Manual
LIQ-MAN-RDO, Rev B
May 2017

Rosemount™ RDO

Optical Dissolved Oxygen Sensor and Analyzer

ROSEMOUNT™

EMERSON™

Contents

Chapter 1 Installation 1
1.1 Box contents 1
1.2 Optional mounting kit 1
1.3 Mounting options 2
1.3.1 Analyzer dimensions 2
1.3.2 Pipe mounting 3
1.3.3 Wall mounting using mounting tabs 5
1.3.4 Wall mounting with user-supplied screws and hardware 6
1.4 Installing dome connectors and plugs 7

Chapter 2 Wiring 9
2.1 Electrostatic discharge (ESD) recommendations 9
2.2 Customer-supplied electrical equipment 9
2.3 Ensuring good electrical connections 9
2.4 AC power and high voltage relay connections 10
2.5 Analog and digital outputs and low voltage relay connections 13
2.6 RDO probe wiring 16
2.7 Tighten dome connectors 16

Chapter 3 Placing the RDO probe in service 17
3.1 Unpacking 17
3.2 Assembling the probe 17
3.3 Installing the probe 18

Chapter 4 Display and Operation 19
4.1 Display and keypad 19
4.2 Using the view function and customizing the display 21

Chapter 5 Programming the analyzer 23
5.1 Initial configuration 23
5.2 Menu tree 25
5.3 Configuring the RDO probes 25
5.3.1 Options (Barometer, Salinity, and Calibration Interval) 26
5.3.2 Parameters (Concentration, Temperature, Saturation, and Partial Pressure 26
5.3.3 Replacing a probe 27
5.3.4 Deleting a probe 28
5.3.5 Adding a probe 28
5.4 Configuring the analyzer 28
5.5 Configuring outputs 29
5.5.1 Current loops 29
5.5.2 Alarm relays 30
5.6 Changing the date and time 32
5.7 Changing the appearance of the screens 32
5.7.1 Locking the display 32
5.7.2 Changing the display contrast 32
5.7.3 Changing the language 32
5.8 Changing power settings 33
5.9 Setting the polling (update) interval 33

5.10 RS485 communications 33
5.10.1 Setting the device address for the analyzer 33
5.10.2 Setting RS485 parameters for the analyzer 33
5.11 Setting security codes 34
5.12 Defaults 34
5.13 Placing the output and relays on hold 34
5.14 Diagnostics 35

Chapter 6 Calibration 37
6.1 Calibration options 37
6.2 One-point calibration (100% saturation) 38
6.3 Two-point calibration (100% and 0% saturation) 39
6.4 Concentration calibration 41

Chapter 7 Maintenance 43
7.1 Analyzer 43
7.1.1 Cleaning the analyzer enclosure 43
7.1.2 Replacing the dessicant 43
7.1.3 Replacing the clock battery 43
7.2 RDO probe 44
7.2.1 Cleaning the sensing cap 44
7.2.2 Cleaning the probe body 44
7.2.3 Cleaning the optical window 44
7.2.4 Replacing the sensing cap 45
7.2.5 Storing the probe 46
7.3 Replacement parts 46

Chapter 8 Specifications 47
8.1 RDO probe 47
8.2 RDO analyzer 47

1 Installation

1.1 Box contents

Remove the analyzer from the shipping box. The shipping box should contain:

- Analyzer (1)
- Enclosure plugs (5)
- Dome connectors (3)
- O-rings (6)
- Large lock nuts (6)
- Sealed dessicant pack (1) that will be placed in the installed analyzer
- Opened dessicant pack (1) that protected the instrument during shipping. Discard after opening the analyzer.

⚠ WARNING!

Only properly trained and qualified personnel should install the RDO instrument described in this manual. This instrument should be installed for use in nonhazardous locations only.

1.2 Optional mounting kit

The mounting kit (PN R0087560) contains the following:

- Two stainless steel mounting brackets
- Two 1 1/2 to 3 1/2 in. diameter hose clamps
- One package containing mounting tabs (4), nuts (4), and screws (4)
- DIN rail mounting brackets

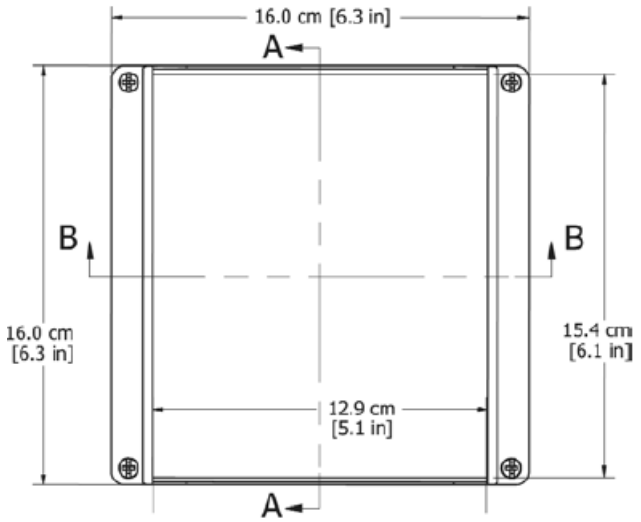
The nuts and screws supplied with the mounting tabs are suitable for use with the mounting brackets.

1.3 Mounting options

1.3.1 Analyzer dimensions

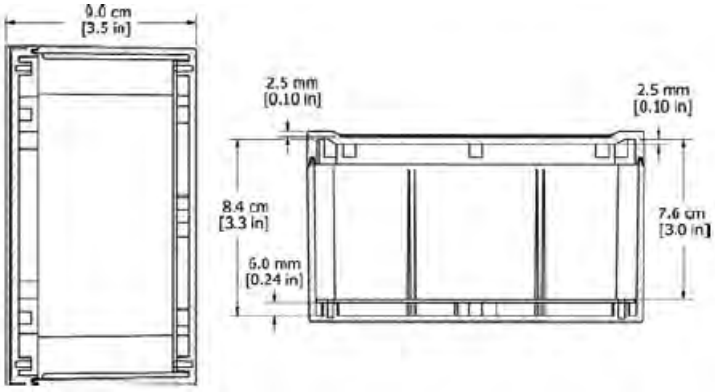
- *Figure 1-1* calls out the analyzer dimensions with the lid closed.

Figure 1-1: Analyzer Dimensions with Lid Closed



- *Figure 1-2* shows the depth dimensions of the analyzer. When wall or panel mounting, make sure to allow adequate space for opening the enclosure door or making electrical connections.

Figure 1-2: Side View Dimensional Drawings

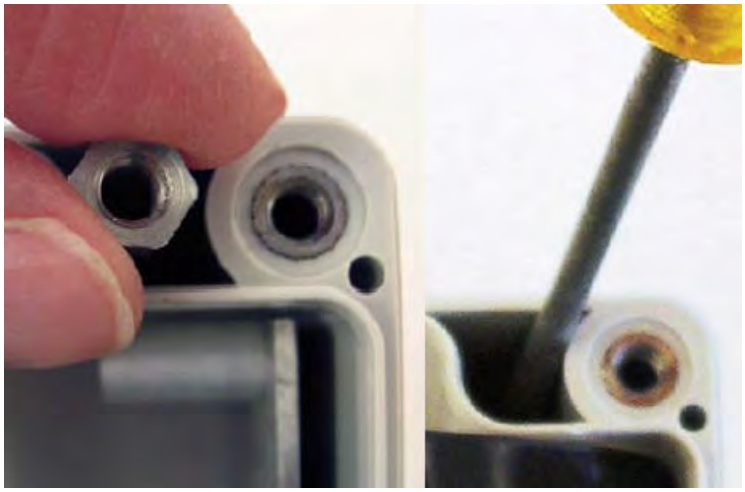


1.3.2 Pipe mounting

Complete the following steps to mount the analyzer on a pipe.

1. Remove the four nuts and four screws from the mounting kit.
2. Open the enclosure and drop one nut into each drilled corner of the box (*Figure 1-3*).

Figure 1-3: Placing the Nut in the Enclosure

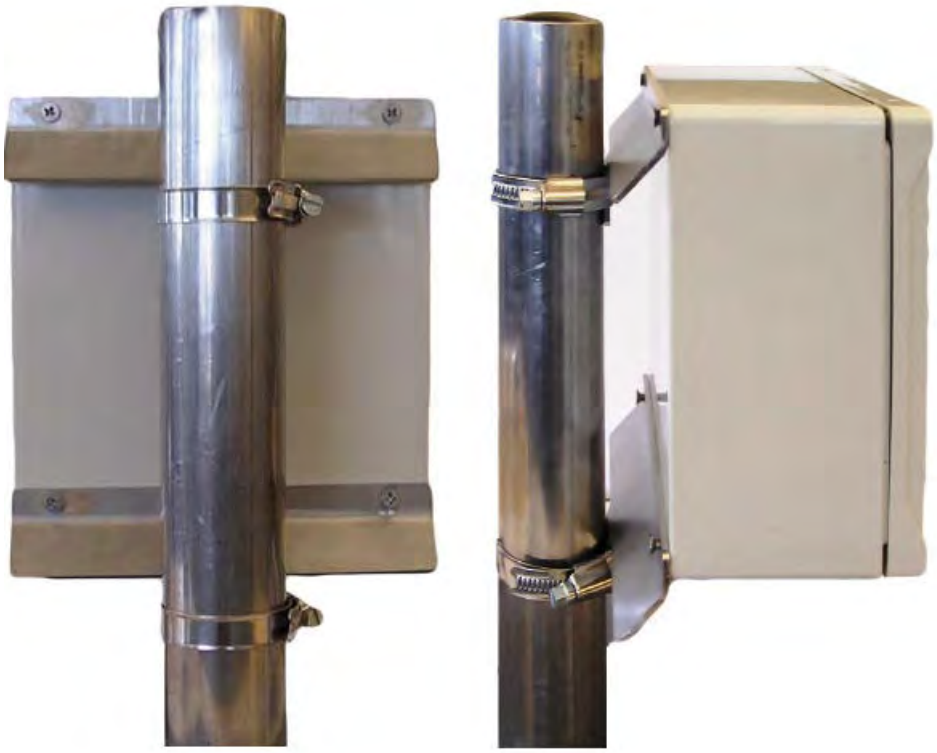


3. Use a screwdriver to push the nut down and set it in place (*Figure 1-3*).
4. Orient the two brackets on the back of the enclosure so that the flanges in the brackets point downward (*Figure 1-4*).

Figure 1-4: Attaching the Mounting Brackets

5. Attach the mounting brackets to the enclosure using two screws for each bracket. Make sure that the screws properly thread into the nuts you seated in steps 2 and 3.
6. Place two hose clamps over the mounting pipe and tighten them until they are almost secure.
7. Place the flanges from the mounting bracket into each of the hose clamps (*Figure 1-3*).
8. Tighten the hose clamps until the analyzer is secure on the pipe.

Figure 1-5: Back and Side View of Pipe-Mounted Analyzer



1.3.3 Wall mounting using mounting tabs

The optional mounting kit contains a set of wall mounting hardware that includes four screws, nuts, and tabs for mounting the analyzer to a wall or panel. Follow the instructions included with the mounting tab hardware to attach the tabs (*Figure 1-6*).

Figure 1-6: Back View of Analyzer with Tabs

1.3.4 Wall mounting with user-supplied screws and hardware

You can supply your own hardware and attach the analyzer to a wall.

Figure 1-3 indicates the placement of the nut. Use a screw that is best suited for your wall material (*Figure 1-7*).

Figure 1-7: Back View of Analyzer

1.4 Installing dome connectors and plugs

Complete the following steps to install the dome connector and plugs.

1. Place the O-ring over the threaded end of the connector or plug.
2. Screw the connector or plug into the opening until it is snug. Then tighten an additional 1/2 turn.

   Do not overtighten.
3. Place the lock nut concave side down on the threads and, using a screwdriver blade and mallet, tighten the lock nut until there is approximately one thread showing.
4. Thread cable through the dome connectors and secure by tightening the nut to about 15 in.-lb of torque.

   Confirm that cable does not slide or wiggle after the nut has been tightened. Leave sufficient cable inside the enclosure to make secure connections without placing stresss on the cable.

Figure 1-8: Attached plug (left) and attached dome connector (right)

2 Wiring

⚠ WARNING!

Only properly trained and qualified personnel should install the RDO instrument described in this manual. This instrument should be installed for use in nonhazardous locations only.

2.1 Electrostatic discharge (ESD) recommendations

- Before making wiring connections or touching circuit boards or other internal components, discharge any static electricity from your body by touching a grounded metal object.
- When making wiring connections, make sure to remain properly grounded by wearing an ESD wriest strap or similar device.

2.2 Customer-supplied electrical equipment

You must supply the following:

- 18-12 AWG wire for electrical connections using conduit or 100-240 Vac power supply
- 24-12 AWG cable for connecting relays and PLC devices
- A 100-240 Vac or 9-36 Vdc source with over current/disconnect protection for hard-wired locations using conduit
- Approved suitable wiring for cord-connected plug and socket locations

2.3 Ensuring good electrical connections

To ensure that all sensors and power sourced function properly, make sure that:

- Each individual wire is stripped and tinned to 1/4 in.
- Each wire is tightly screwed into the terminal strip.
- Each wire is touching the terminal strip. If the plastic wire jacket is clamped into the terminal strip, connections will not be made.
- Clip or cap any unused wires.

2.4 AC power and high voltage relay connections

The AC power board is located under the metal shield on the right side of the enclosure. The terminal strip on the board accommodates the AC power connections as well as two high voltage relay connections.

⚠ WARNING!

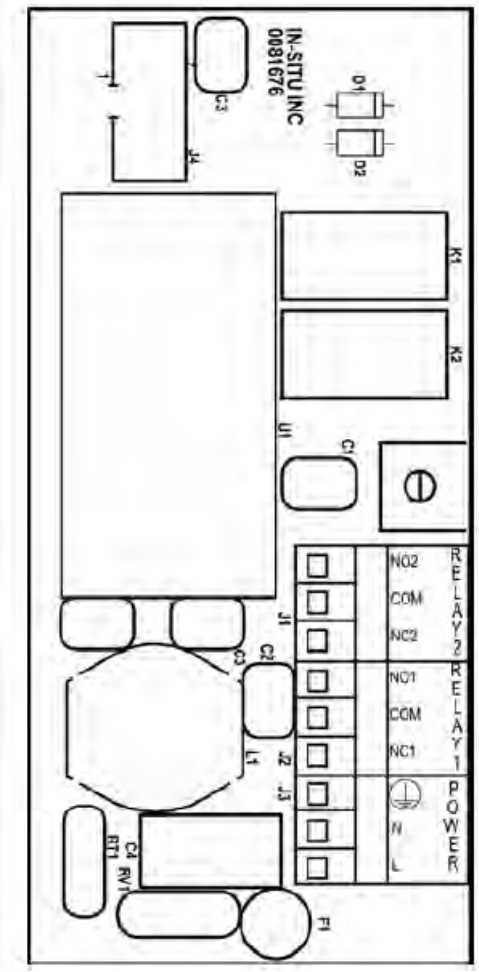
ELECTRIC SHOCK
Make sure that power to the instrument is disconnected before making any wiring connections.

⚠ WARNING!

ELECTRIC SHOCK
Do not connect low voltage circuits (< 50 V) to the terminal connectors on the AC board!

See *Figure 2-1*.

Figure 2-1: AC Circuit Board and Terminal Connections

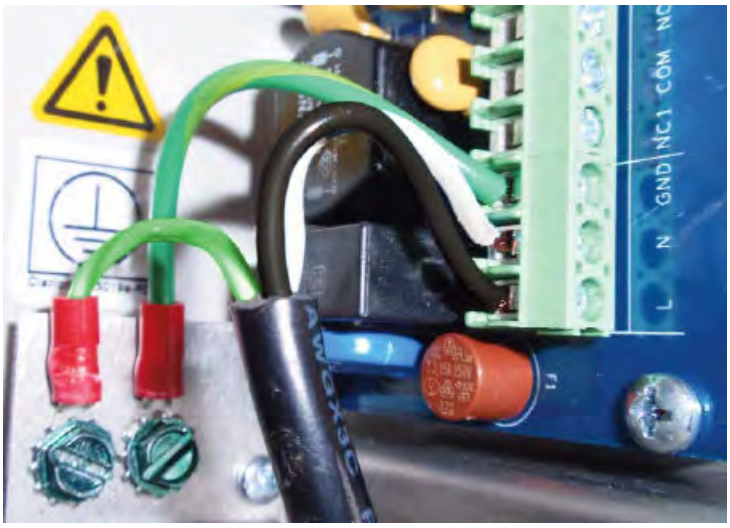


Procedure

1. Remove the front cover of the enclosure.
2. Remove the metal AC power board cover.
3. Thread the power cable and relay wires (if needed) through the dome fittings nearest the power board.
4. Using the green screw, connect the green earth wire of the power cable to the metal frame in the bottom of the enclosure.

   See *Figure 2-2*. A green wire connecting the metal frame to the terminal strip should already be in place.

Figure 2-2: Connect the Ground Wire to the Metal Frame Using the Green Screw



5. Connect the live and neutral power wires to the *L* and *N* terminals.

   See *Figure 2-1*.

Terminal	Description	North America color	Euro color
L	Live	Black	Brown
N	Neutral	White	Blue
⏚	Protective earth	Green	Green and yellow

6. Connect relay wires (if required) to the terminal strip.

   See *Figure 2-1*.

Terminal	Description
COM	Common
NC1 or NC2	Normally closed
NO1 or NO2	Normally open

7. Replace the metal AC power board cover.
8. Replace the front cover of the enclosure.

   Be sure the dessicant pack (PN R0087630) is present.

2.5 Analog and digital outputs and low voltage relay connections

Complete the following steps to connect the analog and digital outputs and low voltage relay.

⚠ WARNING!

ELECTRIC SHOCK
Make sure that the power to the instrument is disconnected before making any wiring connections.

⚠ WARNING!

ELECTRIC SHOCK
The maximum voltage that can be applied across the loop terminals is 36 V.

⚠ WARNING!

ELECTRIC SHOCK
Do not connect high voltage circuits (> 50 V) to the terminal connections on the I/O board!

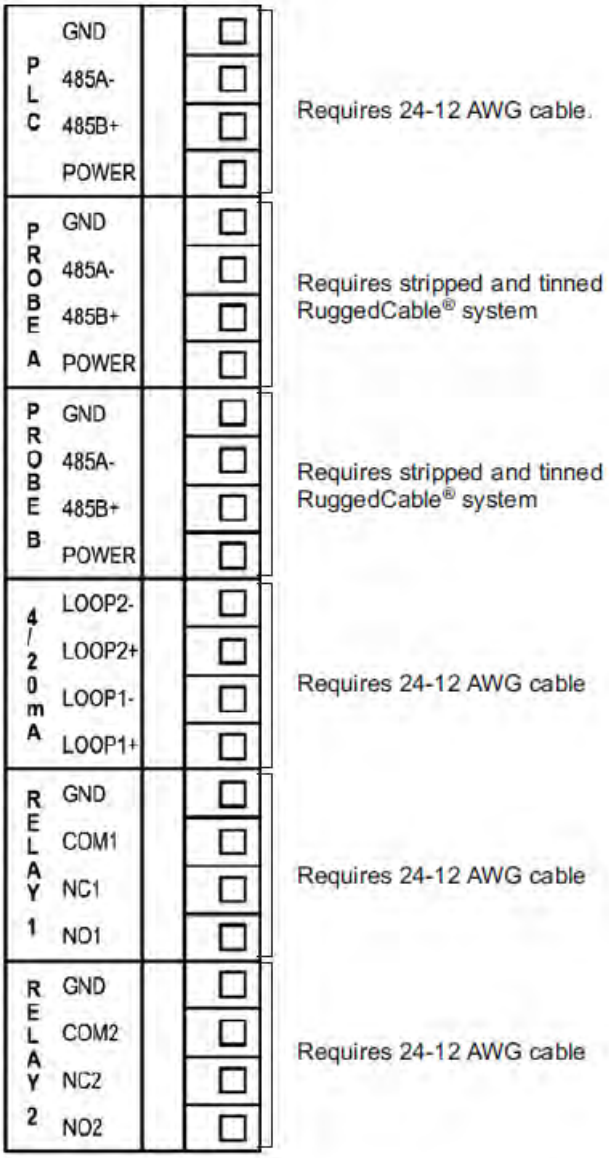
Procedure

1. Remove the front cover of the enclosure.
2. Connect the digital output (Modbus/RS-485) to the PLC terminals.

   See *Figure 2-3*. There is no connection to the GND and POWER terminals. However, the analyzer supplies 24 Vdc to the GND and POWER terminals, which can be used to power external accessories.

Terminal	Description
GND	Signal ground
485-	RS-485 negative
485+	RS-485 positive
POWER	24 Vdc

Figure 2-3: Input/output board



3. Wire the analog current loops to the 4-20 mA terminals.

   Each analog output loop must be powered separately. The maximum voltage at the terminal must not exceed 36 Vdc. The minimum voltage is 9 Vdc.

Terminal	Description
LOOP2-	To negative end of device
LOOP2+	To positive end of device
LOOP1-	To negative end of device

Terminal	Description
LOOP1+	To positive end of device
GREEN EARTH	Cable shield

4. Connect the shield to the green earth ground screw.

   See *Figure 2-4*. Do not ground the device at both ends of the cable.

Figure 2-4: Earth Ground Screws for Analog Outputs and Sensors

5. Make the low voltage relay connections.

Important
Do not apply more than 50 V across the low voltage relays.

Terminal	Description
GND	Signal ground
COM1 or COM2	Common
NC1 or NC2	Normally closed
NO1 or NO2	Normally open

6. Replace the front cover of the enclosure.

   Be sure the dessicant pack (PN R0087630) is present.

2.6 RDO probe wiring

Complete the following steps to wire the RDO probe.

⚠ WARNING!

ELECTRIC SHOCK
Make sure that power to the instrument is disconnected before making any wiring connections.

Procedure

1. Remove the front cover of the enclosure.
2. Wire the RDO probe to the PROBE A or PROBE B terminals on the input/output card.

Terminal	Description	Wire color
GND	Signal ground	Black
485A-	RS485 negative	Green
485+	RS485 positive	Blue
POWER	Input DC/Output AC	Red
GREEN EARTH	Shield	Shield

3. Connect shield wire to the green earth ground screw.

   See *Figure 2-4*.
4. Cut off or cap the unused brown and white wires.
5. Replace the front cover of the enclosure.

   Be sure that the dessicant pack (PN R0087630) is present.

2.7 Tighten dome connectors

The dome connectors installed in *Section 1.4* must be tightened securely after the sensor and electrical cables have been routed through them. The dome connectors are not meant to be weight bearing. Be sure that:

- The cable does not slide or wiggle after the nut has been tightened.
- Sufficient cable has been threaded through the connector so that secure wiring connections remain secure.
- There is no weight or force from water pulling on the cable.

3 Placing the RDO probe in service

3.1 Unpacking

Remove the probe and sensing cap from the box. The sensing cap is shipped in a small plastic cylinder inserted in a hole in the internal cardboard packaging.

3.2 Assembling the probe

Complete the following steps to assemble the RDO probe.

1. Unscrew the nose cone from the probe and remove the red protective dust cap.

   Save the dust cap for later use. Make sure the O-ring grooves are dry and the O-rings are not rolled or pinched.

2. Remove the RDO sensing cap from its shipping/storage sleeve.

   The expected operating lifetime of the cap is two years after the first reading has been taken. Install the cap by the date printed on the packaging (for PN R00804230X only).

Note

Keep the cap in its sealed packaging until you are ready to install it. Install promptly. Avoid allowing moisture, including humidity, inside the cap.

3. Align the arrow on the cap with the index mark on the probe and firmly press the cap onto the probe, without twisting, until it seals.

4. Reattach the nose cone.

Note
The nose cone must be in place whenever the probe is submerged in water.

5. Wire the probe to the analyzer.

See *Section 2.6*.

Note
If you are replacing an existing RDO probe with a new probe, the analyzer may not recognize the new probe. If this is the case, the main display will show the *probe not talking* icon (letter A or B in reverse video). To establish communication, follow the procedure in *Section 5.3*.

3.3 Installing the probe

The RDO dissolved oxygen probe can be submerged in basins or ponds.

The nose cone and the thermistor (the small metal disc on the side of the sensor about 1/6 in. [3 mm] above the nose cone) must be completely submerged. Use the 1 1/4 in. FNPT fitting at the rear of the probe to attach it to a pipe. Be sure the connection is watertight and the upper end of the pipe is closed to keep out water.

⚠ CAUTION!

EQUIPMENT DAMAGE

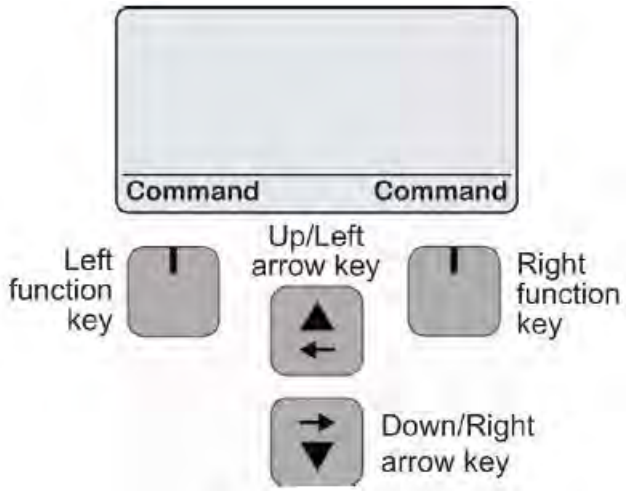
Do not allow the back end of the sensor to get wet.

4 Display and Operation

4.1 Display and keypad

Figure 4-1 shows the keypad and display window.

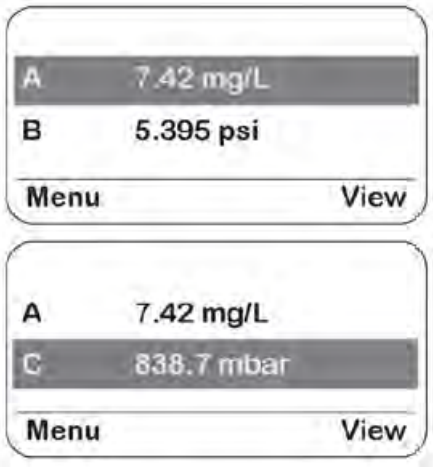
Figure 4-1: Keypad and display



The **Up/Left** arrow key has three functions: it moves the cursor to the left; it moves the cursor up a list; it increases the value of a digit. The **Down/Right** arrow key has three functions: it moves the cursor to the right; it moves the cursor down a list; it reduces the value of a digit. The left and right function keys perform the operation shown in the screen immediately above the key.

The main display has two lines. The measurement from probe A appears in the top line, and the measurement from probe B appears in the bottom line. If no probe B is connected, a row labeled C appears. References to probe C refer to the analyzer, which is called the ConTROLL Pro. See *Figure 4-2*.

Figure 4-2: Two-line display



Lines labeled A and B refer to probes A and B. C refers to measurements made by the analyzer. See also Section 4.2.

Table 4-1: Display Icons and Their Descriptions

Icon	Description
!	Error with parameter
	Calibration stabilizing
	Calibration stable
	View
	View locked
	View unlocked
	Factory calibration for RDO cap has expired.
	User calibration has expired, based on the *Calibrate Interval*.
	Probe A not talking
	Probe B not talking
1	Relay 1 active
2	Relay 2 active

4.2 Using the view function and customizing the display

The view function allows you to view parameters measured by each probe and the analyzer. It also allows you to customize the display.

1. Select the View option.

   An arrow points to the first line in the display.

2. Select View again to move the arrow to the second line in the display.
3. With the arrow pointing at any line, use the **Up** and **Down** arrow keys to cycle through the parameters being measured by the probe and analyzer.
4. To customize the display, move the arrow to the desired line and press the **Up** or **Down** arrow key until the desired measurement appears. Then select View to move to the next line.

5 Programming the analyzer

5.1 Initial configuration

Enter the following information upon first use or any time after you have restored the default settings.

1. Choose English, Spanish, or French. Use the arrow keys to move up or down to the appropriate language. Select **Enter**.
2. Use the arrow keys to adjust the contrast level. Select **Enter**.
3. Enter the time zone.
   a. Refer to *Table 5-1*. Choose the appropriate time zone and find the corresponding UTC value (Universal Time, Coordinated, formerly GMT).

Table 5-1: Selected Regions and Their Time in UTC

Region	UTC value (± numeric value)
Australia Northern Territory	+9.5
Australia Lord Howe Island	+10.5 (Daylight Savings Time +11)
Australia New South Wales	+10 (Daylight Savings Time +11)
Australia Queensland	+10
Australia Victoria	+10 (Daylight Savings Time +11)
Australia Australian Cap. Terr.	+10 (Daylight Savings Time +11)
Australia South	+9.5 (Daylight Savings Time +10.5)
Australia Tasmania	+10 (Daylight Savings Time +11)
Australia Western	+8
Canada Central	-6 (Daylight Savings Time -5)
Canada Eastern	-5 (Daylight Savings Time -4)
Canada Mountain	-7 (Daylight Savings Time -6)
Canada Yukon & Pacific	-8 (Daylight Savings Time -7)
Canada Atlantic	-4 (Daylight Savings Time -3)
Canada Newfoundland	-3.5 (Daylight Savings Time -2.5)
England	0 hours (Daylight Savings Time (+1)
USA Puerto Rico	-4
USA Central	-6 (Daylight Savings Time -5)
USA Eastern	-5 (Daylight Savings Time -4)
USA Mountain	-7 (Daylight Savings Time -6)
USA Arizona	-7
USA Indiana East	-5

Table 5-1: Selected Regions and Their Time in UTC *(continued)*

Region	UTC value (± numeric value)
USA Pacific	-8 (Daylight Savings Time -7)
USA Alaska	-9 (Daylight Savings Time -8)
USA Aleutian	-10
USA Hawaii	-10

b. Use the **Up/Left** arrow key to enter a positive or negative value.
c. Press the **Down/Right** arrow key to move to the appropriate numeric position.
d. Use the **Up/Left** arrow key to enter the correct numeric value. Repeat for additional digits as needed.
e. Select **Enter**.

4. Enter the date using the **Up/Left** arrow key. Select **Enter**.
5. Enter the time using the **Up/Left** arrow key. Select **Enter**.

   The Add Probe A screen appears. The name of the probe wired in the position also appears.

6. Select **Enter** to configure this probe.

   The Add Probe B screen appears. The name of the probe wired in this position also appears. If there is no probe B, the display shows `Probe not connected.`

7. Select **Enter** to configure this probe if it exists or to proceed to the next screen if it does not.

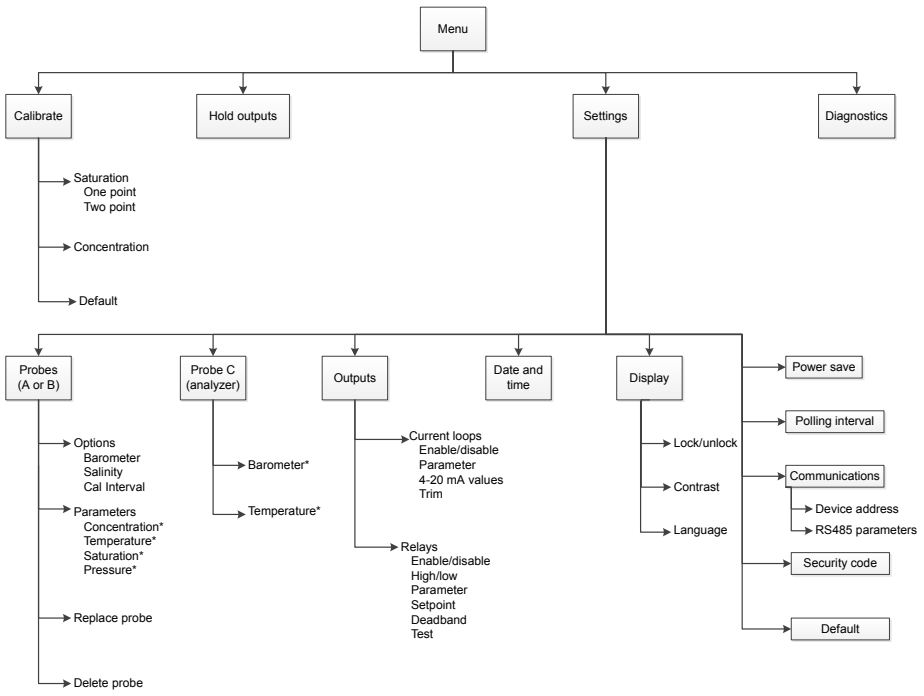
   The main display appears.

For additional information on setting up the probes, see *Section 5.3.3* and *Section 5.3.4*.

5.2 Menu tree

The menu tree for the analyzer is shown in *Figure 5-1*.

Figure 5-1: Menu Tree



Note

**For each parameter:*

- *Enable or disable*
- *Choose units*
- *Choose resolution*
- *Set sentinel*

5.3 Configuring the RDO probes

Configure the RDO probes one at a time.

There are four submenus available for each probe: Options, Parameters, Replace Probe, and Delete Probe.

5.3.1 Options (Barometer, Salinity, and Calibration Interval)

Three settings can be made under Options.

- Barometer: The analyzer has a built-in pressure sensor to measure barometric pressure, which is needed for percent saturation (air) calibration. Emerson strongly recommends the use of automatic barometric pressure.
- Salinity: Salinity is an important setting if dissolved oxygen is being measured in brackish water and percent saturation (air) calibration is being used to calibrate the probe.
- Calibration Interval: The analyzer can be programmed to remind you when a calibration is due.

1. Select **Menu > Settings > Probes**. Select RDO Probe A or RDO Probe B, if it is present, and then select Options.
2. Scroll to Barometer and then select it. The choices are Fixed and Automatic. If you choose Fixed, enter the barometric pressure here before you start percent saturation (air) calibration. If you choose Automatic, the analyzer automatically measures the barometric pressure and uses it during percent saturation (air) calibration.
3. Scroll to Salinity and select it. Choose Fixed. Automatic is not available. Enter the salinity of the process water in PSU (practical salinity units in parts per thousand).
4. Scroll to Calibration Interval. Select a calibration interval. The analyzer will display a message when the next calibration is due.

5.3.2 Parameters (Concentration, Temperature, Saturation, and Partial Pressure

Each RDO probe can measure concentration, temperature, percent saturation, and partial pressure. There are four settings to make for each parameter.

- Enable or disable the measurement. If the measurement is enabled, the probe makes the measurement, and the analyzer displays the result. If the measurement is disabled, the probe does not make the measurement.
- Select units in which measurement results will be displayed.
- Set the display resolution.
- Set a sentinel. The sentinel is the value that will be displayed when the probe returns an error condition for the measurement.

Procedure

1. Select **Menu > Settings > Probes**.
2. Select RDO Probe A or RDO Probe B, if it is present, and then select Parameters.
3. Select Concentration.
   a. Press the **Select** key to toggle between Enable and Disable.

      If the box is checked, Concentration has been selected.
   b. Scroll to Units and select it. Choose between mg/L and ug/L.

c. Scroll to Resolution. Press **Select** repeatedly to change the resolution.

The setting is stored as soon as you press any key to leave.

d. Scroll to Sentinel and press **Select**. Use the arrow keys to change the setting.

4. Select Temperature.

a. Press **Select** to toggle between Enable and Disable.

If the box is checked, Temperature has been selected.

b. Scroll to Units and select it. Choose between °C and °F.

c. Scroll to Resolution. Press **Select** repeatedly to change the resolution.

The setting is stored as soon as you press any key to leave.

d. Scroll to Sentinel and press **Select**. Use the arrow keys to change the setting.

5. Select Saturation.

a. Press **Select** to toggle between Enable and Disable.

If the box is checked, Percent Saturation has been selected.

b. Scroll to Units.

There is no selection to make. the units are % saturation.

c. Scroll to Resolution. Press **Select** repeatedly to change the resolution.

The setting is stored as soon as you press any key to leave.

d. Scroll to Sentinel and press **Select**. Use the arrow keys to change the setting.

6. Select Pressure.

a. Press **Select** to toggle between Enable and Disable.

If the box is checked, Partial Pressure has been selected.

b. Scroll to Units.

There is no selection to make. The units are torr.

c. Scroll to Resolution. Press **Select** repeatedly to change the resolution.

The setting is stored as soon as you press any key to leave.

d. Scroll to Sentinel and press **Select**. Use the arrow keys to change the setting.

5.3.3 Replacing a probe

If you replace the RDO probe with another RDO probe, use **Replace Probe** to transfer the existing setting to the new probe.

1. Disconnect the existing RDO probe and replace it with the new probe.

   See *Section 3.3*.

2. Select **Menu > Settings > Probes**. Select RDO Probe A or RDO Probe B, if it is present, and then select **Replace Probe**.

   The analyzer automatically configures the new probe.

3. Press and hold **Back** to return to the main display.

5.3.4 Deleting a probe

If you plan to permanently remove a probe, follow the steps below.

1. Select **Menu > Settings > Probes**.
2. Highlight the probe you wish to delete and press **Select**.
3. Scroll to `Delete Probe`.
4. Press **Select** and then **Enter** to confirm.

The probe is deleted from the configuration.

5.3.5 Adding a probe

To add a probe, follow the steps below.

1. Select **Menu > Settings > Probes**.
2. Select Probe A or Probe B and then `Add Probe`.

   The Add Probe screen appears with the name of the sensor that is wired in this position. If there is no Probe B, the display says `No probe connected`.

3. Select **Enter** to add the probe.

5.4 Configuring the analyzer

The analyzer (called the ConTROLL PRO) measures two parameters, barometric pressure and temperature. There are four settings to make for each parameter.

- Enable or disable the measurement. If the measurement is enabled, the analyzer makes the measurement and displays the result. If the measurement is disabled, the analyzer does not make the measurement.
- Select units in which measurement results will be displayed.
- Set the display resolution.
- Set a sentinel. The sentinel is the value that will be displayed when the analyzer returns an error condition for the parameter.

Procedure

1. Select **Menu > Settings > Probes**. Select ConTROLL PRO.

2. Select Barometer.
   a. Press **Select** to toggle between Enable and Disable.

      If the box is checked, barometric pressure has been selected.
   b. Scroll to Units and select it. Choose the desired units for barometric pressure.
   c. Scroll to Resolution. Press **Select** repeatedly to change the resolution.

      The setting is stored as soon as you press any key to leave.
   d. Scroll to Sentinel and press **Select**. Use the arrow keys to change the setting.
3. Select Temperature.
   a. Press **Select** to toggle between Enable and Disable.

      If the box is checked, temperature has been selected.
   b. Scroll to Units and select it. Choose the desired units for temperature.
   c. Scroll to Resolution. Press **Select** repeatedly to change the resolution.

      The setting is stored as soon as you press any key to leave.
   d. Scroll to Sentinel and press **Select**. Use the arrow keys to change the setting.

5.5 Configuring outputs

Outputs refer to the analog current loops and the alarm relays.

Important
Configure the probes before configuring the outputs.

5.5.1 Current loops

There are six settings to make:

- Enable/Disable: Choose to enable or disable the output loop.
- Parameter: Assign a probe and parameter to the output.
- 4 mA Value: Enter the value to correspond with 4 mA.
- 20 mA Value: Enter the value to correspond with 20 mA.
- 4 mA Trim: Adjust the 4 mA value of the analyzer to achieve a loop current of 4 mA.
- 20 mA Trim: Adjust the 20 mA value of the analyzer to achieve a loop current of 20 mA.

Procedure

1. Select **Menu > Settings > Outputs > Current Loops**.
2. Choose current loop 1 or current loop 2.
3. Scroll to Enable/Disable and select it. Press **Select** to toggle between Enable and Disable.

If the box is checked, the current loop has been enabled.

4. Scroll to Parameter and select it. Scroll through the list of probes and measurements.

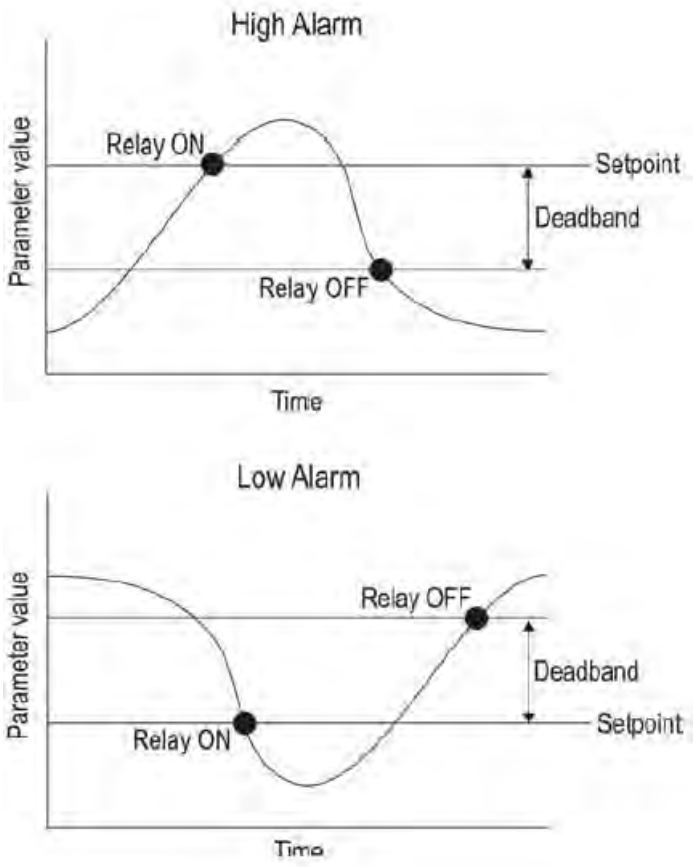
   A is probe A, B is probe B, and C is the analyzer.
5. Scroll to 4 mA value and select it. Use the arrow keys to change the setting.
6. Scroll to 20 mA value and select it. Use the arrow keys to change the setting.
7. Scroll to 4 mA Trim. Use the arrow keys to adjust the loop current to 4 mA.
8. Scroll to 20 mA Trim. Use the arrow keys to adjust the loop current to 20 mA.

5.5.2 Alarm relays

There are six settings to make.

- Enable/Disable: Choose to enable or disable the relay.
- Mode: Choose High Alarm or Low Alarm.
- Parameter: Assign a probe and a parameter to the relay.
- Setpoint: See *Figure 5-2*.
- Deadband: See *Figure 5-2*.
- Test: Manually energize or de-energize a relay to test it.

Figure 5-2: High and Low Alarm Relay Action



Procedure

1. Select **Menu > Settings > Outputs > Relays**.
2. Choose Relay 1 or Relay 2.

   For each relay, there is a high voltage and low voltage relay. Configuring the relay configures both the high voltage and low voltage relay.
3. Scroll to Enable/Disable and select it. Press **Select** to toggle between Enable and Disable.

   If the box is checked, the relay has been enabled.
4. Scroll to Mode and select it. Choose High alarm or Low alarm.
5. Scroll to Parameter and select it. Scroll through the list of probes and measurements.

   A is probe A, B is probe B, and C is the analyzer.
6. Scroll to Setpoint and select it. Use the arrow keys to change the setting.
7. Scroll to Deadband and select it. Use the arrow keys to change the setting.

8. Scroll to Test and select it. Use the arrow keys to change from yes to no.

5.6 Changing the date and time

Complete the following steps to change the date and time on the RDO analyzer.

1. Select **Menu > Settings > Date & Time**.

   Three menu items appear:

   - Date shown as `yyyy-mm-dd`
   - Time shown as `hh:mm:ss` (24 hour clock)
   - UTC shown as `±xx:xx` (see *Table 5-1*)

2. Scroll to the menu item and select it.
3. Use the arrow keys to change the setting.
4. Select **Enter**.

5.7 Changing the appearance of the screens

5.7.1 Locking the display

Locking the display prevents the operator from scrolling through the measurement parameters using the **View** function.

1. Select **Menu > Settings > Display**.
2. Choose Lock View.
3. Use **Select** to toggle between the lock view and the unlocked view.

   The lock symbol at the top of the screen shows whether the screen is locked or unlocked.

5.7.2 Changing the display contrast

Complete the following steps to brighten or darken the screen.

1. Select **Menu > Settings > Contrast**.
2. Use the arrow keys to brighten or darken the screen.
3. Press **Enter**.

5.7.3 Changing the language

Complete the following steps to change the language.

1. Select **Menu > Settings > Language**.
2. Choose English, Spanish, or French.

3. Press **Enter**.

5.8 Changing power settings

To conserve power the analyzer can be set to turn off the display after idling for a certain length of time.

1. Select **Menu > Settings > Power Save**.
2. Select External.

   Do not choose Battery.
3. Select the appropriate interval - Off (always on), 15 sec, 30 sec, 1 min, 5 min, or 15 min.

5.9 Setting the polling (update) interval

The polling interval specifies how often the analyzer checks the probe and updates the configured outputs when the analyzer is in power saving mode.
See *Section 5.8*. The default polling rate is every 15 minutes. The fastest polling rate is every minute; the slowest is every 24 hours.

Important
If the analyzer is not in power saving mode, the display, relays, and outputs update once every 5 sec.

Procedure

1. Select **Menu > Settings > Polling Interval**.
2. Select the desired interval.
3. Press **Enter**.

5.10 RS485 communications

5.10.1 Setting the device address for the analyzer

The device address is a number between 1 and 245. The device address of Probe A is the analyzer address plus 1. The device address of Probe B is the analyzer address plus 2.

1. Select **Menu > Settings > Communications > Address**.
2. Use the arrow keys to enter a number between 1 and 245.
3. Press **Enter**.

5.10.2 Setting RS485 parameters for the analyzer

Complete the following steps to set the RS485 parameters for the analyzer.

1. Select **Menu > Settings > Communication > RS485**.

   There are six settings to make:

   - Mode (choose RTU or ASCII)
   - Baud Rate (choose 9600, 19200, 38400, or 57600)
   - Data Bits (choose 8)
   - Parity (choose Even, Odd, or None)
   - Stop Bits (choose 1 or 2)
   - Defaults (choose yes to restore RS485 default settings)
2. Scroll to the menu item and select it.
3. Use the arrow keys to change the setting.
4. Press **Enter**.

5.11 Setting security codes

You may set up the analyzer with passwords for an administrator and a user. The user can access the Calibrate, Hold, Options, and Diagnostics menus. The administrator can access all functions, most notably the Settings menu. If there is no administrator code set, the user becomes the default administrator and can access all functions. To remove pass code-protected access, enter 0000 for all codes.

1. Select **Menu > Settings > Security Code**.
2. Select Administrator and enter a 4-digit code for the Administrator using the arrow keys. Press **Enter**.
3. Select User. Set a 4-digit code for the User using the arrow keys. Press **Enter**.

5.12 Defaults

Selecting defaults returns all user settings and calibrations to factory default values.

The display also returns to the initial configuration screens described in *Section 5.1*.

5.13 Placing the output and relays on hold

Occasionally, you may wish to temporarily pause the outputs.

1. Select Menu, then Hold Outputs.

   All measurement updates stop, the current values and outputs are held, and the phrase `Hold Outputs` appears at the top of the main display.

2. To take the analyzer out of hold, select Resume.

5.14 Diagnostics

The following diagnostic information is available for the RDO probe:

- Serial number
- Firmware version number
- Date of last user calibration
- Last calibration slope and offset
- Date next calibration is due
- Expiration date for sensing cap (one year from the date the sensing cap took its first measurement, for PN R0084230 only)
- For replacement cap, PN R0084230X, there is no expiration date (expected life is two years)
- Sensing cap serial number

The following diagnostic information is available for analyzer Probe C, also called ConTROLL PRO:

- Serial number
- Firmware version number
- Hardware version number
- Power source

Procedure

1. Select **Menu**, then **Diagnostics**.
2. Select the desired probe (A or B). For analyzer diagnostics, select Probe C.
3. Use the arrow keys to scroll through the diagnostics.
4. To read the last calibration slope and offset, scroll to Last calibration and select it.

   The slope should be between 0.80 and 1.20, and the offset should be between -0.2 and +0.2.

6 Calibration

6.1 Calibration options

There are three ways to calibrate the RDO probe.

- Saturation: Both a two-point (100% and 0% saturation) and one-point (100% saturation) calibration are available. 100% saturation refers to water completely saturated with atmospheric oxygen. 0% refers to water containing no dissolved oxygen.

  The solubility of atmospheric oxygen in water depends on the barometric pressure, temperature, and humidity. If these are known, the concentration of oxygen in air-saturated water can be readily calculated, making it a useful calibration standard. In practice, however, air-saturated water is almost never used. Air is used instead. Air works because, according to Henry's Law, the concentration of oxygen in air-saturated water (expressed in mg/L) is in equilibrium with the partial pressure of oxygen in the air used to saturate the water. Therefore, whether the probe is in air or in air-saturated water, the fluorescence quenching will be exactly the same.

  During calibration at 100% saturation, the micro-processor uses the temperature measured by the probe and the barometric pressure measured by the analyzer to calculate the equilibrium solubility of oxygen in water. Because the calibration assumes the air is completely saturated with water, the calibration must be done with the probe in air having 100% humidity.

  Calibrating at 0% saturation requires water containing no dissolved oxygen. A good 0% saturation standard is water containing about 5% sodium sulfite (Na_2SO_3). Add about one teaspoonful of sodium sulfite crystals to a cup of water.
- Concentration: If the probe is installed in a waste-water aeration basin, it is often inconvenient to remove it for saturation calibration. In this case, concentration calibration, in which the probe is calibrated against a referee instrument, is more suitable.
- Default: Default restores the default calibration.

Although a new probe can be used as received from the factory, Emerson recommends that you do a two-point saturation calibration when the probe is first placed in service.

6.2 One-point calibration (100% saturation)

Complete the following steps to do a one-point calibration.

1. Remove storage cap on top of calibration chamber and replace it with the calibration cap (cap with the vent hole).

Figure 6-1: Calibration and storage caps

2. Fill the calibration chamber to the lower fill line with approximately 10 mL water.

   The water temperature should be as close to the sample temperature as possible.

Figure 6-2: Fill the calibration chamber to the lower line with water.

3. Remove the sensor from the process liquid. If the sensor is fouled or dirty, clean it by following the procedure in *Section 7.2.2*. Gently dry the probe and sensor with a soft cloth, making sure there is no water on the body of the sensor or on the sensing foil.

Important

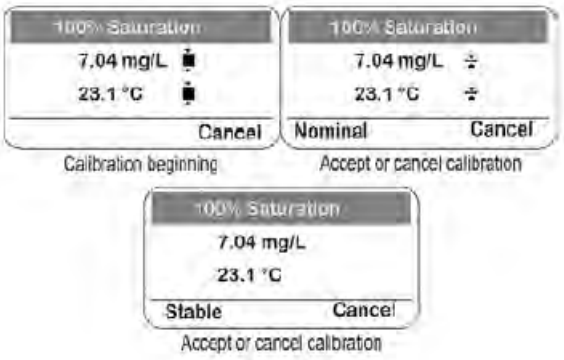
The sensing foil must remain dry during 100% saturation calibration.

4. Place the probe in the calibration chamber keeping the sensing foil about 1 in. (25 mm) above the surface of the water.
5. Allow at least five minutes for the temperature to stabilize before starting the calibration.

   Keeping the sensor in the shade will help reduce drift caused by the sun's heat. Do not leave the calibration chamber for more than 30 minutes, lest condensation form on the surface of the foil, leading to false low readings after calibration. If condensation does occur, remove the probe and dry the foil. Return the sensor to the calibration chamber and continue.
6. Once readings are stable, start the calibration. Select **Menu > Calibrate > RDO PRO > Saturation > One-point cal**.

   The calibration begins immediately. The Calibration Beginning screen shown in *Figure 6-3* appears.

Figure 6-3: The figure shows the screens that appear as the calibration progresses.



Note the *Calibration Beginning* icon next to the mg/L reading. As the reading stabilizes, the bar in the icon shrinks. When the word `Nominal` appears, the stabilization is almost complete, and the calibration can be selected at this point by selecting `Nominal`. However, for best results, wait until `Stable` appears.

7. Select `Stable` to accept the calibration. To end and return to the previous calibration, select **Cancel**.

6.3 Two-point calibration (100% and 0% saturation)

Complete the following steps to perform a two-point calibration on your RDO analyzer.

1. Set up the calibration chamber and probe as described in *Section 6.2*, steps 1 through 5.

Important
Do the 100% calibration step first.

2. Once readings are stable, start the calibration. Select **Menu > Calibrate > RDO PRO > Saturation > Two-point cal**.

   The calibration begins immediately. The Calibration Beginning screen shown in *Figure 6-3* appears, and the other two screens appear as the reading stabilizes. Wait until the word `Stable` appears.

3. Select `Stable` to accept the calibraiton and proceed to the 0% saturation step. To end and return to the previous calibration, select `Cancel`.

   The 0% saturation step starts automatically.

4. Remove the probe and fill the calibration chamber to the upper fill line with approximately 60 mL of fresh sodium sulfite solution (see *Figure 6-4*).

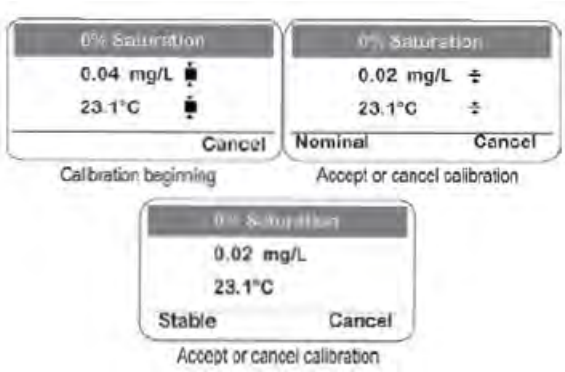
Figure 6-4: Fill the Calibration Chamber to the Upper line with Fresh Sodium Sulfite Solution.

A teaspoonful of sodium sulfite in a cup of water is adequate.

5. Place the probe in the sodium sulfite solution. Be sure the thermistor thermowell (the small metallic disc about 1/8 inch [3 mm] above the nose cone) is completely submerged. Leave at least 1/2 inch (12 mm) between the surface of the foil and the bottom of the chamber. Do not allow the sensing foil to rest on the bottom of the calibration chamber. Allow at least five minutes for readings to stabilize.

   The Calibration Beginning screen shown in *Figure 6-5* appears.

Figure 6-5: The Figure Shows the Screens that Appear as the Calibration Progresses.



Note the *Calibration Beginning* icon next to the mg/L reading. As the reading stabilizes, the bar in the icon shrinks. When the word `Nominal` appears, the stabilization is almost complete. However, for best results, wait until `Stable` appears.

6. Select `Stable` to accept the calibration. To end and return to the previous calibration, select `Cancel`.

   The calibration report screen appears. The slope will be between 0.8 and 1.2, and the offset will be between -0.2 and +0.2.

7. Press **OK**.
8. Remove the probe from the calibration chamber. Rinse it and return it to the process liquid.

6.4 Concentration calibration

Complete the following steps to do a concentration calibration of your RDO analyzer.

1. Calibrate the referree instrument following the manufacturer's instructions.
2. Immerse the referree sensor in the process liquid as close to the RDO probe as possible.
3. Allow adequate time for the referree sensor to come to equilibrium with the process liquid.
4. Once readings are stable, start the calibration. Select **Menu > Calibrate > RDO > Concentration**.
5. Enter the value from the referree instrument as the `Standard Value` shown on the display. Press **Enter**.

7 Maintenance

7.1 Analyzer

7.1.1 Cleaning the analyzer enclosure

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

⚠ CAUTION!

EQUIPMENT DAMAGE

Do not use organic solvents.

7.1.2 Replacing the dessicant

Periodically inspect the dessicant bag in the analyzer enclosure. Replace the dessicant (PN R0087630) when the indicator beads turn from blue to pink.

7.1.3 Replacing the clock battery

The clock battery is located at the bottom of the back of the enclosure cover. To replace the battery:

1. Disconnect AC power to the instrument.
2. Remove the enclosure cover.
3. Remove the clock battery and replace it with a 3 V MnO_2-Li battery, CR2032 or equivalent.
4. Dispose of spent battery properly.
5. Replace the cover.
6. Restore AC power.

7.2 RDO probe

7.2.1 Cleaning the sensing cap

Complete the following steps to clean the sensing cap.

Important

Leave the sensing cap and cone attached to the probe body. Do not remove the sensing cap to clean it.

Procedure

1. Rinse the cap with clean water from a squirt bottle.
2. If biofouling is present, gently wipe the cap with a soft-bristeled brush or soft cloth. If oil or grease is present, wash with a gentle detergent.
3. If extensive fouling or mineral build-up is present, soak the cap of the sensor - do not remove the sensing cap - in vinegar for 15 minutes; then soak in deionized water for 15 minutes.

   ⚠ CAUTION!

   EQUIPMENT DAMAGE

   Do not use organic solvents.

4. After cleaning the sensor, check the calibration in the air. Perform a one or two-point saturation calibration if necessary.

7.2.2 Cleaning the probe body

Complete the following steps to clean the RDO probe body.
Leave the sensing cap and nose cone attached to the probe body while cleaning it. Do not remove the sensing cap.

Procedure

1. Gently scrub the probe body with a soft-bristled brush of a nylon dish scrubber. Use a mild detergent to remove oil or grease.
2. Soak in vinegar followed by deionized water to remove mineral deposits or extensive fouling.

   See step 4 in *Section 7.2.1*.

7.2.3 Cleaning the optical window

Clean the optical window only when the sensing cap is replaced. See *Section 7.2.1*.

7.2.4 Replacing the sensing cap

The replacement sensing cap kit (PN R0084230X and PN R084230) contains a sensing cap, two O-rings, O-ring lubricant, and a lens wipe.

Note

Keep the cap in its sealed packaging until you are ready to install it. Install promptly. Avoid allowing moisture, including humidity, inside the cap.

Procedure

1. Remove the sensor from the process liquid. Rinse with water and dry the probe body and nose cone.
2. Unscrew the nose cone.
3. Pull the sensing cap straight off the probe body.

   Do not twist.
4. Remove and discard the existing O-rings.
5. Remove any moisture in the O-ring grooves.

   Be careful not to touch the lens.
6. Use your finger to apply a thin layer of lubricant around the O-ring grooves.

   ⚠ CAUTION!

   EQUIPMENT DAMAGE

   Be careful not to get grease on the lens or on the sensor pins.
7. Slide the two O-rings into grooves. Check that the O-rings are not twisted or pinched. Apply a thin layer of lubricant over the O-rings and grooves.

   ⚠ CAUTION!

   EQUIPMENT DAMAGE

   Be careful not to get grease on the lens or on the sensor pins.
8. Clean the lens with the wipe provided in the kit and allow it to dry thoroughly. Inspect the lens for scratches or dirt.
9. Remove the new sensing cap from its sealed packaging. Align the arrow on the cap with the index mark on the probe and firmly press the cap onto the probe, without twisting, until it seals. Replace the nose cone.
10. Perform a one or two-point saturation calibration.

7.2.5 Storing the probe

Store the probe in the calibration chamber using the storage cap (cap without notch). Place a few drops of water in the chamber before inserting the probe.

7.3 Replacement parts

Part number	Description
R0094030	RDO analyzer, AC power, no data logging
R0086460X	RDO Pro-X sensor with 32 ft (10 m) of integral cable
R0082490X	RDO Pro-X sensor with twist lock connector
R0087560	RDO analyzer pipe and wall mounting kit
R00CBL10	Twist lock connector cable, 32 ft (10 m)
R00CBL20	Twist lock connector cable, 64 ft (20 m)
R00CBL30	Twist lock connector cable, 96 ft (30 m)
R0084230	RDO sensor cap replacement kit
R0080810	RDO O-ring replacement kit
R0080820	RDO replacement nose cone kit
R0088890	RDO replacement calibration cup
R00087630	RDO replacement dessicant bag for analyzer
R0084230X	RDO Pro-X sensor cap replacement kit

8 Specifications

8.1 RDO probe

Wetted materials	Delrin(1), ABS, Viton(2), titanium, polycarbonate/ poly(methyl, methacrylate) blend
Dimensions	Length: 8.0 in. (203 mm); Diameter: 1.9 in. (47 mm)
Rating	IP-67 with cap off; IP-68 with cap installed
Process connection	1-1/4 in. FNPT
Integral cable length	32 ft (10 m)
Maximum cable length (quick disconnect cable only)	4000 ft (1219 m)
Pressure	Up to 314 psig (2060 kPa abs)
Temperature	0 to 50 °C (32 to 122 °F)
Range	0 to 20 ppm (mg/L) or 0 to 200% saturation
Accuracy	±0.1 ppm between 0 and 8 ppm, ±0.2 ppm between 8 and 20 ppm
Resolution	0.01 ppm (mg/L)
Digital output	Modbus/RS485
Response time	30 sec to 90% of final value; 37 sec to 95% of final value (at 25 °C [77 °F])
Operating life of sensing cap	2 years from first reading
Safety directive	73/23/EEC
EU directives	2004/108/EC for electro-magnetic compatibility (EMC) and 72/23/EEC for Safety
Immunity	EN 61000-6-2, electromagnetic compatibility (EMC) part 6-2 CE
Emissions	Class A requirements of CISPR 11: 2004

(1) Delrin is a registered trademark of DuPoint DeNemours, LLC.

(2) Viton is a registered trademark of DuPoint Dow Elastomers, LLC.

8.2 RDO analyzer

Enclosure	Polycarbonate, rated NEMA 4X, IP67
Dimensions (W x H x D)	6.3 x 6.3 x 3.6 in. (16 x 16 x 9.0 cm)
Display	Liquid crystal; character height: 0.4 in. (6 mm)
Mounting	Suitable for pipe or wall mounting

Conduit openings	Six; PG 13.5 (1/2 in.); three gland fittings and five plugs ship with the analyzer
Ambient temperature and humidity	-20 to 70 °C (-4 to 158 °F); 95% relative humidity (non-condensing)
Power	100 to 240 Vac, approximately 0.15 A, 50 - 60 Hz
Analog outputs	Two fully scalable 4-20 mA outputs, each loop-powered (9-36 Vdc)
Digital output	Modbus/RS485
Relays	Two low voltage relays, <50 Vac or Vdc, maximum current 2 A (resistive or inductive) two high voltage relays, 264 Vac max, maximum current 5 A (resistive or inductive)
Barometric pressure range	8.86 to 29.53 in Hg (300 to 1000 mbar)
Barometric presssure accuracy	±0.09 in Hg (±3 mbar)
EU directive	2004/108/EC for electromagnetic compatibility (EMC)P
Immunity	EN61000-6-2, electromagnetic compatibility (EMC) part 6-2
Emissions	EN61000-6-4 electromagnetic compatibility; includes IEC/EN61000-3-2 and IEC/EN61000-3-3 where applicable
Safety	UL 61010-1 and CAN/CSA C22.2 #61010-1

LIQ-MAN-RDO
Rev B
2017

www.Emerson.com/RosemountLiquidAnalysis
Emerson Automation Solutions
8200 Market Blvd
Chanhassen, MN 55317
Toll Free +1 800 999 9307
F +1 952 949 7001
liquid.csc@emerson.com
www.Emerson.com/RosemountLiquidAnalysis

EUROPE
Emerson Automation Solutions
Neuhofstrasse 19a P.O. Box 1046
CH-6340 Baar
Switzerland
T + 41 (0) 41 768 6111
F + 41 (0) 41 768 6300
liquid.csc@emerson.com
www.Emerson.com/RosemountLiquidAnalysis

MIDDLE EAST AND AFRICA
Emerson Automation Solutions
Emerson FZE
Jebel Ali Free Zone
Dubai, United Arab Emirates, P.O. Box 17033
T +971 4 811 8100
F +971 4 886 5465
liquid.csc@emerson.com
www.Emerson.com/RosemountLiquidAnalysis

ASIA-PACIFIC
Emerson Automation Solutions
1 Pandan Crescent
Singapore 128461
Singapore
T +65 777 8211
F +65 777 0947
liquid.csc@emerson.com
www.Emerson.com/RosemountLiquidAnalysis

ROSEMOUNT™

EMERSON™