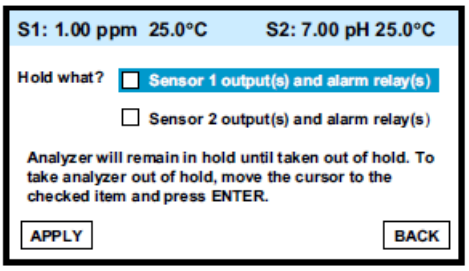
Hold is also useful if calibration, for example, buffering a pH sensor, will cause an out of limits condition. During hold, outputs assigned to the sensor remain at the last value, and alarms assigned to the sensor remain in their present state.

3.4.2 Use the Hold function

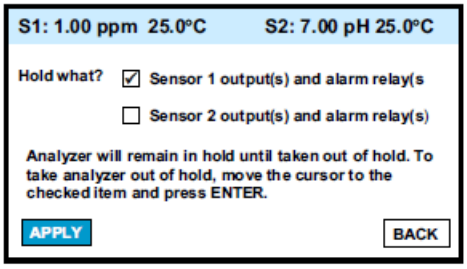
The Hold function uses certain programming features not discussed in Operation.

Procedure

1. With the main display showing, press **ENTER/MENU**.
   The main menu appears.
2. Choose Hold.
   The screen below appears. The cursor is on the first checkbox.



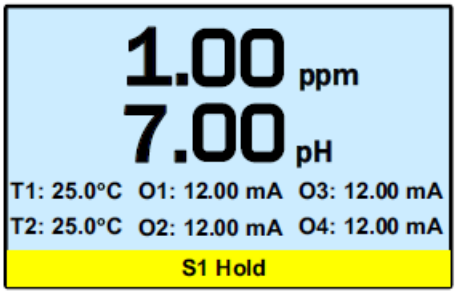
3. To hold outputs and relays associated with sensor 1, press **ENTER/MENU**. A check appears in the checkbox. To put sensor 2 on hold also, move the cursor to the sensor 2 line and press **ENTER/MENU** to select the sensor 2 checkbox.
4. To activate Hold, move the cursor to the APPLY at the bottom left of the screen and press **ENTER/MENU**.
   The selected sensor outputs and alarm relays remain on hold until taken out of hold. However, if power is lost and then restored, hold will automatically be turned off.



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

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

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



3.5 Main display

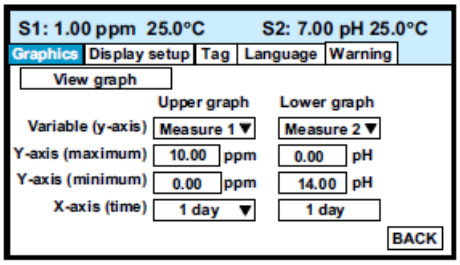
3.5.1 Configuring the main display

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

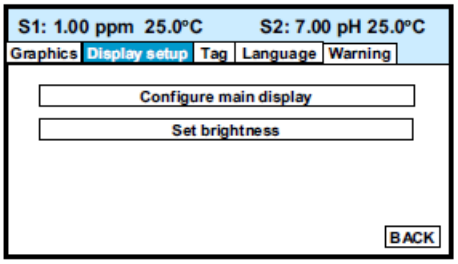
Procedure

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

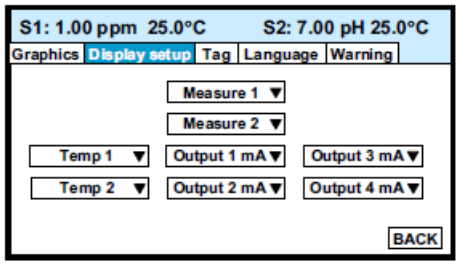
2. Choose **Display Setup**.
   The screen below appears.



3. Move the cursor to Display setup and press **ENTER/MENU**.
   The screen below appears.



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



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

3.5.2 Set brightness

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

Procedure

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

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

3.6 Security

3.6.1 How the security code works

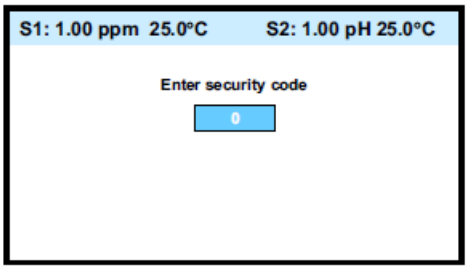
Security codes prevent accidental or unwanted changes to program settings or calibrations.

There are three levels of security:

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

Procedure

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



2. Enter the three digit security code.
   If the entry is correct, the requested submenu appears, and you have access to all the submenus the code entitles you to.

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

3.6.2 Assigning security codes

See Security.

3.6.3 Bypass security codes

Call the factory.

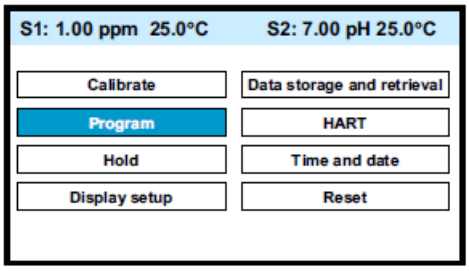
4 Programming the transmitter

4.1 Entering the Program menus

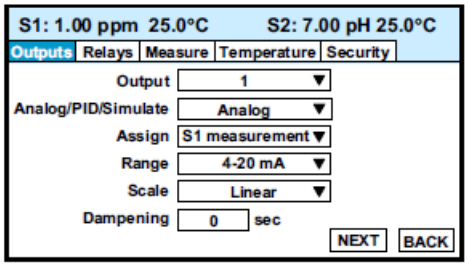
Complete the following steps to access the **Program** menus on your 56 Transmitter.

Procedure

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



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



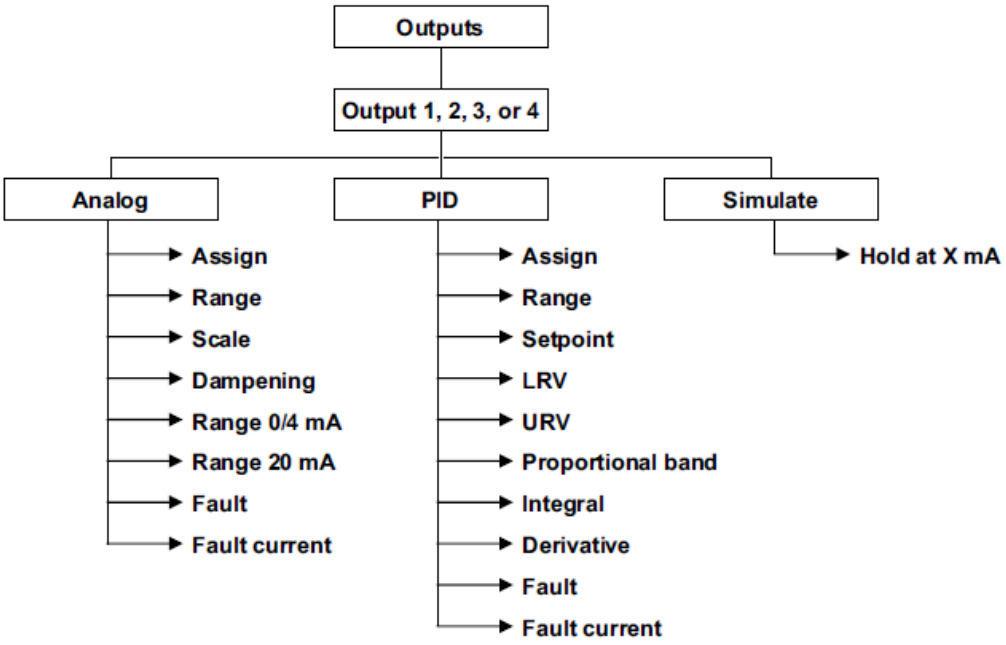
3. Move the cursor to the tab showing the desired submenu and press **ENTER/MENU**.
   A fifth tab, not shown, labeled pH diagnostics setup, will be present if one of the sensors is a pH sensor.

4.2 Outputs

4.2.1 Menu tree

Figure 4-1 is the **Outputs** menu tree.

Figure 4-1: Menu tree for the Outputs submenu



4.2.2 Output settings

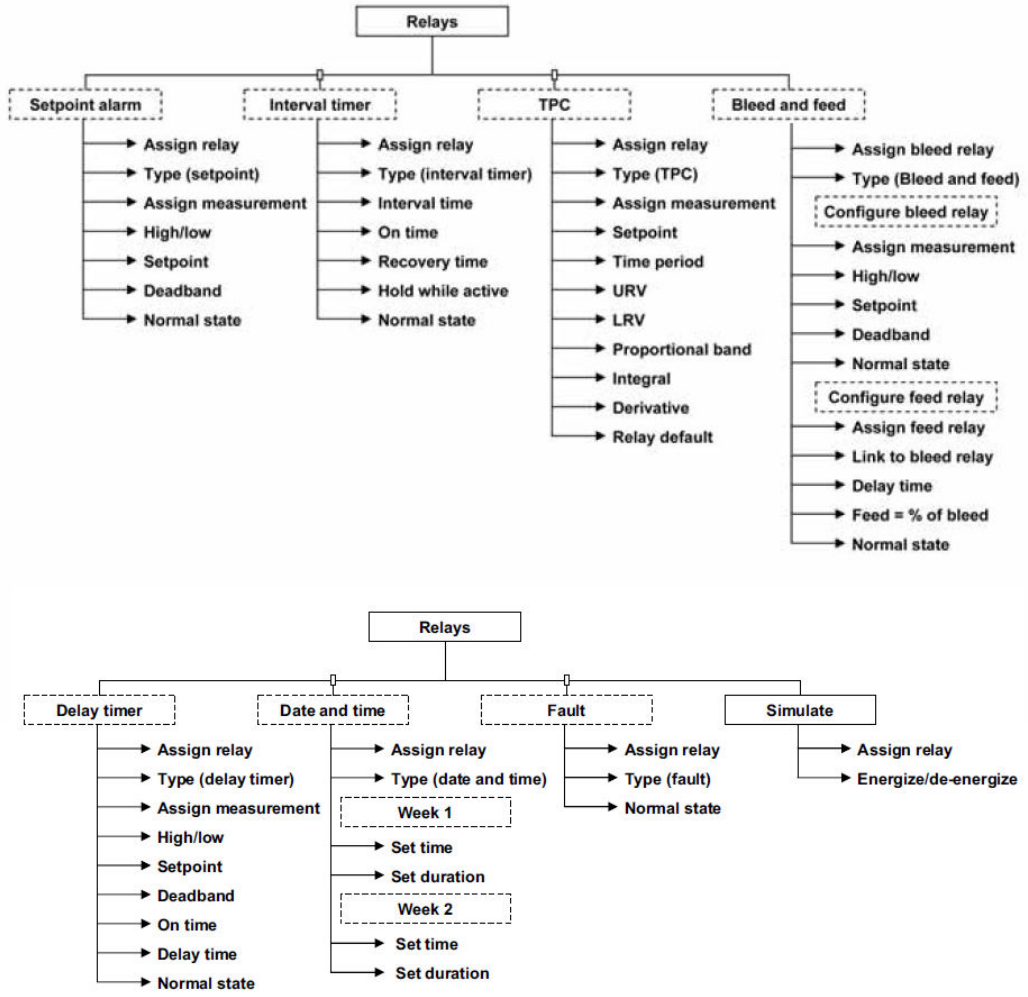
Move the cursor to the appropriate control box and press the desired setting. For more information about the control box the cursor is on, press **INFO**. To close the information screen, press any key.

4.3 Relays

4.3.1 Menu tree

Figure 4-2 is the **Relays** menu tree.

Figure 4-2: Menu tree for the Relays submenu

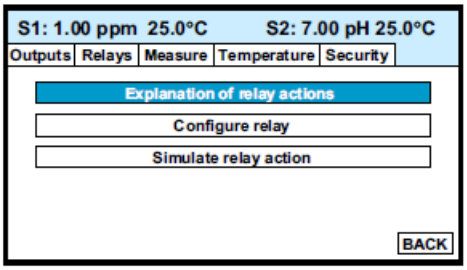


4.3.2 Configure relay settings

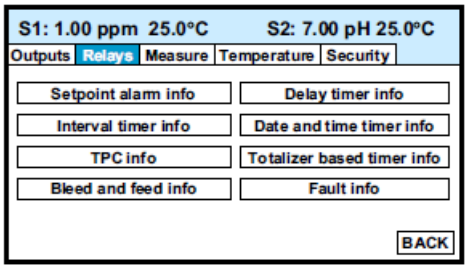
A large number of relay actions are available in the Rosemount 56.

Procedure

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

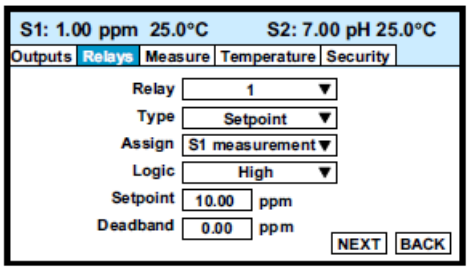


The screen below appears.



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

   The totalizer-based relay timer is not available in the FCL. It is available only if one of the measurements is flow.
4. To configure a relay, press **EXIT** to return to the first screen.
5. Move the cursor to the Configure relay button and press **ENTER/MENU**.
   A screen similar to the one below appears.



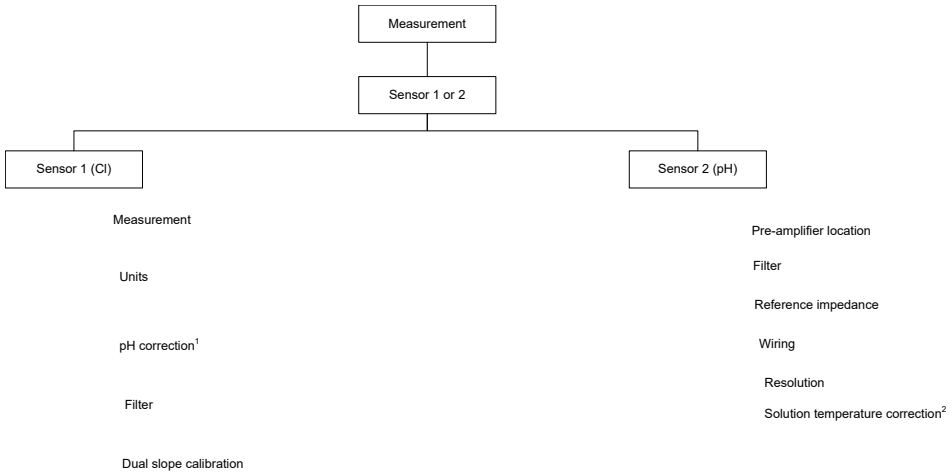
6. Move the cursor to the appropriate control box and make the desired setting.
7. For more information about the control the cursor is on, press **INFO**.
8. To close the information screen, press any key.

4.4 Measurement

4.4.1 Menu tree

Figure 4-3 is the **Measurement** menu tree.

Figure 4-3: Menu tree for the Measurement submenu



A. For FCL-02, choose Live/automatic. For FCL-01, choose manual and set manual pH to the expected pH of the process liquid.

B. If the pH measurement is being made to correct the chlorine sensor reading, leave solution temperature correction off.

4.4.2 Configure measurement settings

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

Procedure

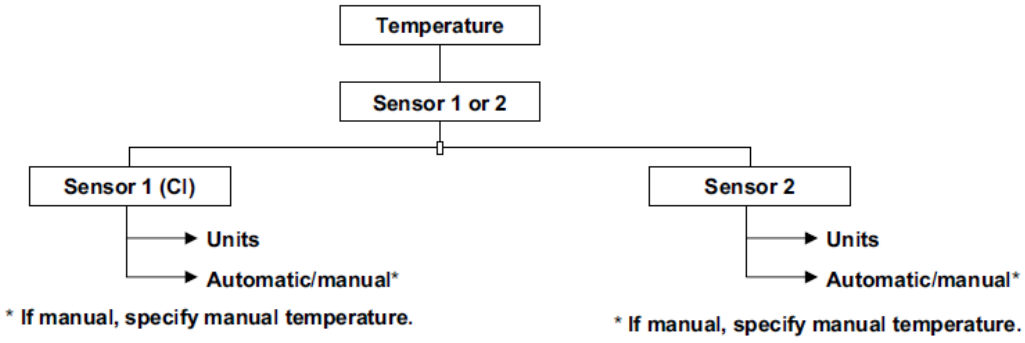
1. Move the cursor to the appropriate control box and make the desired setting.
2. For more information about the control the cursor is on, press **INFO**.
3. To close the information screen, press any key.

4.5 Temperature

4.5.1 Menu tree

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

Figure 4-4: Menu tree for the Temperature submenu



4.5.2 Configure temperature settings

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

Procedure

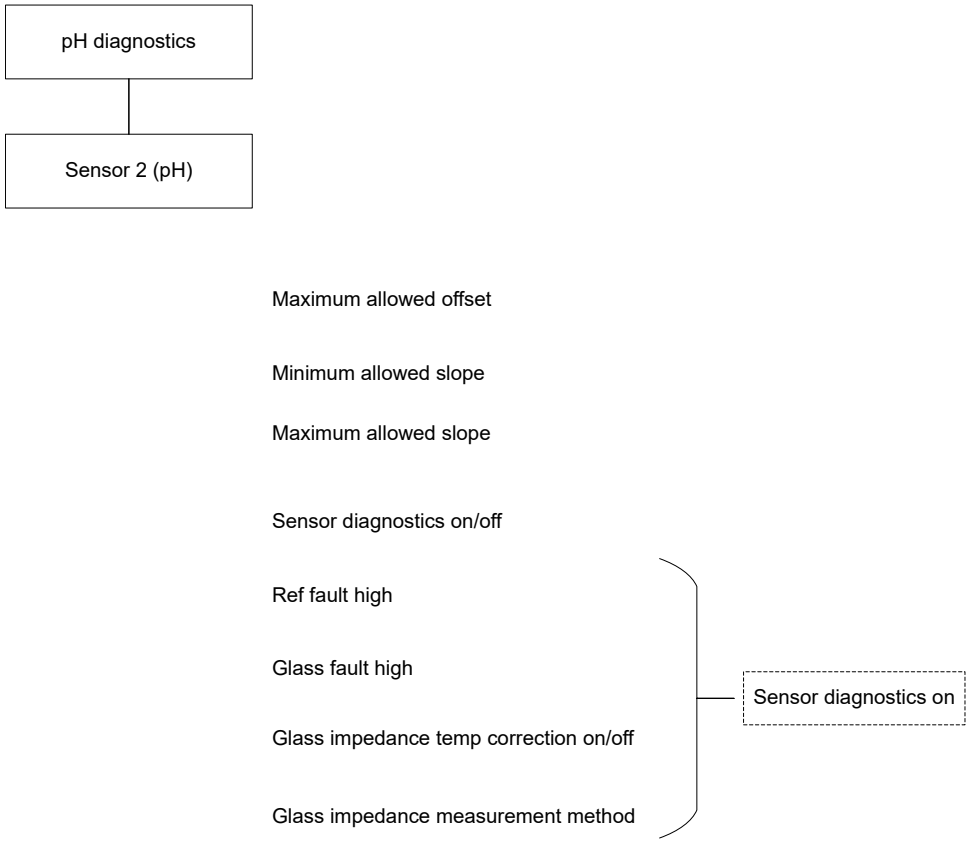
1. Move the cursor to the appropriate control box and make the desired setting.
2. For more information about the control the cursor is on, press **INFO**.
3. To close the information screen, press any key.

4.6 pH diagnostic setup

4.6.1 Menu tree

Figure 4-5 is the pH diagnostic setup menu tree.

Figure 4-5: Menu tree for the pH diagnostic setup submenu



4.6.2 Configure pH settings

Complete the following steps to set up the pH diagnostics on the Rosemount 56 Transmitter.

Procedure

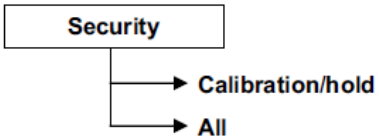
1. Move the cursor to the appropriate control box and make the desired setting.
2. For more information about the control the cursor is on, press **INFO**.
3. To close the information screen, press any key.

4.7 Security

4.7.1 Menu tree

Figure 4-6 is the ***Security*** menu tree.

Figure 4-6: Menu Tree for the Security Sub-Menu



4.7.2 Configure security settings

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

Procedure

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

4.7.3 Restoring default settings

See Reset.

5 Calibration

5.1 Calibrate menu

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

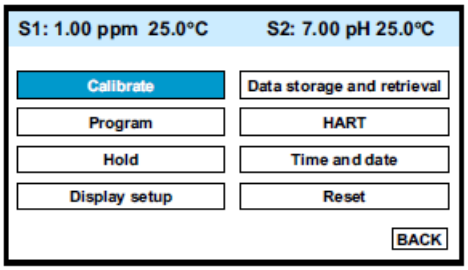
1. Calibrate the RTD (temperature sensing element) in the chlorine and pH sensors.
2. Calibrate the pH sensor. Four methods are available:
   a. Two-point automatic buffer calibration
   b. Manual two-point buffer calibration.
   c. Standardization (one-point calibration) against either a grab sample or an in-process measurement.
   d. Manual entry of pH sensor slope and offset if they are already known.
3. Calibrate the chlorine sensor.
4. Calibrate the analog outputs.

5.2 Entering the Calibration menus

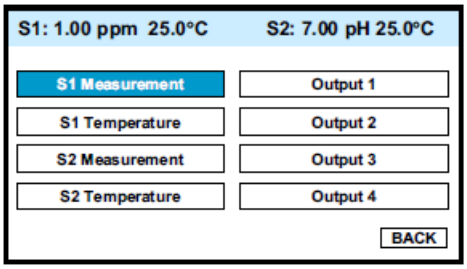
Complete the following steps to enter the **Calibration** submenus on your 56 Transmitter.

Procedure

1. With the main display showing, press **ENTER/MENU** to display the main ***Menu***. The cursor is on Calibrate.



2. Press **ENTER/MENU**.



3. Choose the sensor (measurement or temperature) or output to be calibrated. Sensor 1 (S1) is the free chlorine sensor; sensor 2 (S2) is the pH sensor (if present).

5.3 Calibrating temperature

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

Procedure

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

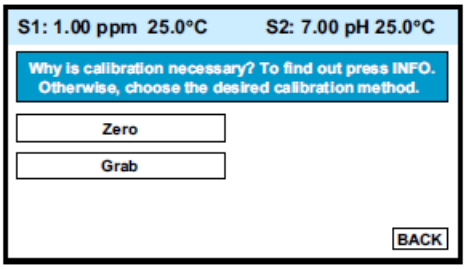
   If you want more information about a calibration step, press **INFO**.

   Once the calibration is complete, the screen shows the results of the calibration. The screen also shows some acceptance criteria to help you determine whether to accept the calibration.
2. Press **INFO** for an information screen to aid with troubleshooting if the calibration results are not acceptable.

5.4 Calibrate the free chlorine sensor

Procedure

1. Choose sensor 1 (free chlorine) in Entering the Calibration menus.
   The screen below appears.



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

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

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

   If the zero current is badly in error, the transmitter displays the ***Zero failed*** screen. Press **INFO** for troubleshooting.
3. To calibrate the sensor response in chlorinated water, select Grab and follow the prompts.

   Be sure the sensor is installed in the flow cell in the FCL and the sample is flowing down the inside tube of the overflow sampler.

Important
If you are calibrating the FCL-02, calibrate the pH sensor first and install it in its flow cell before calibrating the free chlorine sensor.

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

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

5.5 Calibrate the pH sensor

Complete the following steps to calibrate the pH sensor if you have the Rosemount™ FCL-02.

Procedure

1. Choose Sensor 2 (pH) in Entering the Calibration menus.
   The screen below appears. There are five possible ways to calibrate the pH sensor.
2. Select the desired calibration method (Auto buffer is recommended) and follow the prompts.

   For more information about calibration methods, press **INFO**.

   If you choose Auto buffer calibration, the screen below appears to allow you to set up auto buffer calibration parameters. The default values are recommended.

If the calibration is successful, the transmitter displayst he calibration results (slope and offset for automatic and manual buffer calibration and offset for standardize calibration).

If there is a possible calibration error, the transmitter displays the calibration results and the nature of the error. You will be asked to accept the calibration. Press **INFO** for an informations creen to aid with troubleshooting if the calibration is not acceptable.

If there is a serious calibration error, the transmitter displays the calibration results and the error. Press **INFO** for an information screen to aid with troubleshooting and repeat the calibration.

5.6 Calibrate the analog outputs

Complete the following steps to calibrate the analog outputs in the Rosemount 56 transmitter.

Procedure

1. Choose the appropriate output in Entering the Calibration menus and follow the prompts to trim the selected output.

   If you want more information about a calibration step, press **INFO**.
2. Press **INFO** for an information screen to aid with troubleshooting if the calibration is not acceptable.

5.7 Reset

There are three resets.

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

Important
The event logger and data logger (see Data and event logging and retrieval) will be unaffected.

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

Procedure

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

6 Digital communications

The Rosemount 56 Transmitter supplied with the FCL has HART communications as a standard feature. For more information, refer to the Rosemount 56 HART Addendum Manual.

7 Data and event logging and retrieval

7.1 Data and event logging overview

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

When data and event logging is enabled, the 56 Transmitter will automatically store the following events with date and time stamp:

- Faults
- Warnings
- Calibration data
- Calibration results (pass or fail)
- Power on/off cycles
- Hold on/off
- New sensor board detected

At your discretion, the transmitter will also store alarm activation and deactivation as events. The event logger holds 300 events. When the capacity of the logger is reached, the transmitter removes the oldest events to make room for new events.

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

When data/event logging is enabled, the transmitter will automatically store the following measurement data:

Free chlorine

- Date and time
- ppm chlorine
- Temperature
- Sensor current

pH

- Date and time
- pH
- Temperature
- mV
- Glass impedance
- Reference impedance
- Raw pH (if displayed pH has temperature correction applied

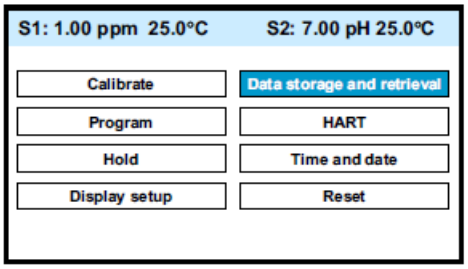
The transmitter can store up to 30 days of data. When the capacity of the logger is reached, the transmitter removes the oldest data to make room for new data. Data storage frequency is every 30 seconds.

7.2 Configure data and event logging and retrieval

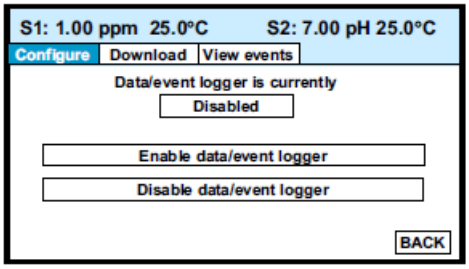
Complete the following steps to configure data and event logging and retrieval on the Rosemount 56 transmitter.

Procedure

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



   The following screen appears. The **Data/event logger** is currently disabled (default).



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

NOTICE

Setting the date or time to an earlier value than the one currently showing will cause data to be lost from the **Data/event logger**. Download data before resetting time or date. See Download data and events.

7.3 Download data and events

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

Procedure

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

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

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

7.4 View events

You can view the ***Event*** log on the Rosemount 56 Transmitter display.

Procedure

1. Move the cursor to the ***View events*** tab and press **ENTER/MENU**.
2. Move the cursor to the **View Events** button and press **ENTER/MENU**.
3. To scroll through the list of events, move the cursor to the **DOWN** or **UP** key at the bottom of the screen and press and hold **ENTER/MENU**.

7.5 Reset date and time

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

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

8 Graphical display

8.1 Graphical display overview

The Rosemount 56 Transmitter has a dual graphical display. You can configure each graph to meet your requirements, although the time axis on both graphs must be the same.

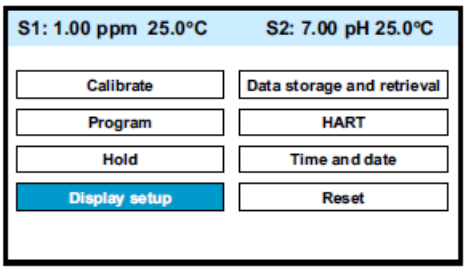
You can set the time scale to:

- One hour
- One day
- Seven days
- 30 days

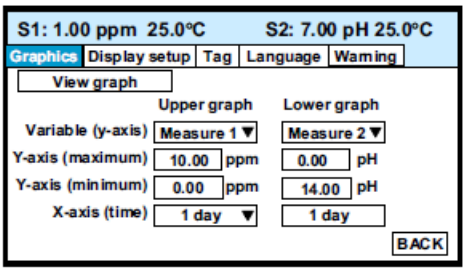
8.2 Configure graphical display

Procedure

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

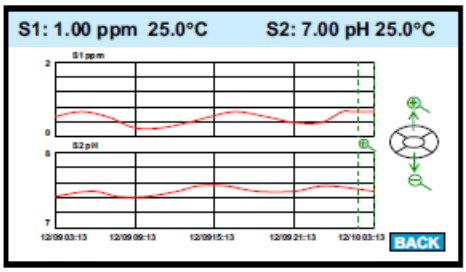


The following screen appears.



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

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



   The time axis can be expanded or shrunk.

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

9 Maintenance

9.1 Replace sensor circuit board

The transmitter used with the Rosemount™ FCl 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.

Sensor circuit boards are replaceable.

PN	Description
21207-00	pH/ORP/ISE sensor board
24203-01	Chlorine sensor board

⚠ WARNING

Electrical shock

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

To replace a 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.
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. Tighten the cable glands.
9. Close the front panel.
10. Turn on power.

9.2 Chlorine sensor

9.2.1 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. For a sensor used in potable water, you may need to clean the membrane on a monthly basis and replace the membrane and electrolyte solution every three months. In water containing large amounts

of suspended solids, for example, open recirculating cooling water, membrane cleaning or replacement will be more frequent.

9.2.2 Clean the membrane

Clean the membrane with water sprayed from a wash bottle.

NOTICE

Do not use tissues to clean the membrane.

9.2.3 Replace the electrolyte solution and membrane

⚠ CAUTION

Harmful substance

Fill solution may cause irritation. May be harmful if swallowed.

Avoid contact with skin and eyes.

Table 9-1: Spare parts

Part number	Description
9550094	O-ring, Viton® 2-014
33521-00	Membrane retainer
23501-08	Free chlorine membrane assembly: includes one membrane assembly and one O-ring
23502-08	Free chlorine membrane kit: includes three membrane assemblies and three O-rings
9210356	#4 free chlorine sensor fill solution, 4 oz. (120 ml)

Procedure

1. Unscrew the membrane retainer.
2. Remove the membrane assembly and O-ring.
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. Inspect the cathode.
    a) If it is tarnished, then clean it using a cotton-tipped swab dipped in baking soda or alumina.

       Use type A dry powder alumina intended for metallographic polishing of medium and soft metals.

    b) Rinse thoroughly with water.
7. Wrap the plug with two turns of pipe tape and set aside.
8. Prepare a new membrane.
    a) Hold the membrane assembly with the cup formed by the membrane and membrane holder pointing up.

b) Fill the cup with electrolyte solution.

c) Wait for the wooden ring to soak up the solution.
This usually takes several minutes.

9. Hold the sensor at about a 45° angle with the cathode end pointing up.
10. Add electrolyte solution through the fill hole until the liquid overflows.
11. Tap the sensor near the threads to release trapped air bubbles.
12. Add more electrolyte solution if necessary.
13. Place the fill plug in the electrolyte port and begin screwing it in.
14. After several threads have engated, rotate the sensor so that the cathode is pointing up and continue tightening the fill plug.
    Do not overtighten.
15. Place a new O-ring in the groove around the cathode post.
16. Cover the holes at the base of the cathode stem with several drops of electrolyte solution.
17. Insert a small blunt probe, like a toothpick with the end cut off, through the pressure equalizing port.

NOTICE

Equipment damage

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

Do not use a sharp probe.

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

9.3 pH sensor

9.3.1 pH sensor maintenance

When used in clean water, the pH sensor requires little maintenance.

Generally, the sensor needs maintenance when the response becomes sluggish or noisy. In clean water, the typical cleaning frequency is once a month. In water containing large amounts of suspended solids, for example, open recirculating cooling water, cleaning frequency will be substantially greater.

9.3.2 Clean the pH sensor

Procedure

1. Remove soft deposits by rinsing with a stream of water from a wash bottle.

2. If the sensor becomes coated with rust, dissolve the rust by soaking the sensor in dilute citric acid (dissolve 0.2 oz. [5 g] of citric acid crystals in 3.4 oz. [100 ml] of water) for no longer than thirty minutes at room temperature.
3. Rinse the sensor thoroughly with water and soak in pH 4 buffer for several hours.
4. Recalibrate the sensor in buffers before returning it to service.

9.3.3 Other maintenance

The Rosemount 3900VP-02-10 sensor supplied with the FCL-02 is disposable.

It has no replaceable parts.

9.4 Constant head flow controller

9.4.1 General constant head flow controller information

After a period of time, deposits may accumulate in the constant head overflow chamber and in the tubing leading to the flow cell(s). Deposits increase the resistance to flow and cause the flow to gradually decrease. Loss of flow may ultimately have an impact on the sensor performance.

The flow controller is designed to provide about 2 gal/hr (120 ml/min) flow. Loss of flow to about 1 gal/hr (60 ml/min) causes about a 5 percent decrease in chlorine sensor output.

Loss of flow has almost no effect on pH sensor performance other than to increase the overall response time.

9.4.2 Clean the flow controller

The flow controller can be taken apart completely for cleaning.

Procedure

1. Use a strong flow of water to flush out the tubing.

   Use a pipe cleaner or small bottle brush to remove more adherent deposits.
2. To prevent leaks, apply a thin layer of silicone grease (or equivalent) to the two O-rings as the base of the overflow chamber and to the O-ring sealing the central overflow tube to the base.

9.4.3 Other maintenance

Table 9-2 and Figure 9-1 show the replacement parts for the flow controller assembly used in the Rosemount FCL-01. Table 9-3 and Figure 9-2 show replacement parts for the flow controller assembly used in the FCL-02.

Figure 9-1: FCL-01 constant head flow controller assembly replacement parts

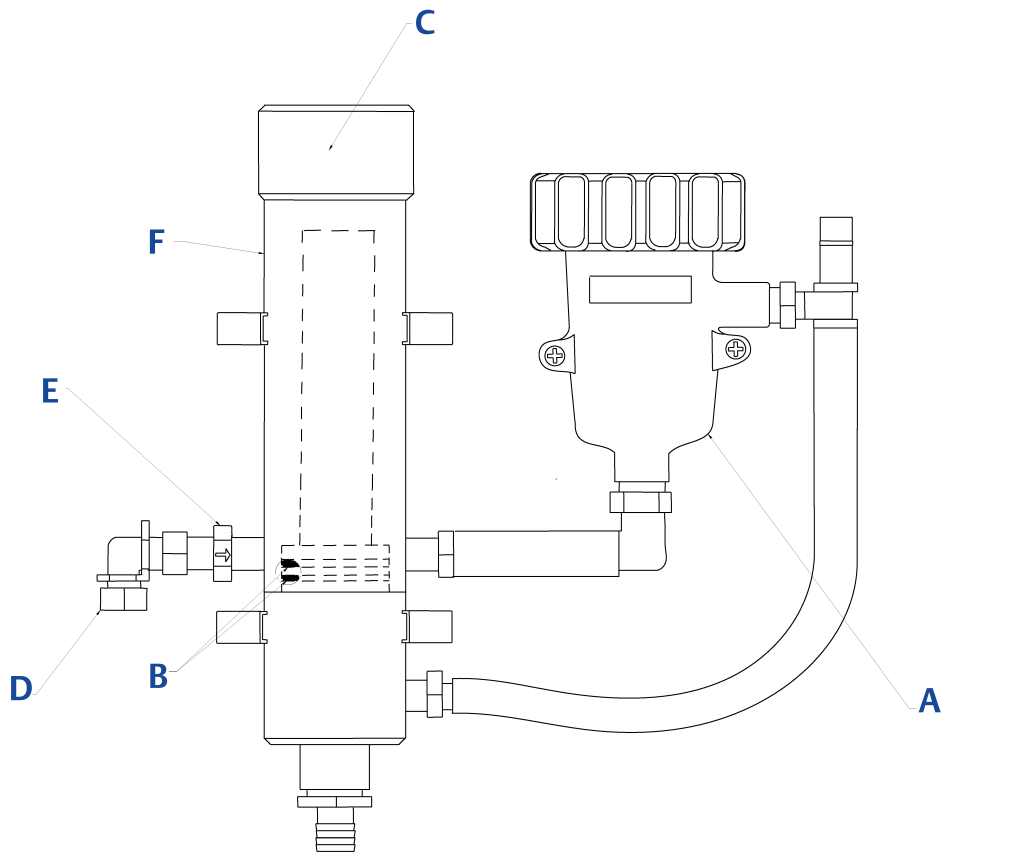


Table 9-2: FCL-01 constant head flow controller assembly replacement parts

Location in Figure 9-1	PN	Description
A	24039-00	Flow cell for chlorine sensor with bubble shedding nozzle
B	24040-00	O-ring kit, two 2-222 and one 2-024 silicone O-rings with lubricant
C	33812-00	Dust cap for constant head flow controller
D	9322032	Elbow, ¼-in. FNPT x ¼-in. OD tubing
E	9350029	Check valve, ¼-in. FNPT
F	33823-00	Outside tube for constant head device
N/A	24035-00	Flow train for FCL-01 (includes panel)

Figure 9-2: FCL-02 constant head flow controller assembly replacement parts

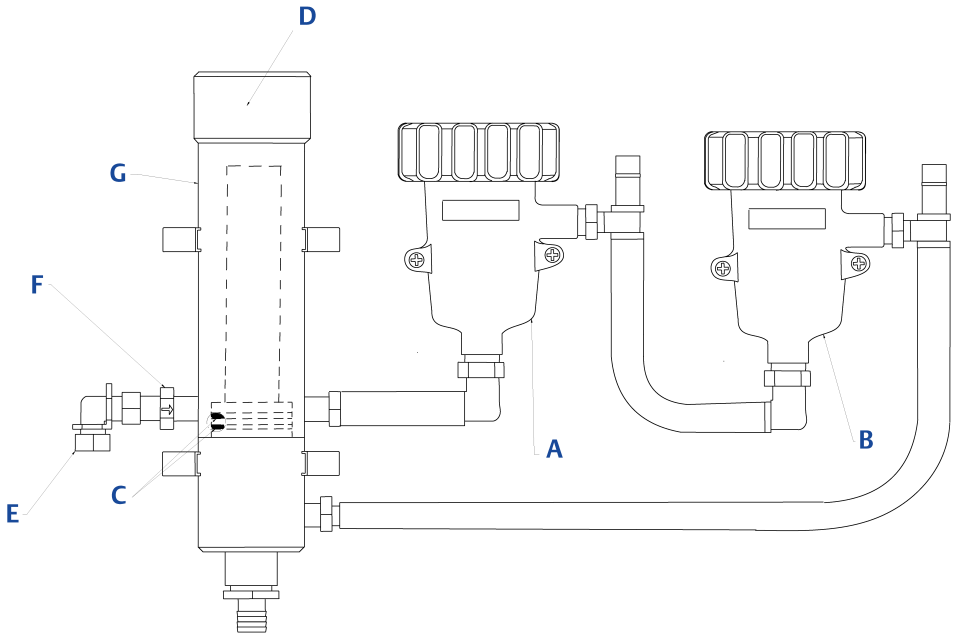


Table 9-3: FCL-02 constant head flow controller assembly replacement parts

Location in Figure 9-2	PN	Description
A	24039-00	Flow cell for chlorine sensor with bubble shedding nozzle
B	24039-01	Flow cell for pH sensor
C	24040-00	O-ring kit, two 2-222 and one 2-024 silicone O-rings with lubricant
D	33812-00	Dust cap for constant head flow controller
E	9322032	Elbow, ¼-in. FNPT x ¼-in. OD tubing
F	9350029	Check valve, ¼-in. FNPT
G	33823-00	Outside tube for constant head device
N/A	24034-00	Flow Train for FCL-02 (Includes Panel)

10 Troubleshooting

10.1 Overview of troubleshooting

When the transmitter identifies a problem the word **warning** or **fault** appears intermittently at the bottom of the display. To read a fault or warning message and troubleshooting information, press **INFO**.

See Read and troubleshoot Fault and Warning messages.

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

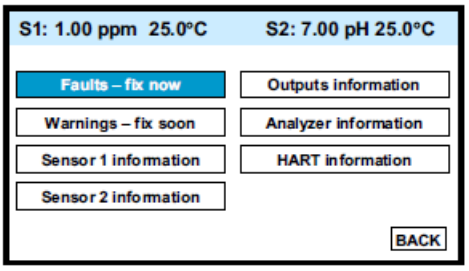
Fault The measurement is seriously in error and is not to be trusted. A fault condition might also mean that the transmitter has failed. Correct fault conditions immediately. When a fault occurs, the analog output goes to 22.00 mA or the value programmed in Outputs. Fault messages cannot be turned off.

10.2 Read and troubleshoot Fault and Warning messages

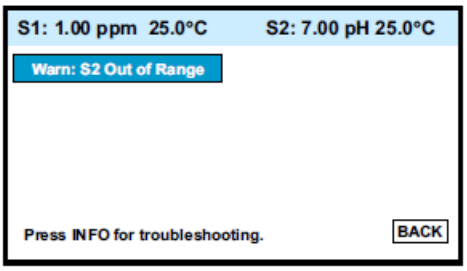
Complete the following steps to access Fault and Warning messages and determine what they mean.

Procedure

1. From the main display, press **INFO**.
   The following screen appears.



2. Move the cursor to the appropriate button and press **ENTER/MENU**.
   A screen like the following appears showing all Fault or Warning messages.



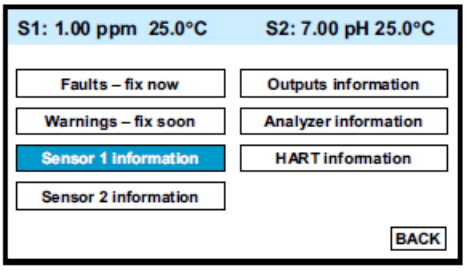
3. For troubleshooting information, press **INFO**.

10.3 Use sensor diagnostics

Sensor diagnostic readings are often useful in troubleshooting measurement problems.

Procedure

1. From the main display, press **INFO**.



2. Move the cursor to `Sensor 1 Information` or `Sensor 2 Information` and press **ENTER/MENU**.
   A list of sensor diagnostics appears.
3. For more information about a specific diagnostic measurement, move the cursor to the diagnostic of interest and press **INFO**.

10.4 Troubleshoot calibration problems

Alert

If a calibration attempt results in an error or a likely error, the transmitter displays the appropriate ***Warning*** screen.

Recommended action

For troubleshooting suggestions, press **INFO**.

10.5 Troubleshooting chlorine measurement errors

Although you can access troubleshooting information in the transmitter by pressing INFO, the transmitter does not display troubleshooting information for process measurement problems.

Table 10-1: Chlorine measurement errors

Problem	See section
Process readings are erratic.	Process readings are erratic
Readings drift.	Readings drift
Sensor does not respond to changes in chlorine level.	Sensor does not respond to changes in chlorine levels
Chlorine readings spike following sudden changes in pH.	Chlorine readings spike following sudden changes in pH (automatic pH correction)

10.5.1 Process readings are erratic

Readings are often erratic when a new sensor or rebuilt sensor is first placed in service. The current usually stabilizes after a few hours.

Recommended actions

1. Verify that wiring is correct. Pay particular attention to shield and ground connections.
2. Rebuild sensor. Refill the sensor electrolyte and replace membrane. In the process of rebuilding, if the holes between the membrane and electrolyte reservoir are plugged, apply low pressure air to the fill port.

10.5.2 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-01 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, chlorine must diffuse freely through the membrane. A coating on the membrane will interfere with the passage of chlorine, resulting in a slow response. Clean the membrane by rinsing with a stream of water from a wash bottle.

   NOTICE

   Equipment damage

   Do not use a tissue to wipe the membrane.

3. Make sure the sample flow is in the recommended range.

   Gradual loss of flow will cause downward drift. Be sure the liquid level in the constant head sampler is level with the central overflow tube and that excess

sample is flowing down the tube. If necessary, disassemble and clean the overflow sampler. See Constant head flow controller.

4. Check to see if the pH of the process is changing.

   If using manual pH, a gradual change in pH will cause a gradual change in the chlorine reading.

5. Check to see if a bubble is trapped against the membrane.

   For the sensor to work properly, the chlorine must continuously diffuse through the membrane. Bubbles block the chlorine in the sample from reaching the membrane, so readings drift downwards as bubbles form and grow. The nozzle at the bottom of the flow cell pushes bubbles to the edges of the membrane where they do no harm. In cold samples, the nozzle may not be as effective.

   a) If bubbles are visible, confirm that they are blocking the membrane by removing the sensor from the flow cell and replacing it.
   Removing the sensor breaks the bubbles, so when you replace the sensor, readings return to normal.

   b) Confirm that the nozzle is properly positioned in the flow cell. Line up your eye with the bottom of the membrane retainer.

      No gap should be visible between the end of the nozzle and membrane retainer.

6. If the sensor is new or has been recently serviced, wait a few hours.

   New or rebuilt sensors may require several hours to stabilize.

10.5.3 Sensor does not respond to changes in chlorine levels

Recommended actions

1. Make sure the grab sample test is accurate and that the grab sample is representative of the sample flowing to the sensor.
2. Make sure that sample is flowing past the sensor, that the liquid level in the constant head sampler is level with the central overflow tube, and that excess sample is flowing down the tube. If necessary, disassemble and clean the overflow sampler.

   See Constant head flow controller.

3. Make sure the pH compensation is correct. If using manual pH correction, verify that the pH value in the transmitter equals the actual pH within ±0.1 pH. If using automatic pH correction, check the calibration of the pH sensor.
4. Make sure the membrane is clean. Clean the membrane with a stream of water and replace it if necessary.

   a) Check that the holes at the base of the cathode stem are open. Use a straightened paper clip to clear blockages.

      See 2 in Zero current is unstable

   b) Replace the electrolyte solution.

5. Replace the sensor.

10.5.4 Chlorine readings spike following sudden changes in pH (automatic pH correction)

Changes in pH alter the relative amounts of hypochlorous acid (HOCl) and hypochlorite ion (OCl^-) in the sample.

Because the sensor responds only to HOCl, an increase in pH causes the sensor current (and the apparent chlorine level) to drop even though the actual free chlorine concentration remains constant. To correct for the pH effect, the transmitter automatically applies a correction. Generally, the pH sensor responds faster than the chlorine sensor. After a sudden pH change, the transmitter will temporarily over-compensate and gradually return to the correct value. The time constant for return to normal is about five minutes.

10.6 Troubleshooting - pH

10.6.1 Sensor does not respond to known pH changes

Recommended actions

1. Check if the pH sensor is responsive to buffers.

   Check sensor response in two buffers at least two pH units apart.
2. Make sure the expected pH changed really occurred. Use a second pH meter to verify the change.
3. Make sure sample is flowing past the sensor. Be sure the liquid level in the constant head sampler is level with the central overflow tube and that excess sample is flowing down the tube. If necessary, disassemble and clean the overflow sampler.

   See Constant head flow controller.
4. Make sure the sensor is properly wired to the transmitter.

   See Wire sensor.
5. Check if the glass bulb is cracked or broken. Go to sensor diagnostics and check the glass electrode impedance.

   See Calibration error during two-point calibration.
6. Make sure the transmitter is working properly. Check the transmitter by simulating the pH input.

   See Simulate pH input.

10.6.2 Buffer calibration is acceptable; process pH is slightly different from expected value

Differences between pH readings made with an on-line instrument and a laboratory or portable instrument are normal.

The on-line instrument is subject to process variables (for example, ground potentials, stray voltages, and orientation effects) that do not affect the laboratory or portable instrument.

Recommended action

To make the process readings agree with a referee instrument, standardize the sensor.

See Standardize pH value.

10.6.3 Calibration was successful, but process pH is grossly wrong and/or noisy

Grossly wrong or noisy readings suggest a ground loop (measurement system connected to earth ground at more than one point), a floating system (no earth ground), or noise being brought into the transmitter by the sensor cable.

The problem arises from the process or installation. It is not a fault of the transmitter. The problem should disappear once the sensor is taken out of the system. Check the following:

Recommended actions

1. Confirm a ground loop.
   a) Verify that the system works properly in buffers. Be sure there is no direct electrical connection between the buffer containers and the process liquid or piping.
   b) Strip back the ends of a heavy gauge wire. Connect one end of the wire to the process piping or place it in the process liquid. Place the other end of the wire in the container of buffer with the sensor.
   The wire makes an electrical connection between the process and sensor.

   If offsets and noise appear after making the connection, a ground loop exists.
2. Ground the piping or tank to a local earth ground.

   The measurement system needs one path to ground: through the process liquid and piping. Plastic piping, fiber glass tanks, and ungrounded or poorly grounded vessels do not provide a path. A floating system can pick up stray voltages from other electrical equipment.

   If noise persists, simple grounding is not the problem. Noise is probably being carried into the instrument through the sensor wiring. Go to Step 3.
3. Simplify the sensor wiring.
   a) Disconnect all sensor wires at the transmitter except: `IN REFERENCE`, `IN pH`, `RTD IN`, and `RTD RETURN`.

      See the wiring diagrams in Wire sensor.
   b) Tape back the ends of the disconnected wires to keep them from making accidental connections with other wires or terminals.
   c) Connect a jumper wire between the `RTD RETURN` and `RTD SENSE` terminals.

      See the wiring diagrams in Wire sensor.

   If noise and/or offsets disappear, the interference was coming into the transmitter through one of the sensor wires. You can operate the system permanently with simplified wiring.
4. Check for extra ground connections or induced noise. To avoid induced noise in the sensor cable, run it as far away as possible from power cables, relays, and electric motors. If ground loop problems persist, consult the factory.

   An experienced service technician may need to solve the problem.

10.6.4 pH readings are moderately noisy and tend to wander

Potential cause

pH readings that are moderately noisy (±0.1 pH) and tend to wander are probably caused by bubbles getting trapped against the pH sensor.

Although the overflow sampler is designed to allow bubbles to escape before they reach the pH sensor, and the sensor itself is designed so trapped air bubbles don't interfere with the measurement, bubbles may occasionally be a problem.

Recommended actions

1. Shake the sensor to dislodge the bubbles.
2. If bubbles remain a problem, contact the factory.

10.7 Other troubleshooting - general

Problem	See Section
Current output is too low.	Current output is too low
Alarm relays do not operate properly.	Alarm relays don't work

10.7.1 Current output is too low

Load resistance is too high. Maximum load is 550 Ω.

10.7.2 Alarm relays don't work

Recommended actions

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

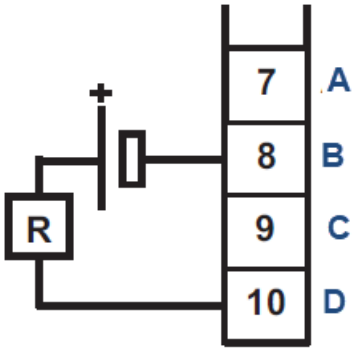
10.8 Simulate chlorine inputs

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 8 and 10 on TB1 and connect a decade box and 1.5 V battery as shown in Figure 10-1.

Figure 10-1: 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 2.8 MΩ.
3. Note the sensor current.

   It should be about 500 nA. The actual value depends on the voltage of the battery. To view the sensor current, go to the main display and press **INFO**. Choose `sensor 1 information`. The input current is the second line in the display.

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

$$\text{current (nA)} = \frac{V_{\text{battery}} - 200\ (\text{voltage in mV})}{\text{resistance}(M\Omega)}$$

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

10.9 Simulate pH input

To simulate a pH measurement, connect a standard millivolt source to the transmitter. If the transmitter is working properly, it will accurately measure the input voltage and convert it to pH.

Procedure

1. Set **automatic temperature correction** to `Manual` and set **manual temperature** to `25 °C`.

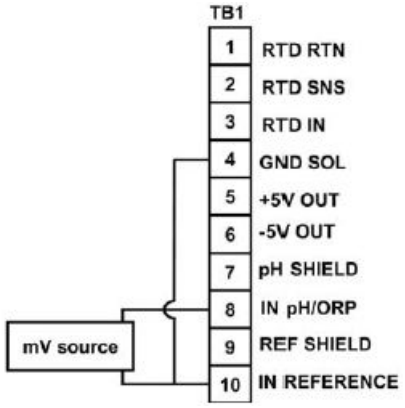
   See Temperature.

2. Disconnect the sensor and jumper wire between the `IN REFERENCE` and `IN pH` terminals.
3. Press **INFO** and choose `sensor 2 (pH)`.

   The **input voltage** should be `0 mV`, and the **pH** should be `7.00`. Because calibration data stored in the transmitter may be offsetting the input voltage, the displayed pH may not be exactly 7.00.

4. If a standard millivolt source is available, disconnect the jumper wire between `IN REFERENCE` and `IN pH` and connect the voltage source as shown in Figure 10-2.

Figure 10-2: Simulating pH input



   Be sure to jumper the `IN REFERENCE` and `GND SOL` terminals.

5. Calibrate the transmitter using the manual buffer procedure.

   Use 0.0 mV for Buffer 1 (pH 7.00) and -177.4 mV for Buffer 2 (pH 10.00).

   If the transmitter is working properly, it should accept the calibration. The slope should be 59.16 mV/pH, and the offset should be zero.

6. To check linearity, set the voltage source to the value shown in the table and verify that the pH and millivolt readings match the values in Table 10-2

Table 10-2: Voltage and pH

Voltage (mV)	pH (at 77 °F [25 °C])
295.8	2.00
177.5	4.00
59.2	6.00

Table 10-2: Voltage and pH *(continued)*

Voltage (mV)	pH (at 77 °F [25 °C])
-59.2	8.00
-177.5	10.00
-295.8	12.00

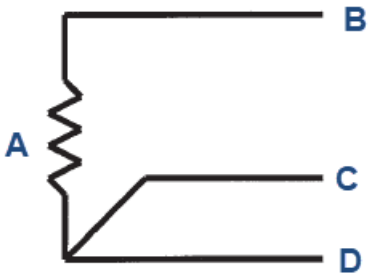
10.10 Simulating inputs - temperature

10.10.1 General information about simulating temperature

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

See Figure 10-3.

Figure 10-3: Three-wire RTD configuration



A. RTD
B. RTD in
C. RTD sense
D. RTD return

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

10.10.2 Simulating temperature

To simulate the temperature input, wire a decade box to the transmitter as shown in Figure 10-4.

Figure 10-4: Simulating RTD inputs

A. RTD return
B. RTD sense
C. RTD in
D. RTD shield

To check the accuracy of the temperature measurement, set the resistor simulating the RTD to the values indicated in Table 10-3 and note the temperature readings. The measured temperature might not agree with the value in Table 10-3. 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.

Table 10-3: Temperature and resistance

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

00809-0200-3412
Rev. AB
2023

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