Reference Manual
00809-0100-3581, Rev AC
October 2019

Rosemount™ 5081

Explosion Proof, Single-Input Intelligent Transmitter

ROSEMOUNT™

EMERSON™

Essential instructions

Read this page before proceeding!

Emerson designs, manufactures, and tests its products to meet many national and international standards. Because these instruments are sophisticated technical products, you must properly install, use, and maintain them to ensure they continue to operate within their normal specifications. The following instructions must be adhered to and integrated into your safety program when installing, using, and maintaining Emerson products. Failure to follow the proper instructions may cause any one of the following situations to occur: loss of life, personal injury, property damage, damage to this instrument, and warranty invalidation.

- Read all instructions prior to installing, operating, and servicing the product.
- If this Reference Manual is not the correct one, call 1-800-854-8257 or 949-757-8500 to request the correct Reference Manual. Save this Reference Manual for future reference.
- If you do not understand any of the instructions, contact your Emerson representative for clarification.
- Follow all warnings, cautions, and instructions marked on and supplied with the product.
- Inform and educate your personnel in the proper installation, operation, and maintenance of the product.
- Install equipment as specified in the installation instructions of the appropriate Reference Manual and per applicable local and national codes. Connect all products to the proper electrical and pressure sources.
- To ensure proper performance, use qualified personnel to install, operate, update, program, and maintain the product.
- When replacement parts are required, ensure that qualified people use replacement parts specified by Emerson. Unauthorized parts and procedures can affect the product's performance, place the safe operation of your process at risk, and VOID YOUR WARRANTY. Look-alike substitutions may result in fire, electrical hazards, or improper operation.
- Ensure that all equipment doors are closed and protective covers are in place, except when maintenance is being performed by qualified people, to prevent electrical shock and personal injury.

⚠ WARNING

Physical access

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

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

Notice

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Contents

1 Start-up

Procedure

1. Using the infrared remote control (IRC), press **PROG**, **NEXT**, **NEXT**, and **ENTER** in this order.
2. Select the measurement type and unit of measurement.
3. Use the arrow keys to toggle between Celsius and Fahrenheit.
4. Press **ENTER** and then **RESET**.
5. Press **PROG**, **NEXT**, and **ENTER** in this order.
6. Use the arrow keys to toggle T AUTO between ON or OFF.

   This determines whether the transmitter uses the process temperature (ON) or a manual temperature (OFF).
7. Press **ENTER**.
8. If you select OFF, enter the manual temperature desired using the arrow keys.
9. Press **ENTER**.

2 Description and specifications

2.1 Features and applications

The Rosemount™ 5081 includes the following features:

General

The Rosemount 5081 explosion-proof transmitter is a loop powered device with a robust design that serves several industrial, commercial, and municipal applications. It offers a local operator interface (LOI) that can display values from a single measurement input. This transmitter is compatible with a multitude of analytical sensors.

Analytical measurements

- pH/ORP
- Contacting conductivity
- Toroidal conductivity
- Dissolved oxygen
- Ozone
- Chlorine

Maintenance features

- Automatic two-point buffer calibration routine
- Automatic recognition of resistance temperature device (RTD)
- Sensor diagnostics

Diagnostics

Continuous monitoring of sensor performance along with warnings and fault messages to alert the user of failures.

Enclosure

Explosion-proof and corrosion resistant

2.2 General specifications

Table 2-1: General Specifications

Housing	Cast aluminum with epoxy coating. NEMA® 4X(IP65) and NEMA7B. Neoprene O-ring seals.
Dimensions	6.3 x 6.9 x 6.4 in. (160.5 x 175.3 x 161.3 mm) See the engineering drawings in Engineering Drawings.
Conduit openings	¾-in. female national pipe thread (FNPT)
Ambient temperature	-4 to 149 °F (-20 to 65 °C)

Table 2-1: General Specifications *(continued)*

Storage temperature	-22 to 176 °F (-30 to 80 °C)
Relative humidity	0 to 95% (non-condensing)
Weight / shipping weight	10 lb./11 lb. (4.5 kg/5.0 kg)
Display	First line: 7 segment LCD, 0.8 in. (20 mm) high. This line shows process variables (pH/ORP, contacting conductivity, toroidal conductivity, etc.) Second line: 7 segment LCD, 0.3 in. (7 mm) high. This line shows process temperature, output current, warnings, faults, and messages during calibration/programming. Display board can be rotated 90 degrees clockwise or counterclockwise if desired.
Temperature resolution	0.1 °C
Hazardous location approval	For details, see Rosemount 5081 - (A/P/C/T) product certifications.
RFI/EMI	Meets all industrial requirements of EN61326.
Diagnostics (may slightly vary based on measurement type)	• Calibration error • Low temperature error • High temperature error • Sensor failure • Line failure • CPU failure • Calibration error • Zero error • Temperature slope error • Sensor failure • ROM failure • Input warning Once one of the above warnings/faults are diagnosed, the LOI will display a message describing the failure detected.

Table 2-2: HART® Digital Communications

Power and load requirements	Supply voltage at the transmitter terminals should be at least 12 Vdc. Power supply voltage should cover the voltage drop on the cable plus the external load resistor required for HART communications (250 Ohms minimum). Minimum power voltage is 12 Vdc. Maximum power voltage is 42.4 Vdc (30 Vdc for intrinsically safe operation). Figure 4-1 shows the supply voltage required to maintain 12 Vdc (upper line) and 30 Vdc (lower line) at the transmitter terminals when the current is 22 mA.
Analog output	Two-wire, 4-20 mA output with superimposed HART digital signal, scalable over the operating range of the sensor.
Output accuracy	±0.05 mA

Table 2-2: HART® Digital Communications *(continued)*

Variables assignable to	• pH • Temperature • mV • Glass impedance • Reference impedance • RTD resistance • Oxidation reduction potential (ORP) • Conductivity • Resistivity • Concentration • Raw conductivity • Chlorine • Dissolved oxygen • Dissolved ozone

Table 2-3: FOUNDATION™ Fieldbus Digital Communications

Power and load requirements	A power supply voltage of 9-32 Vdc at 22 mA is required.
AI blocks assignable to	• pH • Temperature • mV • Glass impedance • Reference impedance • RTD resistance • ORP • Conductivity • Resistivity • Concentration • Raw conductivity • Chlorine • Dissolved oxygen • Dissolved ozone

2.3 Rosemount 5081 - (A/P/C/T) product certifications

Rev 1.0

2.3.1 European Directive Information

A copy of the EU Declaration of Conformity can be found at the end of the Quick Start Guide. The most recent revision of the EU Declaration of Conformity can be found at Emerson.com/Rosemount.

2.3.2 Ordinary Location Certification

As standard, the Power Module has been examined and tested to determine that the design meets the basic electrical, mechanical, and fire protection requirements by a nationally recognized test laboratory (NRTL) as accredited by the Federal Occupational Safety and Health Administration (OSHA).

2.3.3 Installing equipment in North America

The US National Electrical Code® (NEC) and the Canadian Electrical Code (CEC) permit the use of Division marked equipment in Zones and Zone marked equipment in Divisions. The marking must be suitable for the area classification, gas, and temperature class. This information is clearly defined in the respective codes.

2.3.4 USA

FM hazardous locations

Certificate	FM17US0021X
Standards	FM Class 3600:2011, FM Class 3610:2015, FM Class 3611:2016 FM Class 3615:2006, FM Class 3810:2005, ANSI/NEMA 250:1991
Markings	Intrinsically safe for use in Class I, II, and III, Division 1, Groups A, B, C, D, E, F, and G; T4 Ta = -20 °C to 70 °C; per control drawing numbers 1400676; 1400677 Nonincendive for Class I, Division 2, Groups A, B, C, and D; T4 Ta = -20 °C to 70 °C; per control drawing numbers 1400676; 1400677 Dust-ignitionproof for use in Class II and Class III, Division 1, Groups E, F, and G; T6 Ta = -20 °C to 70 °C;per control drawing number 1400678 Explosionproof for use in Class I, Div 1, Groups B, C, and D; T6 Ta = -20 °C to 70 °C; per control drawing number 1400678 Type 4X

Special Conditions for Safe Use (X):

1. The Rosemount 5081-T conductivity transmitters shall only be used with the Rosemount 222, 225, 226, 228 (1 in. and 2 in. only) and 245 toroidal sensors.

2.3.5 Canada

CSA hazardous locations

Certificate	1132747
Standards	C22.2 No. 0-M1987, C22.2 No. 25-1966, C22.2 No. 30-M1986 C22.2 No. 94-M91, C22.2 No 142-M1987, C22.2 No. 157-92, C22.2 No. 213-M1987
Markings	Intrinsically safe for Class I Groups A, B, C, and D; Class II Groups E, F, and G; Class III; T4 Tamb = 70 °C, per installation drawing 1400674 and 1400675 Non-incendive for Class I, Div. 2 for Groups A, B, C, and D; Class II, Div. 2, Groups F and G; Class III; T4 Tamb = 70 °C, per installation drawing 1400674 and 1400675 (Rosemount 5081-A/P/C/T) and per 1700462 (Rosemount 5081-T) Explosion-proof for Class I, Groups B, C, and D; Class II, Groups E, F, and G, Class III, T6 Tamb = 70 °C Type 4X

2.3.6 Europe

Rosemount 5081-A and 5081-P liquid transmitters

ATEX

Certificate	BAS02ATEX1284X
Standards	EN 60079-0:2012+A11:2013 EN 60079-11:2012
Markings	II 1 G Ex ia IIC T4 Ga (-20 °C ≤ Ta ≤ +65 °C)

Special Conditions for Safe Use (X):

1. The Rosemount 5081 enclosure may be made of aluminum alloy and given a protective polyurethane paint finish; however, care should be taken to protect it from impact or abrasion of located in a zone 0.

Rosemount 5081-C liquid transmitter

ATEX

Certificate	Baseefa03ATEX0099X
Standards	EN 60079-0:2012+A11:2013 EN 60079-11:2012

Markings Ⓔx II 1 G
Ex ia IIC T4 Ga
(-20 °C ≤ Ta ≤ +65 °C)

Special Conditions for Safe Use (X):

1. The equipment enclosure may contain light metals. The equipment must be installed in such a manner as to minimize the risk of impact or friction with other metal surfaces.

Rosemount 5081-T liquid transmitter

ATEX

Certificate	Baseefa03ATEX0399X
Standards	EN 60079-0:2012+A11:2013 EN 60079-11:2012
Markings	Ⓔx II 1 G Ex ia IIC T4 Ga (-20 °C ≤ Ta ≤ +65°C)

Special Conditions for Safe Use (X):

1. The equipment may contain light metals. The equipment must be installed in such a manner as to minimize the risk or impact or friction with other metal surfaces.

2.3.7 International

IECEx

Certificate	IECEx BAS 09.0159X
Standards	IEC 60079-0:2011 IEC 60079-11:2011
Markings	Ex ia IIC T4 Ga (-20 °C ≤ Ta ≤ +65°C)

Special Conditions for Safe Use (X):

1. The Rosemount 5081 enclosure may be made of aluminum alloy and given a protective polyurethane paint finish; however, care should be taken to protect it from impact or abrasion if located in a zone 0 environment.

2.4 Functional specifications

The sections below display the specifications for measuring different substances with the Rosemount 5081.

2.4.1 pH/ORP specifications

pH range	0 to 14
ORP range	-1400 to +1400 mV
Calibration/standardization	The automatic buffer recognition uses stored buffer values and their temperature curves for the most common buffer standards available worldwide. The transmitter also performs a stabilization check on the sensor in each buffer. To make a manual two-point calibration, immerse the sensor in two different buffer solutions and enter the pH values. The microprocessor automatically calculates the slope which is used for self-diagnostics. The transmitter displays an error message if the pH sensor is faulty. The operator can read the slope on the display and/or manually adjust it if desired. To complete an on-line, one-point standardization process, enter the pH or ORP value of a grab sample as measured by a lab reference.
Preamplifier location	Use a preamplifier to convert the high impedance pH electrode signal to a low impedance signal for transmitter use. Use the transmitter's integral preamplifier when the sensor to transmitter distance is less than 15 ft. (4.5 m). Use a sensor with a built-in preamplifier or a junction box if distance is longer than 15 ft. (4.5 m).
Automatic temperature compensation	External 3 or 4 wire Pt 100 resistance temperature device (RTD) or Pt 1000 RTD, located in the sensor, compensates the pH reading for temperature fluctuations. Compensation covers the range 5 to 270 °F (-15 to 130 °C). The operator may also select manual temperature compensation.
Accuracy	±01 mv at 77 °F (25 °C) ± 0.01 pH
Repeatability	±01 mv at 77 °F (25 °C) ±0.01 pH
Stability	0.25% / year at 77 °F (25 °C)

2.4.2 Contacting conductivity specifications

Measured range	0-20,000 µS/cm
Calibration	To calibrate, immerse the sensor in a known solution and enter its value or enter the cell constant for ultra-pure applications.
Automatic temperature compensation	3-wire Pt 100 or Pt 1000 resistance temperature device (RTD) Conductivity: 32 to 392 °F (0 to 200 °C) Resistivity: 32 to 212 °F (0 to 100 °C) Low conductivity: 32 to 212 °F (0 to 100 °C)
Accuracy	± 0.5% of reading and ±0.001 µS/cm

Repeatability	± 0.25% of reading
Stability	0.25% of output range/month, non-cumulative
Ambient temperature coefficient	± 0.05% of reading/°C
Temperature slope adjustment	0 to 5%/°C
Other temperature compensation algorithms	Ultra-pure water compensation Cation conductivity Raw (uncompensated) conductivity
Compatible RTD	100 Ohm or 1000 Ohm with automatic recognition

2.4.3 Toroidal conductivity specifications

Measured range	50 to 2,000,000 µS/cm
Calibration	To calibrate, immerse the sensor in a known solution and enter its value.
Automatic temperature compensation	3-wire Pt 100 resistance temperature device (RTD) Conductivity: 32 to 392 °F (0 to 200 °C) % concentration: 32 to 212 °F (0 to 100 °C)
Accuracy	±1.0% of reading
Repeatability	±0.25% of reading
Stability	0.25% of output range/month, non-cumulative
Ambient temperature coefficient	±0.2% of FS/°C
Temperature slope adjustment	0 to 5% / °C
% concentration ranges	Sodium hydroxide: 0 to 15% Hydrochloric acid: 0 to 16% Sulfuric acid: 0 to 25% and 96 to 99.7%

2.4.4 Dissolved oxygen specifications

Measurement range	0 - 99 ppm (mg/L), 0 - 200 saturation
Resolution	0.01 ppm, 0.1 ppb for Rosemount 499ATrDO sensor
Temperature correction for membrane permeability	Automatic between 32 and 122 °F (0 and 50 °C). Can be disabled.
Calibration	Air calibration (user must enter barometric pressure) or calibration against a standard instrument

2.4.5 Free chlorine specifications

Measurement range	0-20 ppm (mg/L) as Cl_2
Resolution	0.001 ppm (auto-ranges at 0.999 to 1.00 and 9.99 to 10.0)
Temperature correction for membrane permeability	Automatic between 32 and 122 °F (0 and 50 °C). Can be disabled.

pH correction	Automatic between pH 6.0 and 9.5. Manual pH correction is also available.
Calibration	Calibrate against grab sample with portable test kit.

2.4.6 Total chlorine specifications

Measurement range	0-20 ppm (mg/L) as Cl_2
Resolution	0.001 ppm (auto-ranges at 0.999 to 1.00 and 9.99 to 10.0)
Temperature correction for membrane permeability	Automatic between 41 and 95 °F (5 and 35 °C). Can be disabled.
Calibration	Calibrate against grab sample with portable test kit.

2.4.7 Ozone specifications

Measurement range	0-10 ppm (mg/L)
Resolution	0.001 ppm (auto-ranges at 0.999 to 1.00 and 9.99 to 10.0)
Temperature correction for membrane permeability	Automatic between 41 and 95 °F (5 and 35 °C). Can be disabled.
Calibration	Against grab sample analyzed using portable test kit.

2.4.8 Percent oxygen in gas

Measurement range	0 - 25% oxygen
Resolution	0.1% - TBD
Calibration	Air calibration (automatic measurement of barometric pressure with internal pressure sensor)
Sample pressure	0 to 50 psig
Sample temperature	32 to 110 °F (0 to 43 °C)

2.5 Ordering information

The Rosemount 5081 two-wire transmitter is intended for the determination of pH/ORP, conductivity (both contacting and toroidal), and for measurements using membrane-covered amperometric sensors (oxygen, ozone, and chlorine). For free chlorine measurements, which often require continuous pH correction, a second input for a pH sensor is available. Use a hand-held infrared remote controller to locally configure and calibrate the transmitter.

Rosemount 5081	**Smart two-wire microprocessor transmitter**
Option	**Description**
P	pH/ORP
C	Contacting conductivity

T	Toroidal conductivity
A	Amperometric (oxygen, ozone, and chlorine)
Option	**Description**
HT	Analog 4-20 mA output with superimposed HART® digital signal
FF	FOUNDATION™ Fieldbus digital output
FI	FOUNDATION Fieldbus digital input with FISCO
Option	**Description**
20	Infrared remote controller included
21	Infrared remote controller not included
Option	**Description**
60	No approval
67	FM approved intrinsically safe, non-incendive (when used with appropriate sensor and safety barrier), and explosion-proof
69	CSA approved intrinsically safe, non-incendive (when used with appropriate sensor and safety barrier), and explosion-proof
73	ATEX/IECEx approved intriniscally safe (when used with appropriate sensor and safety barrier)
Example	**5081-P-HT-20-67**

3 Install

3.1 Unpack and inspect

To unpack the instrument:

Procedure

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

   If items are missing, contact your local Customer Care representative
4. Save the shipping container and packaging.

   They can be used to return the instrument to the factory in case of damage.

3.2 Installation guidelines

1. The transmitter tolerates harsh environments. For best results, install the transmitter in an area where temperature extremes, vibrations, and electromagnetic and radio frequency interference are minimized or absent.
2. To prevent unintentional exposure of the transmitter circuitry to the plant environment, keep the security lock in place over the circuit end cap. To remove the circuit end cap, loosen the lock nut until the tab disengages from the cap end and then unscrew the cover.
3. The transmitter has two ¾-in. conduit openings, one on each side of the housing. Run sensor cable through the left side opening (as viewed from the wiring terminal end of the transmitter) and run power wiring through the right side opening.
4. Use water tight cable glands to keep moisture out of the transmitter.
5. If using conduit, plug and seal the connections at the transmitter housing to prevent moisture from getting inside the transmitter.

   ⚠ CAUTION

   Equipment damage

   Moisture accumulating in the transmitter housing can affect the performance of the transmitter and may void the warranty.
6. If the transmitter is installed some distance from the sensor, a remote junction box with preamplifier in the junction box or in the sensor may be necessary. Consult the sensor reference manual for maximum cable lengths.

3.3 Orient the display board

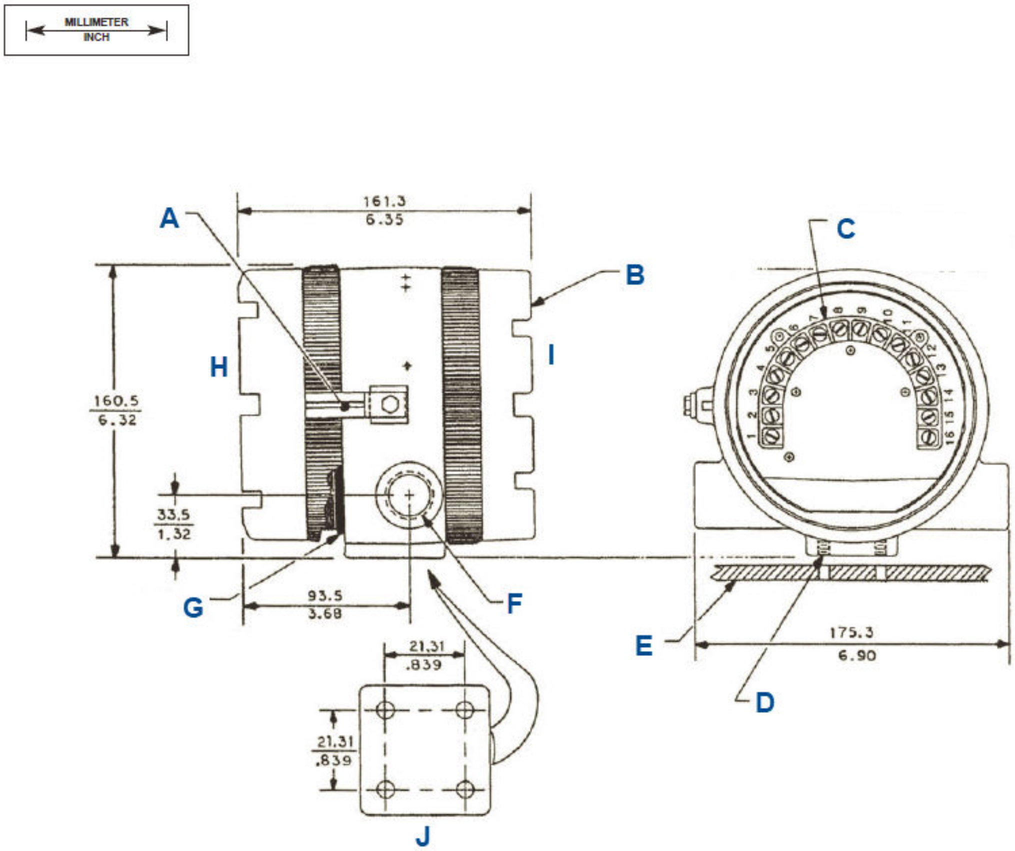
The display board can be rotated 90 degrees, clockwise or counterclockwise, from the original position. To reposition the display:

Procedure

1. Loosen the cover lock nut until the tab disengages from the circuit end cap. Unscrew the cap.
2. Remove the three bolts holding the circuit board stack.
3. Lift and rotate the display board 90 degrees, clockwise or counterclockwise, into the desired position.
4. Position the display board on the stand offs. Replace and tighten the bolts.
5. Replace the circuit end cap.

3.4 Mount on a flat surface

Figure 3-1: Mounting Transmitter on a Flat Surface

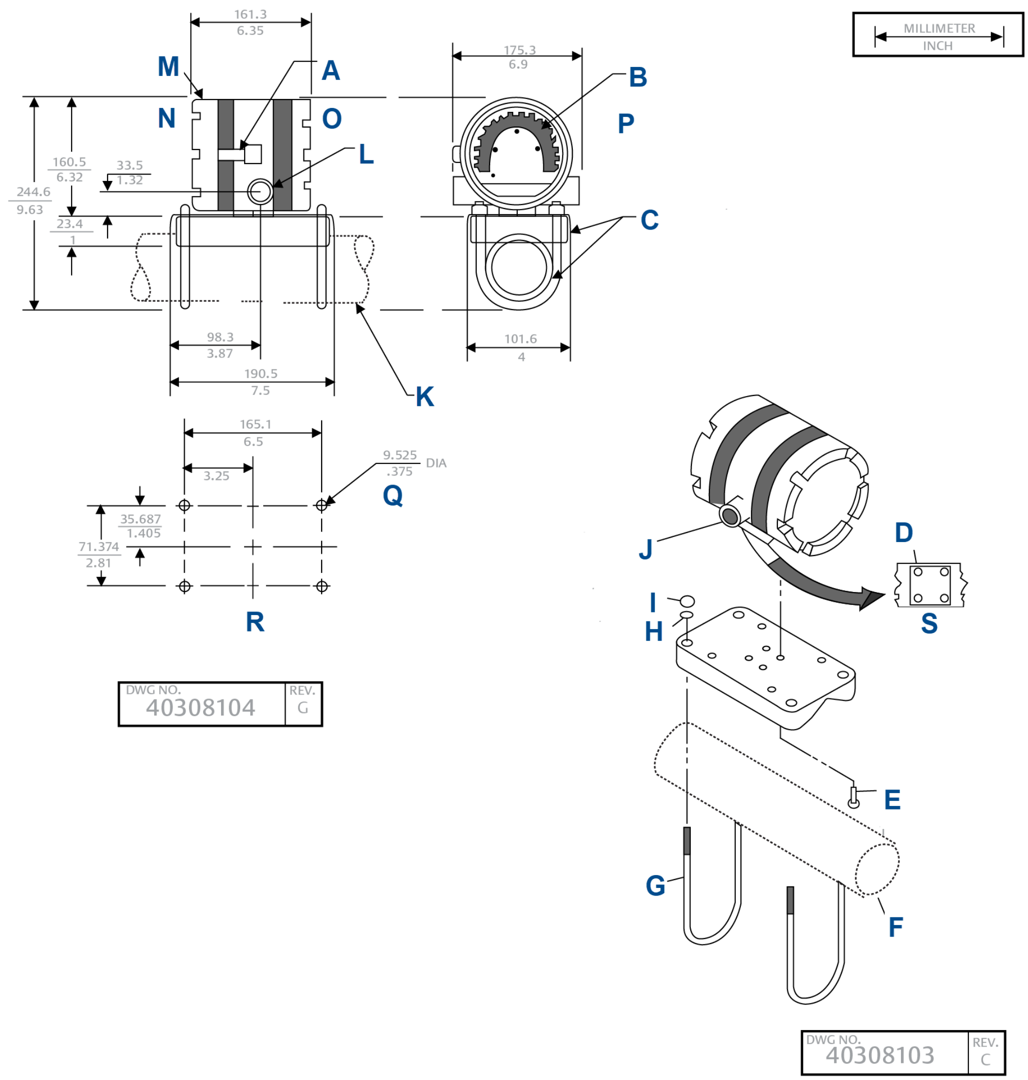


A. *Cover lock*
B. *Threaded cap (two places)*
C. *Terminal block (TB). Terminal end cap omitted for clarity this view.*
D. *¼-in. - 20 threads (four places)*
E. *Surface plate (by others)*
F. *O-ring (two places)*
G. *Circuit end*
H. *Terminal end*
I. *Flat surface mounting pad hole pattern*

3.5 Mount on a pipe

Use pipe mounting kit (23820-00 or 23820-01).

Figure 3-2: Mounting Transmitter on a Pipe



A. *Over look*
B. *Terminal block*
C. *Kit, 2-in. pipe/wall mounting bracket*
   Order PN2002577 as a separate item.
D. *½ - 20 threads*
E. *¼ - 20 screw*
   Screws furnished with mounting kit only. Not furnished with transmitter.
F. *1½-in. to 2-in. pipe (customer furnished)*
G. *U-bolt*

H. 5/16 washer
I. 6/18 - 18 nut
J. ¾ - 14 FNPT (two places)
K. 2-in. pipe supplied by customer
L. ¾ - 14 NPT (two places)
M. Threaded cap, two places
N. Circuit end
O. Terminal end
P. Terminal end cap omitted for clarity this view
Q. Four mounting holes
R. Bottom view

4 Wire

4.1 Wiring overview

To find wiring diagrams for specific sensors, check the wiring sections of the reference manuals for those particular sensors.

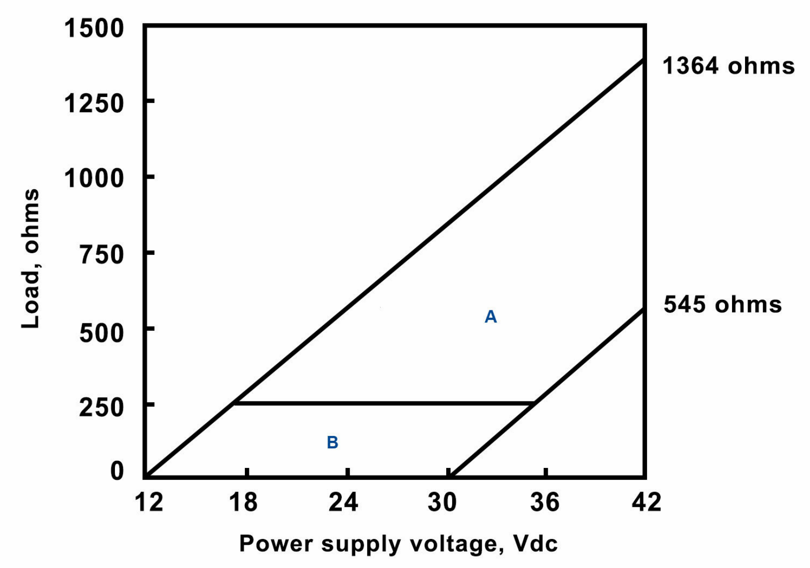
4.2 Power supply/current loop

4.2.1 Power supply overview

The tables below display the minimum and maximum voltages needed to operate the transmitter.

Minimum supply voltage at the transmitter terminals	12.0 Vdc
Minimum power supply for load resister	250 Ohms
Maximum power supply voltage	42.0 Vdc
Maximum power supply voltage for intrinsically safe installations	30.0 Vdc

Figure 4-1: Power Supply Voltage for HART® or without HART Communication Configurations



A. With HART communication
B. Without HART communication

Table 4-1: Values from Graph

Upper line	Power supply voltage needed to provide 12 Vdc at the transmitter terminals for a 22 mA current
Lower line	Power supply voltage needed to provide 30 Vdc for a 22 mA current
Maximum current	About 24 mA
Minimum load for digital communications	250 Ohms
Minimum power supply voltage to supply the 12.0 Vdc lift off voltage at the transmitter	17.5 Vdc

4.2.2 Wire to HART® or FOUNDATION™ Fieldbus communication protocol

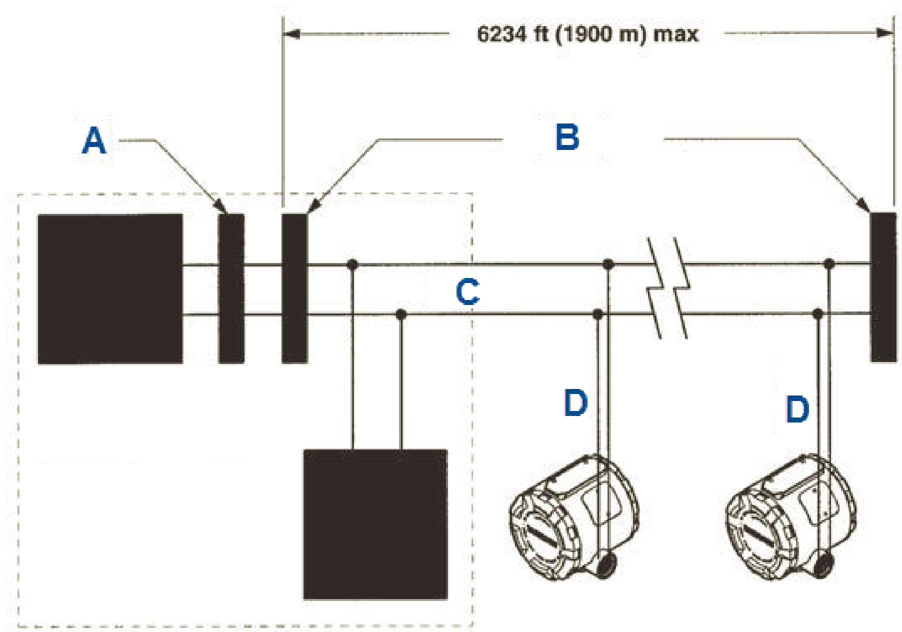
Procedure

1. Run the power/signal wiring through the opening nearest terminals 15 and 16.
2. Use shielded cable and ground the shield to the power supply.
3. To ground the transmitter, attach the shield to the grounding screw on the inside of the transmitter case.

   You can also use a third wire to connect the transmitter to earth ground.

   Note
   For optimum EMI/RFI immunity, shield the power supply and enclose it in an earth ground metal conduit. Do not run power supply/signal wiring in the same conduit or cable tray with AC power lines or with relay actuated signal cables. Keep power supply/signal wiring at least 6 ft. (2 m) away from heavy electrical equipment. An additional 0-1 mA current loop is available between TB-14 and TB-15. A 1 mA current in this loop signifies a sensor fault. See Figure 4-2 for wiring instructions. See Diagnostics and troubleshooting for more information about sensor faults.

Figure 4-2: General Wiring Architecture



A. Filter
B. Terminators
C. Trunk
D. Spur

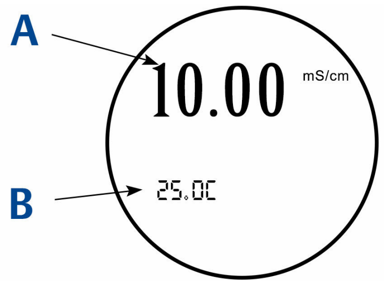
The power supply, filter, first terminator, and configuration device are typically located in the control room.

5 Display and operate

5.1 User interface and main display

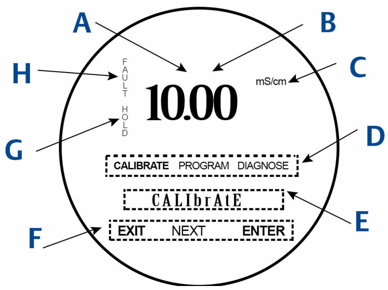
The following are examples of the main (process) display screen (Figure 5-1) and the program display screen (Figure 5-2).

Figure 5-1: Main Display Screen



A. Conductivity value
B. Temperature in °C or °F

Figure 5-2: Program Display Screen



A. Indicates HART® or FOUNDATION™ Fieldbus digital communiciations
B. Conductivity value
C. Units of display
D. Active menu: CALIBRATE, PROGRAM, or DIAGNOSE
E. Sub-menus, prompts, and diagnostic messages appear here.
F. Available commands for sub-menus, prompts, or diagnostic messages
G. Appears when transmitter is in hold
H. Appears when a disabling condition has occurred

5.2 Infrared remote control (IRC)

Use the IRC to read diagnostics messages, calibrate connected sensors, and program the transmitter. Hold the IRC within 6 ft. (1.8 m) of the transmitter and less than 15 degrees from the horizontal of the display window.

Figure 5-3: Infrared Remote Control (IRC) Functions

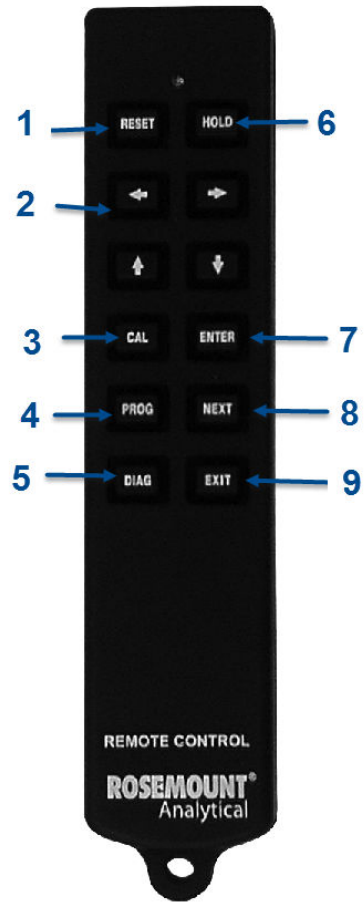
1. **RESET**
   - End current operation and return to the main display.
   - Changes are not saved.
   - Does not return the transmitter to factory default settings.

2. Editing (arrow) keys
   - Change values of a flashing display.
   - Left and right arrows move the cursor by one digit.
   - Up and down arrows increase or decrease the values and navigate through the display options.

3. **CAL**
   - Access to *Calibration* menu.

4. **PROG**
   - Access to *Program* menu.

5. **DIAG**
   - Access to diagnostics.



6. **HOLD**
   - Access to turn hold readings on or off.

7. **ENTER**
   - Advance to the next prompt.
   - Store selected item.
   - Store value in memory.

8. **NEXT**
   - Advance to the next sub-menu.

9. **EXIT**
   - End current operation.
   - Return to the first prompt in the present sub-menu.
   - Changes are not saved.

Guidelines for using IRC

- Do not use harsh chemicals or abrasive brushes when cleaning the remote control.
- If the green LED does not light when you press a key, the issue is probably a weak battery. To restore operation, remove four screws to access and replace the two batteries. Observe the two warning messages posted at the rear of the remote control.
- Requires two 1.5 V AAA batteries. If used in hazardous areas, replacement batteries must be Energizer E92/EN92 or Duracell MN2400/PC2400.
- All functions for remote control PN 24479-00 are the same as those for the previous remote control, PN 23572-00.

5.3 Menu system

There are three main menus: *Calibrate*, *Program*, and *Diagnose*. *Calibrate* and *Program* menus have additional sub-menus as shown in the figures below.

Table 5-1: Program Menu

Displayed item	Definition
OUtpUt	Current output menu header
4MA	4 mA current output (setpoint)
20MA	20 mA current output (setpoint)
HoLd	Current output on hold
FAULt	Fault condition current output setting
dPn	Current output dampening time
tESt	Current output test value
tAUtO	Automatic temperature compensation
tMAn	Manual temperature compensation
dISPLAY	Display menu header
tYP	Measurement type
tEMP	° C/° F toggle selection
OUtPUt	Current (mA) or percent of full scale display
COdE	Access code
OFFSt	Offset value

Figure 5-4: HART® pH Menu Tree

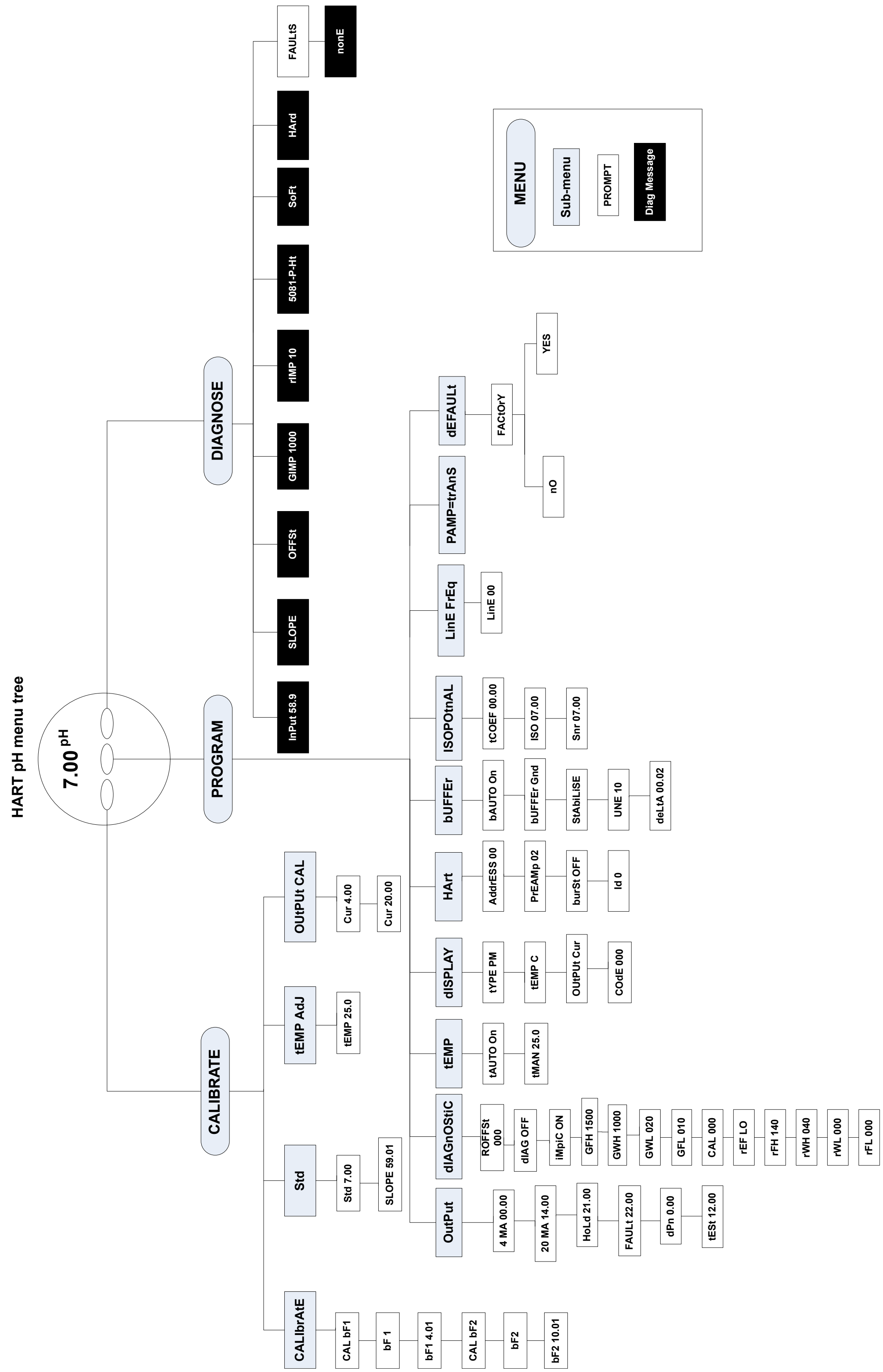


Figure 5-5: HART ORP Menu Tree

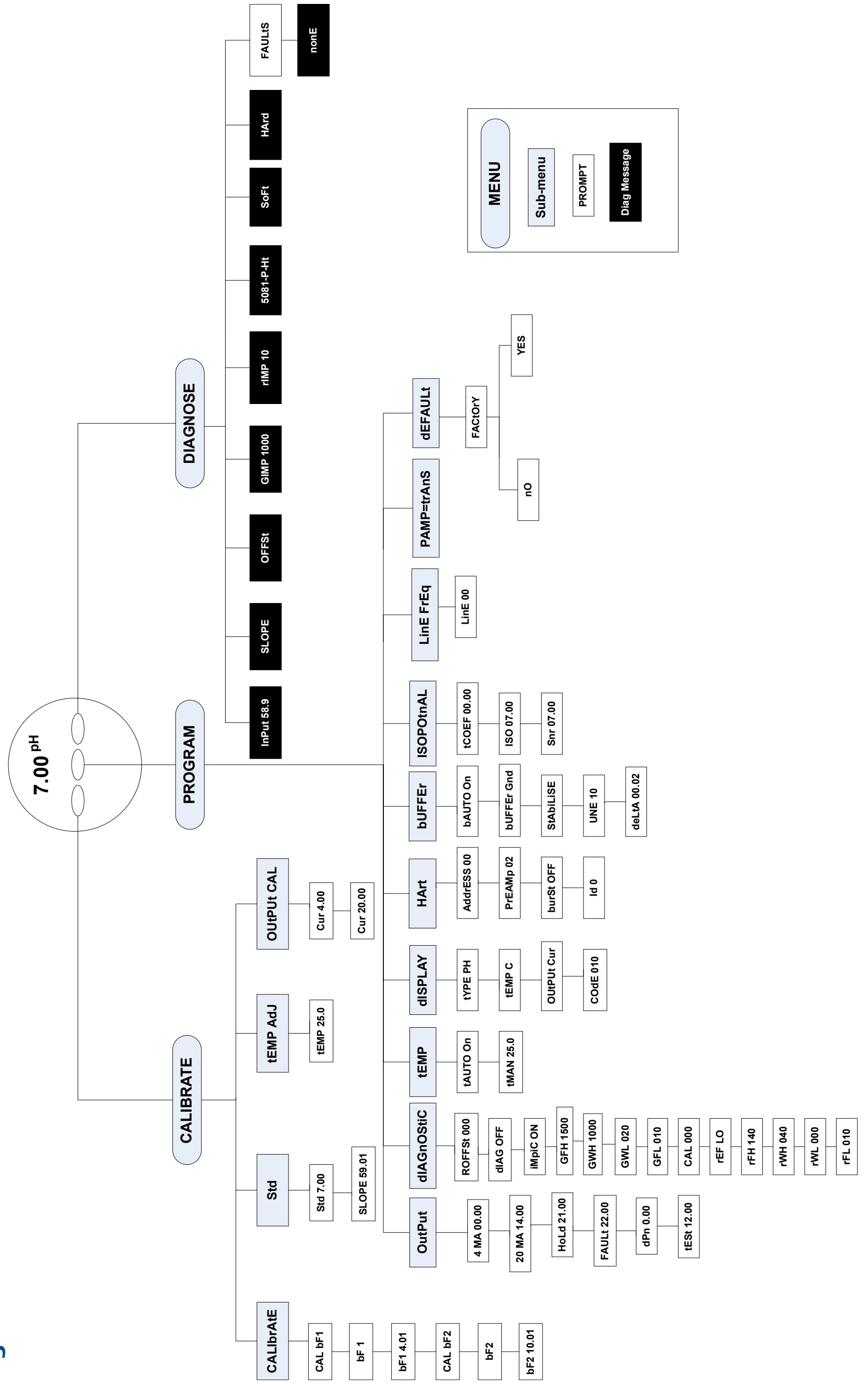


Figure 5-6: HART Contacting Conductivity Menu Tree

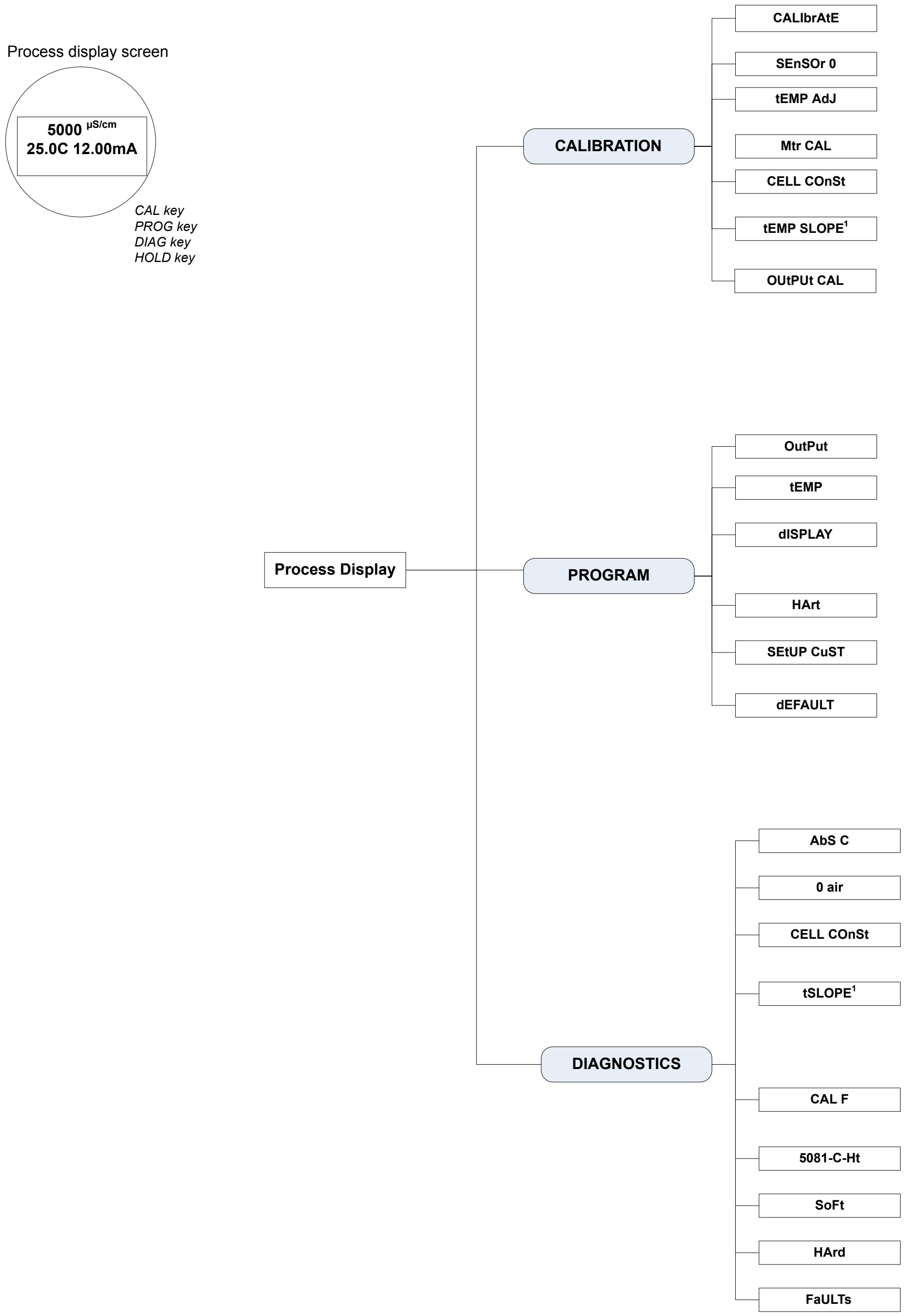


Figure 5-7: HART Toroidal Conductivity Menu Tree

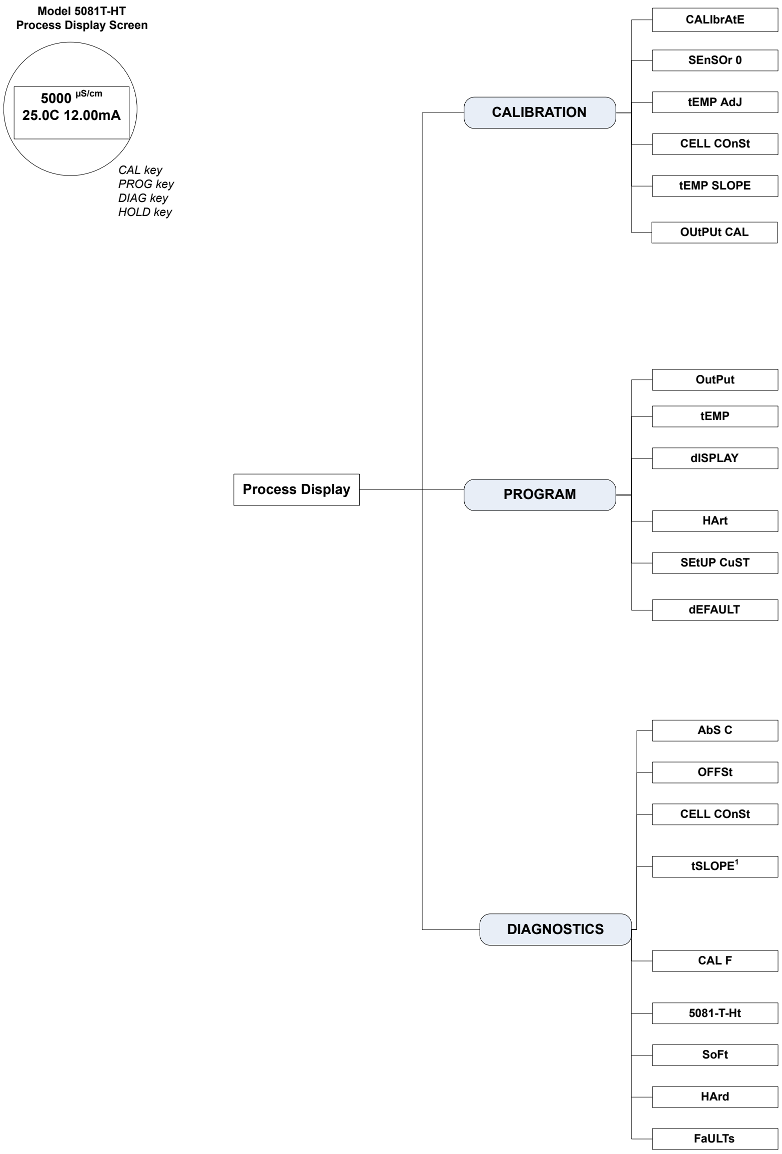


Figure 5-8: HART Chlorine, Dissolved Oxygen, and Ozone Menu Tree

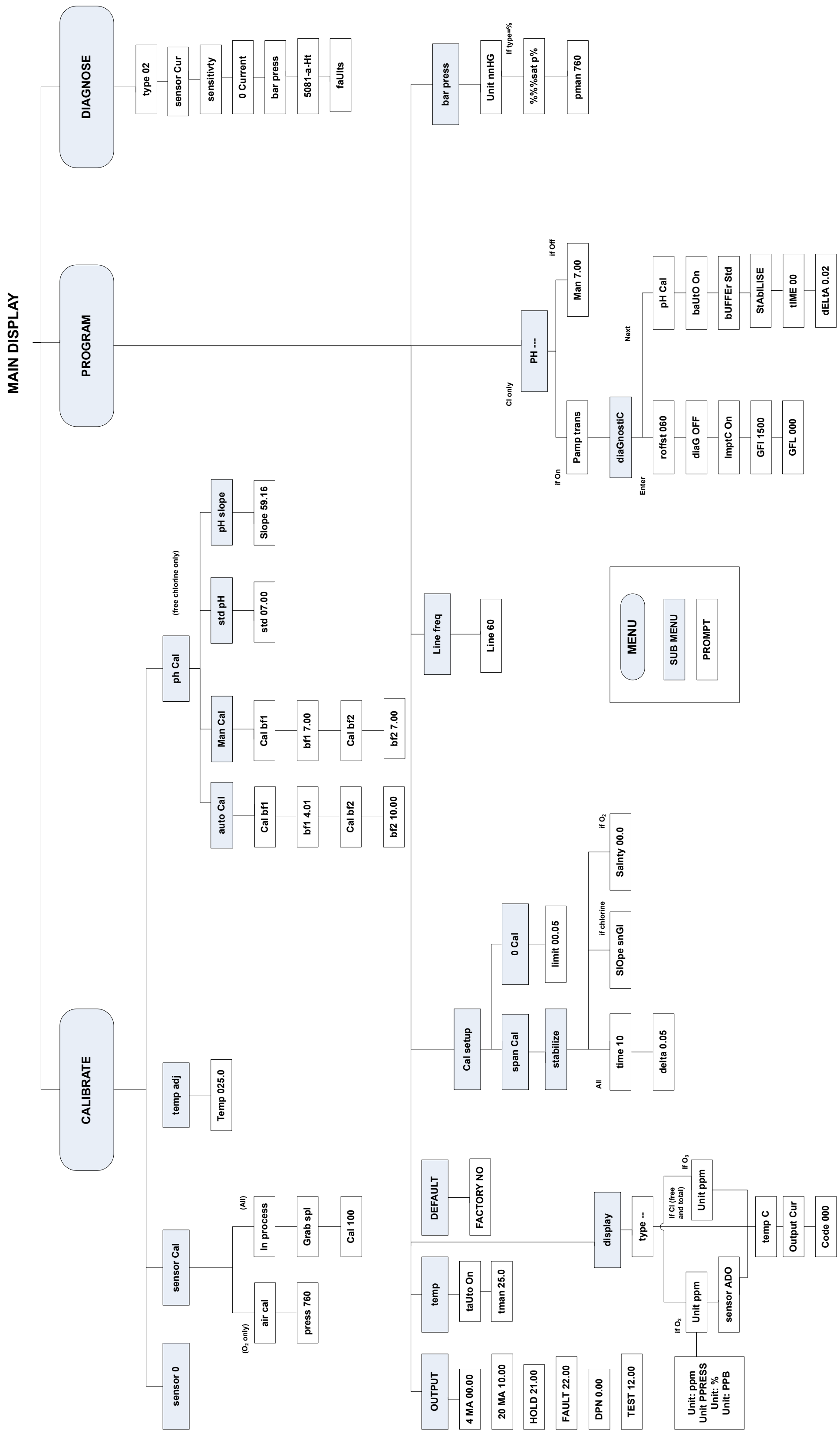


Figure 5-9: FOUNDATION™ Fieldbus pH Menu Tree

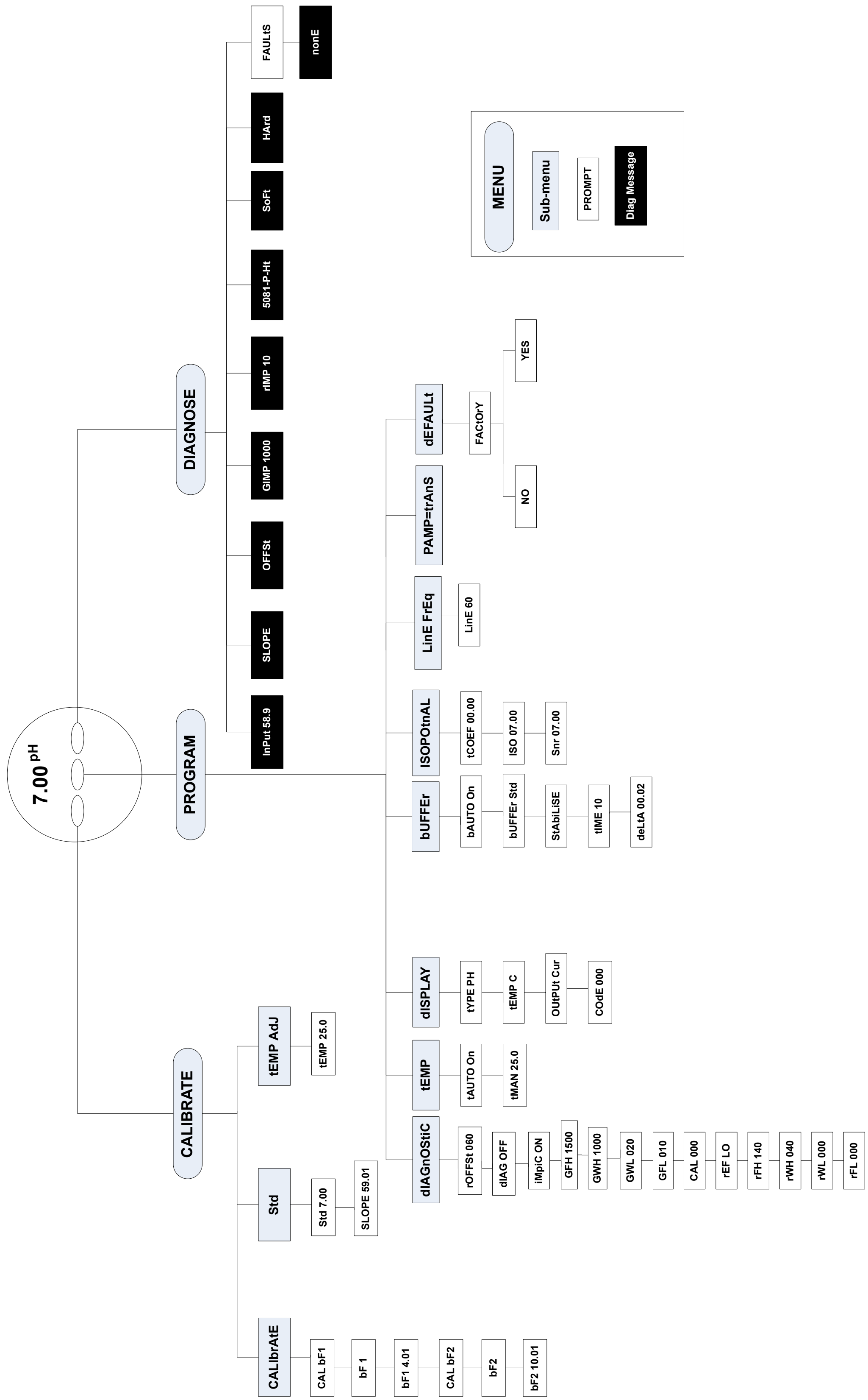


Figure 5-10: FOUNDATION Fieldbus ORP Menu Tree

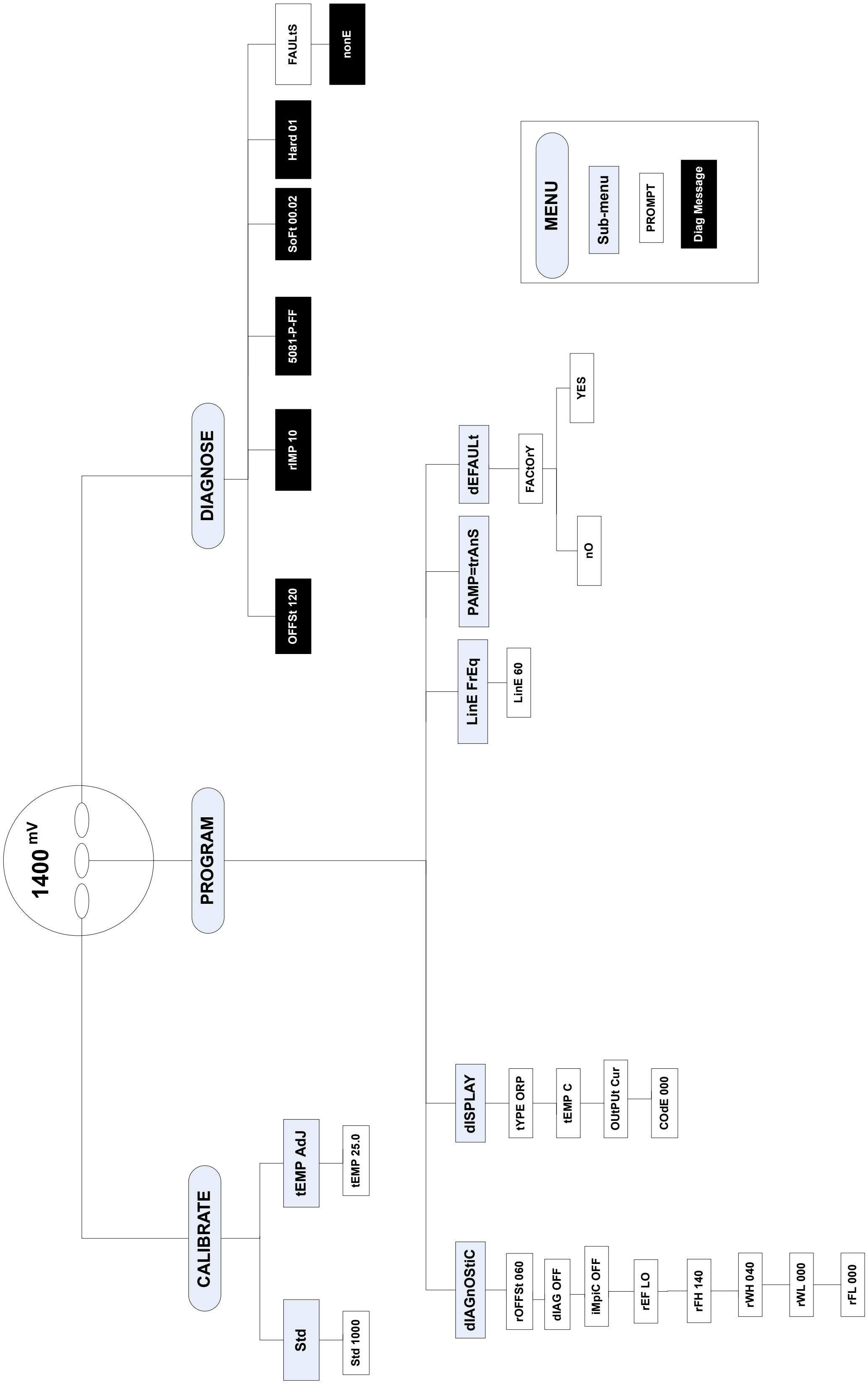


Figure 5-11: FOUNDATION Fieldbus Contacting Conductivity Menu Tree

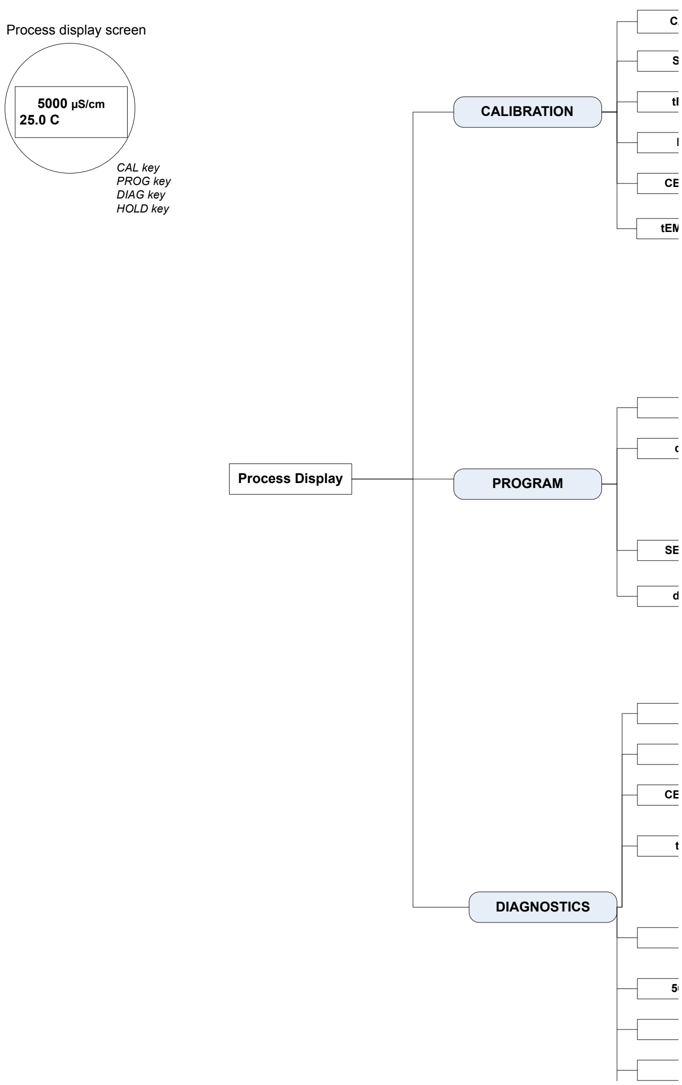


Figure 5-12: FOUNDATION Fieldbus Toroidal Conductivity Menu Tree

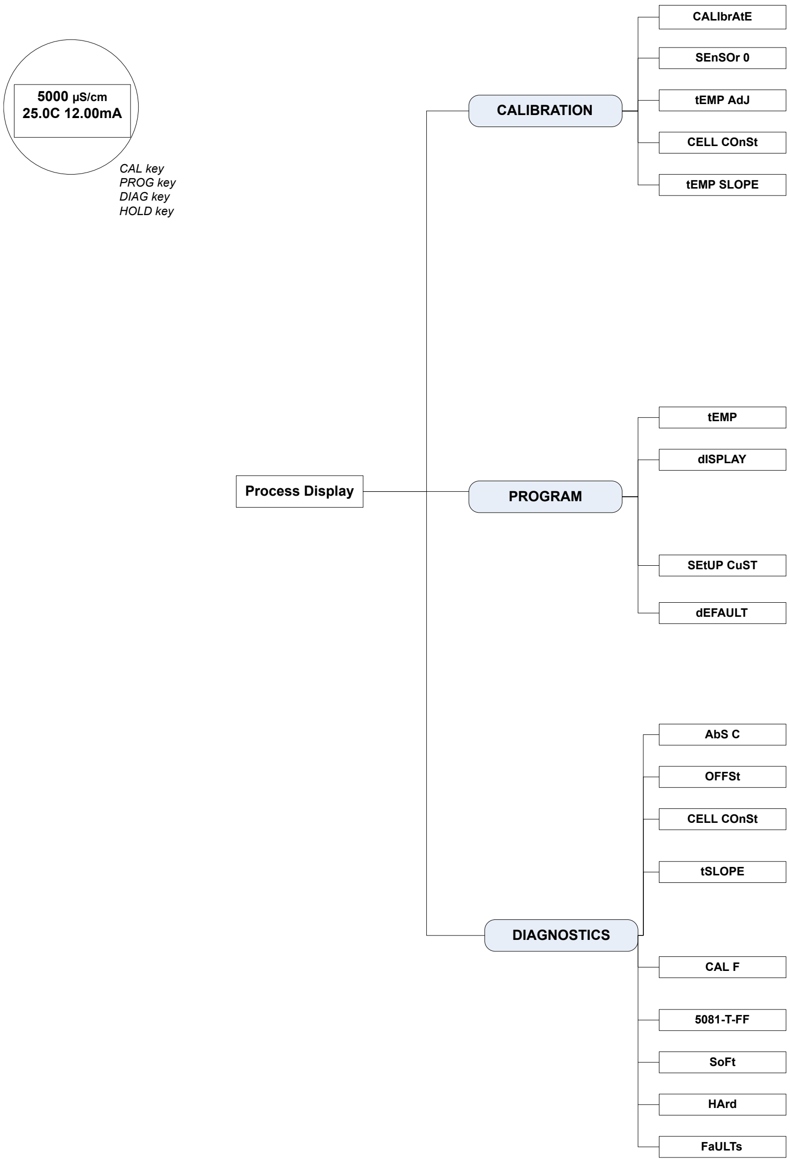
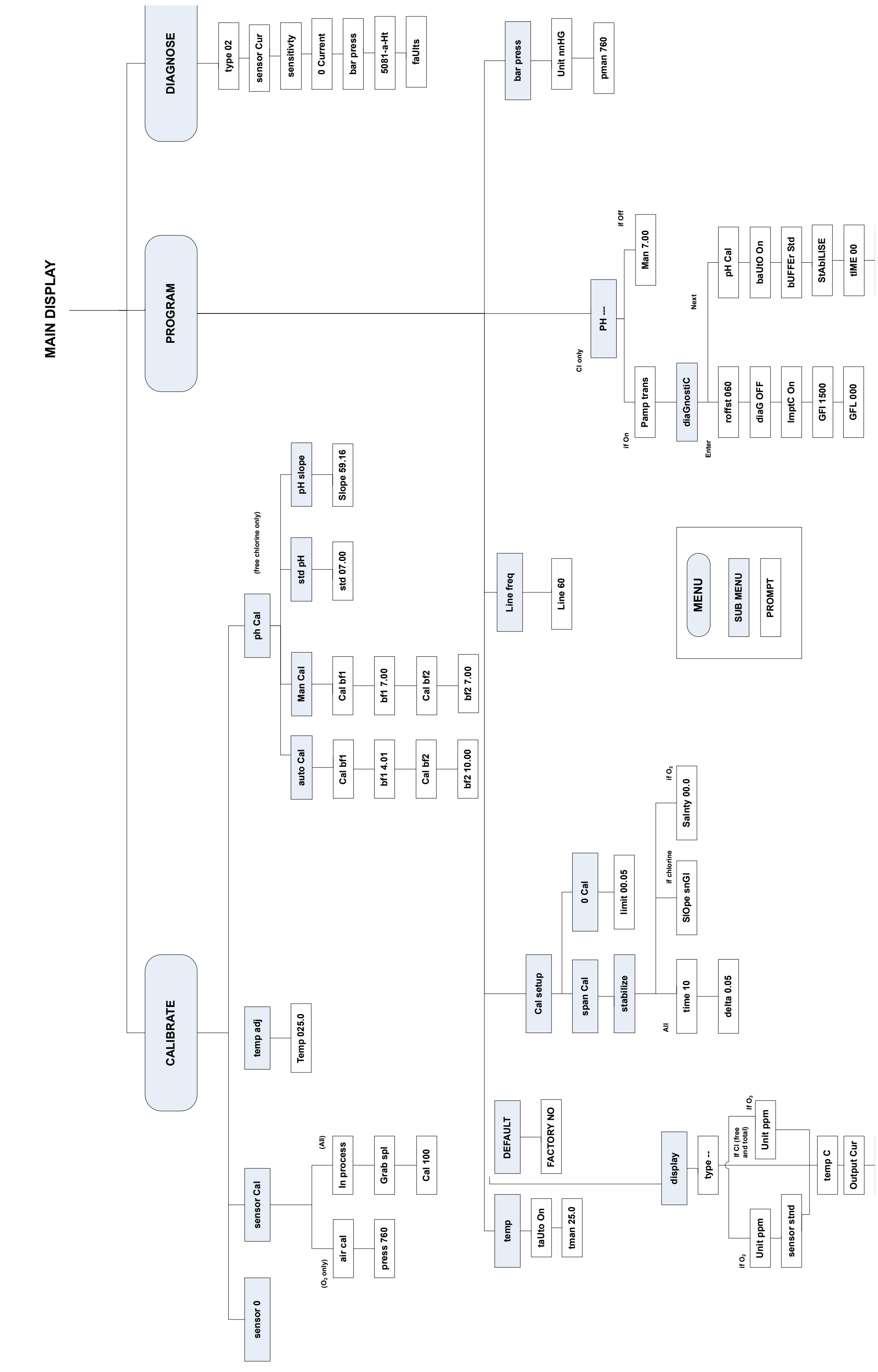


Figure 5-13: FOUNDATION Fieldbus Chorine, Dissolved Oxygen, and Ozone Menu Tree



6 Programming basics

6.1 Programming

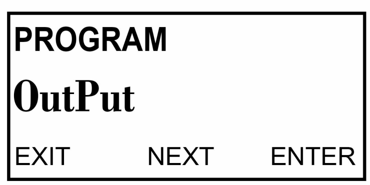
The following can be programmed in the Rosemount™ 5081:

- 4-20 mA outputs
- Current generated by the transmitter during hold
- Current generated by the transmitter when fault is detected
- Automatic temperature correction (enable or disable)
- Type of measurement
- Measurement range
- Factory default setting

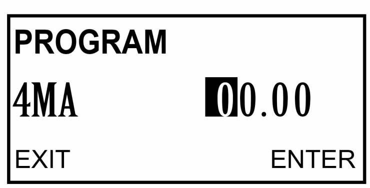
6.2 Test 4-20 mA outputs and current generated during hold and faults

Procedure

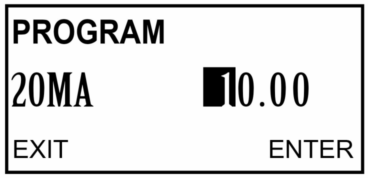
1. Press **PROG** on the remote controller.
   The *OUTPUT* submenu appears.



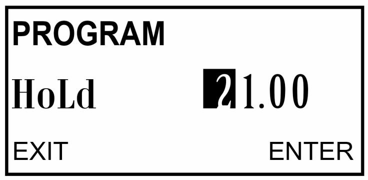
2. Press **ENTER**.
   The screen displays the `4mA` prompt.



3. Use the arrow keys to change the setting. Press **ENTER** to save.
   The screen displays the `20mA` prompt.



4. Use the arrow keys to change the setting. Press **ENTER** to save.
   The screen displays the `HOLD` prompt.



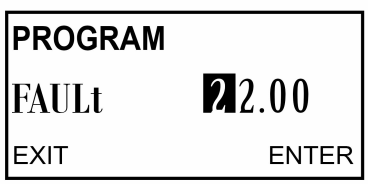
5. Use the arrow keys to change the setting to the output desired when the transmitter is in hold mode.

   The range is 3.80 to 22.0 mA. If you select 00.00, the transmitter will hold the output value.

6. Press **ENTER** to save.

   Note
   The hold setting overrides the fault setting.

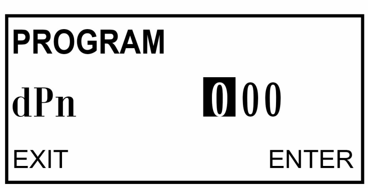
   The screen displays the `FAULT` prompt.



7. Use the arrow keys to change the setting to the output desired when the transmitter is in fault mode.

   The range is 3.80 to 22.0 mA. If you select 00.00, the transmitter will hold the output value.

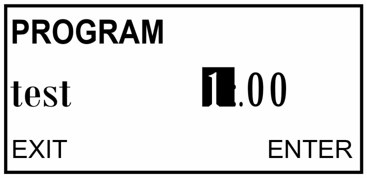
8. Press **ENTER** to save.
   The screen displays the `DPN` prompt.



9. Use the arrow keys to change the setting.

   The range is 0 to 225.

10. Press **ENTER** to save.
    The screen displays the `TEST` prompt.

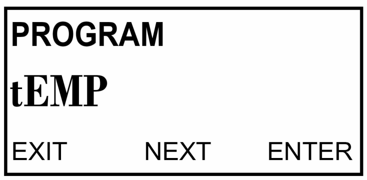


11. Use the arrow keys to enter the desired test current. Press **ENTER** to start the test. Press **EXIT** to end the test.
12. Press **RESET** to return to the main display.

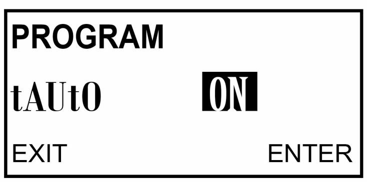
6.3 Correct temperature

Procedure

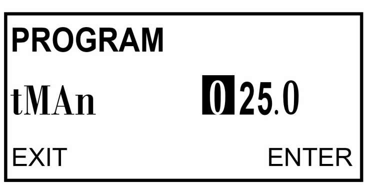
1. Press **PROG**. Press **NEXT** until the *TEMP* submenu appears on the display.



2. Press **ENTER**.
   The screen displays the `T AUTO` prompt.



3. Use the up or down arrow keys to enable (ON) or disable (OFF) the automatic temperature correction feature. Press **ENTER** to save.
   The screen displays the `T MAN` prompt.



4. Use the arrow keys to change to the desired temperature.

   To enter negative numbers, press the left or the right arrow key until no digit is flashing. then press the up or down arrow keys to display the negative sign. The range is 23 to 266 ° F (-5.0 to 130 °C).
5. Press **ENTER** to save. Press **RESET** to return to the main display.

Note
If you disabled T AUTO in Step 3, then the transmitter will use the temperature entered in this step in all subsequent measurements, no matter the actual process temperature.

6.4 Set up a custom curve (conductivity measurements only)

Use custom curves to correlate conductivity to concentration of the measured liquid. The Rosemount 5081 has programmable custom curves that can create a curve (second order) from three to five user supplied points. If it only uses two points, then then the transmitter creates a linear curve (straight lin). In order for the curve to be accurate, take the data points from the liquid having the same reference temperature.

To obtain best results, select data points that are representative of the typical operating range and have at least 5% difference in conductivity values. Observe the graph of conductivity vs. concentration for the particular liquid to ensure that unsuitable points are avoided. Unsuitable points include conductivity values with two concentrations associated with them. In addition to unsuitable points, record any critical points - points that best describe the curve. Following these general guidelines will provide optimal results.

Enter the first point (COND 1) at the normal operating condition. Then enter other points above and below COND 1. Nonlinear conductivity curves require additional data points to characterize these regions. Do not use the same data point more than once and only use actual data (do not interpolate data points).

Note
The default values for the custom curve are three data points, reference temperature of 77 °F (25 °C), and a linear temperature slope of two percent/°C. This combination will yield the best results in most applications. If the normal temperature is over 104 °F (40 °C) or under 50 °F (10 °C), change the reference temperature to the normal process temperature. If known, use the temperature slope at the reference temperature.

Procedure

1. From the main menu, select PROG and then press **NEXT** four times.
   `SETUP CUST` appears.
2. Press **ENTER**.
   `T REF` appears.
3. If needed, change the reference temperature from the factory default 77 °F (25 °C) to a different reference temperature for the process. Press **ENTER**.
   `UNIT` appears.
4. Press the up or down arrow to select the desired measurement units: `µS` (microsiemens), `mS` (millisiemens), `none` (no units displayed), `%` (percent), or `ppm` (parts per million); then press **ENTER**.
   `NUM PTS` appears.

5. Press up or down arrows to select the desired number of data points for a custom conductivity curve. Select `2` to generate a linear relationship for conductivity and concentration at the given temperature.
   a) Enter the concentration for point 1 (displayed as `µS 1`). Press **ENTER**.
   b) Enter the known conductivity for point 1 in µS/cm. Press **ENTER**.
   c) Complete this process for additional known data points. Press **ENTER**.
      `CALC CUST` appears briefly.
   d) Press **ENTER**.
      `PROCESSING` appears briefly; then `APPLY CUST` appears.
   e) Press **ENTER** to register the custom curve into memory and return to the *SETUP CUST* screen.

The custom curve will now be used to display and output all conductivity measurement when the operator selects `CUST` as the measurement type in the *Display* menu.

6.5 Restore to factory default settings

The operator can erase user-defined configurations to return the transmitter to the factory default settings.

Procedure

1. Press **PROG** on the remote controller.
2. Press **NEXT** until `DEFAULT` appears in the display. Press **ENTER**.
3. Use the up and down arrows to toggle between NO and YES. Press **ENTER** to return to the factory default settings.

6.6 Set access (security) code

6.6.1 Security overview

The access (security) code prevents program and calibration settings from accidental changes. Emerson ships the transmitter with the access (security) code disabled.

6.6.2 Enter the access (security) code

Procedure

1. If calibration and program settings are protected with a security code, press **PROG** or **CAL** on the infrared remote controller.
   The *ID* screen appears.
2. Use the editing keys to enter the code. Press **ENTER**.
   If the code is correct, the first sub-menu appears. If the security code is incorrect, the process display reappears.

6.6.3 Retrieve a lost security code

Procedure

1. If the you forget the security code, enter `555` at the ID prompt and press **ENTER**.
   The transmitter displays the present code.
2. Press **EXIT** to return to the process display.
3. Press **PROG** or **CAL**.
   The *ID* screen appears.
4. Use the editing keys to enter the security code. Then press **ENTER**.
   The first sub-menu under the selected menu appears.

6.7 Activate or deactivate HOLD

Activating HOLD keeps the transmitter output at the last value or sends the output to a previously determined value. This is particularly useful when doing calibrations. During calibrations, the sensor may be exposed to solutions that have concentrations outside the normal range of the process. HOLD prevents false alarms and undesired operation as a result of that reading. You can deactivate HOLD when the sensor is reinstalled in the process stream and the readings have relatively stabilized.

Procedure

1. Press **HOLD** on the remote controller.
   The `HOLD` prompt appears in the display.
2. Press **3** (up) or **5** (down) to toggle HOLD between ON and OFF.
3. Press **ENTER** to save.

7 Measurements

7.1 Calibrating pH sensors

7.1.1 Calibration overview

The *Calibration* menu allows you to calibrate the pH and temperature response of the sensor. To calibrate, use either the manual or the auto-calibration option. In both cases, the transmitter does a two-point calibration for pH and one-point standardization against a reference thermometer for temperature. In auto-calibration, the transmitter automatically stores the temperature-corrected calibration data. In manual calibration, you have to enter buffer values. The values are only registered when the readings are stable (automatically determined by the transmitter). All calibration procedures are guided by prompts on the display.

7.1.2 Calibration standards (buffer solutions)

- Calibrations are critical to make accurate pH measurements.
- Emerson recommends that the value of one of the pH buffer solutions is lower than the pH of the process stream and the value of the other pH buffer solution is higher than the pH of the process stream.
- For best results, make sure that the temperature of the solution is the same temperature as that of the sensor. Allow the entire measurement cell, sensor, and solution to reach relatively constant temperature.
- Using buffers at high temperatures can cause evaporation, which will change the concentration of the buffer. The change in concentration causes a change in the pH, thus resulting in an inaccurate calibration.
- Buffers have limited shelf lives. Do not use a buffer if the expiration date has passed. Store buffers at controlled room temperatures.
- Do not reuse buffer solutions. Protect buffers from excessive exposure to air. Exposure to air can cause changes in the pH of the buffer solution.
- Always rinse the sensor with DI water and remove excess water by dabbing with a clean tissue before placing it in a buffer. Only dab the sensor and do not wipe it. Wiping the sensor builds static charge which alters the reading.

7.1.3 Auto-calibrate

Prerequisites

Ensure that auto-calibration is turned ON and the appropriate buffers are used.

Procedure

1. Press **CAL** on the IRC to enter the *CALIBRATE* menu.

The *CALIBRATE* sub-menu appears.

2. At the *CALIBRATE* sub-menu, press **ENTER**.
   The `CAL bF1` prompt appears.
3. Rinse the sensor and place it in the first buffer. Be sure the glass bulb and the temperature element are completely submerged. Keep the sensor at least 3 in. below the liquid level. Do not rest the sensor on the glass bulb. Dislodge any trapped bubbles by swirling the sensor body.
4. Press **ENTER**.
   `BF1` flashes until the measured pH meets the programmed stability limits. If the pH reading is not relatively stable after 20 minutes, the transmitter automatically leaves the *CALIBRATE* menu and returns to the main display. If this occurs, consult Diagnostics and troubleshooting for assistance. Once the reading is stable, the display moves forward by showing a flashing number with the nominal pH.
5. Change the value by using the up and down arrows until the correct pH of the buffer solution appears. Press **ENTER** to save the first calibration point.
   `CAL BF2` appears.
6. Remove the sensor from the first buffer.
7. Rinse the sensor and place it in the second buffer solution. Again, make sure the bulb is completely submerged and the bubbles are dislodged by swirling the sensor body.
8. Press **ENTER**.
   `BF2` flashes until the reading is stable.
9. Repeat steps Step 4 and Step 5.
   The calibration is now complete, but the transmitter remains in the *CALIBRATE* sub-menu for two minutes after you press **ENTER**.
10. Remove the sensor from the buffer and reinstall it into the process stream. If the HOLD feature was used, be sure to turn off HOLD.

    The sensor will not calibrate if the electrode slope (calculated by the transmitter during calibration) is unacceptable. The transmitter displays a `SLOPE ERR HI` or `SLOPE ERR LO` error message. Refer to Diagnostics and troubleshooting for assistance.

Note
To display the electrode slope, press **CAL** on the IRC. The *CALIBRATE* sub-menu appears. Press **NEXT**. The *STD* sub-menu appears. Press **ENTER**. The `STD` prompt appears. Press **ENTER** again, and the slope appears on the display. For a good sensor, the slope is generally 50 to 60 mV.

7.1.4 Calibrate manually

Prerequisites

Ensure that auto-calibration is OFF and the appropriate buffers are used.

Procedure

1. Press **CAL** on the IRC to enter the *CALIBRATE* menu.

The *CALIBRATE* sub-menu appears.

2. At the *CALIBRATE* sub-menu, press **ENTER**.
   The `CAL BF1` prompt appears.
3. Rinse the sensor with DI water and place it in the first buffer along with a calibrated thermometer. Submerge the sensor tip at least 3 in. (76 mm) below the liquid level. Do not rest the sensor on the glass bulb. Dislodge any trapped bubbles by swirling the sensor body.
4. Once the pH reading and temperature are relatively stable, press **ENTER**. Use the editing keys to change the flashing display to the appropriate pH of the buffer solution. Press **ENTER** to save the value as buffer BF1.
   The transmitter expects a reading to be entered within 20 minutes after the `CAL BF1` prompt. If you do not press **ENTER**, the transmitter exits the *CALIBRATE* menu and returns to the process mode.
5. At the `CALBF2` prompt, remove the sensor from the first buffer. Repeat steps Step 3 and Step 4.
   The calibration is now complete, but the transmitter remains in the *CALIBRATE* sub-menu for two minutes after you press **ENTER**.
6. Remove the sensor from the buffer and reinstall it into the process stream. If the HOLD feature was turned on, be sure to turn off HOLD.

   The sensor will not calibrate if the electrode slope (calculated by the transmitter during calibration) is unacceptable. The transmitter displays a SLOPE ERR HI or SLOPE ERR LO error message. Refer to Diagnostics and troubleshooting for assistance.

   Note
   To display the electrode slope, press **CAL** on the IRC. The *CALIBRATE* sub-menu appears. Press **NEXT**. The *STD* sub-menu appears. Press **ENTER**. The `STD` prompt appears. Press **ENTER** again, and the slope appears on the display. For a good sensor, the slope is generally 50 to 60 mV.

7.1.5 Standardize for pH

Use standardization to match the transmitter values with those of another transmitter. The transmitter converts the difference between the two pH values into an equivalent voltage, called the reference offset.

Note
If a sensor that has been calibrated with buffers is standardized, then placing it back in the buffer will show a different measured pH than that of the buffer due to the standardization offset.

Procedure

1. Press **CAL** on the IRC to enter the *CALIBRATE* menu.
   The *CALIBRATE* submenu appears.
2. At the *CALIBRATE* submenu, press **NEXT**.
   The *STD* submenu appears.
3. Press **ENTER** to enter the STD prompt.

The process pH and temperature should be relatively stable.

4. Take a grab sample from the process stream as close to the pH sensor as possible.
   This transmitter reading is called the pH_trans.
5. Measure the pH of the sample (pH_std) using the second pH meter.
6. Note the current process reading (pH_curr). Calculate the corrected reading from the equation: ph_corr = ph_curr + (pH_std - pH_trans)
   - pH_corr = corrected pH value
   - pH_curr = current pH value
   - pH_std = standard instrument's pH value
   - pH_trans = measured sample's pH value
7. Use the editing keys to enter the pH_corr value calculated using the equation above. Press **ENTER** to save the value.
   If the corrected value is acceptable, then the display shows the slope (current electrode slope).
8. If the slope is acceptable, press **EXIT**. If the slope is unacceptable, use the editing keys to change it. Then press **ENTER**.
9. To leave the *CALIBRATE* menu, press **EXIT**.

7.2 Calibrating oxidation reduction potential (ORP) sensors

7.2.1 Oxidation reduction potential (ORP) overview

ORP is a function of temperature. The accuracy of a sensor/transmitter loop is about ±1 °C. A new sensor does not need to be calibrated often. Only calibrate the loop when:

1. ±1 °C is not acceptable.
2. You suspect an error in temperature measurement

7.2.2 Calibrate temperature with an oxidation reduction potential (ORP) sensor

Procedure

1. Place the ORP sensor and a reference thermometer in an insulated container of water at ambient temperature. Keep the sensor submerged at least 3 in. (76 mm) below the water level. Stir continuously and wait at least 20 minutes for the water, sensor, and thermometer to reach a constant temperature.
2. Press **CAL** on the IRC to enter the *CALIBRATE* menu.
   The *STD* submenu appears.
3. At the *STD* submenu, press **NEXT**.
   The *TEMP ADJ* submenu appears.

4. Press **ENTER** to display the temperature editing prompt.
5. Compare the temperature displayed by the transmitter with the temperature measured by the reference thermometer. If there is a discrepancy between the two values, use the editing keys to change the measured value to that of the thermometer.

   Note
   The reading cannot be changed more than 15 °C.

6. Press **ENTER**.
   The transmitter saves the value, and the display returns to the *TEMP ADJ* submenu.
7. Press **EXIT** to leave the *CALIBRATE* menu.
8. Check for linearity by measuring the temperature of water: -10 to -15 °C and +10 to +15 °C than the water used for calibration.

7.2.3 Standardize with an oxidation reduction potential (ORP) sensor

ASTM d 1498-93 gives procedures for making iron (ii) - iron (iii) and quinhydrone ORP standards. Emerson recommends the iron (ii) - iron (iii) standard. It is fairly easy to make and has a shelf life of approximately one year; in contrast, quinhydrone standards contain toxic quinhydrone and have only an eight hour shelf life. Iron (ii) - iron (iii) standard is available from Rosemount™ as PN R508-16OZ. The ORP of the standard solution measured against a silver-silver chloride reference electrode is 476 ± 20 mV at 77 °F (25 °C).

Procedure

1. Press **CAL** on the IRC to enter the *CALIBRATE* menu.
   The *STD* submenu appears.
2. Rinse the sensor with DI water and place it in the ORP standard with a reference thermometer. Ensure that the ORP sensor is submerged at least 3 in. (76 mm) below the water level.
3. Once the temperature and ORP readings are stable, press **ENTER**.
4. Use the editing keys to change the flashing display to the desired ORP reading. Press **ENTER** to save.
5. Press **EXIT** to return to the main display.

7.2.4 Match transmitter to oxidation reduction potential (ORP) sensor's temperature element

Procedure

1. Press **PROG** on the IRC.
2. Press **NEXT** until the *TEMP* submenu appears in the display. Press **ENTER**.
3. Press **EXIT** to return to the main display.

7.3 Calibrating contacting and toroidal conductivity sensors

7.3.1 Overview of calibrating contacting conductivity sensors

Contacting conductivity sensors do not require frequent calibrations. The sensors are ready to be installed right out of the box.

7.3.2 Calibrate contacting conductivity sensors

Procedure

1. Pres **CAL** on the IRC. Press **ENTER**.
   The *CALIBRATE* submenu appears.
2. Place the sensor in a standard solution of known conductivity and allow the measurement reading to become relatively stable.
3. Press **ENTER** to access the CAL segment with the flashing prompt.
4. Use the IRC editing keys to enter the conductivity value of the standard solution. Press **ENTER**.
5. Press **EXIT** to return to the main display.

7.3.3 Zero the sensor

Procedure

1. Press **CAL** and then **NEXT** to enter the *SENSOR 0* menu.
2. Press **ENTER** to access the *SENSOR 0* submenu.
3. Hold the sensor in the air and press **ENTER** again to zero the sensor.
4. Press **EXIT** to return to the *SENSOR 0* submenu.

7.3.4 Adjust temperature

Procedure

1. Press **CAL** and then **NEXT** until you see `TEMP`.
2. Press **ENTER**.
   The *TEMP* submenu appears.
3. Place the sensor in any solution of known temperature. Allow the temperature of the sensor to become relatively stable.
4. Use the editing keys of the IRC to change the values as needed.
5. Press **ENTER** to standardize the temperature reading and return to the *TEMP ADJ* screen.
6. Press **EXIT** to return to the main display.

7.3.5 Calibrate in-process

Procedure

1. Press **CAL** and then **NEXT** three times to access MTR CAL.
2. Use the IRC to go through the on-screen prompts.
3. Press **EXIT** to return to the main display.

7.3.6 Calibrate temperature slope

Procedure

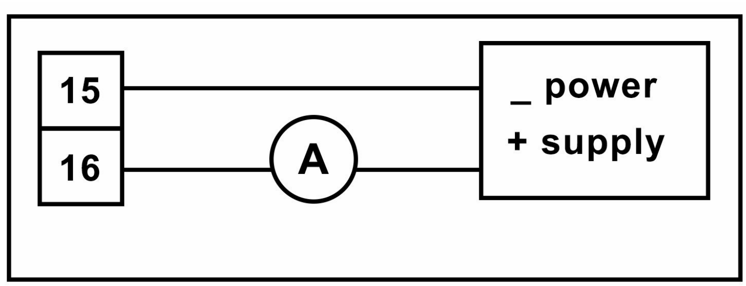
1. From the *CAL* menu, press **NEXT** until `TEMP SLOPE` displays.
2. Use the IRC arrow keys to enter the slope. Press **ENTER** to register the slope in the memory of the transmitter. Press **EXIT** to return to the main screen.
3. If you don't know the temperature slope of the process, then refer to the below guide:
   - Acids: 1.0 percent to 1.6 percent per °C
   - Bases: 1.8 percent to 2.2 percent per °C
   - Salts: 2.2 percent to 3.0 percent per °C
   - Water: 2.0 percent per °C
4. Press **ENTER** to proceed to the *T SLOPE* submenu with the flashing prompt. Use the IRC keys to generate the desired slope value. Press **ENTER**.
5. Press **EXIT** to return to the main screen.

7.3.7 Calibrate output

Procedure

1. Wire an accurate milliammeter as shown in Figure 7-1.

Figure 7-1: Milliammeter Wiring



2. Press **CAL** on the IRC.
3. Press **NEXT** until the *OUTPUT CAL* submenu appears. Press **ENTER**.

4. Use the arrow keys to change the display to match the reading from the milliammeter. Press **ENTER**.
5. Press **RESET** to return to the main display.

7.4 Calibrating dissolved oxygen, ozone, free chlorine, total chlorine, and ozone sensors

7.4.1 Calibrating amperometric sensors

You can calibrate amperometric sensors in multiple ways: zeroing, air calibrations, dual slope calibrations, and in process calibrations.

7.4.2 Zero the sensor

Procedure

1. Place the sensor in a solution of 5% sodium sulfite (Na_2SO_3) in water. Ensure that air bubbles are not trapped against the membrane.
2. Go to the main display; press **DIAG** and then **NEXT**.
   The `SENSOR CUR` prompt appears.
3. Press **ENTER** to view the sensor current. Make sure the sensor reaches its zero current.

   This may require several hours. Do not start the zero routine until the sensor has been in zero solution for at least two hours.
4. Press **CAL** on the IRC.
   The `SENSOR 0` prompt appears.
5. Press **ENTER**.
   The screen shows the appropriate value correlating to the zero value. The screen shows `0.02`. The reading must be below 0.02 ppm for the zero calibration to be accepted.
6. To change the zero limit, use the editing keys and then press **ENTER**.
   The `TIME DELAY` message appears and remains until the zero current is below the concentration limit. If the current is already below the limit, `TIME DELAY` will not appear.
7. To bypass the time delay, press **ENTER**.
   When the procedure is complete, `0 DONE` appears.
8. Press **EXIT**.
9. Press **RESET** to return to the main display.

7.4.3 Calibrate in air (dissolved oxygen)

Procedure

1. Remove the sensor from the process liquid. Use a soft tissue and a wash bottle to clean the membrane. Dry it by blotting.

   The membrane must be completely dry during air calibration.
2. Pour some water into a beaker and suspend the sensor with the membrane approximately ½ in. (approximately 1 cm) above the water surface.

   Keep the sensor out of direct sunlight.
3. Monitor the dissolved oxygen and temperature reading. Once the readings are relatively stable, begin the calibration.

   It may take 10 - 15 minutes for the sensor reading in the air to stabilize.
4. Press **CAL** on the IRC.
5. Press **NEXT**.
   The ***SENSOR CAL*** submenu appears.
6. Press **ENTER**.
   The `AIR CAL` prompt appears.
7. Press **ENTER**.
8. Select the units. Then press **NEXT**.
9. Use the arrow keys to enter the barometric pressure. Press **ENTER** when done.
   The `TIME DELAY` message appears and remains until the sensor reading is relatively stable.
10. To bypass the time delay, press **ENTER**.
    `CAL DONE` appears when the calibration is complete.
11. Press **EXIT**.
12. To return to the main display, press **RESET**.

7.4.4 Calibrate in process (dissolved oxygen)

You can calibrate the sensor against a standard instrument.

Procedure

1. Press **CAL** on the IRC.
2. Press **NEXT**.
   The ***SENSOR CAL*** submenu appears.
3. Press **ENTER**.
4. Press **NEXT**.
   The `AIR CAL` prompt appears.
5. Press **NEXT**.
   The `INPROCESS` prompt appears.
6. Press **ENTER**.

The TIME DELAY message appears and will remain until the sensor is relatively stable. To bypass the time delay, press **ENTER**. The GRAP SPL message appears.

7. Press **ENTER**.
8. Use the arrow keys to change the flashing display to the value indicated by the standards instrument. Press **ENTER**.
9. Press **RESET** to return to the main display.

7.4.5 Calibrate full scale (free chlorine, total chlorine, ozone)

Procedure

1. Place the sensor in the process liquid. Ensure that the pH sensor is calibrated or the pH value is entered in case of manual pH correction, if applicable.
2. Adjust the chlorine concentration until it is near the upper end of the control range. Wait until the reading is relatively stable before starting the calibration.
3. Press **CAL** on the IRC.
4. Press **NEXT**.
   The *SENSOR CAL* submenu appears.
5. Press **ENTER**.
   The TIME DELAY message appears and will remain until the sensor reading is relatively stable. To bypass the time delay, press **ENTER**. The GRAB SPL prompt appears.
6. Take a sample of the process liquid and determine the concentration of chlorine in the sample. Press **ENTER**.
7. Press **RESET** to return to the main display.

7.4.6 Calibrate dual slope (free chlorine, total chlorine)

Procedure

1. Zero the sensor.
2. Place the sensor in the process liquid. Ensure that the pH sensor is calibrated or the pH valve is entered in case of manual pH correction, if applicable.
3. Press **CAL** on the IRC. Press **NEXT**.
   The *SENSOR CAL* prompt appears.
4. Press **ENTER**.
   The CAL PT1 prompt appears.
5. Adjust the chlorine concentration until it is near the upper end of the linear range of the sensor. Press **NEXT**.
   The TIME DELAY message appears and will remain until the sensor reading is relatively stable. To bypass the time delay, press **ENTER**. The GRAB SPL prompt appears.
6. Take a sample of the process liquid and determine the concentration of chlorine in the sample.
7. Press **ENTER**.

The `PT1` prompt appears.

8. Use the arrow keys to change the flashing display to the concentration of chlorine determined in the grab sample. Press **ENTER** to save.
   The `CAL PT2` prompt appears.
9. Adjust the concentration of chlorine until it is near the top end of the range. Press **ENTER**.
   The `TIME DELAY` message appears and will remain until the sensor reading is relatively stable. To bypass the time delay, press **ENTER**. The `GRAB SPL` prompt appears.
10. Take the sample of the process liquid and determine the concentration of chlorine in the sample.
11. Press **ENTER**.
    The `PT2` prompt appears.
12. Use the arrow keys to change the flashing display to the concentration of chlorine determined in the grab sample. Press **ENTER** to save.
13. Press **RESET** to return to the main display.

8 Diagnostics and troubleshooting

8.1 Warning and fault messages

The Rosemount™ 5081 transmitter continuously monitors the measurement loop (sensor and transmitter) for conditions that cause inaccurate measurements. When a problem occurs, the transmitter displays either a warning or fault message. A warning alerts you that a potentially system disabling condition exists. If you don't fix the problem, there is a high probability that the measurement will be incorrect. A fault alerts you that a system disabling condition exists. If a fault message is showing, regard all measurements as incorrect.

When a warning condition exists:

1. The main display remains stable; it does not flash.
2. A warning message appears alternately with the temperature display. See Figure 8-1. See Troubleshooting when a diagnostic message is showing for an explanation of the different warnings and suggested ways of correcting the problem.

Figure 8-1: Warning Annunciation

When a Fault exists:

1. The main display flashes.
2. The words `FAULT` and `HOLD` appear in the main display.
3. A fault message appears alternately with the temperature/output display. See Figure 8-2. See Troubleshooting when a diagnostic message is showing for an explanation of the different fault messages and suggested ways of correcting the problem.
4. The output current will remain at the present value or go to the programmed fault value.
5. If the transmitter is in Hold when the fault occurs, the output remains at the programmed hold value. To alert you that a fault exists, the word `FAULT` appears in the main display, and the display flashes. A fault or diagnostic message also appears.

6. If the transmitter is simulating an output current when the fault occurs, the transmitter continues to generate the simulated current. To alert you that a fault exists, the word FAULT appears in the display, and the display flashes.

Figure 8-2: Fault Annunciation

When a a fault occurs, the display appears as pictured above. To further alert you that measurements are in error, the display flashes. Diagnostic messages appear in the temperature/output area on the screen.

8.2 pH/ORP diagnostics and troubleshooting

8.2.1 Calibration errors

If an error occurs during calibration, an error message appears in the main display and the transmitter does not update the calibration. The calibration errors are `Std Err`, `SLOPE Err LO`, and `SLOPE Err HI`. See Troubleshooting when a diagnostic message is showing for an explanation of the error messages and suggested ways of correcting the problem.

8.2.2 General troubleshooting

Procedure

1. Look for a diagnostic message on the display to help identify the problem.
   Refer to Troubleshooting when a diagnostic message is showing for an explanation of the message and a list of the possible problems that triggered it.
2. Refer to Troubleshooting when no diagnostic message is showing for common measurement problems and the recommended actions to resolve them.
3. Follow the step-by-step troubleshooting approach, offered in Displaying diagnostic variables, to diagnose and correct less common or more complex problems.

8.2.3 Troubleshooting when a diagnostic message is showing

The Rosemount 5081-P pH/ORP transmitter continuously monitors the measurement loop (sensor and transmitter) for problems. If a problem is detected, the transmitter displays a fault or error message. The message appears in the temperature/output area of the main display. The table lists each diagnostic message and the section to consult for help.

Message	Section
GLASSFAIL	GLASSFAIL
GLASSWArn	GLASSWArn
rEF FAIL	rEF FAIL
rEF WArn	rEF WARn
CALIbrAtE	CALIbrAtE
tEMP HI	tEMP HI and tEMP LO
tEMP LO	tEMP HI and tEMP LO
LInE FAIL	LinE FAIL
InPUt WArn	InPUt WArn
SLOPE Err LO	SLOPE Err LO
SLOPE Err HI	SLOPE Err HI
Std Err	Std Err
rOM FAIL	rOM FAIL or CPU FAIL
CPU FAIL	rOM FAIL or CPU FAIL
AdC WArn	AdC WArn or CyCLE PWr
CyCLE PWr	AdC WArn or CyCLE PWr
WrItE Err	WritE Err
FACt FAIL	FACt FAIL

GLASSFAIL

GLASSFAIL is an electrode fault message. It means the glass impedance is outside the programmed Glass Fault High (GFH) or Glass Fault Low (GFL) limit. Glass Fault High suggests the electrode is aging or the electrode is not immersed in the process liquid. Glass Fault Low implies that the pH sensitive glass is cracked. GLASSFAIL also appears if inappropriate limits have been entered into the transmitter.

If the measurement system was previously commissioned and operating correctly, GLASSFAIL likely means a real problem exists. However, if the system is being started up or if the advanced diagnostic feature is being used for the first time, GLASSFAIL could be caused by a miswired sensor or by programmed limits that are not correct for the sensor.

Note
GLASSFAIL is a sensor diagnostic message. Sensor diagnostic messages are optional. They can be turned off.

Recommended actions

1. Be sure the sensor is completely immersed in the process liquid.

If the diagnostic message disappears, the sensor is in good condition.

If the diagnostic message remains, go to Step 2.

2. Measure the glass impedance. See Testing the transmitter by simulating the pH for the procedure. Note the reading.

   If the glass impedance is low (< 40 megohms)...

   a. Check preamp location in program menus (PAMP = _____).
      - If the location is incorrect, go to 2.b.
      - If after selecting the correct location of Preamp in the Program menu, the glass impedance is still low, go to Step b.

   b. Calibrate the sensor.
      - If the sensor calibrates properly...
         1. The sensor is in good condition, but the Glass Fail Low (GFL) limit is set too high.
         2. Lower the GFL limit to about 10 megohms below the glass impedance value (GIMP).
         3. If the Glass Warning Low (GWL) message was also flashing, lower the limit from its former value by the same amount the GFL was lowered from its former value.
      - If the sensor cannot be calibrated, the pH glass membrane is likely cracked and the sensor must be replaced. The crack in the glass may not be visible or may be difficult to see.

   If the glass impedance is high (> 800 megohms)...

   a. Check that the sensor is correctly wired to the transmitter. Pay particular attention to the following:
      1. For Rosemount PLUS (+) and TUpH sensors with integral preamplifiers, the blue solution ground wire must be attached to TB-8 (SOL GND), and the gray reference in wire must be attached to TB-7 (REF IN).

         Note
         TB-8 means terminal 8 on the terminal board.

      2. If the sensor was wired with the blue solution ground wire unattached and a jumper between the terminals TB-8 and TB-7, remove the jumper and reattach the blue solution ground wire to TB-8. Keep the gray reference in wire attached to TB-7.
      3. For Rosemount PLUS (+) and TUpH sensors that do not have an integral preamplifier, attach the blue solution ground wire to TB-8 or, better, leave the blue wire unattached and jumper TB-7 to TB-8.
      4. If the sensor does not have a blue solution ground wire, jumper terminals TB-7 and TB-8.
         - If the wiring was correct and the glass impedance is still too high, go on to 2.b.

- If correcting wiring errors causes the diagnostic message to disappear, the sensor is in good condition.
- If after correcting wiring errors, the glass impedance is still high, go on to Step b.

b. Inspect and clean the sensor. After cleaning the sensor, calibrate it. Be sure to note the sensor slope.
   - If cleaning the sensor lowers the impedance below 800 megohms:
     1. The sensor is in good condition.
     2. Return the calibrated sensor to service.
   - If cleaning does not lower the glass impedance and the sensor can be calibrated:
     1. The sensor is probably in good condition; however, it may be nearing the end of its life. The electrode slope is a good indicator of remaining life.

Slope	Condition of sensor
54-60 mV/unit pH	Sensor is in good condition.
48-50 mV/unit pH	Sensor is nearing the end of its life. Once the slope drops below 48 mV/unit pH, the sensor can no longer be calibrated.

     2. The Glass Fail High (GFH) limit is probably set too low for the sensor. Set the GFH limit to about 150 megohms greater than the measured glass impedance.
     3. If the `GLASSWArn` message was also flashing, raise the GWH limit from its former value by the same amount the GFH was raised from its former value.
   - If cleaning does not lower the glass impedance and the sensor cannot be calibrated, the sensor has failed and should be replaced.

GLASSWArn

`GLASSWArn` is an electrode fault message. It means the glass impedance is outside the programmed Gas Warning High (GWH) or Glass Warning Low (GWL) limit. Ideally, when the measurement system exceeds the glass warning limits, you will have adequate time to diagnose and correct problems before a failure occurs. High impedance implies the electrode is aging or the sensor is not completely submerged in the process liquid. Low impedance suggests the pH sensitive glass is cracked. The message also appears if inappropriate limits have been entered into the transmitter.

If the measurement system was previously commissioned and operating correctly, `GLASSWArn` likely means a real problem exists. However, if the system is being started up or if the advanced diagnostic feature is being used for the first time, `GLASSWArn` could be caused by a miswired sensor or by programmed limits that are not correct for the sensor.

Note
GLASSWArn is a sensor diagnostic message. All sensor diagnostic messages are optional. They can be turned off.

Troubleshooting GLASSWArn problems is exactly the same procedure as troubleshooting GLASSFAIL problems. Refer to GLASSFAIL.

rEF FAIL

rEF FAIL is an electrode fault message. rEF FAIL means that the reference impedance exceeds the programmed reference high fault (RFH) limit. A plugged or dry reference junction is the usual cause of a high reference impedance. High reference impedance also occurs if the sensor is not submerged in the process liquid or if inappropriate limits have been entered into the transmitter.

If the operator previously commissioned the measurement system and it was operating correctly, rEF FAIL likely means a real problem exists. However, if the operator is just starting up the system or using the advanced diagnostic feature for the first time, rEF FAIL could be caused by a miswired sensor or by programmed limits that are not correct for the sensor.

Note
rEF FAIL is a sensor diagnostic message. All sensor diagnostic messages are optional. They can be turned off.

Recommended actions

1. Be sure the sensor is completely immersed in the process liquid.
   - If the diagnostic message disappears, the sensor is in good condition.
   - If the diagnostic message remains, go to Step 2.
2. Check that the sensor is properly wired to the transmitter. Be sure the reference in wire is attached to TB-7 and the solution ground wire is attached to TB-8.

   Note
   TB-8 means terminal 8 on the terminal board.

   - If correcting wiring problems makes the diagnostic message disappear, the sensor is in good condition.
   - If the wiring is correct and the message still remains, go to Step 3.
3. Measure and make a note of the reference impedance (rIMP). See Testing the transmitter by simulating the pH.
   - If the reference impedance is low (< 70 kilohms)...
     a. The reference electrode is in good condition. pH sensors manufactured by Rosemount use low impedance silver/silver chloride reference electrodes.
     b. The reference failure high (RFH) limit is probably set too low. Change the limit to a value about 50 kilohms greater than the measured reference impedance. If rEF WARN was also displayed, change the reference

warning high (RWH) limit to about 25 kilohms above the measured reference impedance.

- If the reference impedance is high (> 70 kilohms)...
  a. The sensor may be dirty, in which case cleaning it will lower the impedance. If the sensor is rebuildable, the reference electrolyte may be depleted. Finally, the sensor may be in good condition. The warning and failure limits are simply set too high.

  b. Inspect and clean the sensor. If the sensor is rebuildable, replace the reference junction and replenish the electrolyte solution. Refer to the sensor reference manual for details. Check the reference impedance again.
     — If cleaning the sensor reduces the impedance...
        1. The sensor is in good condition. Calibrate the sensor and return it to the process.
        2. Change the reference failure high (RFH) limit to a value about 50 kilohms greater than the measured reference impedance. If `rEF WARN` was also displayed, change the reference warning high (RWH) limit to about 25 kilohms above the measured reference impedance.

     — If cleaning does not reduce the impedance and the sensor is not rebuildable...
        1. Try the reference junction rejuvenation procedure. The rejuvenation procedure may not work. At best, it will get a little more life out of a sensor with a plugged reference.
        2. Whether or not the rejuvenation procedure worked, go to 3.c.

  c. Recalibrate the sensor using the autocalibration procedure.
     — If the sensor can be calibrated:
        1. The sensor is in good condition. Return it to the process.
        2. Change the reference failure high (RFH) limit to a value about 50 kilohms greater than the measured reference impedance. If `rEF WARN` was also displayed, change the reference warning high (RWH) limit to about 25 kilohms greater than the measured reference impedance.

     — If the sensor cannot be calibrated, the sensor has failed and must be replaced.

rEF WARn

`rEF WArn` is an electrode fault message. It means the reference electrode impedance exceeds the programmed reference warning high (RWH) limit. Ideally, when the measurement system exceeds the warning limits, you will have adequate time to diagnose and correct problems before a failure occurs. A high reference impedance implies that the liquid junction is plugged or the reference electrolyte is depleted. The message also appears if an inappropriate limit has been entered into the transmitter.

If the measurement system was previously commissioned and operating correctly, rEF WArn likely means a real problem exists. However, if the system is being started up or if the advanced diagnostic feature is being used for the first time, rEF WArn could be caused by a miswired sensor or by programmed limits that are not correct for the sensor.

Note
rEF WArn is a sensor diagnostic message. Sensor diagnostic messages are optional. They can be turned off.

Troubleshooting rEF WArn problems is exactly the same as troubleshooting rEF FAIL problems. Refer to rEF FAIL.

CALIbrAtE

CALIbrAtE is a diagnostic intended for future use. If the CALIbrAtE message is showing, disable CALIbrAtE.

tEMP HI and tEMP LO

tEMP HI and tEMP LO mean the transmitter has detected a problem with the temperature measuring circuit. The problem may lie in the sensor, the cable, or the transmitter. The determination of temperature is an integral part of the pH measurement. Therefore, failure of the temperature measuring circuit is a system disabling condition. However, in an emergency, automatic temperature compensation can be disabled and the transmitter placed in manual temperature compensation. For manual temperature compensation, choose a temperature equal to the average temperature of the process. The resulting pH reading will be in error. The more variable the temperature and the further the pH from 7, the greater the error.

Recommended actions

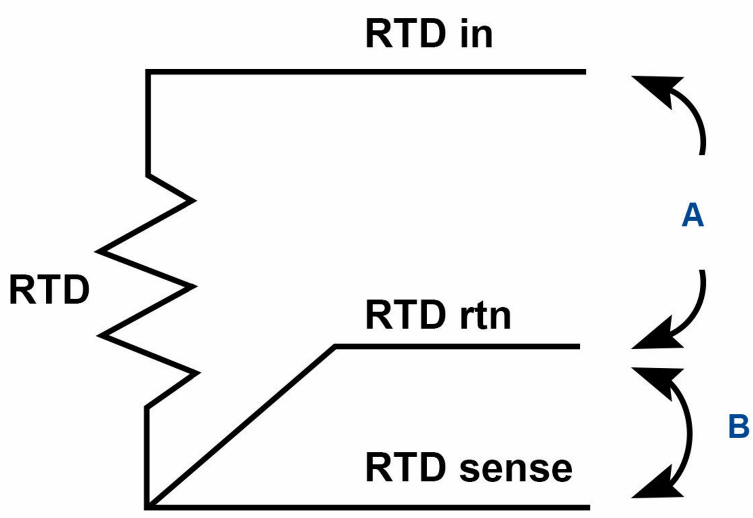
1. Check wiring, jumper settings, and software settings.
   a. Check the wiring between the sensor and the transmitter. Pay particular attention to TB=3 (RTD RTN), TB-4 (RTD SN), and TB-5 (RTD RTN).

      Note
      TB-3 means terminal 3 on the terminal board.

   b. Be sure the software settings match the type of resistance temperature device (RTD) in the sensor.
      - If the diagnostic message disappears, the sensor is in good condition.
      - If the message persists, go to Step 2.
2. Check the sensor. Disconnect the RTD leads and measure the resistances shown in Figure 8-3.

   The measured resistance should agree with the value in Table 8-1 to within about one percent. If the measured resistance is appreciably different (between one and five percent) from the value shown, the operator can calibrate out the discrepancy.

Figure 8-3: Three-Wire RTD



A. Compare resistance between these wires to the values in Table 8-1.
B. Resistance between these wires should be less than 2 ohms.

Consult Table 8-1 for resistance-temperature data. Lead resistance is about 0.05 ohm/ft at 77 °F (25 °C). Therefore, 15 feet of cable increases the resistance by about 1.5 ohm. The resistance between the RTD return and RTD sense leads should be less than 2 ohms.

Table 8-1: RTD Resistance Values

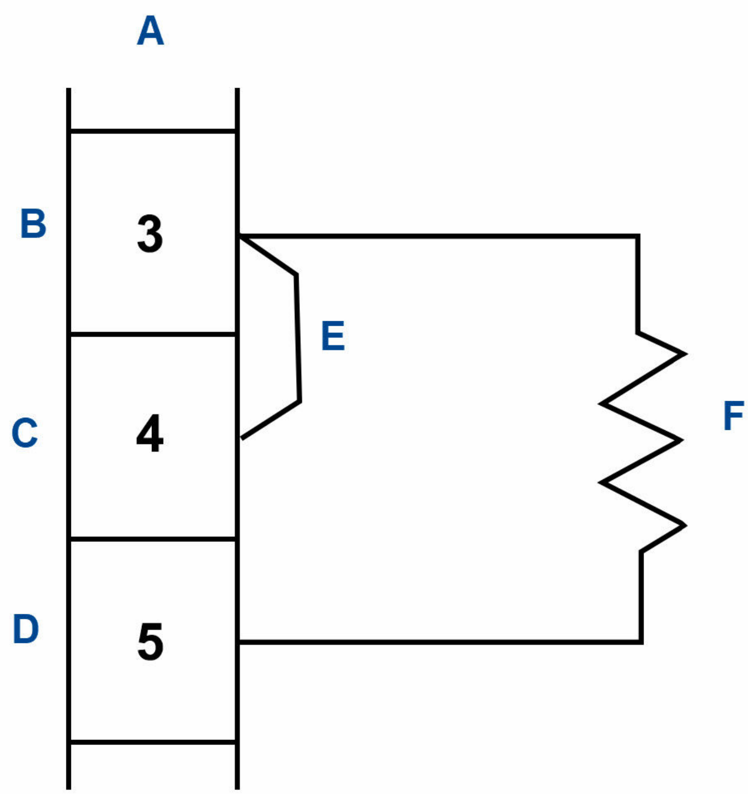
Temperature	Pt-100 resistance	Pt-1000 resistance
0 °C (32 °F)	100.0 ohms	1000 ohms
10 °C (50 °F)	103.9 ohms	1039 ohms
20 °C (68 °F)	107.8 ohms	1078 ohms
25 °C (77 °F)	109.6 ohms	1096 ohms
30 °C (86 °F)	111.7 ohms	1117 ohms
40 °C (104 °F)	115.5 ohms	1155 ohms
50 °C (122 °F)	119.4 ohms	1194 ohms
60 °C (140 °F)	123.2 ohms	1232 ohms
70 °C (158 °F)	127.1 ohms	1271 ohms
80 °C (176 °F)	130.9 ohms	1309 ohms
90 °C (194 °F)	134.7 ohms	1347 ohms
100 °C (212 °F)	138.5 ohms	1385 ohms

- If a connections is open or shorted and it should not be, the sensor has failed. Replace the sensor.

- If the measured resistances are acceptable, go to Step 3.

3. Check the transmitter. Disconnect the RTD sensor leads and wire the circuit shown in Figure 8-4. Set the resistance to the value for 25 °C (77 °F) shown in Table 8-1. The measured temperature should equal 25 °C (77 °F) within ±1 °C.

Figure 8-4: Temperature Simulation into the Rosemount 5081 pH/ORP Transmitter



A. Terminal board
B. RTD return
C. RTD sense
D. RTD in
E. Jumper
F. Standard resistor(s) to stimulate RTD

- If the measured temperature is correct, the transmitter is working properly.
- If the measured temperature is incorrect, calibrate the transmitter against the standard resistance equivalent to 77 °F (25 °C). Change the resistance and verify that the temperature reading changes to the correct value.
  — If the transmitter works properly after temperature calibration, the original calibration was in error. Re-attach the RTD wires and check the temperature performance of the sensor.

- If the reading is still wrong, the transmitter electronics have failed. Replace the sensor board stack.

LinE FAIL

`LinE FAIL` almost always means the transmitter is measuring an incorrect distance between terminal TB-3 (resistance temperature device [RTD] return) and TB-4 (RTD sense). These terminals are critical connections for the three-wire RTD measurement. Figure 8-3 shows a three-wire RTD connection.

Recommended actions

1. Check for miswires and open connections at TB-3 and TB-4. Open connections can be caused by loose connections, poor spade crimps, or broken wires. Be sure the check junction boxes for proper pass through of all wires.
   - If correcting a wiring problem makes the message disappear, the system is in good condition.
   - If the message is still showing, go to Step 2.
2. The RTD sense or the RTD return wire inside the sensor cable may be broken. Keep the sensor wires attached and jumper TB-3 and TB-4.
   - If the diagnostic message disappears, either the RTD return or RTD sense wire is broken. To verify a broken wire, disconnect the leads and measure the resistance between them. Installing the jumper completes the circuit, but bypasses the three-wire function. The transmitter no longer corrects for changes in lead wire resistance with temperature. replace the sensor as soon as possible.
   - If the diagnostic message remains, go to Step 3.
3. The cable connecting the sensor to the transmitter may be too long. Test using a sensor with a shorter cable.
   - If shortening the cable eliminates the problem, move the transmitter closer to the sensor. It may also be possible to increase diameter of the RTD wires. Consult the factory for assistance.
   - If the diagnostic message remains, go to Step 4.
4. Check the temperature of the transmitter. Simulate both temperature and pH. See tEMP HI and tEMP LO (steps 2 and 3) for temperature simulation and Simulating inputs - pH for pH simulation.
   - If the transmitter fails either simulation, the electronic board stack should be replaced.
   - If the transmitter passes the simulations, the transmitter is not in good condition, and the sensor should be replaced.

InPUt WArn

`InPUt WArn` means that the input value or the calculated pH is outside the measurement range. The measured pH is less than -2 or greater than 16.

Recommended actions

1. Check for miswires and open connections, particularly at TB-10. Open connections can be caused by loose connections, poor spade crimps, or broken wires. Be sure to check junction boxes for proper pass through of all wires.
   - If correcting a wiring problem clears the message, the system is in good condition.
   - If the message is still showing, go to Step 2.
2. Check that the transmitter is working properly by simulating a pH input. See Testing the transmitter by simulating the pH.
   - If the transmitter does not respond to simulated inputs, replace the board stack.
   - If the transmitter performs satisfactorily and the preamplifier is located in a remote junction box or in a sensor-mounted junction box, go to Step 3.
   - If the transmitter performs properly and the preamplifier is located in the transmitter, the sensor has failed and should be replaced.
3. The problem may lie with the remote preamplifier or with the cable connecting the preamplifier and junction box to the transmitter.
   a) Be sure all wires between the junction box and transmitter are connected.
   b) Use Rosemount cable.
      Generic cable may not work.
   - If the disagnostic message clears, the interconnecting cable was the problem.
   - If the message remains, go to Step 4.
4. Confirm that the problem is with the remote preamplifier.
   a) Wire the pH sensor directly to the transmitter.
   b) Change the menu from PAMP=SnSr to trAnS for the test and return it to SnSr afterwards.
   - If the error message clears, the remote preamplifier is faulty. Replace the preamplifier.
   - If the error message remains, the sensor has failed. Replace the sensor.

SLOPE Err LO

`SLOPE Err LO` means that a two-point buffer calibration attempt has failed. The slope is too low (<40 mV/pH) for a good measurement.

Recommended actions

1. Repeat the calibration.
   a) Inaccurate buffers can cause a low slope. Repeat the calibration using fresh buffers. Alkaline buffers, pH 10 or greater, are particularly susceptible to changing value in air or with age. If you used a high pH buffer in the failed calibration, try a lower pH buffer when repeating the calibration. For example, use pH 4 and 7 buffer instead of pH 7 and 10 buffer.

   b) Allow adequate time for readings in buffer to become constant. If the sensor was in a process substantially colder or hotter than the buffer, allow at least 20 minutes for readings in the buffer to stabilize. Alternatively, place the sensor in a container of water at ambient temperatures for 20 minutes before starting the calibration.

   c) Be sure the correct buffer values are being entered during calibration.

   - If the second calibration was successful, an error was made during the first attempt.
   - If the second calibration fails, go to Step 2.

2. Check wiring. Connections to TB-10, TB-7, and TB-8 are particularly important. Recalibrate the sensor.
   - If the wiring was the only problem, the sensor should calibrate.
   - If the message persists, go to Step 3.
3. Inspect and clean the sensor. Recalibrate the sensor.
   - If the sensor was dirty, it should calibrate after cleaning.
   - If the message persists, go to Step 4.
4. Check for a faulty sensor.
   - If a spare sensor is available, connect it to the transmitter. Use the auto calibration procedure to calibrate the sensor.
     - If the new sensor cannot be calibrated, the transmitter is faulty. Go to Step 5.
     - If the new sensor can be calibrated, the old sensor has failed.
   - If a spare sensor is not available, measure the glass impendance (GIMP). See Testing the transmitter by simulating the pH.
     - If the glass impedance is less than about 20 megohms, the glass has cracked and the electrode must be replaced.
     - If the glass impedance is greater than about 20 megohms, the sensor is probably in good condition. Go to Step 5.
5. Check transmitter performance by simulating pH inputs. See Testing the transmitter by simulating the pH.
   - If the transmitter performs satisfactorily, go to Step 6.
   - If the transmitter does not respond to stimulated inputs, replace the board stack.
6. If the transmitter responds to simulated inputs, the problem must lie with the sensor or the interconnecting wiring. Verify the interconnecting wiring point to point. Fix or replace bad cable. If the cable is good, replace the pH sensor.

SLOPE Err HI

`SLOPE Err HI` means that a two-point buffer calibration attempt has failed. The slope is too high (> 62 mV/pH) for a good measurement.

Recommended actions

1. Repeat the calibration.
   a) Inaccurate buffers can cause a high slope. Repeat the calibration using fresh buffers. Alkaline buffers, pH 10 or greater, are particularly susceptible to changing value in air or with age. If you used a high pH buffer in the failed calibration, try a lower pH buffer when repeating the calibration. For example, use pH4 and 7 buffer instead of pH 7 and 10 buffer.

   b) Allow adequate time for readings in buffer to become constant. If the sensor was in a process substantially colder or hotter than the buffer, allow at least 20 minutes for readings in the buffer to stabilize. Alternatively, place the sensor in a container of water at ambient temperature for 20 minutes before starting the calibration.

   c) Be sure the correct buffer values are being entered during calibration. To minimize errors caused by entering the wrong buffer values, use the autocalibration procedure.

   d) Verify that the temperature reading is accurate. Compare the sensor reading against a thermometer known to be accurate. Recalibrate if necessary.

   - If the second calibration was successful, an error was made during the first attempt.
   - If the second calibration fails, go to Step 2.

2. There is a remote possibility of a problem with the autocalibration program. Repeat the calibration using the manual calibration procedure.
   - If manual calibration was successful when autocalibration failed, the problem might be with the sensor electronics. Call the factory for assistance.
   - If manual calibration is not possible, go to Step 3.

3. Check the transmitter performance by simulating pH inputs. See Testing the transmitter by simulating the pH.
   - If the transmitter performs satisfactorily, go to Step 4.
   - If the transmitter does not respond to stimulated inputs, replace the board stack.

4. If the transmitter responds to simulated inputs, the problem must lie with the sensor or the interconnecting wiring. Verify the interconnecting wiring point to point. Fix or replace bad cable. If cable is good, replace the pH sensor.

Std Err

`Std Err` means the reference electrode voltage has changed drastically. Typical causes are exposure to poisoning agents, sulfides or cyanides, or prolonged exposure to high temperature.

Troubleshooting depends on the type of sensor.

Recommended actions

1. If the sensor is rebuildable, replenish the electrolyte solution and replace the liquid junction. Calibrate the sensor.
   - If the sensor can be calibrated, the problem has been corrected.
   - If the sensor cannot be calibrated, replace the sensor. If the sensor has separate measuring and reference electrodes, replace only the reference electrode.
2. If the sensor is not rebuildable, try the reference electrode rejuvenation procedure.
   - If the rejuvenated sensor can be calibrated, the problem has been corrected.
   - If the sensor cannot be calibrated, replace the sensor.

rOM FAIL or CPU FAIL

`rOM FAIL` or `CPU FAIL` means the transmitter electronics have failed.

Recommended action

Replace the electronic board stack (PN 23992-02 [-HT] or PN 23992-03 [-HF]).

AdC WArn or CyCLE PWr

The `Adc WArn` or `CyCLE PWr` message appears momentarily when the transmitter has recognized an internal calculation problem. The transmitter repeats the calculation, and the message disappears once the calculation is successful. If the message is displayed constantly, the transmitter electronics may be faulty.

Recommended actions

1. Check transmitter performance by simulating pH inputs. See Testing the transmitter by simulating the pH.
   - If the transmitter performs satisfactorily, go to Step 2.
   - If the transmitter does not respond to simulated inputs, replace the board stack.
2. If the transmitter responds to simulated inputs, the problem must lie with the sensor or the interconnecting wiring. Verify the interconnecting wiring point to point. Fix or replace bad cable. If cable is good, replace the pH sensor.

WritE Err

`WriTE Err` means that jumper JP1 on the CPU board is not in place. If the sensor is not in place, the transmitter cannot be programmed or calibrated.

Recommended actions

1. Check the position of jumper JP1 on the CPU board. If the jumper is hanging off one of the pins, place it across both pins. If the jumper is missing entirely, use jumper JP3 (50/60 Hz), which is not a critical jumper.

   There are similar numbered jumpers on the analog board. The jumper to be checked is on the CPU board, which is the center board in the stack.
2. Turn the power to the transmitter off and then back on.

- Toggling the power should cause the message to disappear.
- If the message does not disappear, replace the electronic board stack.

FACt FAIL

`FACt FAIL` means the unit has not been factory calibrated. Call the factory. The transmitter will probably need to be returned to the factory for calibration.

8.2.4 Troubleshooting when no diagnostic message is showing

If no diagnostic message is showing, locate the symptom(s) in the table below and refer to the appropriate section for assistance.

Symptom	Section
`Id000` appears in display when trying to program or calibrate transmitter	Id000 in display
Error message flashing in display	Troubleshooting when a diagnostic message is showing
Transmitter does not respond to remote controller	Transmitter not responding to IRC
Calibration problems	
`SLOPE Err HI` or `SLOPE Err LO` appears after calibration attempt	SLOPE Err LO or SLOPE Err Hi appear after calibration attempt
`bF1` or `bF2` continuously flashes during auto calibration	bF1 or bF2 continuously flashes during autocalibration
pH reading in buffer drifts during manual calibration	pH reading in buffer drifts during manual calibration
Measurement problems	
Sensor does not respond to known pH changes	Sensor does not respond to known pH changes
Buffer calibration is acceptable; process pH is slightly different from expected value	Buffer calibration is acceptable; process pH is slightly different from expected value.
Buffer calibration is acceptable; process pH is grossly wrong and/or readings are noisy	Buffer calibration is acceptable; process pH is grossly different from expected value
Temperature reading is inaccurate	Temperature reading is inaccurate
Transmitter problems	
No display	No display
Display segments missing or display incorrect	Display segments missing
Transmitter locked up, all display segments lit	Transmitter locks up
Transmitter periodically restarts itself	Transmitter periodically restarts itself

Id000 in display

A security code has been programmed into the transmitter. The correct code must be entered before the transmitter can be programmed or calibrated.

Transmitter not responding to IRC

Recommended actions

1. Be sure the transmitter is receiving the signal.
    a) Clean the window in front of the IR detector.
    The detector is a small rectangle just above the main display.
    b) Hold the IRC at least 6 ft. (1.8 m) from the transmitter and not more than 15 degrees from the center.
    c) Hold the IRC closer (within 2 ft. [.6 m]) in case the batteries are getting weak.
2. If Step 1 fails, check the IRC.
    a) If a second transmitter is available, test the IRC on that transmitter. If a spare transmitter is not available, continue with Step b.
    b) The green LED, located just above and between the **RESET** and **HOLD** buttons, should light when a key is pressed. A piece of black rubber film may be covering the LED. Scrape the film away with your fingernail to expose the LED.
    The two clear LEDs on the front end of the IRC never light. They transmit the invisible IR signal.
    c) If the green LED does not light, the IRC is not working. Go to Step 3.
3. Take the IRC to a non-hazardous area and replace the two 1.5 Vdc AAA batteries.
    - If the green LED lights, but the transmitter still does not respond, go to Step 4.
    - If neither the LED lights nor the transmitter responds, replace the IRC.
4. Replace the transmitter display board.

SLOPE Err LO or SLOPE Err Hi appear after calibration attempt

Refer to SLOPE Err LO and SLOPE Err HI for assistance in solving calibration slope problems.

bF1 or bF2 continuously flashes during autocalibration

During autocalibration, `bF1` or `bF2` flashes until the pH reading of the sensor in the buffer is stable.

Recommended actions

1. Check the stability limits.
    If the stabilization range (prompt `PH`) is set too narrow or the stabilization time (prompt `tIME`) is set too long, the transmitter will not accept buffer readings. A good choice for `PH` is 0.02, and a good choice for `tIME` is 10 - 20 seconds.

2. Allow adequate time for the temperature of the sensor to reach the temperature of the buffer. If the sensor was in a process substantially hotter or colder than the buffer, allow at least 20 minutes for readings in the buffer to stabilize. Alternatively, place the sensor in a container of water at ambient temperature for 20 minutes before starting the calibration.
3. Be sure to swirl the sensor after placing it in each new buffer solution.
4. Finally, check the sensor. Verify that wiring is correct. Also, the sensor may be dirty or aged, or the reference junction may be depleted.
    a) Check that the sensor is properly wired to the transmitter.

       Pay particular attention to terminals TB-10 (mV in), TB-7 (reference), and TB-8 (solution ground).
    b) Clean the sensor.
    c) If the sensor is not rebuildable, rejuvenate the reference junction.
    d) If the sensor is rebuildable, replenish the reference electrolyte and replace the liquid junction.
    e) Replace the sensor.
       A clean pH sensor should not drift in buffer.

pH reading in buffer drifts during manual calibration

Recommended actions

1. Allow adequate time for the temperature of the sensor to reach the temperature of the buffer. If the sensor was in a process substantially hotter or colder than the buffer, allow at least 20 minutes for readings in the buffer to stabilize. Alternatively, place the sensor in a container of water at ambient temperature for 20 minutes before starting the calibration.
2. Be sure to swirl the sensor after placing it in each new buffer solution.
3. Finally, check the sensor. Verify that wiring is correct. Also, the sensor may be dirty or aged, or the reference junction may be depleted.
    a) Check that the sensor is properly wired to the transmitter.

       Pay particular attention to terminals TB-10 (mV in), TB-7 (reference), and TB-8 (solution ground).
    b) Clean the sensor.
    c) If the sensor is not rebuildable, rejuvenate the reference junction.
    d) If the sensor is rebuildable, replenish the reference electrolyte and replace the liquid junction.
    e) Replace the sensor.
       A clean pH sensor should not drift in buffer.

Sensor does not respond to known pH changes

Recommended actions

1. Verify that the change really happened. If you were checking pH response in buffers, recheck performance with fresh buffers. If a process pH reading was not what was expected, check the performance of the sensor in buffers. Also, use a second pH meter to verify that the expected change in the process pH really occurred.
2. Check the sensor. Verify that wiring is correct. Also, the sensor may be dirty or aged, or the reference junction may be depleted. Check that the sensor is properly wired to the transmitter.

   See Wire. Pay particular attention to terminals TB-10 (mv in), TB-7 (reference), and TB-8 (solution ground).
3. If a clean, properly wired sensor does not respond to pH changes, the glass bulb is probably broken or cracked.
   a) If a spare sensor is available, check the spare.
      If the spare sensor responds to pH changes, the old sensor has failed.

      If the spare sensor does not respond to pH changes, go to Step 4.
   b) If a spare sensor is not available, check the glass impedance (GIMP) of the existing sensor.
      If the impedance is less than about 20 megohm, the pH sensor is cracked. Replace the sensor.

      If the impedance is greater than about 20 megohm, go to Step 4.
4. Check transmitter performance by simulating pH inputs.

   See Testing the transmitter by simulating the pH.

   If the transmitter responds to simulated inputs, the problem must lie with the sensor or the interconnecting wiring. Verify the interconnecting wiring point to point. Fix or replace bad cable. If cable is good, replace pH sensor.

   If the transmitter does not respond to simulated inputs, replace the board stack.

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.

Buffer calibration is acceptable; process pH is grossly different from expected value

The systems suggest a ground loop (measurement system connected to earth ground at more than one point), a floating system (no earth ground), or noise being induced into the transmitter by a sensor cabling.

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.

Recommended actions

1. To 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 similar symptoms develop after making the connection, a ground loop exists. If no symptoms develop, a ground loop may or may not exist.
2. Check the grounding of the process.

   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.
   a) Ground the piping or tank to a local earth ground.

      Metal tees, grounding rings, or grounding rods may be required.

   b) If problems persist, connect a wire from the ground connection at the dc power supply to the transmitter case. Connect a second wire from the transmitter case to the process.
      These connections force the grounds to the same potential.

   If the problem persists, simple grounding is not the problem. The sensor wiring is probably carrying noise into the instrument. Go to Step 3.
3. Simplify the sensor wiring.
   a) Disconnect all sensor wires at the transmitter except: TB-4 (resistance temperature device [RTD] sense), TB-5 (RTD IN), TB-7 (Reference IN), and TB-10 (pH/ORP IN). If you are using a remote preamplifier, disconnect the wires at the input side of the junction box.

   b) Tape back the ends of the disconnected wires, including all shield and drain wires, to keep them from making accidental connections with other wires, terminals, or the transmitter case.

   c) Connect a jumper wire between TB-3 (RTD return) and TB-4 (RTD sense). Connect a second jumper wire between TB-7 (Reference IN) and TB-8 (Solution ground).

   d) Place the sensor back in the process liquid. If diagnostic measures such as `GLASSFAIL` or `REF WArn` appear, turn off the sensor diagnostics.

   If the symptoms disappear, interference was coming into the transmitter along one of the sensor wires. The measurement system can be operated permanently with simplified wiring.

If symptoms still persist, go to Step 4.

4. Check for extra ground connections or reduced noise.

   The electrode system is connected to earth ground through the process. If other ground connections exist, there are multiple paths and ground loops are present. Noise enters the measurement either by a direct connection, usually between the cable and grounded metal, or by an indirect connection, usually EMI/RFI picked up by the cable.

   a) If the sensor cable is run inside conduit, there may be a short between the cable and the conduit. Re-run the cable outside the conduit. If symptoms disappear, then a short exists between the table and the conduit. Likely a shield is exposed and is touching the conduit. Repair the cable and reinstall it in the conduit.

   b) To avoid induced noise in the sensor cable, run it as far away as possible from the power cables, relays, and electric motors. Keep sensor wiring out of crowded panels and cable trays.

   c) Occasionally, noise can travel into the transmitter housing from the metal it is mounted on. The noise is then radiated into the transmitter electronics. If isolating the transmitter from its metal mounting eliminates the symptoms, move the transmitter to a different location or mount it with isolating materials.

   If ground loop problems persist, consult the factory. It may require a visit from an experienced service technician to solve plant-induced problems.

Temperature reading is inaccurate

Recommended actions

1. To troubleshoot temperature problems, refer to tEMP HI and tEMP LO.
2. Calibrate the temperature response of the sensor.
3. If necessary, automatic temperature compensation can be temporarily disabled and the transmitter placed in manual temperature compensation. For manual temperature, choose a temperature equal to the average temperature of the process.
   The resulting pH reading will be in error. The more variable the temperature and the further from pH 7, the greater the error.

HART® communication problems

Recommended actions

1. If the handheld communicator software does not recognize the =transmitter, order an upgrade from Rosemount at 800 999 9307.
2. Be sure the HART load and voltage requirements are met.

   - HART communications requires a minimum 250 ohm load in the current loop.
   - Install a 250 - 500 ohm resistor in series with the current loop. Check the actual resistor value with an ohmmeter.

- For HART communications, the power supply voltage must be at least 18 Vdc.

3. Be sure the HART communicator is properly connected.
   - The communicator leads must be connected across the load.
   - The communicator can be connected across the power terminals (TB-15 and TB-16).
4. Verify that the handheld communicator is working correctly by testing it with another HART Smart device.
   If the communicator is working, the transmitter electronics may have failed. Call Rosemount for assistance.

   If the communicator seems to be malfunctioning, call Rosemount at 800 999 9307 for assistance.

No display

Recommended actions

1. Be sure power requirements are being met.
   a. The positive voltage lead must be connected to TB-16.
   b. Check dc voltage requirements and load restrictions.
2. Check for bad connections between the circuit boards. Be sure the ribbon cable between the display and CPU boards is firmly seated in the socket on the CPU board. Be sure the socket connection between the CPU and analog boards is firm.

Display segments missing

Recommended action

Replace the display board.

Transmitter locks up

Recommended actions

1. Turn the dc power off; then turn it back on.
2. If the problem persists, replace the electronic board stack (HART®: PN 23992-02; FOUNDATION™ Fieldbus: PN 23992-03).

Transmitter periodically restarts itself

Recommended actions

1. The problem is usually related to improperly wired resistance temperature device (RTD) input terminals.
   a) The RTD return wire must be connected to TB-3. The RTD sense wire must be connected to TB-4, and the RTD in wire must be connected to TB-5. If the pH sensor does not have an RTD, connect a jumper wire across the terminals TB-3 and TB-4 and a second jumper across TB-4 and TB-5.

   b) If you have jumpered the RTD connections as described in 1.a, turn off automatic temperature compensation and operate the transmitter in manual temperature mode.

2. If RTD wiring is correct and problems still persist:
   a) Monitor the power supply. Be sure the power is not intermittent and the correct voltage is present.
   b) Try connecting the transmitter to a different power supply.

8.2.5 Displaying diagnostic variables

This section describes how to display the diagnostic variables listed below:

Diagnostic measurements

1. Sensor voltage in mv (`InPut`)
2. Glass impedance in megohms (`GIMP`)
3. Reference temperature in kilohms (`rIMP`)(1)
4. Temperature in °C

Diagnostic messages

1. Software version (`VEr`)
2. Display last three fault messages (`ShoW FLt`)

Note
Displays are read only.

Procedure

1. Press **DIAG** on the IRC to enter the ***Diagnostic*** menu.
   Sensor voltage in mV (`InPut`) appears.
2. Press **NEXT**.
   The temperature corrected glass impedance in megohms (`GIMP`) appears.
3. Press **NEXT**.
   The reference impedance (`rIMP`) appears. For conventional low impedance silver/ silver chloride reference electrodes, the reference impedance has units of kilohms. For the rare occasions when a high impedance reference is used, the units are megohms.
4. Press **NEXT**.
   The model number and software version (`Ver`) appears.
5. Press **NEXT**.
   The temperature (`tEMP`) measured by the sensor appears.
6. Press **NEXT**.
   The ***ShoW Fit*** submenu appears.

(1) For high impedance reference electrodes, the reference impedance is in megohms.

7. Press **ENTER**.
   The most recent fault message appears in the display.
8. Press **NEXT** repeatedly to scroll through the stored messages.
   The transmitter only remembers the three most recent messages. `nonE` appears if there are no faults. Press **EXIT** to clear all the stored messages and return the transmitter to the *ShoW Fit* display. If the transmitter loses power, all stored warnings and fault messages are lost.
9. Press **EXIT** to return to the process display.

8.2.6 Testing the transmitter by simulating the pH

Overview of simulating a pH input

This section describes how to simulate a pH input into the Rosemount 5081-P pH/ORP transmitter. pH is directly proportionsl to voltage.

To simulate the 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. Although the general procedure is the same, the wiring details depend on the location of the preamplifier. Consult the table to find the correct procedure.

Preamplifier located in	Section
Transmitter	Simulate pH when the preamplifier is located in the transmitter
Remote junction box	Simulate pH when the preamplifier is located in a remote junction box or in a sensor-mounted junction box
Sensor-mounted junction box	Simulate pH when the preamplifier is located in a remote junction box or in a sensor-mounted junction box
Sensor	Simulate pH when preamplifier is in sensor

Simulate pH when the preamplifier is located in the transmitter

Procedure

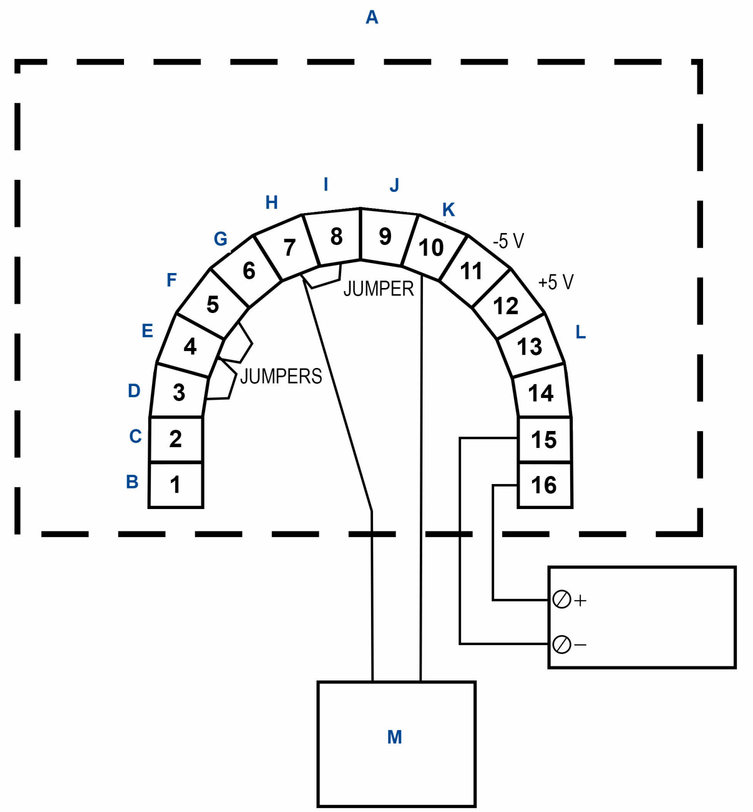
1. Program PAMP to transmitter.
2. Turn off sensor diagnostics.
3. Turn off automatic temperature compensation. Set manual temperature compensation to 77 °F (25 °C).
4. Disconnect the sensor and wire transmitter as shown in Figure 8-5.
5. Attach a jumper between TB-7 (Reference IN) and TB-10 (pH IN).
6. Measure the voltage. Press **DIAG** on the infrared remote control (IRC).
   The InPut voltage in millivolts appears in the temperature-output area. The main display continues to show pH. The measured voltage should be 0 mV, and the pH should be approximately 7. Because the calibration data in the transmitter may be offsetting the input voltage, the displayed pH may not be exactly 7.0. If the actual readings are close to expected, the transmitter is probably operating normally.

7. If a standard millivolt source is available, remove the jumper between TB-7 and TB-10 and connect the voltage source.
8. Calibrate the transmitter. Use 0.0 mV for pH 7 (bF1) and -177.4 mV for pH 10 (bF2). If the transmitter is working, it should accept the calibration.
9. To check linearity, leave autocalibration and return to the main display. Set the voltage source to the values in the table and verify that the pH reading matches the expected value.

Voltage (mV)	pH
295.8	2.00
118.3	5.00
-118.3	9.00
-295.8	12.00

Example

Figure 8-5: pH simulation when the preamplifier is located in the transmitter



A. *Transmitter*
B. *Earth ground*
C. *Shield*
D. *Resistance temperature device (RTD) return*
E. *-RTD sense*
F. *RTD in*
G. *Reference ground*
H. *Reference in*
I. *Solution ground*
J. *pH guard*
K. *pH in*
L. *+RTD sense*
M. *mV source*

Simulate pH when the preamplifier is located in a remote junction box or in a sensor-mounted junction box

Procedure

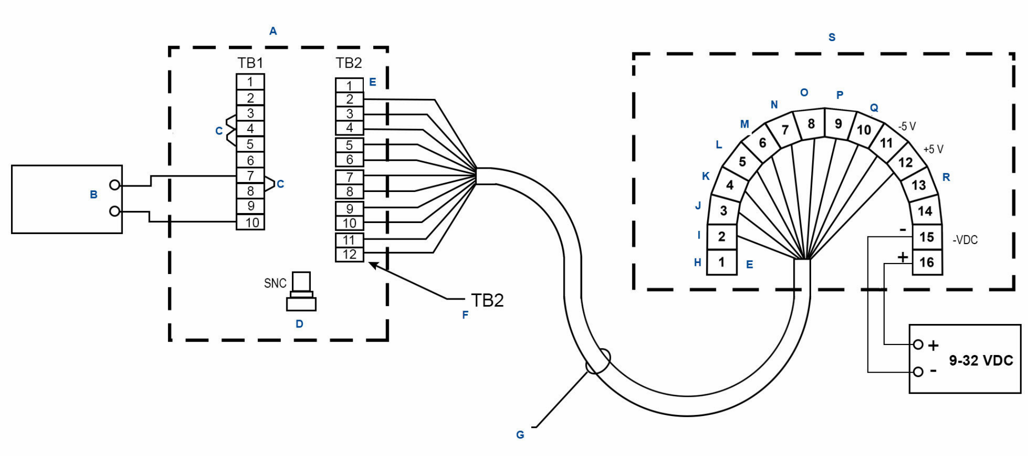
1. Program PAMP to sensor.

2. Turn off sensor diagnostics.
3. Turn off automatic temperature compensation. Set manual temperature compensation to 77 °F (25 °C).
4. Disconnect the sensor and wire the sensor side of the junction box as shown in Figure 8-5. Leave the interconnecting cable between the junction box and transmitter in place.
5. Attach a jumper between TB1-7 (Reference IN) and TB1-10 (pH IN)
6. From this point on, continue with steps 6 through 9 in Simulate pH when the preamplifier is located in the transmitter.

   For testing using a standard millivolt source. Be sure to remove the jumper between TB1-7 and TB1-10 before connecting the standard millivolt source.

Example

Figure 8-6: pH simulation when the preamplifier is located in a remote junction box or in a sensor mounted junction box



A. *Remote junction box: PN 23555-00 (includes preamplifier). Board PN 23557-00*
B. *mV source*
C. *Jumpers*
D. *No connection*
E. *Normally closed*
F. *Far side*
G. *Extension cable point to point wiring terminals 2 to 12*
H. *Earth ground*
I. *Shield*
J. *Resistance temperature device (RTD) return*
K. *-RTD sense*
L. *RTD in*
M. *Reference ground*
N. *Solution ground*
O. *pH guard*
P. *pH in*
Q. *+RTD sense*
R. *Transmitter*

Simulate pH when preamplifier is in sensor

The preamplifier in the sensor simply converts the high impedance signal into a low impedance signal without amplifying it.

8.3 Contacting and toroidal conductivity diagnostics and troubleshooting

8.3.1 Diagnose menu

The transmitter automatically monitors for fault conditions. The ***Diagnose*** menu displays current variable settings and fault messages. The messages are defined in Table 8-2.

Troubleshoot contacting conductivity analyzers

Procedure

1. Look for a diagnostic fault message on the display to help pinpoint the problem.

   Refer to Diagnostic messages for an explanation of the message recommended actions to solve it.
2. Refer to Troubleshooting when no diagnostic message is showing for common loop problems and the recommended actions to resolve them.

Display diagnostic values

Use the **DIAG** key on the IRC is used to access the ***Diagnose*** menu. The messages are defined in Table 8-2.

Use the *FAuLtS* submenu to show the last three faults/warnings. The most recent is displayed first. Use **NEXT** to scroll through the remaining faults. Press **EXIT** to clear all fault/warnings and returns the ***FAuLtS*** segment. Disconnecting the transmitter removes all fault messages from memory. The `nonE` message is displayed when no faults/warnings have occurred.

Table 8-2: Diagnostic variables mnemonics

AbS	Absolute conductivity (µS/cm or mS/cm)
0 A ir	Sensor zero in air
CELL ConSt	Sensor cell constant (used in C mode)
tSLOPE	Temperature slope in %/° C
CAL F	Calibration factor
SoFt	Software version
HArd	Hardware version
FAuLtS	Show fault messages
nonE	No fault messages in memory

8.3.2 Fault conditions

The diagnostic program detects and diffentiates three classes of error conditions/ problems. System disabling problems are faults caused by failures in the loop or significant variations in the process. System non-disabling problems are warnings and deal with input or A to D conversion settings. The third class of detection problems are error messages and occur when the calibration limits are exceeded.

Disabling faults

When a disabling fault occurs:

1. Both FAULT and HOLD annunciation fields become active (Figure 8-7).
2. The process variable flashes at the rate of 1 second on and 1 second off.
3. The appropriate fault message alternates with the normal Temperature/Current output display (see Figure 8-7).
4. The output current loop is forced to run the non-zero fault value last entered or held at last value if fault value = 0 if the transmitter is not in the TEST, HOLD, or Multidrop operational modes.
5. A 0-1 mA output signal is available for external use when system disability conditions are active. These conditions drive this output to 1 mA. Please contact factory for specific application information.

Figure 8-7: Disabling Fault Annunciation

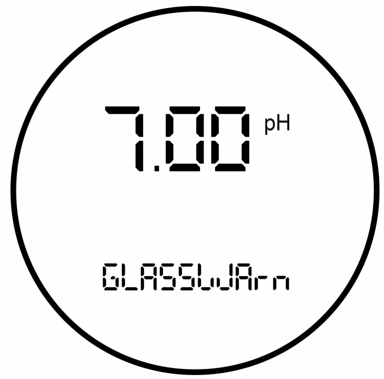
Non-disabling warnings

When a non-system-disabling condition occurs, a warning message is displayed.

The process variable does not flash. The appropriate message alternates with the Temperature/Current output display (see Figure 8-8).

If more than one fault exists, the display will sequence through each diagnostic message. This will continue until the cause of the fault has been corrected.

Figure 8-8: Warning Annunciation



8.3.3 Diagnostic messages

The transmitter's diagnostics constantly monitor the conductivity loop for possible problems. If an operational problem is encountered, check the display for a fault or error message. These are displayed in the *Temperature/Current output* segment of the display. Note the message and refer to the following sections for a description of possible problems that may have triggered the diagnostic message.

Faults

tEmP LO

Temperature is too low.

Recommended actions

1. Check wiring or sensor/process temperature.
2. Check resistance temperature device (RTD).

tEmP HI

Temperature is too high.

Recommended actions

1. Check wiring or sensor/process temperature.
2. Check resistance temperature device (RTD).

rtd FAIL

The resistance temperature device (RTD) sensor line fault limits have been exceeded into the sensor.

Recommended action

Check wiring or check *Program/Temp* menu setting to verify the 100-3 or 100-4 sensor type connected.

CPU FAIL

The CPU has failed during RAM or EEPROM verification.

Recommended action

Recycle. If persistent, contact the factory.

FACt FAIL

`FACt FAIL` appears if the transmitter factory calibration message has been triggered.

A stray noise spike can cause this message to appear.

Recommended actions

1. If the pH reading seems acceptable, reset the calibration flag.
   a) Press **2** on the infrared remote control (IRC) ten times to enter the ***factory calibration*** menu.
   The display does not change.
   b) Press **3**.
   `FActorYCAL` appears in the display.
   c) Press **NEXT**.
   `rEPAir` appears in the display.
   d) Press **NEXT**.
   `ConFIG` appears in the display.
   e) Press **NEXT**.
   `rESEt` appears in the display.
   f) Press **NEXT**.
   `rESEtCFG` appears in the display.
   g) Press **ENTER**.
   `rESET` appears again.
   h) Press **NEXT**.
   `FActorYCAL` reappears.
   i) Press **ENTER**.
   `FactOn` appears in the display.
   j) Press **3**.
   `FactOFF` appears.
   k) Press **ENTER** to store the settings.
   l) Press **EXIT** repeatedly until the main display reappears.

   If the message does not clear or problems persist, the electronics have failed. Replace the electronic board stack.
2. Contact factory.

rOm FAIL

The PROM failed the check-sum test.

Recommended action

Contact factory.

CyCLE PoWr

A wrong value was detected during power-up.

Recommended action

Recycle the power.

SEnSor FAIL

Bad sensor means that the sensor current is a large negative number. `SEnSor FAIL` may appear for a while when the sensor is first placed in service.

Recommended actions

1. Observe the sensor. Go to SEnSor Cur under the ***Diagnostic*** menu.
   If the sensor is moving in the positive direction, there is probably nothing wrong. The error message should soon disappear.
2. Verify that wiring is correct. Pay particular attention to the anode and cathode connections.
3. Verify that the transmitter is configured for the correct measurment.

   Configuring the measurement sets several things, including the polarizing voltage. Applying the wrong polarizing voltage to the sensor can cause a negative current.
4. Replace the sensor membrane and electrolyte solution and clean the cathode if necessary.

   See the sensor reference manual for details.
5. Replace the sensor.

Warnings

InPUt WArn

`InPUt WArn` means that the input value or the calculated pH is outside the measurement range. The measured pH is less than -2 or greater than 16.

Recommended actions

1. Check for miswires and open connections, particularly at TB-10. Open connections can be caused by loose connections, poor spade crimps, or broken wires. Be sure to check junction boxes for proper pass through of all wires.
   - If correcting a wiring problem clears the message, the system is in good condition.
   - If the message is still showing, go to Step 2.
2. Check that the transmitter is working properly by simulating a pH input. See Testing the transmitter by simulating the pH.
   - If the transmitter does not respond to simulated inputs, replace the board stack.

- If the transmitter performs satisfactorily and the preamplifier is located in a remote junction box or in a sensor-mounted junction box, go to Step 3.
- If the transmitter performs properly and the preamplifier is located in the transmitter, the sensor has failed and should be replaced.

3. The problem may lie with the remote preamplifier or with the cable connecting the preamplifier and junction box to the transmitter.
    a) Be sure all wires between the junction box and transmitter are connected.
    b) Use Rosemount cable.

        Generic cable may not work.

- If the disagnostic message clears, the interconnecting cable was the problem.
- If the message remains, go to Step 4.

4. Confirm that the problem is with the remote preamplifier.
    a) Wire the pH sensor directly to the transmitter.
    b) Change the menu from PAMP=SnSr to trAnS for the test and return it to SnSr afterwards.

- If the error message clears, the remote preamplifier is faulty. Replace the preamplifier.
- If the error message remains, the sensor has failed. Replace the sensor.

OvEr rAnGE and AMP FAIL

The current range setting has been exceeded or the measurment exceeds the display limit.

This error message appears if the sensor current is too high. Normally, excessive sensor current implies that the sensor is miswired or the sensor has failed.

Recommended actions

1. Verify the 4 and 20 mA settings in the ***Program/output*** menu.
2. Verify that the wiring is correct and connections are tight. Be sure to check connections at the junction box if one is being used.
3. Replace the sensor membrane and electrolyte solution and clean the cathode if necessary.

    See the sensor reference manual for details.

4. Replace the sensor.

AdC Error

`AdC Error` means the analog to digital converter has failed.

Recommended actions

1. Verify that the sensor wiring is correct and connections are tight.

    Be sure to check connections at the junction box if one is being used.

2. Disconnect sensor(s) and simulate temperature and sensor input.

If the transmitter does not respond to simulated signals, the analog PCB has probably failed.

3. Recycle the power.
4. Call the factory for assistance.

nEEd 0 CAL

The message `nEEd 0 CAL` means that the concentration of the analyte is too negative.

Recommended actions

1. Check the zero current (go to `0 CurrEnt` under the ***Diagnose*** menu).
   If the zero current is appreciably greater than the measurement current, the `nEEd 0 CAL` warning appears.
2. Verify that the zero current is close to the value given in the calibration section for the analyte being determined.
3. Rezero the sensor.
   Refer to the calibration and troubleshooting sections of the sensor reference manual for more information.

Errors

CAl Err or OFFSEt Err

A calibration error has occurred between the standard and process.

Recommended action

Press **RESET** and repeat. Check calibration standards and unit configuration.

tSLOPE Err

The limit for T-2 in a two point calibration has been exceeded.

Recommended action

Press **RESET** and repeat the ***calibration/temp. slope*** menu setting.

-0- Err

Sensor zero limit has been exceeded.

Recommended actions

Press ***RESET*** and repeat the ***calibrate/sensor*** menu setting.

WritE Err

An attempt to write on the EEPROM has failed.

The jumper JP-1 on the CPU board has been removed.

SenSE OPEn

Most Rosemount sensors use a Pt100 or Pt1000 in a three-wire configuration. The in and return leads connect the resistance temperature device (RTD) to the measuring circuit in the transmitter. A third wire, called the sense line, is connected to the return lead. The sense line allows the transmitter to correct for the resistance of the in and return leads and to correct for changes in lead wire resistance with changes in ambient temperature.

Recommended actions

1. Verify all wiring connections, including wiring in a junction box if one is being used.
2. Disconnect the RTD SENSE and RTD RETURN wires. Measure the resistance between the leads.

   It should be less than 5 Ω.
3. If the sense line is open, replace the sensor as soon as possible.

   The transmitter can be operated with the sense line open. The measurement will be less accurate, because the transmitter can no longer compensate for lead wire resistance. However, if using the sensor at approximately constant ambient temperatures, you can eliminate the lead wire resistance error by calibrating the sensor to the measurement temperature. Errors caused by changes in ambient temperature cannot be eliminated.
4. To make the error message disappear, connect the RTD SENSE and RETURN terminals with a jumper.

8.3.4 Troubleshooting when no diagnostic message is showing

The following sections identify some of the more common symptoms and suggest actions to help resolve a problem. In general, wiring is the most common cause.

Wrong temperature reading

Recommended actions

1. Perform a temperature standardization.
2. Verify sensor's resistance temperature device (RTD).

Suspected temperature compensation problem

Recommended action

Check wiring.

Display segments missing

Recommended action

Replace the display board.

Transmitter locks up

The transmitter won't respond

Recommended actions

1. Replace PCB stack.

2. Press **RESET**.
3. Check batteries in infrared remote control (IRC).

Erratic displays

Recommended action

Check sensors in process.

Transmitter won't respond to infrared remote control (IRC) key presses

Recommended actions

1. Verify and clean ribbon cable connection on CPU board.
2. Check batteries in IRC.

Key press gives wrong selection

Recommended actions

1. Replace infrared remote control (IRC).
2. Check ribbon cable connection on CPU board.

Wrong or no current output

Recommended actions

1. Verify that output is not being overloaded.
2. Remove load.
3. Replace PCB stack.

No display or indicators

Recommended action

Replace PCB stack.

Excess input

Recommended action

Check sensor wiring.

Reverse input

Recommended action

Perform sensor zero.

Check sensor zero

The transmitter will not zero.

Recommended action

Place the sensor in the air and access zero routine.

8.3.5 Troubleshoot in the field

When it is apparent by grab sample analysis that the transmitter is giving inaccurate readings, try the following:

Prerequisites

Make sure the sensor surfaces are totally wetted by the process and that air bubbles are not trapped in the vicinity of electrodes. If you find air bubbles, change the installation technique to eliminate air bubbles.

Procedure

1. Visually inspect the installation.
    a) Check that the transmitter is mounted securely and that its internal parts are properly connected.
    b) Check all input and output wiring.
2. If Step 1 did not indicate the source of the problem, isolate the problem to either the transmitter or the sensor.
3. To troubleshoot the sensor:
    a) Disconnect the sensor from the transmitter.
    b) Remove the sensor from the process.
    c) Thoroughly dry the sensor electrodes.

    Refer to the sensor reference manual for additional troubleshooting checks.
4. To troubleshoot the transmitter independently of the sensor, use an appropriate resistor across the temperature input connectors and connect the conductivity inputs to resistance decade box.

8.3.6 Troubleshoot conductivity measurement

If troubleshooting in the field does not resolve the error, try the following procedure to troubleshoot a conductivity measurement problem in the process.

Note
Before starting this procedure, make sure that all wiring is correct.

Procedure

1. Remove the sensor from process and place the sensor in air. Zero the transmitter.

    This step is for normal contacting only, not for low conductivity or resistivity.

    If the transmitter zeros correctly, place the sensor in the process and standardize.
2. If the transmitter does not zero correctly:
    a) Check diagnostic messages.

        Refer to Diagnostic messages.

   b) Check wiring for short.
   c) Consult service center.

3. If the sensor does not standardize:
   a) Remove the sensor from the process and test it in a known conductivity solution or against a certified conductivity instrument.
   b) Check for ground loops and/or improper installation.

8.3.7 Resistance temperature device (RTD) resistance values

Table 8-3 is a ready reference of RTD resistance values at various temperatures. Use these values to test and evaluate the sensor.

Note
Resistance values are read across the RTD element and are based on the manufacturer's stated values (±1%). Allow enough time for the RTD element in the sensor to stabilize to the surrounding temperature.

Table 8-3: RTD Resistance Values

Temperature	Pt-100 resistance (ohms)	Pt-1000 resistance (ohms)
32 °F (0 °C)	100.00	1000
50 °F (10 °C)	103.9	1039
68 °F (20 °C)	107.79	1078
77 °F (25 °C)	109.62	1096
86 °F (30 °C)	111.67	1117
104 °F (40 °C)	115.54	1155
122 °F (50 °C)	119.40	1194
140 °F (60 °C)	123.24	1232
158 °F (70 °C)	127.07	1271
176 °F (80 °C)	130.89	1309
194 °F (90 °C)	134.70	1347
212 °F (100 °C)	138.50	1385

Figure 8-9: Conductivity Determination

Formula:

$$\frac{\text{cell constant value x 1,000,000}}{\text{desired simulated conductivity in } \mu\text{S/cm}} = \text{resistance in ohms}$$

Example:

$$\frac{.01 \text{ x } 1{,}000{,}000}{10 \ \mu\text{S/cm}} = \text{use 1,000 ohm resistance}$$

Use the formula to determine the appropriate resistance value to use to simulate a conductivity value.

8.4 Chlorine, dissolved oxygen, and ozone diagnostics

8.4.1 Diagnostics overview

The Rosemount 5081 transmitter can display diagnostic information that is useful in troubleshooting. The diagnostics available depend on the measurement being made. To read diagnostic information, go to the main display and press **DIAG** on the infrared remote controller. Press **NEXT** until the desired diagnostic message appears. Refer to the appropriate section below for more information.

8.4.2 Diagnostic messages for dissolved oxygen

Message	See section
TYPE O2	TYPE O2
SEnSor Cur	SEnSor Cur
SEnSitvtY	SEnSitviTY
0 CurrEnt	0 CurrEnt.
bAr PreSS	bAr PreSS.
5081-A-Ht	5081-A-Ht.
FAULtS	FAULtS

TYPE O2

Transmitter is measuring oxygen.

Recommended action

Press **NEXT** to view diagnostics.

SEnSor Cur

Recommended action

Press **ENTER** to display raw current from sensor.

SEnSitviTY

Sensitivity is calculated during calibration. It is the measured current divided by the concentration.

Recommended action

Press **ENTER** to display sensitivity.

0 CurrEnt

Recommended actions

1. Press **ENTER** to display the zero current measured during calibration.
2. Note units.

bAr PreSS

Recommended action

Press **ENTER** to display the barometric pressure used by the transmitter during air calibration.

5081-A-Ht

This is the model number.

Recommended actions

1. Press **ENTER** to display the software revision level (`SFtr`).
2. Press **NEXT** to show the hardware revision level (`HArdr`).

FAULtS

Recommended action

Press **ENTER** to scroll through existing fault messages.

8.4.3 Diagnostic messages for ozone and total chlorine

Message	See section
TYPE O3 or tCL	TYPE O3 or TYPE tCL
SEnSor Cur	SEnSor Cur

Message	See section
SEnSitvtY	SEnSitviTY
0 CurrEnt	0 CurrEnt
5081-A-Ht	5081-A-Ht
FAULtS	FAULtS

TYPE O3 or TYPE tCL

The transmitter is measuring ozone or total chlorine.

Recommended actions

Press **NEXT** to view diagnostics.

8.4.4 Diagnostic messages for free chlorine

Message	See section
TYPE FCL	TYPE FCL
SEnSor Cur	SEnSor Cur
SEnSitvtY	SEnSitviTY
0 CurrEnt	0 CurrEnt
pH	pH
InPut	InPut
SLOPE	SLOPE
OFFSt	OFFSt
GIMP	GIMP
5081-A-Ht	5081-A-Ht
FAULtS	FAULtS

TYPE FCL

Transmitter is measuring free chlorine.

Recommended action

Press **NEXT** to view diagnostics.

pH

Recommended actions

1. Press **ENTER** to view pH diagnostics.
2. Press **NEXT** to skip pH diagnostics.

InPut

Current pH sensor input voltage in millivolts.

SLOPE

Sensor slope in millivolts per unit pH. Slope is calibrated during buffer calibration.

OFFSt

Sensor voltage in millivolts in pH 7 buffer.

GIMP

Glass impedance in MΩ.

8.5 Chlorine, dissolved oxygen, and ozone troubleshooting

8.5.1 Troubleshooting fault or warning messages

Message	Explanation	See section
OvEr rAnGe	Over range, measurement exceeds display limit.	OvEr rAnGE and AMP FAIL
AMP FAIL	Amperometric sensor failure, sensor current is too high.	OvEr rAnGE and AMP FAIL
bAd SEnSor	Bad sensor, sensor current is a large negative number.	bAd SEnSor
0 too biG	Zero current is too large, sensor was zeroed while current exceeded 100 nA.	0 too bIG
CAL Error	Calibration error, sensitivity (nA/ppm) is too high or too low.	CAL Error
nEEd 0 CAL	Sensor needs re-zeroing; reading is too negative.	nEEd 0 CAL
bAd rtd	Bad temperature reading.	bAd rtd and rtd OPEn
TEMP HI	Temperature reading exceeds 302 °F (150 °C).	tEmP HI
TEMP LO	Temperature reading is less than 5 °F (-15 °C).	tEmP LO.
rtd OPEn	Resistance temperature device (RTD) or thermistor is open.	bAd rtd and rtd OPEn
SenSE OPEn	Sense line is not connected.	SenSE OPEn
PH in	Raw millivolt reading from pH sensor is too large.	pH IN

Message	Explanation	See section
SLOPE HI	pH sensor slope exceeds 62 mV/pH.	SLOPE Err HI
SLOPE LO	pH sensor slope is less than 40 mV/pH.	SLOPE Err LO
-0- OFFSEt	Zero offset during standardization exceeds programmed limit.	-0- OFFSEt
GLASSFAIL	Measured glass impedance is less than programmed limit.	GLASSFAIL
FACt FAIL	Unit has not been factory calibrated.	FACt FAIL
CPU FAIL	Internal CPU tests have failed.	CPU FAIL
ROM FAIL	Internal memory has failed.	rOm FAIL
AdC	Analog to digital conversion failed.	AdC Error
bAd Gnd	Bad ground.	bAd Gnd
In too biG	mV signal from pH sensor is too large.	In too biG
RitE Err	CPU PCB jumper (JP-1) has been removed.	RitE Err

bAd SEnSor

Bad sensor means that the sensor current is a large negative number. `bAd SEnSor` may appear for a while when the sensor is first placed in service. Observe the sensor current by going to SEnSor Cur under the ***Diagnostic*** menu. If the sensor current is moving in the positive direction, there is probably nothing wrong, and the error message should soon disappear.

Recommended actions

1. Verify that wiring is correct. Pay particular attention to the anode and cathode connections.
2. Verify that the transmitter is configured for the correct measurement.

   Configuring the measurement sets (among other things) the polarizing voltage. Applying the wrong polarizing voltage to the sensor can cause a negative current.
3. Replace the sensor membrane and electrolyte solution and clean the cathode if necessary.

   See the sensor reference manual for details.
4. Replace the sensor.

0 too bIG

Normally, the transmitter will not accept a zero current until the current has fallen below a reasonable value. See the calibration section of the appropriate sensor reference manual for the analyte being determined for zero currents. However, you can force the transmitter to accept the present current as the zero value. The `0 too bIG` warning appears if the current at the time the sensor is zeroed is greater than 100 nA. Because the transmitter subtracts the zero current from the measured current before converting the result to a concentraiton, zeroing too soon will cause readings to be too low.

Procedure

1. Allow adequate time, possibly as long as overnight, for the sensor to stabilize before starting the zero routine.
2. Verify that the solution used for zeroing the sensor contains no analyte.

   Refer to the calibration section of the appropriate sensor reference manual for details.
3. Replace the sensor membrane and electrolyte solution and clean the cathode if necessary.

   See the appropriate sensor manual for details.
4. Replace the sensor.

CAL Error

At the end of the calibration step, the transmitter calculates the sensitivity in nA/ppm. If the sensitivity is outside the range normally expected, the transmitter displays the CAL Error message, and the transmitter does not update the calibration. For assistance, refer to the troubleshooting section specific to the sensor.

bAd rtd and rtd OPEn

These messages usually mean that the resistance temperature device (RTD) (or themistor in the case of the Rosemount Hx438sensor) is open or shorted or there is an open or short in the connecting wiring.

Recommended actions

1. See Simulate temperature.
2. Verify all wiring connections, including wiring in a junction box if one is being used.
3. Disconnect the RTD IN, RTD SENSE, and RTD RETURN leads or the thermistor leads at the transmitter. Note the color of the wire and where it was attached. Measure the distance between the RTD IN and RETURN leads. For a thermistor, measure the resistance between the two leads. The resistance should be close to the value in Table 8-4. If the temperature element is open or shorted, replace the sensor. In the meantime, use manual temperature compensation.

pH IN

`pH In` means the voltage from the pH measuring cell is too large.

Recommended actions

1. Verify all wiring connections, including connections in a junction box.
2. Check that the pH sensor is completely submerged in the process liquid.
3. Check the pH sensor for cleanliness. If the sensor looks fouled or dirty, clean it.

   Refer to the sensor reference manual for cleaning procedures.
4. Replace the sensor.

-0- OFFSEt

The `-0- OFFSEt` message appears if the standardization offset (in mV) exceeds the programmed limit. The default limit is 60 mV, which is equivalent to about a unit change in pH. Before increasing the limit to make the `-0- OFFSEt` message disappear, check the following:

Recommended actions

1. Verify that the reference pH meter is working properly and is properly calibrated.
2. Verify that the process pH sensor is working. Check its response in buffers.
3. If the transmitter is standardized against pH determined in a grab sample, be sure to measure the pH before the temperature of the grab sample changes more than a few degrees.
4. Verify that the process sensor is fully immersed in the liquid.

   If the sensor is not completely submerged, it may be measuring the pH of the liquid film covering the sensor. The pH of this film may be different from the pH of the bulk liquid.
5. Check the pH sensor for cleanliness. If the sensor looks fouled or dirty, clean it.

   Refer to the sensor reference manual for cleaning procedures.A large standardization offset may be caused by a poisoned reference electrode. Poisoning agents can cause the pH to be offset by as much as two pH units. To check the reference voltage, see Measuring reference voltage.

bAd Gnd

`bAd Gnd` usually means a problem with the analog PCB.

Recommended action

Contact the factory.

In too biG

`In too biG` means the raw millivolt signal from the pH sensor is too large.

Recommended actions

1. Verify that sensor wiring is correct and connections are tight. Be sure to check connections at the junction box if one is being used.
2. Replace the pH sensor with a sensor known to be working.
3. If replacing the pH sensor does not cause the message to disappear, call the factory for assistance.

RitE Err

Cause

CPU PCB jumper (JP-1) has been removed.

Recommended action

Reinsert the JP-1 jumper into the CPU board.

8.5.2 Oxygen measurement and calibration problems

Problem	See section
Zero current is too high.	Zero current too high
Zero reading is unstable.	Zero reading unstable
Sensor current during air calibration is substantially different from expected.	Sensor current outside range
Process and standard instrument readings during in-process calibration are substantially different.	Process and standard readings different
Process readings are erratic.	Process readings erratic
Readings drift.	Readings drift
Sensor does not respond to changes in oxygen level.	Sensor does not respond to changes in oxygen level
Readings are too low.	Oxygen readings are too low

Zero current too high

The zero current is substantially greater than the values in the table below.

Sensor	Zero current
Rosemount 499ADO	< 50 nA
Rosemount 499ATrDO	< 5 nA
Rosemount Hx438	< 1 nA

Recommended actions

1. Make sure the sensor is properly wired to the transmitter.
2. Make sure the membrane is completely covered with zero solution and that air bubbles are not trapped against the membrane. Swirl and tap the sensor to release air bubbles.
3. Make sure the zero solution is fresh and properly made. Zero the sensor in a solution of five percent sodium sulfite in water. Prepare the solution immediately before use.

   It has a shelf life of only a few days.
4. If you are zeroing the sensor with nitrogen gas, verify that the nitrogen is oxygen-free and the flow is adequate to prevent back-diffusion of air into the chamber.
5. The major contributor to the zero current is dissolved oxygen in the electrolyte solution inside the sensor. A long zeroing period usually means that an air bubble is trapped in the electrolyte. To ensure that the Rosemount 499ADO or 499ATrDO sensor contains no air bubbles, carefully follow the procedure in the appropriate

sensor reference manual for filling the sensor. After replacing the electrolyte solution, allow several hours for the zero current to stabilize.

On rare occasions, the sensor may need 24 hours to zero.

6. Check the membrane for damage and replace the membrane if necessary.

Zero reading unstable

Recommended actions

1. Make sure the sensor is properly wired to the transmitter and that all wiring connections are tight.
2. Readings are often erratic when a new or rebuilt sensor is first placed in service. Wait an hour for the readings to stabilize.
3. Make sure that the space between the membrane and the cathode is filled with electrolyte solution and that the flow path between the electrolyte reservoir and the membrane is clear. Hold the sensor with the membrane end pointing down and sharply shaking the sensor a few times as though shaking down a clinical thermometer.
4. If shaking does not work, try the following:
    a) For Rosemount 499ADO and 499ATrDO sensors, verify that the holes at the base of the cathode stems are open (use a straightened paper clip to clear the holes). Also verify that air bubbles are not blocking the holes. Fill the reservoir and establish electrolyte flow to the cathode.

       Refer to the sensor reference manual for the detailed procedure.

    b) For Rosemount Hx438 sensors, add fresh electrolyte solution to the sensor.

       Refer to the sensor reference manual for details.

Sensor current outside range

The sensor current is different from the numbers in the table below.

Sensor	nA/ppm
Rosemount 499ADO	1800 - 3100
Rosemount 499ATrDO	3600 - 6100
Rosemount Hx438	4.8 - 9.8

Recommended actions

1. Make sure the sensor is properly wired to the transmitter and that all connections are tight.
2. Make sure the membrane is dry.

   The membrane must be dry during air calibration. A droplet of water on the membrane during air calibration will lower the sensor current and cause an inaccurate calibration.

3. If the sensor current in the air is very low and the sensor is new, either the electrolyte flow has stopped or the membrane is torn or loose.

For instructions on how to restart electrolyte flow, see Zero reading unstable or refer to the sensor reference manual. To replace a torn membrane refer to the sensor reference manual.

4. Check the temperature.

   Sensor current is a strong function of temperature. The sensor current decreases about 3% for every 1 °C drop in temperature.

5. Check if the membrane is fouled or dirty. A dirty membrane inhibits diffusion of oxygen through the membrane, reducing the sensor current. Clean the membrane by rinsing it with a stream of water from a wash bottle or by gently wiping the membrane with a soft tissue. If cleaning the membrane does not improve the sensor response, replace the membrane and electrolyte solution. If necessary, polish the cathode.

   See the sensor reference manual for more information.

Process and standard readings different

This error warning appears if the current process reading and the reading it is being changed to (i.e., the reading from the standard instrument) are appreciably different.

Recommended actions

1. Make sure the standard instrument is properly zeroed and calibrated.
2. Make sure the standard and process sensor are measuring the same sample. Place the sensors as close together as possible.
3. Make sure the process sensor is working properly. Check the response of the process sensor in air and in sodium sulfite solution.

Process readings erratic

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

Recommended actions

1. Make sure the sample flow is within the recommended range.

   High sample flow may cause erratic readings. Refer to the sensor reference manual for flow rates.

2. Make sure gas bubbles are not impinging on the membrane. Orient the sensor at an angle away from the vertical to reduce the noise.
3. Make sure the holes between the membrane and electrolyte reservoir might be plugged (applies to Rosemount 499ADO and 499ATrDO sensors only).

   Refer to Zero reading unstable.

4. Verify that wiring is correct. Pay particular attention to shield and ground connections.
5. Make sure the membrane is in good condition and the sensor is filled with electrolyte solution. Replace the fill solution and electrolyte.

   Refer to the sensor reference manual for details.

Readings drift

Recommended actions

1. See if the sample temperature is changing.

   Membrane permeability is a function of temperature. For the Rosemount 499ADO and 499ATrDO sensors, the time constant for a response to a temperature change is about five minutes. Therefore, the reading may drift for a while after a sudden temperature change. The time constant for Rosemount Hx438 sensors is much shorter; these sensors respond fairly rapidly to temperature changes.

2. Make sure the membrane is clean.

   For the sensor to work properly oxygen must diffuse freely through the membrane. A coating on the membrane will interfere with the passage of oxygen, resulting in a slow response.

3. Move the sensor out of direct sunlight.

   If the sensor is in direct sunlight during air calibration, readings drift as the sensor warms up. Because the temperature reading lags the true temperature of the membrane, calibrating the sensor in direct sunlight may introduce an error.

4. Make sure the sample flow is within the recommended range.

   Gradual loss of sample flow will cause downward drift.

5. See if the sensor is new or has recently been serviced.

   New or rebuilt sensors may require several hours to stabilize.

6. Check if the reagent flow is about 0.2 mL/min.

Sensor does not respond to changes in oxygen level

Recommended actions

1. If you are comparing readings with a portable laboratory instrument, verify that the laboratory instrument is working.
2. See if the membrane is clean. Clean the membrane and replace it as necessary. Check that the holes at the base of the cathode stem are open. Use a straightened paper clip to clear blockages. Replace the electrolyte solution.
3. Replace the sensor.

Oxygen readings are too low

Potential cause

Low readings can be caused by zeroing the sensor before the residual current has reached a stable minimum value. Residual current is the current the sensor generates even when no oxygen is in the sample. Because the residual current is subtracted from subsequent measured currents, zeroing before the current is a minimum can lead to low results.

Example: The true residual (zero) current for a Rosemount 499ADO sensor is 0.05 µA, and the sensitivity based on calibration in water-saturated air is 2.35 µA/ppm. Assume the measured current is 2.00 µA. The true concentration is (2.00 - 0.05)/2.35 or 0.83 ppm. If the sensor was zeroed prematurely when the current was 0.2 µA, the measured concentration will be (2.00 - 0.02)/2.35 or 0.77 ppm. The error is 7.2%. Suppose the measured current is 5.00 μA. The true concentration is 2.11 ppm, and the measured concentration is 2.05 ppm. The error is now 3.3%. The absolute difference between the readings remains the same, 0.06 ppm.

Recommended action

Sensor response depends on flow. If the flow is too low, readings will be low and flow sensitive. Verify that the flow past the sensor equals or exceeds the minimum value. See the sensor reference manual for recommended flows. If the sensor is in an aeration basin, move the sensor to an area where the flow or agitation is greater.

8.5.3 Free chlorine measurement and calibration problems

Problem	See section
Zero current is substantially outside the range -10 to 10 nA.	Zero current outside range
Zero reading is unstable.	Zero reading unstable
Sensor current during calibration is substantially less than about 350 nA/ppm at 25 °C (77 °F) and pH 7.	Sensor current too low
Process readings are erratic.	Process readings erratic
Readings drift.	Readings drift
Sensor does not respond to changes in chlorine level.	Sensor not responding to chlorine changes
Chlorine reading spikes following rapid change in pH (automatic pH correction only).	Chlorine readings spike
Readings are too low.	Chlorine readings too low

Zero current outside range

The zero current is substantially outside the range: -10 to 10 nA.

Recommended actions

1. Make sure the sensor is properly wired to the transmitter.
2. Make sure the zero solution is chlorine-free. Take a sample of the solution and test it for free chlorine level.

   The concentration should be less than 0.02 ppm.
3. Make sure you have allowed adequate time for the sensor to reach a minimum stable residual current.

   It may take several hours, sometimes as long as overnight, for a new sensor to stabilize.
4. Check the membrane for damage and replace if necessary.

Zero reading unstable

Recommended actions

1. Make sure the sensor is properly wired to the transmitter and that all wiring connections are tight.
2. Readings are often erratic when a new or rebuilt sensor is first placed in service. Wait an hour for the readings to stabilize.
3. Make sure that the space between the membrane and the cathode is filled with electrolyte solution and that the flow path between the electrolyte reservoir and the membrane is clear. Hold the sensor with the membrane end pointing down and sharply shaking the sensor a few times as though shaking down a clinical thermometer.
4. If shaking does not work, try the following:
    a) For Rosemount 499ADO and 499ATrDO sensors, verify that the holes at the base of the cathode stems are open (use a straightened paper clip to clear the holes). Also verify that air bubbles are not blocking the holes. Fill the reservoir and establish electrolyte flow to the cathode.

       Refer to the sensor reference manual for the detailed procedure.

    b) For Rosemount Hx438 sensors, add fresh electrolyte solution to the sensor.

       Refer to the sensor reference manual for details.

Sensor current too low

The sensor current during calibration is substantially less than 250 nA/ppm at 77 °F (25 °C).

Recommended actions

1. Check to see if the temperature is low or the pH is high.

   Sensor current is a strong function of pH and temperature. The sensor current decreases about 3% for every °C drop in temperature. Sensor current also decreases as pH increases. Above pH 7, a 0.1 unit increase in pH lowers the current about 5%.

2. Check the rate of the sample flow.

   Sensor current depends on the rate of sample flow past the sensor tip. If the flow is too low, chlorine readings will be low. Refer to the sensor reference manual for recommended sample flows.

3. Check the electrolyte flow to the cathode and membrane.

   See step 3 in Zero reading unstable

4. Check if the membrane is fouled or coated. A dirty membrane inhibits diffusion of free chlorine through the membrane, reducing the sensor current and increasing the response time. Clean the membrane by rinsing it with a stream of water from a wash bottle.

⚠ CAUTION

Equipment damage

Do not use a tissue to wipe the membrane.

5. If cleaning the membane does not improve the sensor response, replace the membrane and electrolyte solution. If necessary, polish the cathode.

   See the sensor reference manual for details.

Sensor not responding to chlorine changes

Recommended actions

1. Make sure the grab sample test is accurate and that the grab sample representative of the sample is flowing to the sensor.
2. Check if the pH compensation is correct. If the transmitter is using manual pH correction, verify that the pH value in the transmitter equals the actual pH to within ±0.1 pH. If the transmitter is using automatic pH correction, check the calibration of the pH sensor.
3. Clean the membrane and replace if necessary. Check that the holes at the base of the cathode stem are open. Use a straightened paper clip to clear blockages. Replace the electrolyte solution.
4. Replace the sensor.

Chlorine readings spike

Chlorine readings spike following sudden changes in pH.

Cause

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 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.

A time constant for return to normal is about five minutes.

Chlorine readings too low

Recommended actions

1. Make sure the sample was tested as soon as it was taken.

   Chlorine solutions are unstable. Test the sample immediately after collecting it. Avoid exposing the sample to sunlight.

2. Low readings can be caused by zeroing the sensor before the residual current has reached a stable minimum value. Residual current is the current the sensor generates even when no chlorine is in the sample. Because the residual current is

subtracted from subsequent measured currents, zeroing before the current is a minimum can lead to low results.

3. Sensor response depends on flow. If the flow is too low, readings will be low and flow sensitive. Verify that the flow past the sensor equals or exceeds the minimum value.

   See the sensor reference manual for recommended flow.

8.5.4 Ozone measurement and calibration problems

Problem	See section
Zero current is substantially outside the range -10 to 10 nA.	Ozone zero current outside range
Zero reading is unstable.	Ozone zero reading unstable
Sensor current during calibration is substantially less than about 350 nA/ppm at 77 °F (25 °C).	Sensor current less than 350 nA/ppm
Process readings are erratic.	Ozone process readings erratic
Readings drift.	Ozone readings drift
Sensor does not respond to changes in ozone level.	Sensor not responding to ozone changes
Ozone readings are too low.	Oxygen readings are too low

Ozone zero current outside range

The ozone zero current is substantially outside the range: -10 to 10 nA.

Recommended actions

1. Make sure the sensor is properly wired to the transmitter.
2. Make sure the zero solution is ozone free. Test the zero solution for ozone level.

   The concentration should be less than 0.02 ppm.
3. Make sure you allow adequate time for the sensor to reach a minimum stable residual current.

   It may take several hours, sometimes as long as overnight, for a new sensor to stabilize.
4. Check the membrane for damage and replace it if necessary.

Ozone zero reading unstable

Recommended actions

1. Verify that the sensor is properly wired to the transmitter and that all wiring connections are tight.
2. Readings are often erratic when a new or rebuilt sensor is first placed in service. Wait about an hour for readings to stabilize.

3. Make sure that the space between the membrane and cathode is filled with electrolyte solution and the flow path between the electrolyte reservoir and membrane are clear.
   a) Hold the sensor with the membrane end pointing down and shake it sharply a few times as though shaking down a clinical thermometer.
   b) If shaking does not work, try cleaning the holes around the cathode stem. Hold the sensor with the membrane end pointing up. Be sure the wood ring remains with the membrane assembly. Use the end of a straightened paper clip to clear the holes at the base of the cathode stem. Replace the membrane.
   c) Verify that the sensor is filled with electrolyte solution.

      Refer to the sensor reference manual for details.

Sensor current less than 350 nA/ppm

The sensor current is less than 350 nA/ppm at 77 °F (25 °C).

Recommended actions

1. Check the temperature.

   Sensor current is a strong function of temperature. The sensor current decreases about 3% for every °C drop in temperature.
2. Check the rate of the sample flow past the sensor tip.

   If the flow is too low, ozone readings will be low. Refer to the sensor instruction sheet for recommended sample flows.
3. Check the electrolyte flow.

   A lack of electrolyte flow to the cathode and membrane can cause low current. See Step 3 in Ozone zero reading unstable.
4. Check if the membrane is fouled or coated.

   A dirty membrane inhibits diffusion of ozone through the membrane, reducing the sensor current and increasing the response time.
   a) Clean the membrane by rinsing it with a stream of water from a wash bottle or gently wipe the membrane with a soft tissue.
   b) If cleaning the membrane does not improve the sensor response, replace the membrane and electrolyte solution.
   c) If necessary, polish the cathode.

      See the sensor reference manual for details.

Ozone process readings erratic

The ozone process readings are erratic.

Recommended actions

1. Readings are often erratic when a new sensor or rebuilt sensor is first placed in service. Wait a few hours for the current to stabilize.

2. Check if the sample flow is within the recommended range.

   High sample flow may cause erratic readings. Refer to the sensor reference manual for recommended flow rates.
3. Check if the holes between the membrane and the electrolyte reservoir are open.

   Refer to Ozone zero reading unstable.
4. Verify that the wiring is correct. Pay particular attention to shield and ground connections.
5. Make sure the membrane is in good condition and the sensor is filled with electrolyte solution. Replace the fill solution and electrolyte.

   Refer to the sensor reference manual for details.

Ozone readings drift

Recommended actions

1. Check if the sample temperature is changing.

   Membrane permeability is a function of temperature. The time constant for the Rosemount 499AOZ sensor is about five minutes. Therefore, the reading may drift for a while after a sudden temperature change.
2. Check if the membrane is clean.

   For the sensor to work properly, ozone must diffuse freely through the membrane. A coating on the membrane will interfere with the passage of ozone, resulting in a slow response. Clean the membrane by rinsing it with a stream of water from a wash bottle, or gently wipe the membrane with a soft tissue.
3. Check if the sample flow is within the recommended range.

   Gradual loss of sample flow will cause a downward drift.
4. Check if the sensor is new or recently serviced.

   New or rebuilt sensors may require several hours to stabilize.

Sensor not responding to ozone changes

Recommended actions

1. Make sure the grab sample test is accurate and representative of the sample flowing to the sensor.
2. Clean the membrane and replace it if necessary.
   a) Check that the holes at the base of the cathode stem are open.
   b) Use a straightened paper clip to clear blockages.
   c) Replace the electrolyte solution.
3. Replace the sensor.

Ozone readings too low

Recommended actions

1. Test the sample immediately after collecting it.

   Ozone solutions are highly unstable.

2. Zeroing the sensor before the residual current has reached a stable minimum value can cause low readings.

   Residual current is the current the sensor generates even when no ozone is in the sample. Because the residual current is subtracted from subsequent measured currents, zeroing before the current is a minimum can lead to low results. See Oxygen readings are too low.

3. Verify that the flow past the sensor equals or exceeds the minimum value.

   Sensor response depends on flow. If the flow is too low, readings will be low and flow sensitive. See the sensor reference manual for recommended flows.

8.5.5 pH measurement and calibration problems

Problem	See Section
SLOPE HI or SLOPE LO message is showing.	SLOPE Err HI or SLOPE Err LO
-0- OFFSEt message is showing.	-0- OFFSEt
Transmitter will not accept manual slope.	Transmitter not accepting manual slope
Sensor does not respond to known pH changes.	Sensor not responding to pH changes
Process pH is slightly different from the expected value.	Process pH slightly different
Process pH reading changes when flow changes.	Process pH reading changes with flow
Process pH is grossly wrong and/or noisy.	Process pH grossly wrong or noisy
Process readings are noisy.	Process readings noisy

Transmitter not accepting manual slope

Recommended action

If you know the slope from other sources, enter it directly into the transmitter.

The transmitter will not accept a slope (at 77 °F [25 °C]) outside the range 45 to 60 mV/pH. If you attempt to enter a slope less than 45 mV/pH, the transmitter will automatically change the entry to 45. If you attempt to enter a slope greater than 60 mV/pH, the transmitter will change the entry to 60 mV/pH.

Sensor not responding to pH changes

Recommended actions

1. If the process pH reading was not as expected, check the performance of the sensor in buffers. Also, use a second pH meter to verify the change.
2. Make sure the sensor is properly wired to the transmitter.
3. Check the glass electrode impedance to see if the glass bulb is cracked or broken.
4. Check the transmitter by simulating the pH input.

Process pH slightly different

Differences between pH readings made with an online instrument and a laboratory or portable instrument are normal. The online instrument is subject to process variables (for example, ground potentials, stray voltages, and orientation effects) that may not affect the laboratory or portable instrument.

Process pH reading changes with flow

The sensor has some degree of flow sensitivity (i.e., changing the sample flow causes the pH readings to change). Flow sensitivity varies from sensor to sensor.

Flow sensitivity can be a source of error if the pH and chlorine sensor flow cells are connected in series. The chlorine sensor requires a fairly rapidly flowing sample, and high flows may affect the pH reading. Typically, the difference in pH reading from a pH sensor in a rapidly (16 gph) and slowly (<2 gph) flowing sample is less than about 0.05.

Recommended action

If the change is greater than 0.05, install the pH and chlorine sensors in parallel streams.

Process pH grossly wrong 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. Check if a ground loop is present.
   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. Check if the process is grounded. 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 still persists, simple grounding is not the problem. The sensor wiring is probably carrying noise into the instrument.

3. Simplify the sensor wiring.
    a) Verify that pH sensor wiring is correct.
    b) Disconnect all sensor wires at the transmitter except pH/mV IN, REFERENCE IN, RTD IN, and RTD RETURN. If the sensor is wired to the transmitter through a remote junction box containing a preamplifer, disconnect the wires at the sensor side of the junction box.
    c) Tape back the ends of the disconnected wires to keep them from making accidental connections with other wires or terminals.
    d) Connect a jumper wire between the RTD RETURN and RTD SENSE terminals.

    If noise and/or offsets disappear, the interference was coming into the transmitter through one of the sensor wires. The system can be operated permanently with simplified wiring.
4. Check for ground connections or induced noise.
    a) If the sensor cable is run inside conduit, there may be a short between the cable and the conduit. Re-run the cable outside the conduit. If symptoms disappear, there is a short between the cable and the conduit. Likely, a shield is exposed and touching the conduit. Repair the cable and reinstall it in the conduit.
    b) To avoid induced noise in the sensor cable, run it as far away as possible from the power cables, relays, and electric motors. Keep sensor wiring out of crowded panels and cable trays.
    c) If ground loops persist, contact the factory. A visit from a service technician may be required to solve the problem.

Process readings noisy

Recommended actions

1. Check the conductivity of the sample.

    Measuring pH in samples having conductivity less than about 50 µS/cm can be very difficult. Special sensors are often needed and special attention must be paid to grounding and sample flow rate.

    Note
    Measuring free chlorine in samples having low conductivity can also be a problem. Generally, for a successful chlorine measurement, the conductivity should be greater than 50 µS/cm.
2. Check if the sensor is dirty of fouled.

Suspended solids in the sample can coat the reference junction and interfere with the electrical connection between the sensor and the process liquid. The result is often a noisy reading.

3. Make sure the sensor is properly wired to the transmitter.
4. Check if a ground loop is present.

   Refer to Process pH grossly wrong or noisy.

8.5.6 Simulate input currents - dissolved oxygen

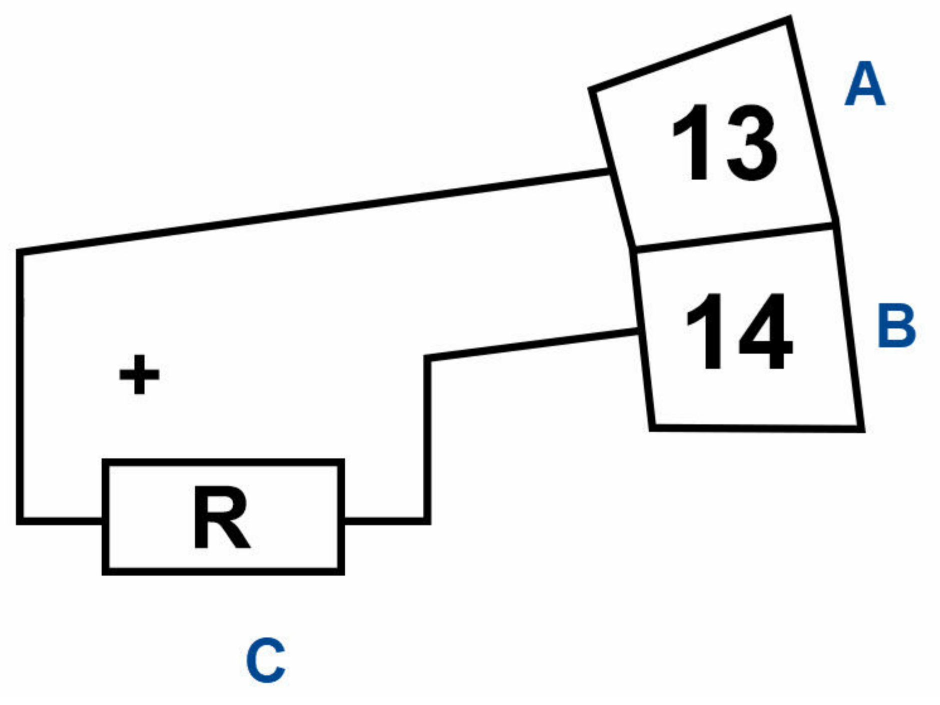
To check the performance of the transmitter, use a decade box to simulate the current from the oxygen sensor.

Procedure

1. Disconnect the anode and cathode leads from terminals 13 and 14 and connect a decade box as shown in Figure 8-10.

   It is not necessary to disconnect the resistance temperature device (RTD) leads.

Figure 8-10: Simulate Dissolved Oxygen



A. Anode
B. Cathode
C. Simulates sensor

2. Set the decade box to the resistance shown in the table.

Sensor	Polarizing voltage	Resistance	Expected current
Rosemount 499ADO	-675 mV	34 kΩ	20 µA
Rosemount 499ATrDO	-800 mV	20 kΩ	40 µA
Rosemount Hx438	-675 mV	8.4 MΩ	80 nA

3. Note the sensor current. To view the sensor current:
    a) Go to the main display and press **DIAG**.
    b) Press **NEXT**.
    `SEnSor Cur` appears in the display.
    c) Press **ENTER**.
    The display shows the sensor current.
    d) Note the units.
    µA is microamps; nA is nanoamps.
4. Change the decade box resistance and verify that the correct current is shown.
Calculate the current from the equation:

$$\text{current } (\mu\text{A}) = \frac{\text{voltage (mV)}}{\text{resistance (k}\Omega\text{)}}$$

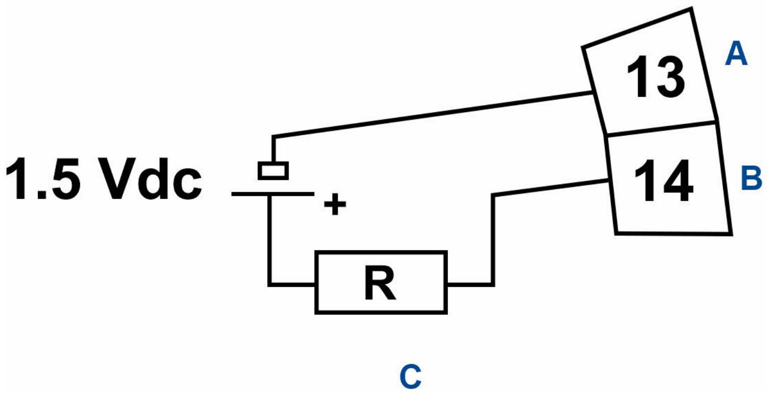
8.5.7 Simulate input currents - chlorine and ozone

To check the performance of the transmitter, use a decade box and a 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 13 and 14 and connect a decade box and battery as shown in Figure 8-11.
It is not necessary to disconnect the resistance temperature device (RTD) leads.

Figure 8-11: Simulate Chlorine and Ozone



A. Anode
B. Cathode
C. Simulates sensor

2. Set the decade box to the resistance shown in the table.

Sensor	Polarizing voltage	Resistance	Expected current
Rosemount 499ACL-01 (free chlorine)	200 mV	28 MΩ	500 nA
Rosemount 499ACL-02 (total chlorine)	250 mV	675 kΩ	2000 nA
Rosemount 499AOZ	200 mV	2.7 MΩ	500 nA

3. Note the sensor current.

   It should be close to the value in the table. The actual value depends on the voltage of the battery. To view the sensor current:

   a) Go to the main display and press **DIAG**.

   b) Press **NEXT**.
      `SEnSor Cur` appears in the display.

   c) Press **ENTER**.
      The display shows the sensor current.

   d) Note the units
      µA is microamps; na is nanoamps.

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

$$\text{current } (\mu A) = \frac{V_{battery} - V_{polarizing}\,(mV)}{\text{resistance } (k\Omega)}$$

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

8.5.8 Simulating inputs - pH

General information about simulating pH inputs

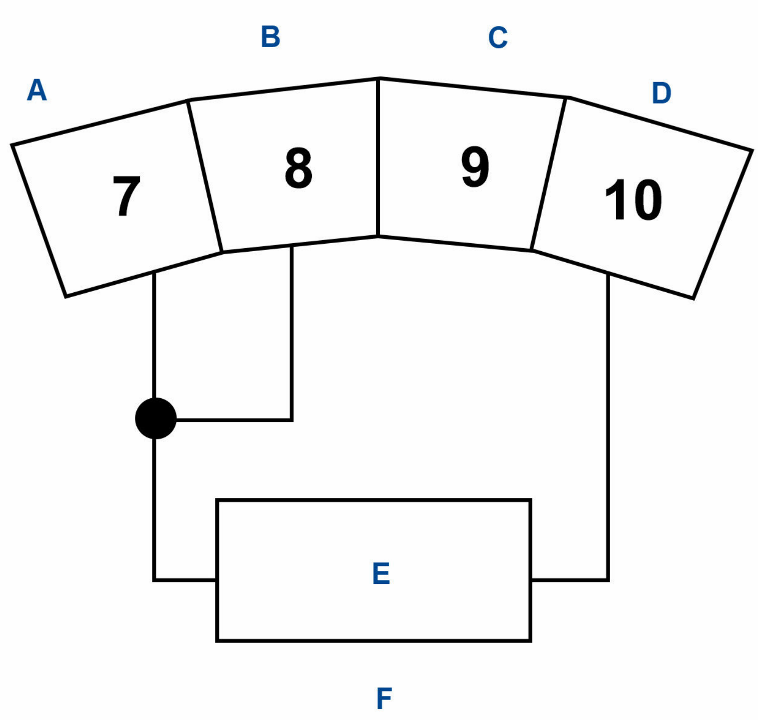
This section describes how to simulate a pH input into the transmitter. To simulate a pH measurement, connect a standard millivolt source to the transmitter. If the transmitter is working properly, it will accurately measure the input voltage and convert it to pH. Although the general procedure is the same, the wiring details depend on whether the preamplifier is in the sensor, a junction box, or the transmitter.

Simulate pH inputs when the preamplifier is in the transmitter

Procedure

1. Turn off automatic temperature correction and set the manual temperature to 77 °F (25 °C).
2. Disconnect the pH sensor. Also, disconnect the chlorine sensor anode lead. Connect a jumper wire between the pH IN and REF IN terminals.
3. Confirm that the transmitter is reading the correct mV value.
   a) With the main display showing, press **DIAG**.
   b) Press **NEXT** until the display shows `PH`.
   c) Press **ENTER**.
   The display shows `InpUt` followed by a number. The number is the raw input signal in millivolts. The measured voltage should be 0 mV.
4. Confirm that the transmitter is reading the correct pH value.
   a) Go to the main display.
   b) Press **3** or **5**.
   The second line of the display shows the pH. The pH should be approximately 7.00. Because calibration data stored in the transmitter may be offsetting the input voltage, the displayed pH may not be exactly 7.00
5. If a standard millivolt source is available, disconnect the jumper wire between the pH IN and REF IN terminals and connect the voltage source as shown in Figure 8-12.

Figure 8-12: Simulate pH



A. *Reference in*
B. *Solution ground*
C. *pH guard*
D. *pH in*
E. *mV source*
F. *Simulates pH*

6. Calibrate the transmitter. 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.
7. To check linearity, set the voltage source to the values shown in the table and verify that the pH and millivolt readings match the values in the table.

Voltage (mV)	pH (at 77 °F [25 °C])
295.8	2.00
177.5	4.00
59.2	6.00
59.2	8.00
177.5	10.00
295.8	12.00

Simulate pH inputs when the preamplifier is in a junction box

The procedure is the same as described in Simulate pH inputs when the preamplifier is in the transmitter. Keep the connection between the transmitter and the junction box in place. Disconnect the sensor at the sensor side of the junction box and connect the voltage source to the sensor side of the junction box.

Simulate pH inputs when the preamplifier is in a sensor

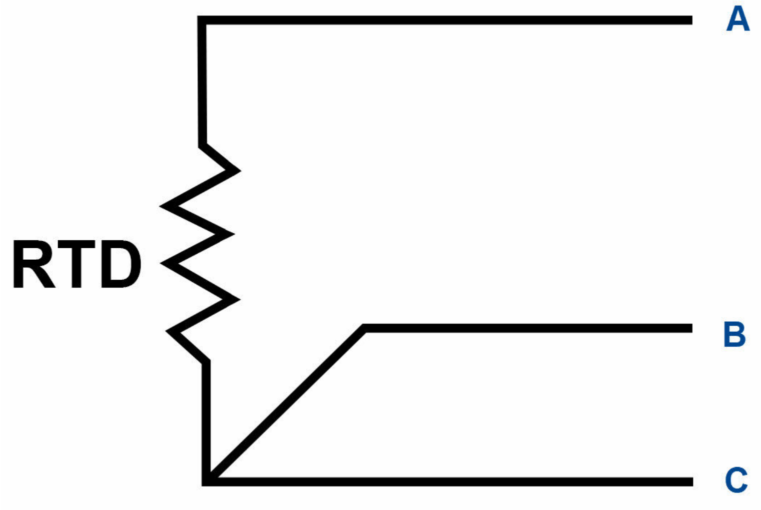
The preamplifier in the sensor converts the high impedance signal into a low impedance signal without amplifying it. To simulate pH values, follow the procedure in Simulate pH inputs when the preamplifier is in the transmitter.

8.5.9 Simulate temperature

The transmitter accepts either a Pt100 resistance temperature device (RTD) (used in Rosemount pH, 499ADO, 499ATrDO, 499ACL-01, 499ACL-02, and 499AOZ sensors) or a 22k NTC thermistor (used in Rosemount Hx438 dissolved oxygen sensors and most steam-sterilizable sensors from other manufacturers).

The Pt100 RTD has a three-wire configuration. See Figure 8-13. The thermistor has a two-wire configuration.

Figure 8-13: Three-Wire RTD Configuration



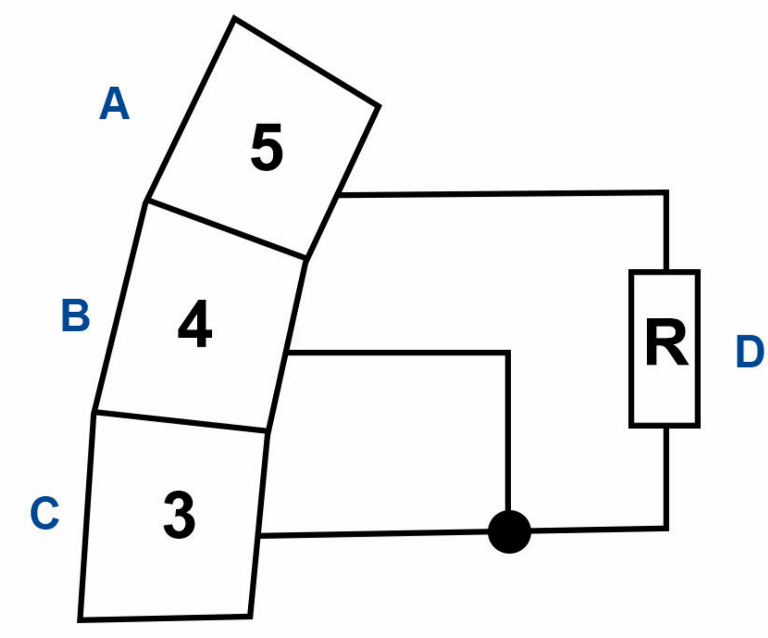
A. *RTD in*
B. *RTD sense*
C. *RTD return*

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

Procedure

1. To simulate the temperature input, wire a decade box to the transmitter or junction box as shown in Figure 8-14.

Figure 8-14: Simulating RTD Inputs



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

The figure shows wiring connections for sensors containing a Pt 100 RTD. For sensors using a 22k NTC thermistor (Rosemount Hx438), wire the decade box to terminals 1 and 2 on TB6.

2. To check the accuracy of the temperature measurement, set the resistor to simulating the RTD to the values indicated in Table 8-4 and not the temperature readings.

   The measured temperature might not agree with the value in the table. During sensor calibration, an offset might have been applied to make the measured temperature agree with a standard thermometer. The offset is also applied to the simulated resistance. The controller is measuring temperature correctly if the difference between measured temperatures equals the difference between the values in the table to within ±0.1 °C.

Table 8-4: RTD Values

Temp	Pt 100 (Ω)	22k NTC (kΩ)
1 °C (34 °F)	100.0	64.88
10 °C (50 °F)	103.9	41.33
20 °C (68 °F)	107.8	26.99
25 ° C (77 °F)	109.7	22.00
30 °C (86 °F)	111.7	18.03

Table 8-4: RTD Values *(continued)*

Temp	Pt 100 (Ω)	22k NTC (kΩ)
40 °C (104 °F)	115.5	12.31
50 °C (122 °F)	119.4	8.565
60 °C (140 °F)	123.2	6.072
70 °C (150 °F)	127.1	4.378
80 °C (176 °F)	130.9	3.208
85 °C (185 °F)	132.8	2.761
90 °C (194 °F)	134.7	2.385
100 (212 °F)	138.5	1.796

Example

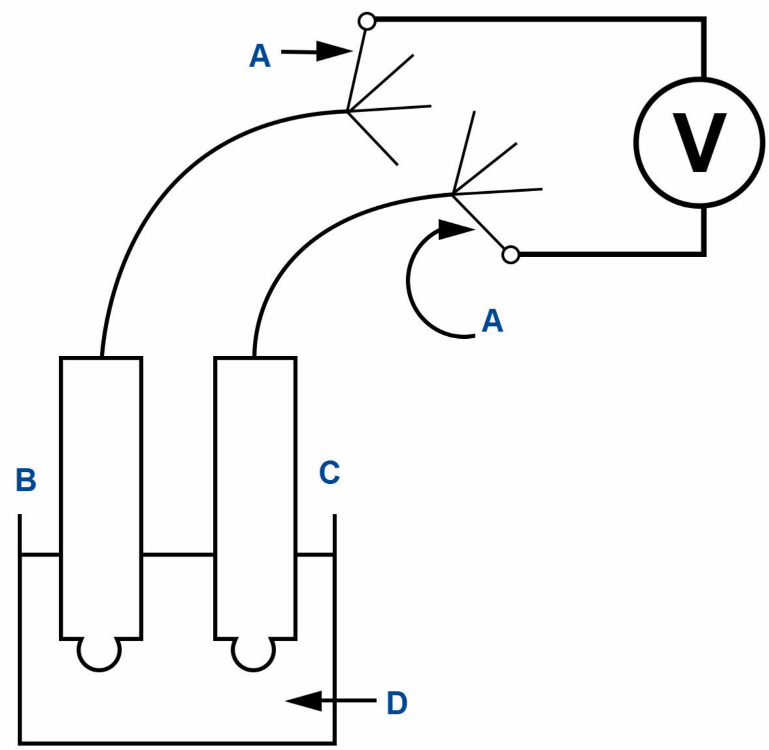
For example, start with a simulated resistance of 103.9 Ω, which corresponds to 10.0 °C (50 °F). Assume that the offset from the sensor calibration was -0.3 Ω. Because of the offset, the transmitter calculates temperature using 103.6 Ω. The result is 9.2 °C (48.6 °F). Now change the resistance to 107.8 Ω, which corresponds to 20.0 °C (68 °F). The transmitter uses 107.5 Ω to calculate the temperature, so the display reads 19.2 °C (66.6 °F). 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.

8.5.10 Measuring reference voltage

Some processes contain substances that poison or shift the potential of the reference electrode. Sulfide is a good example. Prolonged exposure to sulfide converts the reference electrode from a silver/silver chloride electrode to a silver/silver sulfide electrode. The change in reference voltage is several hundred millivolts.

A good way to check for poisoning is to compare the voltage of the reference electrode with a silver/silver chloride electrode known to be good. The reference electrode from a new sensor is best. See Figure 8-15. If the reference electrode is good, the voltage difference should be no more than about 20 mV. A poisoned reference electrode usually requires replacement.

Figure 8-15: Checking for a Poisoned Reference Electrode



A. *Reference lead*
B. *Suspect sensor*
C. *Good sensor*
D. *Buffer of KCl solution*

Refer to the sensor wiring diagram to identify the reference leads. A laboratory silver/silver chloride electrode can be used in place of the second sensor.

8.6 Factory assistance and repairs

For assistance in correcting transmitter, sensor, and measurement problems:

- In the United States, call Emerson Liquid Division at +1 800 854 8257
- Outside the United States, call the nearest Emerson office. See the back page of the manual.

9 Digital communications

9.1 HART® communications

9.1.1 HART® communications overview

HART (highway addressable remote transducer) is a digital communication system in which two frequencies are superimposed on the 4 to 20 mA output signal from the transmitter. A 1200 Hz sine wave represents the digit 1, and a 2400 Hz sine wave represents the digit 0. Because the average value of a sine wave is zero, the digital signal adds no dc component to the analog signal. HART permits digital communication while restarting the analog signal for process control.

The HART protocol, originally developed by Fisher-Rosemount, is now overseen by the independent HART Communication Foundation. The foundation ensures that all HART devices can communicate with one another. For more information about HART communications, call the HART Communication Foundation at (512) 794-0369. The web address is http://www.fieldcommgroup.org.

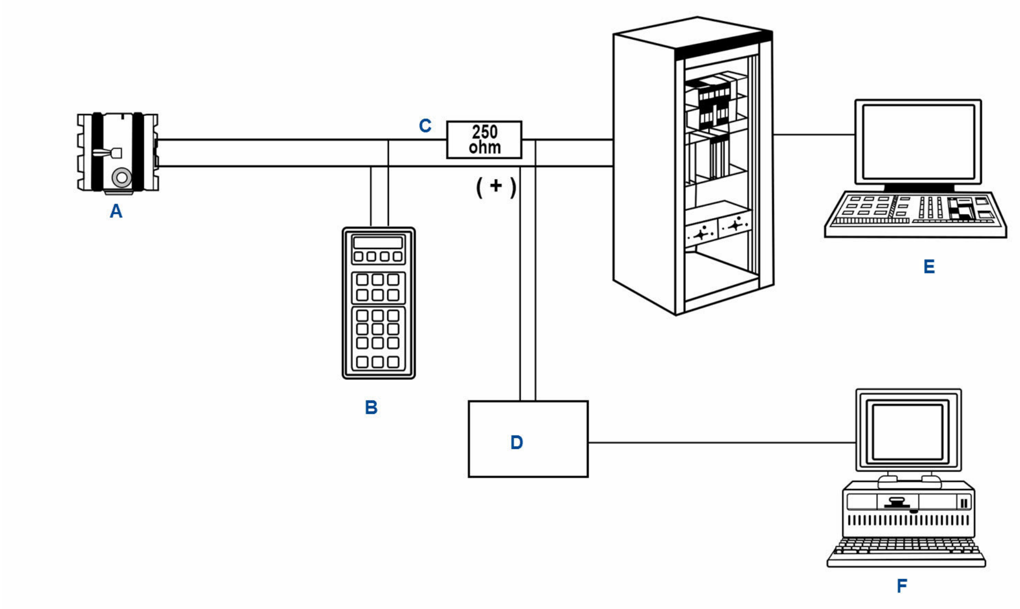
9.1.2 HART® interface devices

With HART communicators, you can view measurement data (pH, ORP, and temperature), program the transmitter, and download information from the transmitter for transfer to a computer for analysis. You can also send downloaded information to another HART transmitter. To access the HART interface, you can use either a handheld communicator or a computer.

HART interface devices operate from any wiring termination point in the 4 - 20 mA loop. A minimum load of 250 ohms must be present between the transmitter and the power supply. See Figure 9-1.

If your communicator does not recognize the Rosemount™ 5081 transmitter, you may need to update the device description library. Call the manufacturer of your HART communication device for updates.

Figure 9-1: HART Communicators

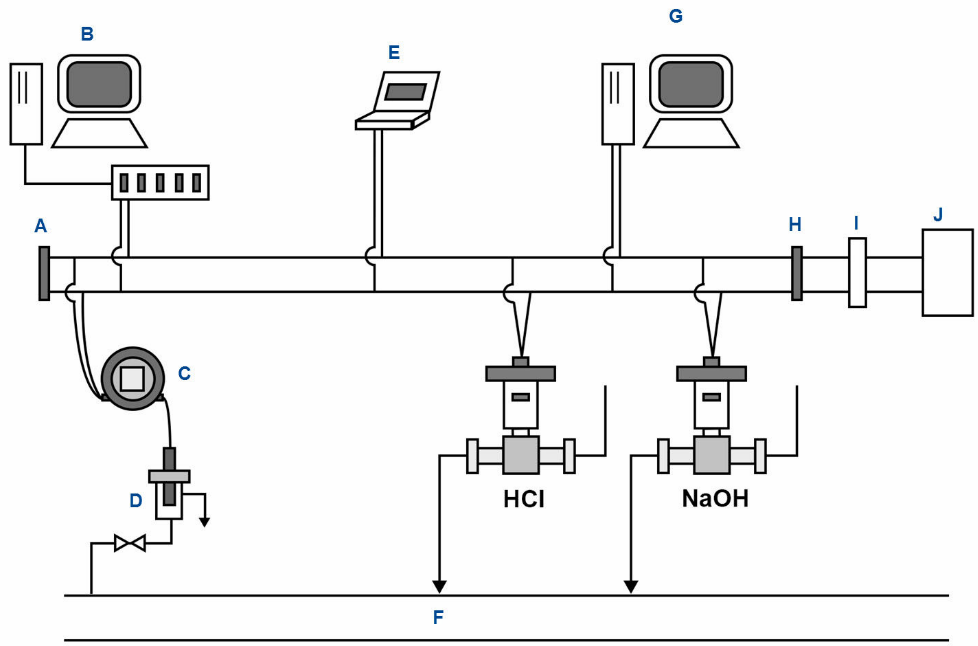


A. *Rosemount 5081 two-wire transmitter*
B. *Handheld communicator (configurator)*
C. *4-20 mA + digital*
D. *Bridge*
E. *Control system*
F. *Computer*

9.2 FOUNDATION™ Fieldbus communication

Figure 9-2 shows the Rosemount 5081 using FOUNDATION Fieldbus to measure conductivity. The figure also shows three ways in which Fieldbus communciation can be used to read process variables and configure the transmitter.

Figure 9-2: Configuring Rosemount 5081 Transmitter with FOUNDATION Fieldbus



A. *Terminator*
B. *DeltaV configurator and host*
C. *Rosemount 5081*
D. *Sensor*
E. *Fieldbus technician configurator*
F. *Process line*
G. *Other host*
H. *Terminator*
I. *Filter*
J. *Power supply*

9.2.1 FOUNDATION™ Fieldbus specifications

Model	Rosemount 5081 Fieldbus transmitter
Device ITK profile	6 (released for (ITK 6.0.0/6.0.1)
Manufacturer identification (MANUFAC_ID)	0x524149
Device type (DEV_TYPE)	0x4084
Device revision (DEV_REV)	0x03
Linkmaster	Yes
Number of link objects	20
VCRs supported	20

Mandatory features	• Resource block • Alarm and events • Function block linking • Trending • Multi-bit alert reporting • Field diagnostics
Additional features	• Common software download • Block instantiation • Supports DeltaV auto commissioning • Supports DeltaV auto replacement • Supports DeltaV firmware live download • PlantWeb alerts with re-annunciation/ multibit • Supports easy configuration assistant
Function blocks (execution time)	• 4 - analog input blocks (15 mseconds) • AI block channels Channel 1: Conductivity, resistivity, concentration Channel 2: Temperature Channel 3: Raw conductivity • Proportional integral derivative (25 milliseconds)
Power	• Two wire device; Fieldbus polarity insensitive • Current draw: 21 mA • Device certifications: IS / FISCO • Maximum certified input voltage for IS: 30 V • Maximum certified input current for IS: 300 mA • Maximum certified input power for IS: 1.3 W • Internal capacitance (Ci): 0 nF • Internal inductance (Li): 0 µH

9.3 Asset Management Solutions

Asset Management Solutions (AMS) is software that helps plant personnel better monitor the performance of analytical instruments, pressure and temperature transmitters, and control valves. Continuous monitoring means maintenance personnel can anticipate equipment failures and plan preventative measures before costly breakdown maintenance is required.

AMS uses remote monitoring. The operator, sitting at a computer, can view measurement data, change program settings, read diagnostic and warning messages, and retrieve historical data from any HART®-compatible device, including the Rosemount 5081 transmitter. Although AMS allows access to the basic functions of any HART compatible device, Rosemount has developed additional software that allows access to all features of the Rosemount 5081 transmitter.

AMS can play a central role in plant quality assurance and quality control. Using AMS Audit Trail, plant operators can track calibration frequency and results as well as warnings and diagnostic messages. The information is available to Audit Trail whether calibrations were done using the infrared remote controller, the HART communicator, or AMS software.

AMS operates in Windows 95. AMS communicates through a HART-compatible modem with any HART transmitters, including those from other manufacturers. AMS is also compatible with FOUNDATION™ Fieldbus, which allows future upgrades to Fieldbus instruments.

Rosemount AMS windows provide access to all transmitter measurement and configuration variables. You can read raw data, final data, and program settings and can reconfigure the transmitter from anywhere in the plant.

10 Return of material

10.1 General information

To expedite the repair and return of instruments, proper communication between the customer and the factory is important. Call 1-800-999-9307 for a Return Materials Authorization (RMA) number.

10.2 Warranty repair

To return instruments still under warranty:

Procedure

1. Contact Rosemount™ for authorization.
2. To verify warranty, supply the factory sales order number or the original purchase order number.

   In the case of individual parts or sub-assemblies, supply the serial number on the unit.
3. Carefully package the materials and enclose your Letter of Transmittal. If possible, pack the materials in the same manner as they were received.
4. Send the package prepaid to:

   Emerson Automation Solutions

   8200 Market Blvd

   Chanhassen, MN 55317

   RMA No. __________
5. Mark the package: *Returned for Repair*

   Model No. __________

10.3 Non-warranty repair

To return instruments that are no longer under warranty for repair:

Procedure

1. Call Rosemount for authorization.
2. Supply the purchase order number and make sure to provide the name and telephone number of the individual to be contacted should additional information be needed.
3. Do steps 3-5 of Warranty repair.

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

A Engineering Drawings

The following is a list of engineering drawings in the order in which they appear in this manual.

Drawing number	Title
1400674	Schem, CSA I.S. / NIFW installation 5081 C/T
1400675	Schem, CSA I.S. / NIFW install 5081 P/A
1400676	Schem, FM I.S. / NIFW install 5081 A/P
1400677	Schem, FM I.S / NIFW installation 5081 C/T
1400678	Sch, system FM DIP/EXP proof 5081 C/T
1400679	Sch, system FM DIP/EXP proof 5081 P/A
1700783	Certified product, 5081 XMTR, CSA
1700784	Certified product, 5081 XMTR, FM
1700785	Certified product, 5081 P/A ATEX/IECEx
1700786	Certified product, 5081 C/T ATEX/IECEx

TABLE I

GAS GROUPS	C OPTION OUTPUT PARAMETERS		
	Ca (µf)	La (mH)	
		FF / FI	HT
A, B	2.05	0.4	0.5
C	490.05	1.6	2.0
D	9990.05	3.1	3.7

TABLE II

C OPTION OUTPUT PARAMETERS	5081C TB1, PINS 1 THRU 12	
	FF / FI	HT
Vt	6.51 Vdc	6.51 Vdc
It	302.59 mA	280 mA
Pt	365 mW	442 mW

TABLE III

5081C/T INPUT PARAMETERS, SUPPLY/SIGNAL TERMINALS, TB1 PINS 15 & 16						Voc MAX OUT: (Vdc)	Isc MAX OUT: (mA)
OPTIONS	Vmax(Vdc)	Imax (mA)	Pmax (W)	Ci (nF)	Li (Uh)		
FI (FISCO)	17.5	380	5.32	5	10		
FF/FI (NON-FISCO)	30	300	1.3	27.8	0		
HT (NON-FISCO)	30	200	0.9	27.8	0		
ENTITY PARAMETERS: FIELD COMMUNICATOR							
375/475	30	200	1	.00	0.0	1.9	3.2

17. FOR THE C OPTION, THE CAPACITANCE AND INDUCTANCE CONNECTED TO THE SENSOR TERMINALS MUST NOT EXCEED THE VALUES SPECIFIED IN TABLE I.
16. FOR C OPTION, SENSORS SHALL BE CSA APPROVED IN ACCORDANCE WITH THE ENTITY REQUIREMENTS OR MEET THE REQUIREMENTS OF SIMPLE APPARATUS AS DEFINED IN ANSI/ISA RP12.6 AND THE NEC, ANSI/NFPA 70. THEY CANNOT GENERATE NOR STORE MORE THAN 1.5V, 0.1mA, 25mW OR A PASSIVE COMPONENT THAT DOES NOT DISSIPATE MORE THAN 1.3W. SEE TABLES I AND II.

△15 NON-INCENDIVE FIELD WIRING METHODS MAY BE USED FOR CONNECTING SENSORS TO THE INSTRUMENT. ATTACHED SENSORS MUST BE CSA APPROVED AS NON-INCENDIVE FOR CLASS 1, DIVISION 2, GROUPS ABCD WITH INPUT VALUES OF Vmax AND Imax ≥ Voc (Vt) AND Isc (It) LISTED IN TABLE II AND THE Ci AND Li OF THE SENSOR AND INTERCONNECTED WIRING MUST BE ≤ Ca AND La LISTED IN TABLE 1 OR BE CLASSIFIED AS "SIMPLE APPARATUS". SIMPLE APPARATUS ARE DEVICES WHICH ARE INCAPABLE OF GENERATING OR STORING MORE THAN 1.2 V, 0.1 A, 25 mW OR 20 µJ (CONTACTING CONDUCTIVITY SENSORS QUALIFY AS SIMPLE APPARATUS).

△14 INSTALLATION TO BE IN ACCORDANCE WITH THE CANADIAN ELECTRICAL CODE.

△13 DIVISION 2 WIRING METHOD PER THE CANADIAN ELECTRICAL CODE (EXCLUDING NONINCENDIVE FIELD WIRING).

△12 INTRINSICALLY SAFE APPARATUS (5081, IRC TRANSMITTER, 375/475 FIELD COMMUNICATOR, FIELDBUS TERMINATOR OR ANY OTHER FIELDBUS DEVICES) AND ASSOCIATED APPARATUS (SAFETY BARRIER) SHALL MEET THE FOLLOWING REQUIREMENTS:
THE VOLTAGE (Vmax) AND CURRENT (Imax) OF THE INTRINSICALLY SAFE APPARATUS MUST BE EQUAL TO OR GREATER THAN THE VOLTAGE (Voc OR Vt) AND CURRENT (Isc OR It) WHICH CAN BE DELIVERED BY THE ASSOCIATED APPARATUS (SAFETY BARRIER). IN ADDITION, THE MAXIMUM UNPROTECTED CAPACITANCE (Ci) AND INDUCTANCE (Li) OF THE INTRINSICALLY SAFE APPARATUS, INCLUDING INTERCONNECTING WIRING, MUST BE EQUAL OR LESS THAN THE CAPACITANCE (Ca) AND INDUCTANCE (La) WHICH CAN BE SAFELY CONNECTED TO THE APPARATUS. (REF. TABLE III)

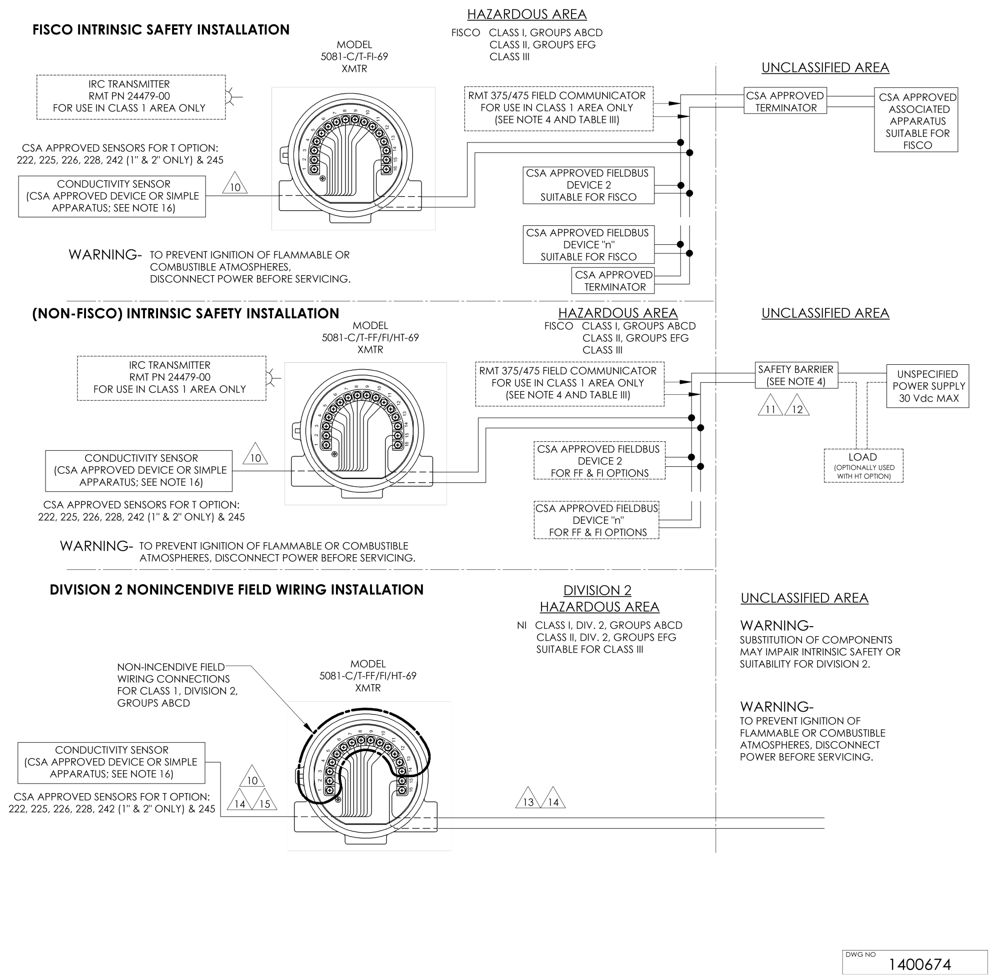
△11 FOR (NON-FISCO) INTRINSIC SAFETY INSTALLATION, ANY SINGLE SHUNT ZENER DIODE SAFETY BARRIER APPROVED BY CSA HAVING THE FOLLOWING OUTPUT PARAMETERS:
SUPPLY/SIGNAL TERMINALS ON TB1, PINS 15 AND 16.
Voc OR Vt NOT GREATER THAN 30 V FOR FF, FI AND HT OPTIONS
Isc OR It NOT GREATER THAN 300 mA FOR FF AND FI OPTIONS, OR 200 mA FOR HT OPTION
Pmax NOT GREATER THAN 1.3 W FOR FF AND FI OPTIONS, OR 0.9 mW FOR HT OPTION.

△10 FOR T OPTION, MAXIMUM CABLE LENGTH IS 250 FEET.
9. USE SUPPLY WIRES SUITABLE FOR 5°C ABOVE SURROUNDING AMBIENT.
8. NO REVISION TO DRAWING WITHOUT PRIOR CSA APPROVAL.
7. THE CONFIGURATION OF ASSOCIATED APPARATUS MUST BE CSA APPROVED UNDER THE ASSOCIATED CONCEPT AND (FOR HT AND FF OPTIONS) BE RESISTIVELY LIMITED WITH LINEAR OUTPUTS.
6. CONTROL EQUIPMENT CONNECTED TO ASSOCIATED APPARATUS MUST NOT USE OR GENERATE MORE THAN 250 Vrms OR Vdc.
5. ASSOCIATED APPARATUS MANUFACTURER'S INSTALLATION DRAWING MUST BE FOLLOWED WHEN INSTALLING THIS EQUIPMENT.
4. THE ENTITY CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS WITH ASSOCIATED APPARATUS WHEN THE FOLLOWING IS TRUE:

FIELD DEVICE INPUT		ASSOCIATED APPARATUS OUTPUT
Vmax OR Ui	≥	Voc, Vt OR Uo
Imax OR Ii	≥	Isc, It OR Io
Pmax OR Pi	≥	Po
Ci + Ccable	≤	Ca, Ct OR Co (FOR NON-FISCO INSTALLATIONS)
Li + Lcable	≤	La, Lt OR Lo (FOR NON-FISCO INSTALLATIONS)

3. RESISTANCE BETWEEN INTRINSICALLY SAFE GROUND AND EARTH GROUND MUST BE LESS THAN 1.0 Ohm.
2. DUST-TIGHT CONDUIT SEAL MUST BE USED WHEN INSTALLED IN CLASS II AND CLASS III ENVIRONMENTS.
1. INSTALLATION SHOULD BE IN ACCORDANCE WITH ANSI/ISA RP12.06 "INSTALLATION OF INTRINSICALLY SAFE SYSTEMS FOR HAZARDOUS (CLASSIFIED) LOCATIONS" (EXCEPT CHAPTER 5 FOR FISCO INSTALLATIONS) AND THE CANADIAN ELECTRICAL CODE (CSA C22.1).

NOTES: UNLESS OTHERWISE SPECIFIED



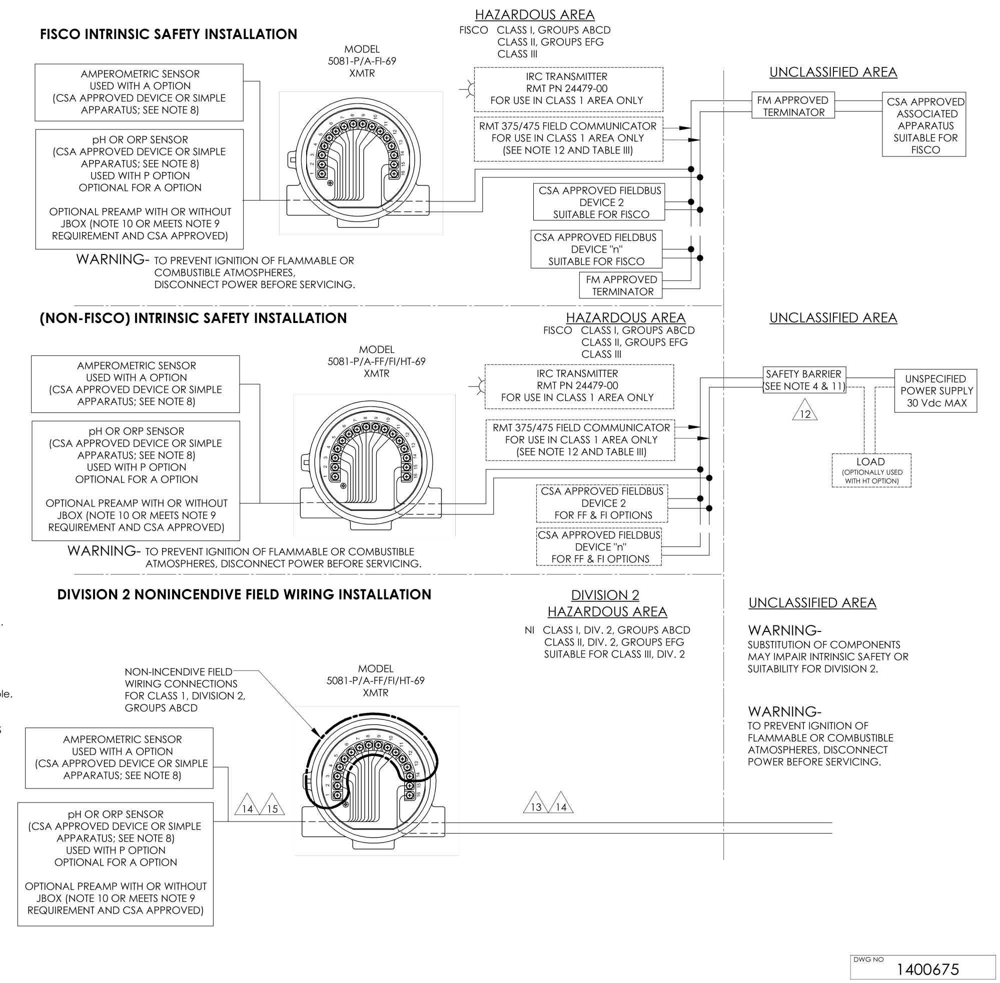


TABLE I

GAS GROUPS	5081 P/A OUTPUT PARAMETERS		
	Ca (μf)	La (mH)	
		FF / FI	HT
A, B	0.96	3.1	2.5
C	5.99	12.3	9.8
D	21.69	25	19.8

TABLE II

OUTPUT PARAMETERS	5081 P/A TB1, PINS 1 THRU 12	
	FF / FI	HT
Vt	13.02 Vdc	13.02 Vdc
It	105.64 mA	120 mA
Pt	147 mW	192 mW

TABLE III

5081 P/A INPUT PARAMETERS, SUPPLY/SIGNAL TERMINALS, TB1 PINS 15 & 16						Voc MAX OUT: (Vdc)	Isc MAX OUT: (mA)
OPTIONS	Vmax(Vdc)	Imax (mA)	Pmax (W)	Ci (nF)	Li (Uh)		
FI (FISCO)	17.5	380	5.32	27.8	0		
FF/FI (NON-FISCO)	30	300	1.3	27.8	0		
HT (NON-FISCO)	30	200	0.9	27.8	0		
ENTITY PARAMETERS: FIELD COMMUNICATOR							
375/475	30	200	1	.00	0.0	1.9	32

17. THE CAPACITANCE AND INDUCTANCE CONNECTED TO THE SENSOR TERMINALS MUST NOT EXCEED THE VALUES SPECIFIED IN TABLE I.
16. NO REVISION TO DRAWING WITHOUT CSA APPROVAL.
15. NON-INCENDIVE FIELD WIRING METHODS MAY BE USED FOR CONNECTING SENSORS TO THE INSTRUMENT. ATTACHED SENSORS MUST BE CSA APPROVED AS NON-INCENDIVE FOR CLASS 1, DIVISION 2, GROUPS ABCD WITH INPUT VALUES OF Vmax AND Imax ≥ Voc (Vt) AND Isc (It) LISTED IN TABLE II AND THE Ci AND Li OF THE SENSOR AND INTERCONNECTED WIRING MUST BE ≤ Ca AND La LISTED IN TABLE 1 OR BE CLASSIFIED AS "SIMPLE APPARATUS". SIMPLE APPARATUS ARE DEVICES WHICH ARE INCAPABLE OF GENERATING OR STORING MORE THAN 1.2 V, 0.1 A, 25 mW OR 20 μJ (AMPEROMETRIC SENSORS WITHOUT PREAMPS QUALIFY AS SIMPLE APPARATUS).
14. INSTALLATION TO BE IN ACCORDANCE WITH THE CANADIAN ELECTRICAL CODE.
13. DIVISION 2 WIRING METHOD (EXCLUDING NONINCENDIVE FIELD WIRING).
12. INTRINSICALLY SAFE APPARATUS (5081, IRC TRANSMITTER, 375/475 FIELD COMMUNICATOR, FIELDBUS TERMINATOR OR ANY OTHER FIELDBUS DEVICES) AND ASSOCIATED APPARATUS (SAFETY BARRIER) SHALL MEET THE FOLLOWING REQUIREMENTS:
THE VOLTAGE (Vmax) AND CURRENT (Imax) OF THE INTRINSICALLY SAFE APPARATUS MUST BE EQUAL TO OR GREATER THAN THE VOLTAGE (Voc OR Vt) AND CURRENT (Isc OR It) WHICH CAN BE DELIVERED BY THE ASSOCIATED APPARATUS (SAFETY BARRIER). IN ADDITION, THE MAXIMUM UNPROTECTED CAPACITANCE (Ci) AND INDUCTANCE (Li) OF THE INTRINSICALLY SAFE APPARATUS, INCLUDING INTERCONNECTING WIRING, MUST BE EQUAL OR LESS THAN THE CAPACITANCE (Ca) AND INDUCTANCE (La) WHICH CAN BE SAFELY CONNECTED TO THE APPARATUS. (REF. TABLE III)
11. FOR INTRINSIC SAFETY (NON-FISCO) INSTALLATION.
ANY SINGLE SHUNT ZENER DIODE SAFETY BARRIER APPROVED BY FM HAVING THE FOLLOWING OUTPUT PARAMETERS:
SUPPLY/SIGNAL TERMINALS TB1-15, 16
Voc OR Vt NOT GREATER THAN 30 V FOR FF, FI AND HT OPTIONS
Isc OR It NOT GREATER THAN 300 mA FOR FF AND FI OPTIONS, OR 200 mA FOR HT OPTION
Pmax NOT GREATER THAN 1.3 W FOR FF AND FI OPTIONS, OR 0.9 mW FOR HT OPTION.
10. PREAMPLIFIER TYPE 23546-00, 23538-00 OR 23561-00 MAY BE UTILIZED INSTEAD OF THE 5081P/L/D/Z INTEGRAL PREAMPIFIER. A WEATHER RESISTANT ENCLOSURE MUST HOUSE THE TYPE 23546-00 PREAMPLIFIER. OTHER PREAMPS OR PREAMP CONTAINING SENSORS MAY BE USED IF OVERALL C AND L ARE < THE LIMITS DETAILED IN NOTE 9 AND THE MAXIMUM ENITY PARAMETERS ARE > THOSE IN TABLE II.
9. THE 5081 P/A INCLUDES INTEGRAL PREAMPLIFIER CIRCUITRY. AN EXTERNAL PREAMPLIFIER MAYALSO BE USED. THE OUTPUT PARAMETERS SPECIFIED IN TABLE II ARE VALID FOR EITHER PREAMPLIFIER. THE CAPACITANCE AND INDUCTANCE OF THE LOAD CONNECTED TO THE SENSOR TERMINALS MUST NOT EXCEED THE VALUES SPECIFIED IN TABLE I WHERE Ca > Ci (SENSOR) +Ccable AND La > Li(SENSOR) + Lcable.
8. SENSORS SHALL BE CSA APPROVED IN ACCORDANCE WITH THE ENTITY REQUIREMENTS OR MEET THE REQUIREMENTS OF SIMPLE APPARATUS AS DEFINED IN ANSI/ISA RP12.6 AND THE NEC, ANSI/NFPA 70. THEY CANNOT GENERATE NOR STORE MORE THAN 1.5V, 0.1mA, 25mW OR A PASSIVE COMPONENT THAT DOES NOT DISSIPATE MORE THAN 1.3W. SEE TABLES I AND II.
7. THE CONFIGURATION OF ASSOCIATED APPARATUS MUST BE CSA APPROVED UNDER THE ASSOCIATED CONCEPT AND BE RESISTIVELY LIMITED HAVING LINEAR OUTPUTS.
6. CONTROL EQUIPMENT CONNECTED TO ASSOCIATED APPARATUS MUST NOT USE OR GENERATE MORE THAN 250 Vrms OR Vdc.
5. ASSOCIATED APPARATUS MANUFACTURER'S INSTALLATION DRAWING MUST BE FOLLOWED WHEN INSTALLING THIS EQUIPMENT.
4. THE ENTITY CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS WITH ASSOCIATED APPARATUS WHEN THE FOLLOWING IS TRUE:

FIELD DEVICE INPUT		ASSOCIATED APPARATUS OUTPUT
Vmax OR Ui	≥	Voc, Vt OR Uo
Imax OR Ii	≥	Isc, It OR Io
Pmax OR Pi	≥	Po
Ci + Ccable	≤	Ca, Ct OR Co
Li + Lcable	≤	La, Lt OR Lo

3. RESISTANCE BETWEEN INTRINSICALLY SAFE GROUND AND EARTH GROUND MUST BE LESS THAN 1.0 Ohm.
2. DUST-TIGHT CONDUIT SEAL MUST BE USED WHEN INSTALLED IN CLASS II AND CLASS III ENVIRONMENTS.
1. INSTALLATION SHOULD BE IN ACCORDANCE WITH ANSI/ISA RP12.06 "INSTALLATION OF INTRINSICALLY SAFE SYSTEMS FOR HAZARDOUS (CLASSIFIED) LOCATIONS" (EXCEPT CHAPTER 5 FOR FISCO INSTALLATIONS) AND THE CANADIAN ELECTRICAL CODE (CSA C22.1).

NOTES: UNLESS OTHERWISE SPECIFIED

TABLE I

GAS GROUPS	5081-A/P OUTPUT PARAMETERS		
	Ca (µf)	La (mH)	
		FF / FI	HT
A, B	0.96	3.1	2.5
C	5.99	12.3	9.8
D	21.69	25	19.8

TABLE II

OUTPUT PARAMETERS	5081-A/P TB1, PINS 1 THRU 12	
	FF / FI	HT
Vt	13.02 Vdc	13.02 Vdc
It	105.64 mA	120 mA
Pt	147 mW	192 mW

TABLE III

5081-A/P INPUT PARAMETERS, SUPPLY/SIGNAL TERMINALS, TB1 PINS 15 & 16						Voc MAX OUT: (Vdc)	Isc MAX OUT: (mA)
OPTIONS	Vmax(Vdc)	Imax (mA)	Pmax (W)	Ci (nF)	Li (Uh)		
FI (FISCO) GROUPS IIB/CDEFG	17.5	380	5.32	5	10		
FI (FISCO) GROUPS IIC/ABCDEFG	17.5	360	2.52	5	10		
FF/FI (NON-FISCO)	30	300	1.3	27.8	0		
HT (NON-FISCO)	30	200	0.9	27.8	0		
ENTITY PARAMETERS: FIELD COMMUNICATOR							
375/475	30	200	1	.00	0.0	1.9	32

17. THE CAPACITANCE AND INDUCTANCE CONNECTED TO THE SENSOR TERMINALS MUST NOT EXCEED THE VALUES SPECIFIED IN TABLE I.

16. NO REVISION TO DRAWING WITHOUT FM APPROVAL.

15 (△) NON-INCENDIVE FIELD WIRING METHODS MAY BE USED FOR CONNECTING SENSORS TO THE INSTRUMENT. ATTACHED SENSORS MUST BE FM APPROVED AS NON-INCENDIVE FOR CLASS 1,DIVISION 2, GROUPS ABCD WITH INPUT VALUES OF Vmax AND Imax ≥ Voc (Vt) AND Isc (It) LISTED IN TABLE II AND THE Ci AND Li OF THE SENSOR AND INTERCONNECTED WIRING MUST BE ≤ Ca AND La LISTED IN TABLE 1 OR BE CLASSIFIED AS "SIMPLE APPARATUS". SIMPLE APPARATUS ARE DEVICES WHICH ARE INCAPABLE OF GENERATING OR STORING MORE THAN 1.2 V, 0.1 A, 25 mW OR 20 µJ (AMPEROMETRIC SENSORS WITHOUT PREAMP QUALIFY AS SIMPLE APPARATUS).

14 (△) INSTALLATION TO BE IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE.

13 (△) DIVISION 2 WIRING METHOD PER THE NEC (EXCLUDING NONINCENDIVE FIELD WIRING).

12 (△) INTRINSICALLY SAFE APPARATUS (5081, IRC TRANSMITTER, 375/475 FIELD COMMUNICATOR, FIELDBUS TERMINATOR OR ANY OTHER FIELDBUS DEVICES) AND ASSOCIATED APPARATUS (SAFETY BARRIER) SHALL MEET THE FOLLOWING REQUIREMENTS: THE VOLTAGE (Vmax) AND CURRENT (Imax) OF THE INTRINSICALLY SAFE APPARATUS MUST BE EQUAL TO OR GREATER THAN THE VOLTAGE (Voc OR Vt) AND CURRENT (Isc OR It) WHICH CAN BE DELIVERED BY THE ASSOCIATED APPARATUS (SAFETY BARRIER). IN ADDITION, THE MAXIMUM UNPROTECTED CAPACITANCE (Ci) AND INDUCTANCE (Li) OF THE INTRINSICALLY SAFE APPARATUS, INCLUDING INTERCONNECTING WIRING, MUST BE EQUAL OR LESS THAN THE CAPACITANCE (Ca) AND INDUCTANCE (La) WHICH CAN BE SAFELY CONNECTED TO THE APPARATUS. (REF. TABLE III)

11. FOR INTRINSIC SAFETY (NON-FISCO) INSTALLATION, ANY SINGLE SHUNT ZENER DIODE SAFETY BARRIER APPROVED BY FM HAVING THE FOLLOWING PARAMETERS:
SUPPLY/SIGNAL TERMINALS ON TB1, PINS 15 AND 16.
Voc OR Vt NOT GREATER THAN 30 V FOR FF, FI AND HT OPTIONS
Isc OR It NOT GREATER THAN 300 mA FOR FF AND FI OPTIONS, OR 200 mA FOR HT OPTION
Pmax NOT GREATER THAN 1.3 W FOR FF AND FI OPTIONS, OR 0.9 mW FOR HT OPTION.

10. PREAMPLIFIER TYPE 23546-00, 23538-00 OR 23561-00 MAY BE UTILIZED INSTEAD OF THE 5081P/L/D/Z INTEGRAL PREAMPIFIER. A WEATHER RESISTANT ENCLOSURE MUST HOUSE THE TYPE 23546-00 PREAMPLIFIER. OTHER PREAMPS OR PREAMP CONTAINING SENSORS MAY BE USED IF OVERALL C AND L ARE < THE LIMITS DETAILED IN NOTE 9 AND THE MAXIMUM ENITY PARAMETERS ARE > THOSE IN TABLE II.

9. THE 5081-A/P INCLUDES INTEGRAL PREAMPLIFIER CIRCUITRY. AN EXTERNAL PREAMPLIFIER MAYALSO BE USED. THE OUTPUT PARAMETERS SPECIFIED IN TABLE II ARE VALID FOR EITHER PREAMPLIFIER. THE CAPACITANCE AND INDUCTANCE OF THE LOAD CONNECTED TO THE SENSOR TERMINALS MUST NOT EXCEED THE VALUES SPECIFIED IN TABLE I WHERE Ca > Ci (SENSOR) +Ccable AND La > Li(SENSOR) + Lcable.

8. SENSORS SHALL BE FM APPROVED IN ACCORDANCE WITH THE ENTITY REQUIREMENTS OR MEET THE REQUIREMENTS OF SIMPLE APPARATUS AS DEFINED IN ANSI/ISA RP12.6 AND THE NEC, ANSI/NFPA 70. THEY CAN NOT GENERATE NOR STORE MORE THAN 1.5V, 0.1mA, 25mW OR A PASSIVE COMPONENT THAT DOES NOT DISSIPATE MORE THAN 1.3W. SEE TABLES I AND II.

7. THE CONFIGURATION OF ASSOCIATED APPARATUS MUST BE FM APPROVED UNDER THE ASSOCIATED CONCEPT.

6. CONTROL EQUIPMENT CONNECTED TO ASSOCIATED APPARATUS MUST NOT USE OR GENERATE MORE THAN 250 Vrms OR Vdc.

5. ASSOCIATED APPARATUS MANUFACTURER'S INSTALLATION DRAWING MUST BE FOLLOWED WHEN INSTALLING THIS EQUIPMENT.

4. THE ENTITY CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS WITH ASSOCIATED APPARATUS WHEN THE FOLLOWING IS TRUE:

FIELD DEVICE INPUT		ASSOCIATED APPARATUS OUTPUT
Vmax OR Ui	≥	Voc, Vt OR Uo
Imax OR Ii	≥	Isc, It OR Io
Pmax OR Pi	≥	Po
3Ci + 3Ccable	≤	Ca, Ct OR Co (FOR FISCO INSTALLATIONS)
3Li + 3Lcable (FOR FISCO INSTALLATIONS)	≤	La, Lt OR Lo; Lc/Rc ≤ (La/Ra OR Lo/Ro) AND Li/Ri ≤ (La/Ra OR Lo/Ro)
Ci + Ccable	≤	Ca, Ct OR Co (FOR FIELDBUS (NON-FISCO) INSTALLATIONS)
Li + Lcable	≤	La, Lt OR Lo (FOR FIELDBUS (NON-FISCO) INSTALLATIONS)

3. RESISTANCE BETWEEN INTRINSICALLY SAFE GROUND AND EARTH GROUND MUST BE LESS THAN 1.0 Ohm.

2. DUST-TIGHT CONDUIT SEAL MUST BE USED WHEN INSTALLED IN CLASS II AND CLASS III ENVIRONMENTS.

1. INSTALLATION SHOULD BE IN ACCORDANCE WITH ANSI/ISA RP12.06 "INSTALLATION OF INTRINSICALLY SAFE SYSTEMS FOR HAZARDOUS (CLASSIFIED) LOCATIONS" (EXCEPT CHAPTER 5 FOR FISCO INSTALLATIONS) AND THE NATIONAL ELECTRICAL CODE (ANSI/NFPA 70)SECTIONS 504 AND 505.

NOTES: UNLESS OTHERWISE SPECIFIED

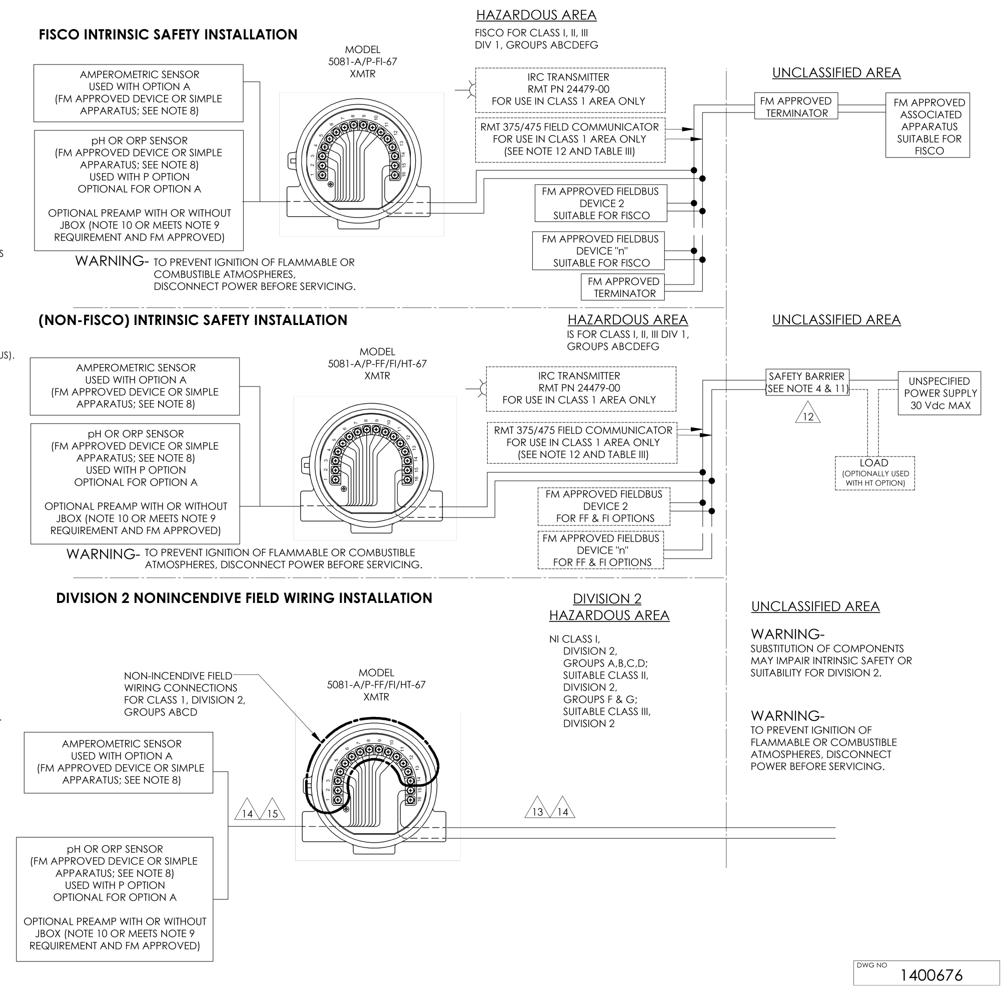


TABLE I

GAS GROUPS	C OPTION OUTPUT PARAMETERS		
	Ca (µf)	La (mH)	
		FF / FI	HT
A, B	12.05	0.4	0.5
C	490.05	1.6	2.0
D	9990.05	3.1	3.7

TABLE II

C OPTION OUTPUT PARAMETERS	5081C TB1, PINS 1 THRU 12	
	FF / FI	HT
Vt	6.51 Vdc	6.51 Vdc
It	302.59 mA	280 mA
Pt	365 mW	442 mW

TABLE III

5081C/T INPUT PARAMETERS, SUPPLY/SIGNAL TERMINALS, TB1 PINS 15 & 16						Voc MAX OUT: (Vdc)	Isc MAX OUT: (mA)
OPTIONS	Vmax(Vdc)	Imax (mA)	Pmax (W)	Ci (nF)	Li (Uh)		
FI (FISCO) GROUPS IIB/CDEFG	17.5	380	5.32	5	10		
FI (FISCO) GROUPS IIC/ABCDEFG	17.5	360	2.52	5	10		
FF/FI (NON-FISCO)	30	300	1.3	27.8	0		
HT (NON-FISCO)	30	200	0.9	27.8	0		
ENTITY PARAMETERS: FIELD COMMUNICATOR							
375/475	30	200	1	.00	0.0	1.9	32

17. FOR THE C OPTION, THE CAPACITANCE AND INDUCTANCE CONNECTED TO THE SENSOR TERMINALS MUST NOT EXCEED THE VALUES SPECIFIED IN TABLE I.

16. FOR C OPTION, SENSORS SHALL BE FM APPROVED IN ACCORDANCE WITH THE ENTITY REQUIREMENTS OR MEET THE REQUIREMENTS OF SIMPLE APPARATUS AS DEFINED IN ANSI/ISA RP12.6 AND THE NEC, ANSI/NFPA 70. THEY CANNOT GENERATE NOR STORE MORE THAN 1.5V, 0.1mA, 25mW OR A PASSIVE COMPONENT THAT DOES NOT DISSIPATE MORE THAN 1.3W. SEE TABLES I AND II.

15 △ NON-INCENDIVE FIELD WIRING METHODS MAY BE USED FOR CONNECTING SENSORS TO THE INSTRUMENT. ATTACHED SENSORS MUST BE FM APPROVED AS NON-INCENDIVE FOR CLASS 1,DIVISION 2, GROUPS ABCD WITH INPUT VALUES OF Vmax AND Imax ≥ Voc (Vt) AND Isc (It) LISTEDIN TABLE II AND THE Ci AND Li OF THE SENSOR AND INTERCONNECTED WIRING MUST BE ≤ Ca AND La LISTED IN TABLE 1 OR BE CLASSIFIED AS "SIMPLE APPARATUS". SIMPLE APPARATUS ARE DEVICES WHICH ARE INCAPABLE OF GENERATING OR STORING MORE THAN 1.2 V, 0.1 A, 25 mW OR 20 µJ (CONTACTING CONDUCTIVITY SENSORS QUALIFY AS SIMPLE APPARATUS).

14 △ INSTALLATION TO BE IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE.

13 △ DIVISION 2 WIRING METHOD PER THE NEC (EXCLUDING NONINCENDIVE FIELD WIRING).

12 △ INTRINSICALLY SAFE APPARATUS (5081, IRC TRANSMITTER, 375/475 FIELD COMMUNICATOR, FIELDBUS TERMINATOR OR ANY OTHER FIELDBUS DEVICES) AND ASSOCIATED APPARATUS (SAFETY BARRIER) SHALL MEET THE FOLLOWING REQUIREMENTS: THE VOLTAGE (Vmax) AND CURRENT (Imax) OF THE INTRINSICALLY SAFE APPARATUS MUST BE EQUAL TO OR GREATER THAN THE VOLTAGE (Voc OR Vt) AND CURRENT (Isc OR It) WHICH CAN BE DELIVERED BY THE ASSOCIATED APPARATUS (SAFETY BARRIER). IN ADDITION, THE MAXIMUM UNPROTECTED CAPACITANCE (Ci) AND INDUCTANCE (Li) OF THE INTRINSICALLY SAFE APPARATUS, INCLUDING INTERCONNECTING WIRING, MUST BE EQUAL OR LESS THAN THE CAPACITANCE (Ca) AND INDUCTANCE (La) WHICH CAN BE SAFELY CONNECTED TO THE APPARATUS. (REF. TABLE III)

11 △ FOR (NON-FISCO) INTRINSIC SAFETY INSTALLATION, ANY SINGLE SHUNT ZENER DIODE SAFETY BARRIER APPROVED BY FM HAVING THE FOLLOWING OUTPUT PARAMETERS:
SUPPLY/SIGNAL TERMINALS ON TB1, PINS 15 AND 16.
Voc OR Vt NOT GREATER THAN 30 V FOR FF, FI AND HT OPTIONS
Isc OR It NOT GREATER THAN 300 mA FOR FF AND FI OPTIONS, OR 200 mA FOR HT OPTION
Pmax NOT GREATER THAN 1.3 W FOR FF AND FI OPTIONS, OR 0.9 mW FOR HT OPTION.

10 △ FOR T OPTION, MAXIMUM CABLE LENGTH IS 250 FEET.

9. USE SUPPLY WIRES SUITABLE FOR 5°C ABOVE SURROUNDING AMBIENT.
8. NO REVISION TO DRAWING WITHOUT PRIOR FM APPROVAL.
7. THE CONFIGURATION OF ASSOCIATED APPARATUS MUST BE FM APPROVED UNDER THE ASSOCIATED CONCEPT.

6. CONTROL EQUIPMENT CONNECTED TO ASSOCIATED APPARATUS MUST NOT USE OR GENERATE MORE THAN 250 Vrms OR Vdc.

5. ASSOCIATED APPARATUS MANUFACTURER'S INSTALLATION DRAWING MUST BE FOLLOWED WHEN INSTALLING THIS EQUIPMENT.

4. THE ENTITY CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS WITH ASSOCIATED APPARATUS WHEN THE FOLLOWING IS TRUE:

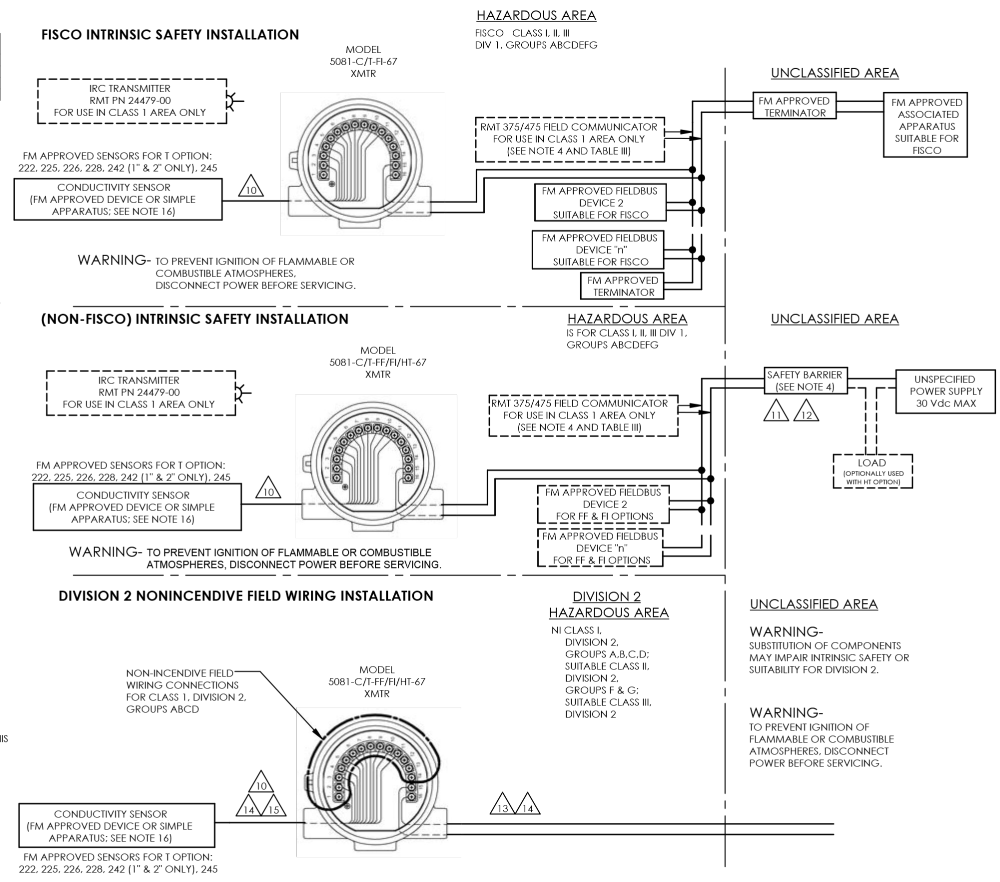
FIELD DEVICE INPUT		ASSOCIATED APPARATUS OUTPUT
Vmax OR Ui	≥	Voc, Vt OR Uo
Imax OR Ii	≥	Isc, It OR Io
Pmax OR Pi	≥	Po
3Ci + 3Ccable	≤	Ca, Ct OR Co (FOR FISCO INSTALLATIONS)
3Li + 3Lcable	≤	La, Lt OR Lo; Lc/Rc ≤ (La/Ra OR Lo/Ro) AND Li/Ri ≤ (La/Ra OR Lo/Ro) (FOR FISCO INSTALLATIONS)
Ci + Ccable	≤	Ca, Ct OR Co (FOR FIELDBUS (NON-FISCO) INSTALLATIONS)
Li + Lcable	≤	La, Lt OR Lo (FOR FIELDBUS (NON-FISCO) INSTALLATIONS)

3. RESISTANCE BETWEEN INTRINSICALLY SAFE GROUND AND EARTH GROUND MUST BE LESS THAN 1.0 Ohm.

2. DUST-TIGHT CONDUIT SEAL MUST BE USED WHEN INSTALLED IN CLASS II AND CLASS III ENVIRONMENTS.

1. INSTALLATION SHOULD BE IN ACCORDANCE WITH ANSI/ISA RP12.06 "INSTALLATION OF INTRINSICALLY SAFE SYSTEMS FOR HAZARDOUS (CLASSIFIED) LOCATIONS" (EXCEPT CHAPTER 5 FOR FISCO INSTALLATIONS) AND THE NATIONAL ELECTRICAL CODE (ANSI/NFPA 70) SECTIONS 504 AND 505.

NOTES: UNLESS OTHERWISE SPECIFIED



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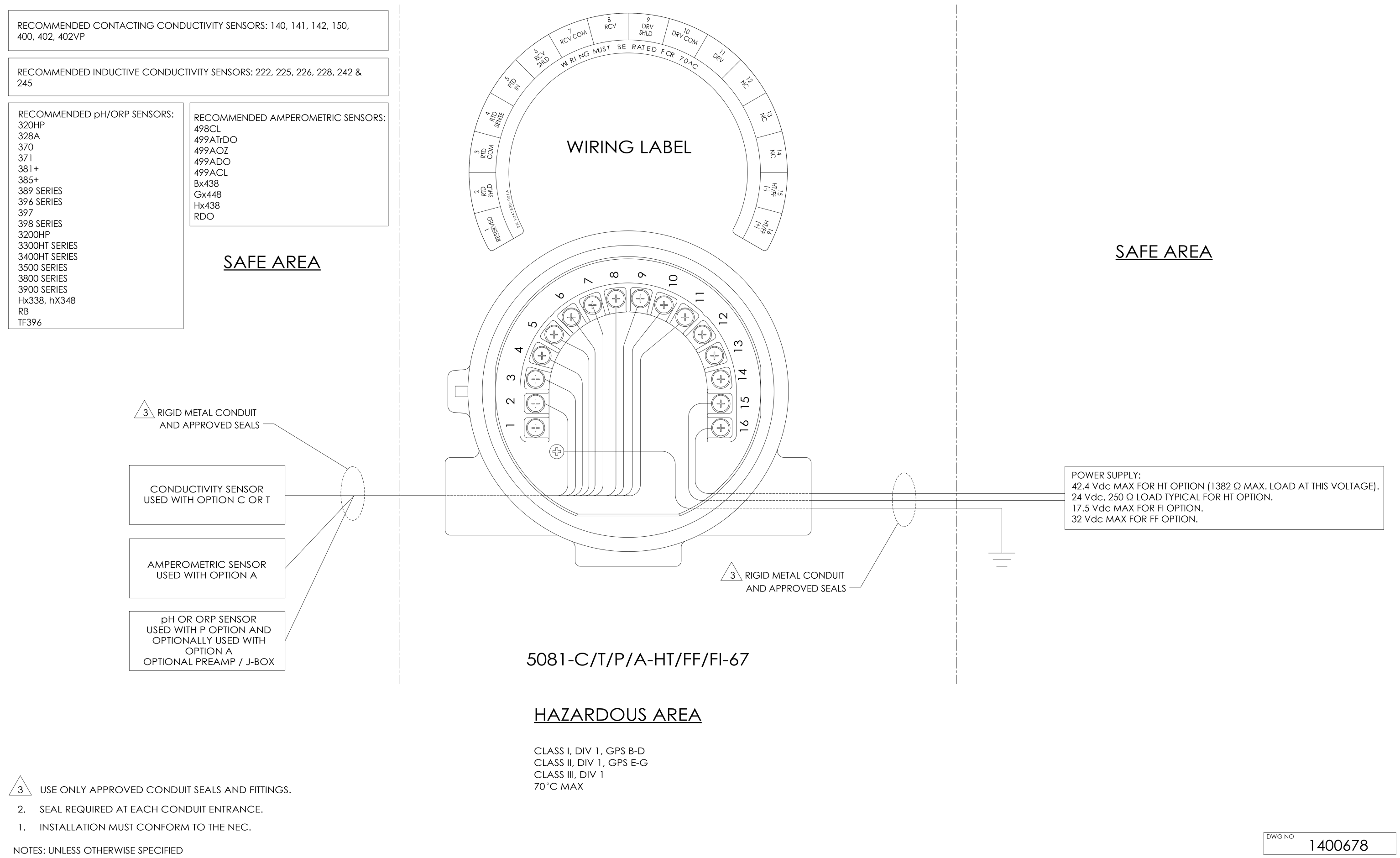
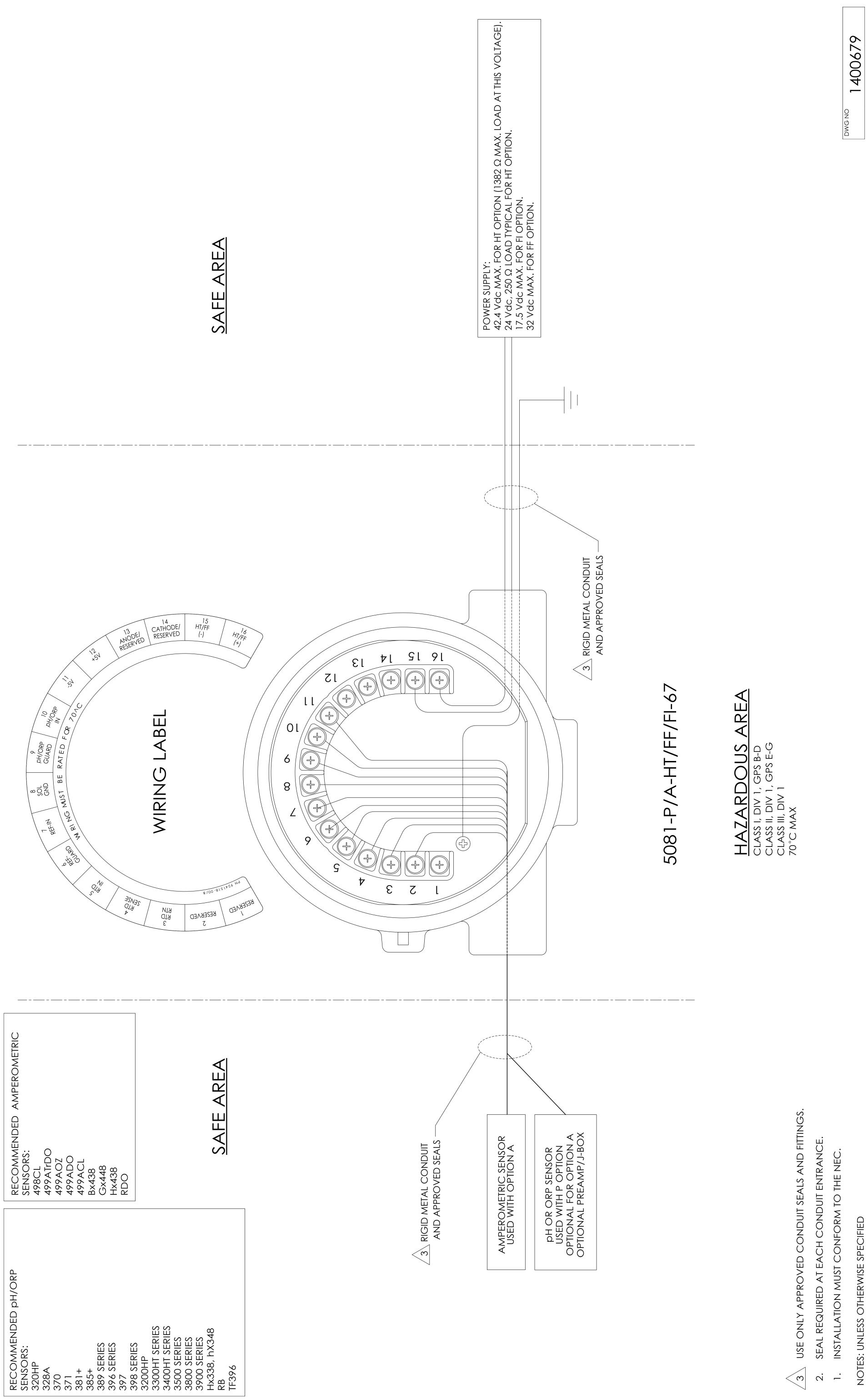
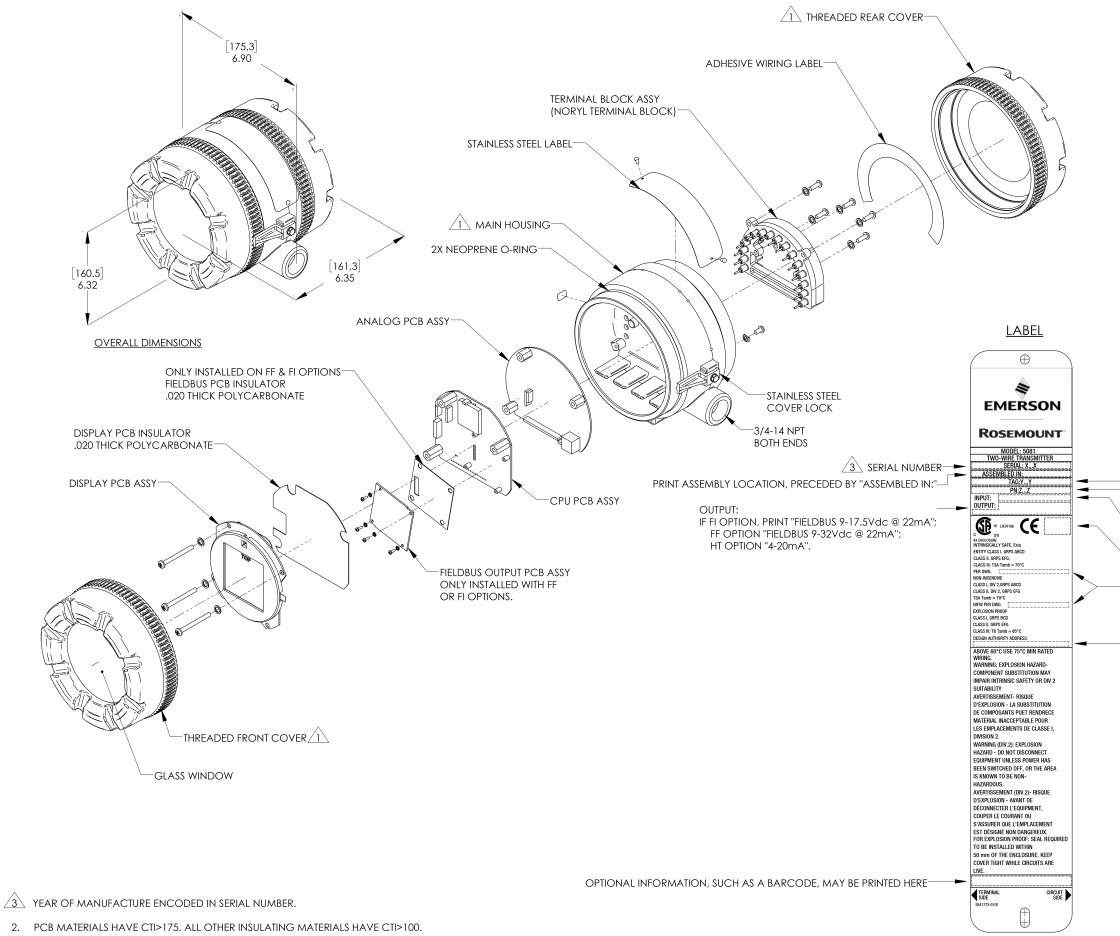

RECOMMENDED CONTACTING CONDUCTIVITY SENSORS: 140, 141, 142, 150, 400, 402, 402VP
RECOMMENDED INDUCTIVE CONDUCTIVITY SENSORS: 222, 225, 226, 228, 242 & 245
RECOMMENDED pH/ORP SENSORS: 320HP 328A 370 371 381+ 385+ 389 SERIES 396 SERIES 397 398 SERIES 3200HP 3300HT SERIES 3400HT SERIES 3500 SERIES 3800 SERIES 3900 SERIES Hx338, hX348 RB TF396
RECOMMENDED AMPEROMETRIC SENSORS: 498CL 499ATrDO 499AOZ 499ADO 499ACL Bx438 Gx448 Hx438 RDO
SAFE AREA
WIRING LABEL
WIRING MUST BE RATED FOR 70°C
SAFE AREA
RIGID METAL CONDUIT AND APPROVED SEALS
CONDUCTIVITY SENSOR USED WITH OPTION C OR T
AMPEROMETRIC SENSOR USED WITH OPTION A
pH OR ORP SENSOR USED WITH P OPTION AND OPTIONALLY USED WITH OPTION A OPTIONAL PREAMP / J-BOX
POWER SUPPLY:
42.4 Vdc MAX FOR HT OPTION (1382 Ω MAX. LOAD AT THIS VOLTAGE).
24 Vdc, 250 Ω LOAD TYPICAL FOR HT OPTION.
17.5 Vdc MAX FOR FI OPTION.
32 Vdc MAX FOR FF OPTION.
RIGID METAL CONDUIT AND APPROVED SEALS
5081-C/T/P/A-HT/FF/FI-67
HAZARDOUS AREA
CLASS I, DIV 1, GPS B-D
CLASS II, DIV 1, GPS E-G
CLASS III, DIV 1
70°C MAX
3 USE ONLY APPROVED CONDUIT SEALS AND FITTINGS.
2. SEAL REQUIRED AT EACH CONDUIT ENTRANCE.
1. INSTALLATION MUST CONFORM TO THE NEC.
NOTES: UNLESS OTHERWISE SPECIFIED
DWG NO 1400678


SAFE AREA
POWER SUPPLY:
42.4 Vdc MAX. FOR HT OPTION (1382 Ω MAX. LOAD AT THIS VOLTAGE).
24 Vdc, 250 Ω LOAD TYPICAL FOR HT OPTION.
17.5 Vdc MAX. FOR FI OPTION.
32 Vdc MAX. FOR FF OPTION.
DWG NO
1400679
WIRING LABEL
RIGID METAL CONDUIT AND APPROVED SEALS
5081-P/A-HT/FF/FI-67
HAZARDOUS AREA
CLASS I, DIV 1, GPS B-D
CLASS II, DIV 1, GPS E-G
CLASS III, DIV 1
70°C MAX
RECOMMENDED pH/ORP SENSORS:
320HP
328A
370
371
381+
385+
389 SERIES
396 SERIES
397
398 SERIES
3200HP
3300HT SERIES
3400HT SERIES
3500 SERIES
3800 SERIES
3900 SERIES
Hx338, hX348
RB
TF396
RECOMMENDED AMPEROMETRIC SENSORS:
499CL
499ATrDO
499AOZ
499ADO
499ACL
Bx438
Gx448
Hx438
RDO
SAFE AREA
RIGID METAL CONDUIT AND APPROVED SEALS
AMPEROMETRIC SENSOR USED WITH OPTION A
pH OR ORP SENSOR USED WITH P OPTION OPTIONAL FOR OPTION A OPTIONAL PREAMP/J-BOX
NOTES: UNLESS OTHERWISE SPECIFIED
1. INSTALLATION MUST CONFORM TO THE NEC.
2. SEAL REQUIRED AT EACH CONDUIT ENTRANCE.
3 USE ONLY APPROVED CONDUIT SEALS AND FITTINGS.



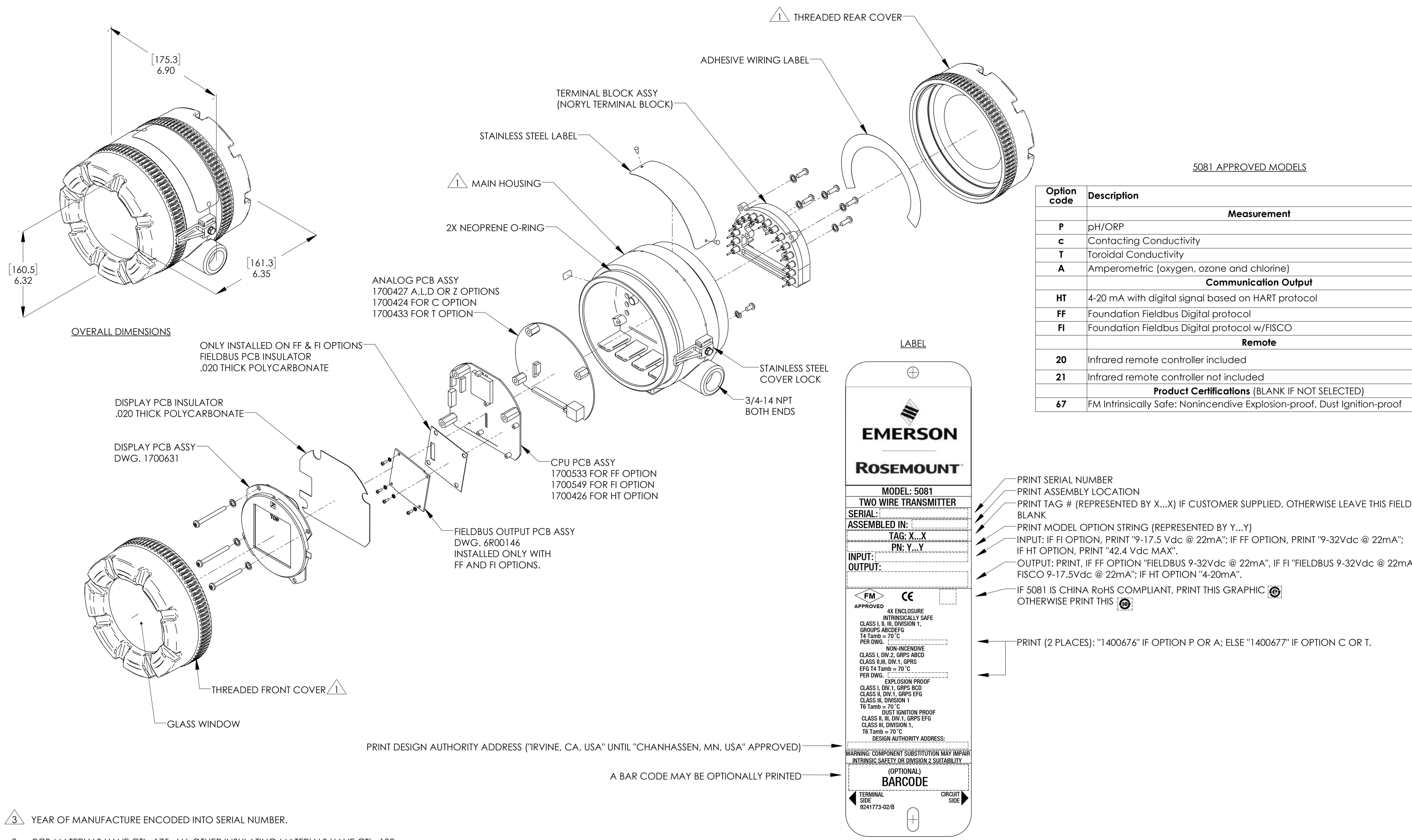
5081 APPROVED MODELS

Option code	Description
	Measurement
P	pH/ORP
C	Contacting Conductivity
T	Toroidal Conductivity
A	Amperometric (Oxygen, Ozone, Chlorine)
	Communication Output
HT	4-20 mA with digital signal based on HART protocol
FF	Foundation Fieldbus Digital protocol
FI	Foundation Fieldbus Digital protocol w/FISCO
	Remote
20	Infrared remote controller included
21	Infrared remote controller not included
	Product Certifications (BLANK IF NOT SELECTED)
60	No approval
69	CSA Intrinsically Safe; Nonincendive, explosion proof

3. YEAR OF MANUFACTURE ENCODED IN SERIAL NUMBER.
2. PCB MATERIALS HAVE CTI>175. ALL OTHER INSULATING MATERIALS HAVE CTI>100.
1. MATERIAL: ALUMINUM ALLOY CONTAINING LESS THAN 6% BY WEIGHT OF MAGNESIUM.

NOTES: UNLESS OTHERWISE SPECIFIED

DWG NO 1700783



5081 APPROVED MODELS

Option code	Description
	Measurement
P	pH/ORP
c	Contacting Conductivity
T	Toroidal Conductivity
A	Amperometric (oxygen, ozone and chlorine)
	Communication Output
HT	4-20 mA with digital signal based on HART protocol
FF	Foundation Fieldbus Digital protocol
FI	Foundation Fieldbus Digital protocol w/FISCO
	Remote
20	Infrared remote controller included
21	Infrared remote controller not included
	Product Certifications (BLANK IF NOT SELECTED)
67	FM Intrinsically Safe: Nonincendive Explosion-proof, Dust Ignition-proof

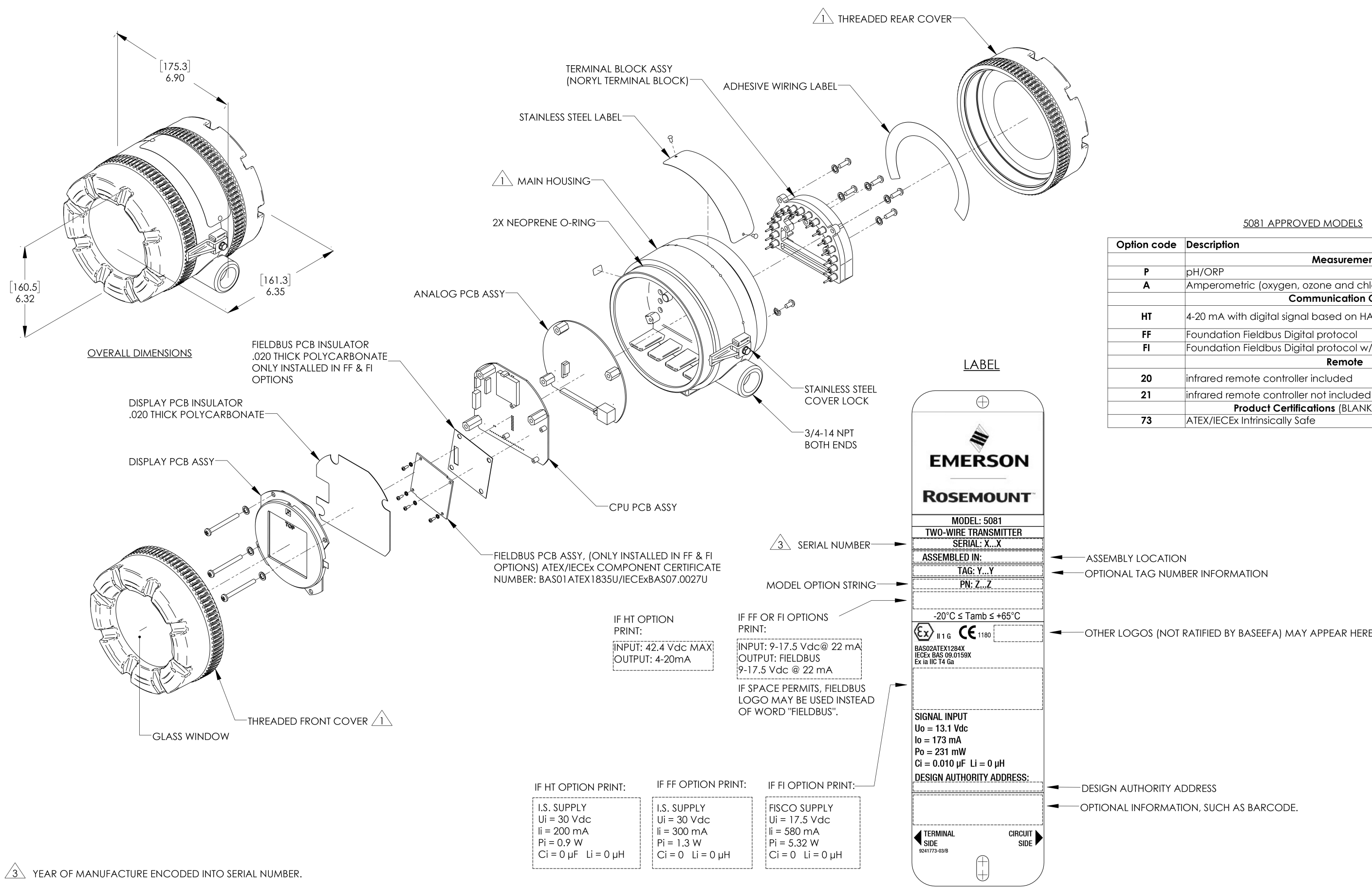
3. YEAR OF MANUFACTURE ENCODED INTO SERIAL NUMBER.

2. PCB MATERIALS HAVE CTI> 175. ALL OTHER INSULATING MATERIALS HAVE CTI> 100.

1. MATERIAL: ALUMINUM ALLOY CONTAINING LESS THAN 6% BY WEIGHT OF MAGNESIUM.

NOTES: UNLESS OTHERWISE SPECIFIED

DWG NO 1700784



5081 APPROVED MODELS

Option code	Description
	Measurement
P	pH/ORP
A	Amperometric (oxygen, ozone and chlorine)
	Communication Output
HT	4-20 mA with digital signal based on HART protocol
FF	Foundation Fieldbus Digital protocol
FI	Foundation Fieldbus Digital protocol w/FISCO
	Remote
20	infrared remote controller included
21	infrared remote controller not included
	Product Certifications (BLANK IF NOT SELECTED)
73	ATEX/IECEx Intrinsically Safe

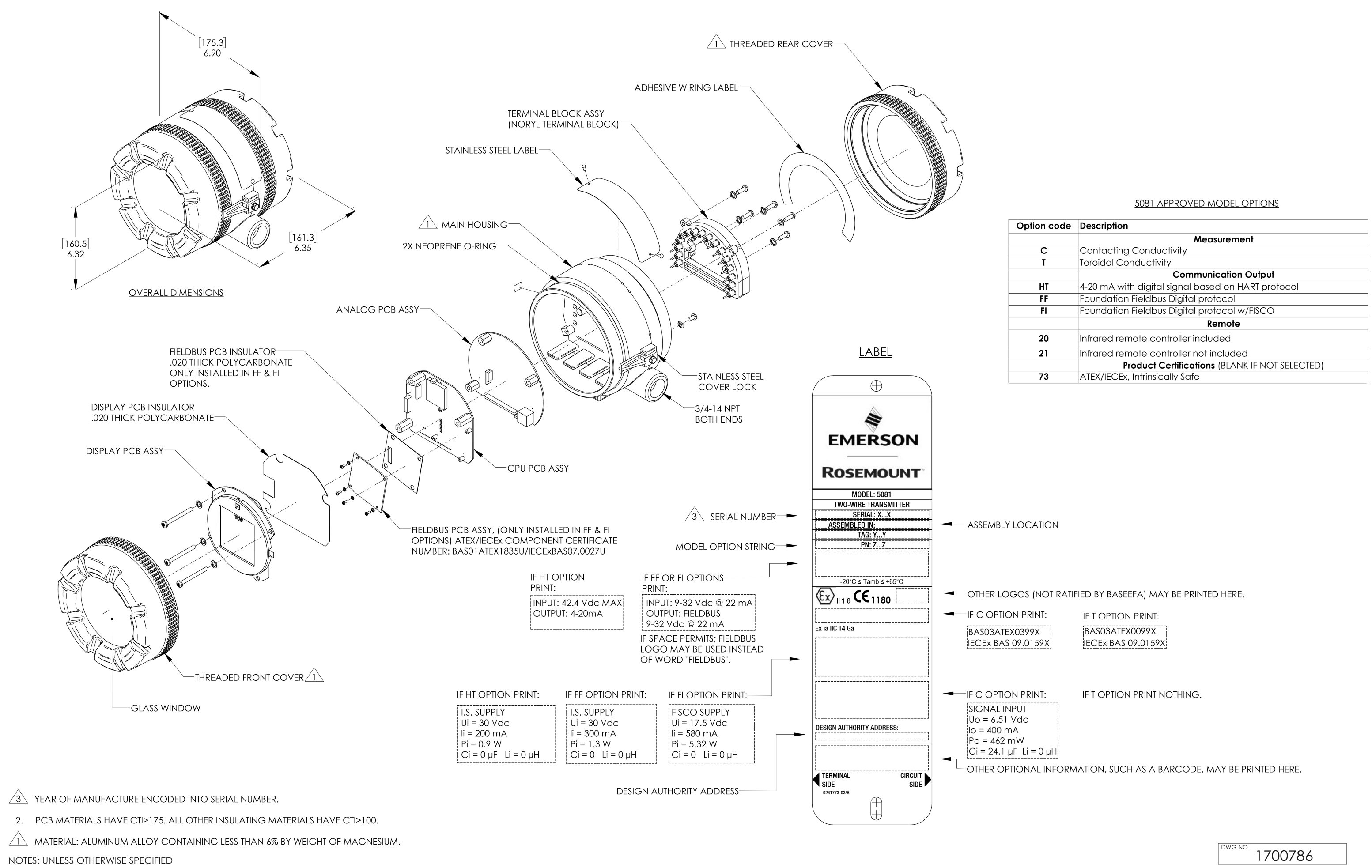
3. YEAR OF MANUFACTURE ENCODED INTO SERIAL NUMBER.

2. PCB MATERIALS HAVE CTI>175. ALL OTHER INSULATING MATERIALS HAVE CTI>100.

1. MATERIAL: ALUMINUM ALLOY CONTAINING LESS THAN 6% BY WEIGHT OF MAGNESIUM.

NOTES: UNLESS OTHERWISE SPECIFIED

DWG NO 1700785



5081 APPROVED MODEL OPTIONS

Option code	Description
	Measurement
C	Contacting Conductivity
T	Toroidal Conductivity
	Communication Output
HT	4-20 mA with digital signal based on HART protocol
FF	Foundation Fieldbus Digital protocol
FI	Foundation Fieldbus Digital protocol w/FISCO
	Remote
20	Infrared remote controller included
21	Infrared remote controller not included
	Product Certifications (BLANK IF NOT SELECTED)
73	ATEX/IECEx, Intrinsically Safe

3. YEAR OF MANUFACTURE ENCODED INTO SERIAL NUMBER.
2. PCB MATERIALS HAVE CTI>175. ALL OTHER INSULATING MATERIALS HAVE CTI>100.
1. MATERIAL: ALUMINUM ALLOY CONTAINING LESS THAN 6% BY WEIGHT OF MAGNESIUM.

NOTES: UNLESS OTHERWISE SPECIFIED

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2019

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