Instruction Manual
LIQ-MAN-5081, Rev A
September 2017

Rosemount™ 5081 Explosion-Proof Transmitter

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Essential instructions

Read this page before proceeding!

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

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- 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 your equipment as specified in the installation instructions of the appropriate manual and per applicable local and national codes. Connect all products to the proper electrical and pressure sources.
- Install your equipment as specified in the Installation section and per applicable local and national codes. Connect all products to the proper electrical and pressure sources.
- To ensure proper performance, use qualified personnel to install, operate, update, program, and maintain the product.
- When replacement parts are required, ensure that qualified people use replacement parts specified by Rosemount. Unauthorized parts and procedures can affect the product's performance and place the safe operation of your process at risk. Look alike substitutions may result in fire, electrical hazards, or improper operation.
- Ensure that all equipment doors are closed and protective covers are in place, except when maintenance is being performed by qualified people, to prevent electrical shock and personal injury.

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Contents

Appendices and reference

1 Startup procedure

Complete the following steps to start the 5081 transmitter.

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 if using a 5081-P or 5081-C.
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*). Once the selection has been made, press *ENTER*. If *OFF* is selected, then enter the manual temperature desired using the arrow keys. Once completed, press *ENTER*.

2 Description and specifications

2.1 Features and applications

The 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, and chlorine

Maintenance features: Automatic 2 point buffer calibration routine, automatic recognition of RTD, and 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 *Appendix A*.
Conduit openings	3/4 in. FNPT
Ambient temperature	-4 to 149 °F (-20 to 65 °C)
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 specifications for the measurement of interest.

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

RFI/EMI	EN-61326
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.

Digital communications

Table 2-2: HART

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). The graph 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
Variables assignable to	pH, Temperature, mV, Glass impedance, Reference impedance, RTD resistance, ORP, Conductivity, Resistivity, Concentration, Raw conductivity, Chlorine, Dissolved oxygen, and Ozone

Table 2-3: FOUNDATION FIELDBUS

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, and Ozone

2.3 Hazardous area certifications

IECEx

Certificate	IECEx BAS 9.0159X
Intrinsically safe marking	Ex ia IIC T4 Ga (-20 °C ≤ T_{amb} ≤ +65 °C)
Certification conditions	The 5081 enclosure may be made of aluminum alloy and given a protective polyurethane paint finish; however, care should be taken to prevent it from impact or abrasion if located in a Zone 0 environment.
Certification standards	IEC 60079-0:2011, IEC 60079-11:2011

ATEX

Certificate	Bas02ATEX1284X	(5081A/P)
	Baseef03ATEX0099X	(5081C)
	Baseefa03ATEX0399X	(5081T)
Intrinsically safe marking	Ex ia IIC T4 Ga (-20 °C ≤ T_{amb} ≤ +65 °C)	
Certification conditions	The 5081 enclosure may be made of aluminum alloy and given a protective polyurethane paint finish; however, care should be taken to prevent it from impact or abrasion if located in a Zone 0 environment.	
Certification standards	EN60079-0:2012+A11:2013, EN60079-11:2012	

CSA

Explosion proof certification	Class I, Division 1, Groups A, B, C, D Class II, Division 1, Groups E, F, G Class III T6 T_{amb} max. 70 °C 4X enclosure type
Certification conditions	Seal required at each conduit entry
Intrinsic safety certification	Class I, Division 1, Groups A, B, C, D Class II, Division 1, Groups E, F, G Class III T4 T_{amb} max. 70 °C 4X enclosure type
Certification conditions	For Intrinisically Safe installation, see drawings 1400674 or 1400675.
Non incendive certification	Class I, Division 2, Groups A, B, C, D Class II, Division 2, Groups E, F, G Class III T4 T_{amb} max. 70 °C 4X enclosure type
Certification conditions	For Non-Incendive Field Wiring installation, see drawings 1400674 or 1400675
Certification standards	CSA standards: 22.2 No. 0-M1987, 22.2 No. 142-M1987, 22.2 No. 157-921, 22.2 No. 213-M1987

FM

FM APPROVED

Explosion proof certification	Class I, Division 1, Groups B, C, D T6 T_{amb} max. 70 °C 4X enclosure type
Certification conditions	Install per control drawing 1400678 or 1400679.
Dust ignition proof certification	Class II & III, Division1, Groups E, F, G T6 T_{amb} max. 70 °C
Certification conditions	Install per control drawing 1400678 or 1400679.
Intrinsic safety certification	Class I, Division 1, Groups A, B, C, D Class II, Division 1, Groups E, F, G Class III, Division 1 T4 T_{amb} max. 70 °C 4X enclosure type

Certification conditions	Connect per control drawings 1400676 or 1400677 for Intrinsically Safe Installations.
Non incendive certification	Class I, Division 2, Groups A, B, C, D T4 T_{amb} max. 70 °C 4X enclosure type
Certification conditions	For non-incendive field wiring, see installation drawings 1400676 or 1400677.
Certification standards	Certified to FM Approvals standards: 3600:2011, 3610:2015, 3611:2016, 3615:2006, 3810:2005, and ANSI/NEMA 250:1991

2.4 Functional specifications

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

Table 2-4: pH/ORP

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. A manual two-point calibration is made by immersing the sensor in two different buffer solutions and entering the pH values. The microprocessor automatically calculates the slope which is used for self-diagnostics. An error message is displayed if the pH sensor is faulty. This slope can be read on the display and/or manually adjusted if desired. An on-line, one-point process standardization is accomplished by entering the pH or ORP value of a grab sample as measured by a lab reference.
Preamplifier location	A preamplifier must be used to convert the high impedance pH electrode signal to a low impedance signal for transmitter use. The integral preamplifer of the 5081 may be used when the sensor to transmitter distance is less than 15 ft. (4.5 m). A sensor with a built-in preamplifier or a junction box can be used if distance is longer than 15 ft. (4.5 m).
Automatic temperature compensation	External 3 or 4 wire Pt 100 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). Manual temperature compensation is also selectable.
Accuracy	±01 mv at 25 °C (77 °F) ± 0.01 pH
Repeatability	±01 mv at 25 °C (77 °F) ±0.01 pH
Stability	0.25% / year at 25 °C (77 °F)

Table 2-5: Contacting conductivity

Measured range	0-20,000 µS/cm
Calibration	Calibration is easily accomplished by immersing the sensor in a known solution and entering its value or entering the cell constant for ultra-pure applications.
Automatic temperature compensation	3-wire Pt 100 or Pt 1000 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	0-5%/°C
Other temperature compensation algorithms	Ultra-pure water compensation Cation conductivity Raw (uncompensated) conductivity
Compatible RTD	100 Ohm or 1000 Ohm with automatic recognition

Table 2-6: Toroidal conductivity

Measured range	50 to 2,000,000 µS/cm
Calibration	Calibration is easily accomplished by immersing the sensor in a known solution and entering its value.
Automatic temperature compensation	3-wire Pt 100 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 - 5% / °C
% concentration ranges	Sodium hydroxide: 0 to 15% Hydrochloric acid: 0 to 16% Sulfuric acid: 0 to 25% and 96 to 99.7%

Table 2-7: Dissolved oxygen

Measurement range	0 - 99 ppm (mg/L), 0 - 200 saturation
Resolution	0.01 ppm, 0.1 ppb for 499ATrDO sensor
Temperature correction for membrane permeability	Automatic between 0 and 50 °C (can be disabled)

Table 2-7: Dissolved oxygen *(continued)*

Calibration	Air calibration (user must enter barometric pressure) or calibration against a standard instrument

Table 2-8: Free chlorine

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 0 and 50 °C (can be disabled)
pH correction	Automatic between pH 6.0 and 9.5. Manual pH correction is also available.
Calibration	Against grab sample analyzed using portable test kit.

Table 2-9: Total chlorine

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 5 and 35 °C (can be disabled)
Calibration	Against grab sample analyzed using portable test kit.

Table 2-10: Ozone

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.

Table 2-11: 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 Model 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. A hand-held infrared remote controller is required for local configuration and calibration of the transmitter.

Model 5081	**Smart Two-Wire Microprocessor Transmitter**
Code	**Required selection**
P	pH/ORP
C	Contacting conductivity
T	Toroidal conductivity
A	Amperometric (oxygen, ozone, and chlorine)
Code	**Required selection**
HT	Analog 4-20 mA output with superimposed HART digital signal
FF	Foundation Fieldbus digital output
FI	Foundation Fieldbus digital input with FISCO
Code	**Required selection**
20	Infrared remote controller included
21	Infrared remote controller not included
Code	**Agency approvals**
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
5081-P-HT-20-67	**Example**

3 Installation

3.1 Unpacking and inspection

Complete the following steps when you unpack your instrument.

1. Inspect the shipping container. If there is damage, contact the shipper immediately for instructions.
2. If there is no apparent damage, remove the transmitter.
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 reused to return the transmitter to the factory in case of damage.

3.2 Installation

3.2.1 General information

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 3/4 inch 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 conduit is used, 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 instruction manual for maximum cable lengths.

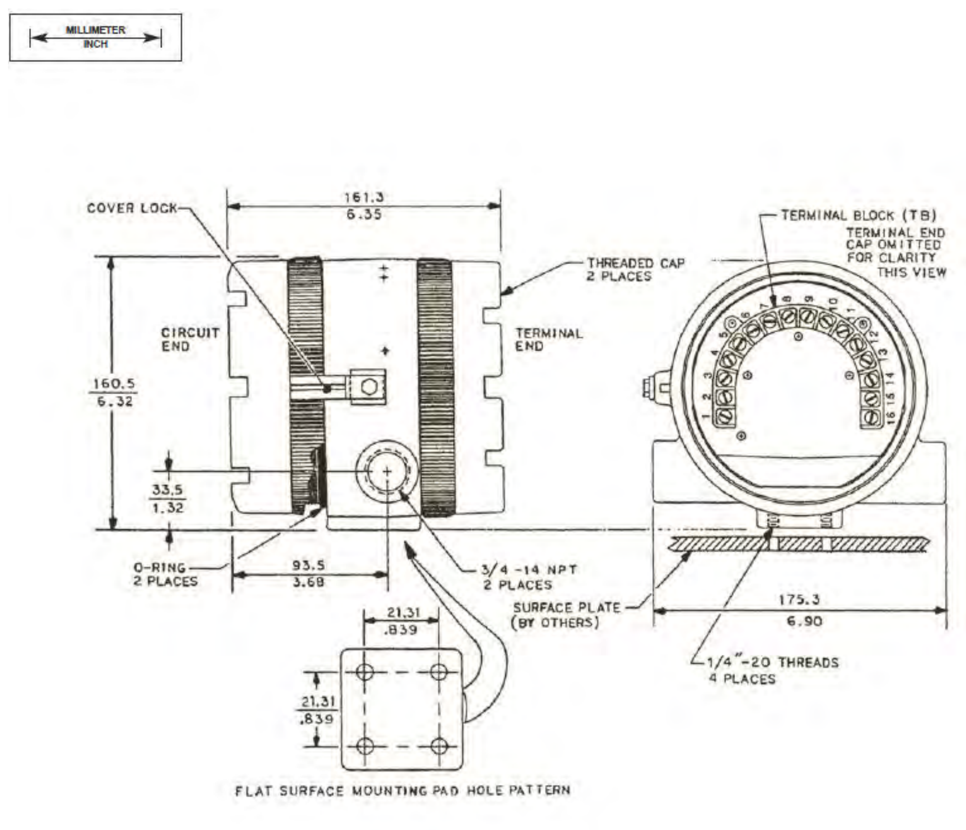
3.2.2 Orienting the display board

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

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.

3.2.3 Mounting on a flat surface

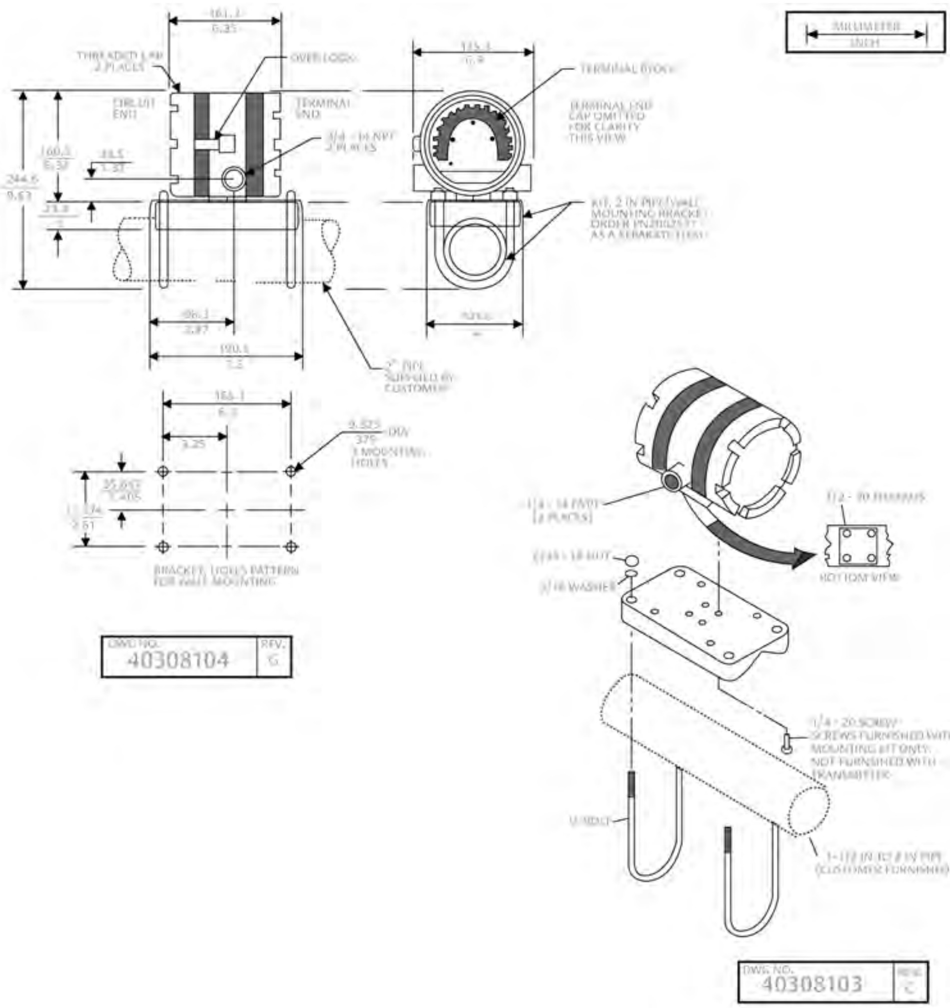
Figure 3-1: Mounting 5081 on a flat surface



3.2.4 Mounting on a pipe

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

Figure 3-2: Mounting 5081 on a pipe



4 Wiring

4.1 Wiring overview

Wiring diagrams for specific sensors can be found in the wiring sections of manuals of those particular sensors.

4.2 Power supply/current loop

4.2.1 Power supply overview

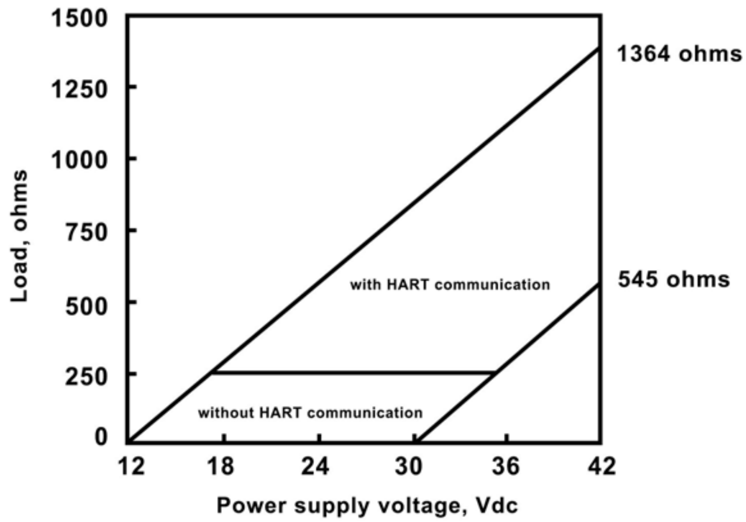
The tables below display the minimum and maximum voltages needed to operate the 5081.

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

Table 4-1: 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

Figure 4-1: Power supply voltage for HART or without HART communication configurations



4.2.2 HART and Foundation Fieldbus

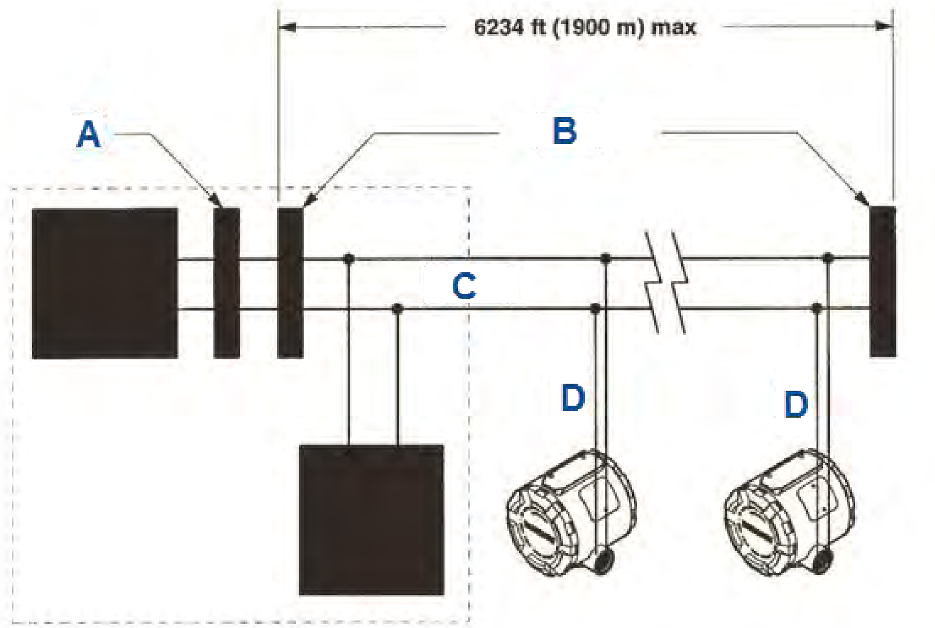
1. Run the power/signal wiring through the opening nearest terminals 15 and 16.
2. Use shielded cable and ground the shield to the power supply.
3. To ground the transmitter, attach the shield to the grounding screw on the inside of the transmitter case.

   A third wire can also be used to connect the transmitter to earth ground.

NOTICE

For optimum EMI/RFI immunity, the power supply/output cable should be shielded and enclosed in an earth grounded 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 loope 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 *Chapter 8* for more information about sensor faults.

Figure 4-2: General wiring architecture



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

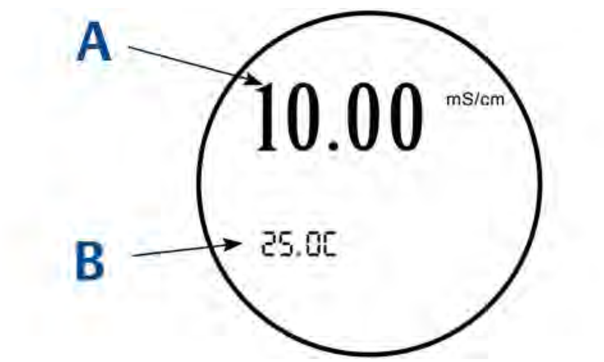
The power supply, filter, first terminator, and configuration device are typically located in the control room.

5 Display and operation

5.1 User interface and main display

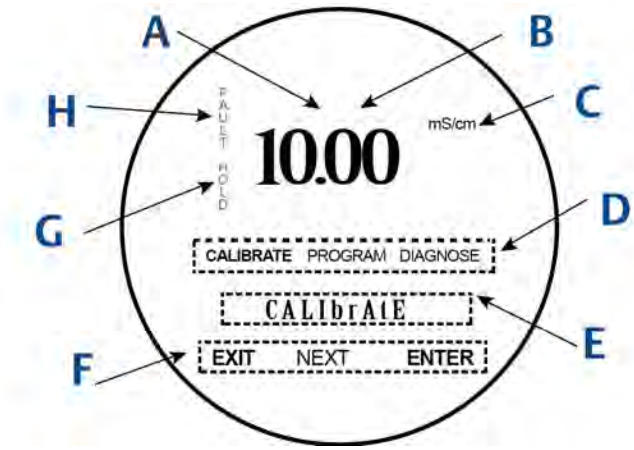
The following are examples of the main (process) display screen (*Figure 5-1*) and the program display screen (*Figure 5-2*).

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)

The IRC is used to read diagnostics messages, calibrate connected sensors, and program the transmitter. It must be held within 6 feet 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.*

5.3 Menu system

5.3.1 Overview of main menus

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

Table 5-1: Program menu *(continued)*

Displayed item	Definition
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

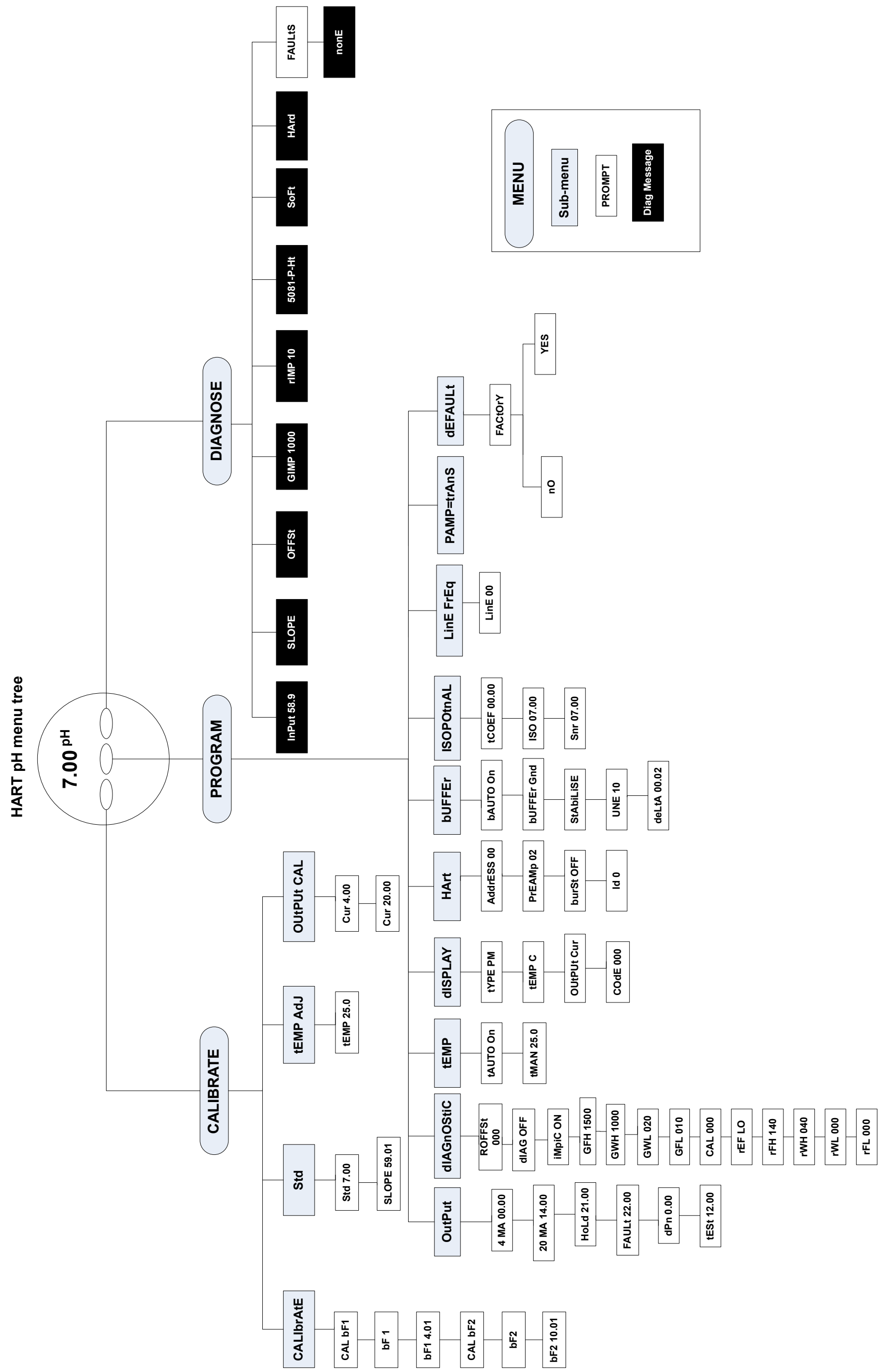


Figure 5-5: HART ORP menu tree

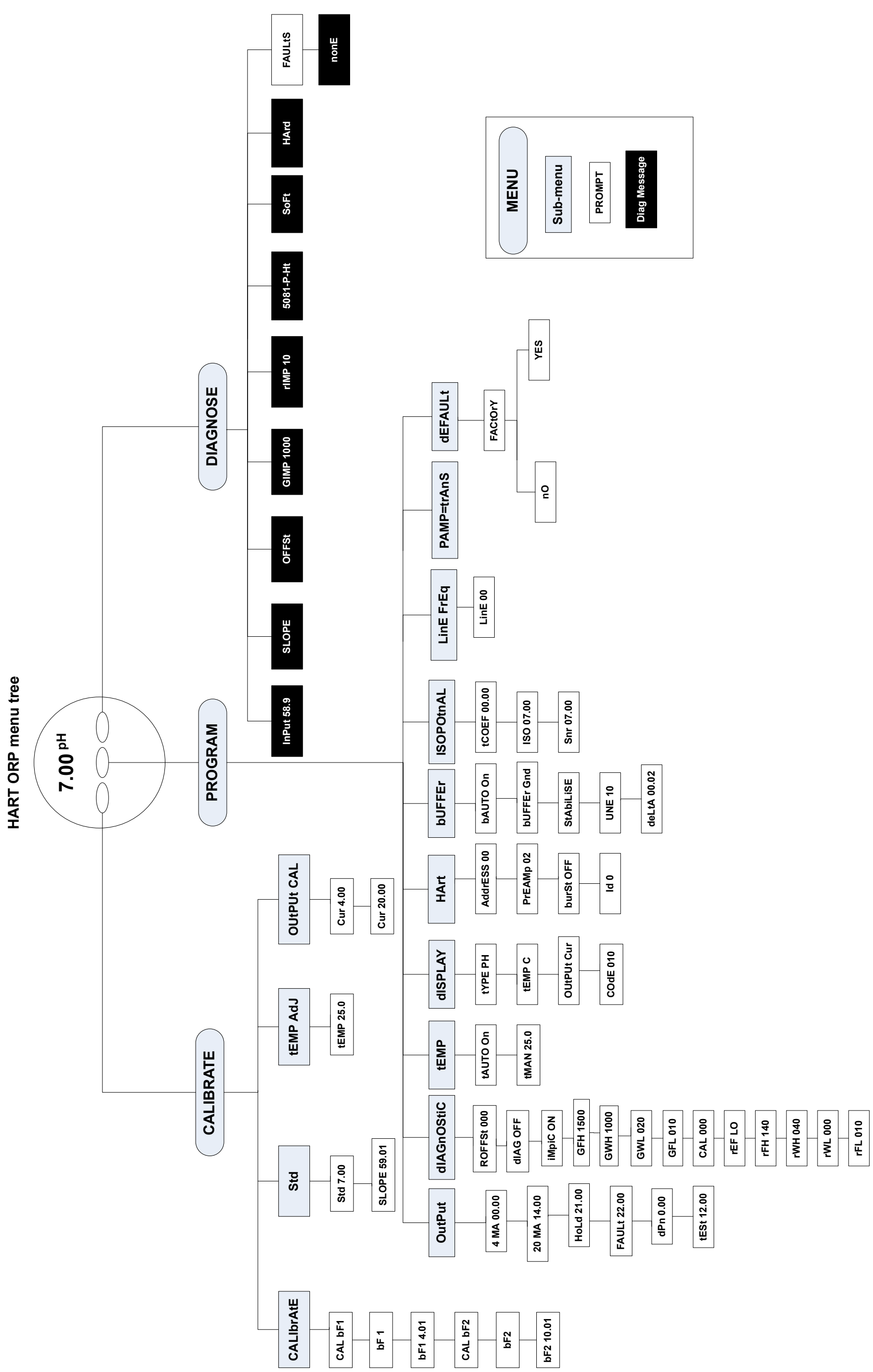


Figure 5-6: HART contacting conductivity menu tree

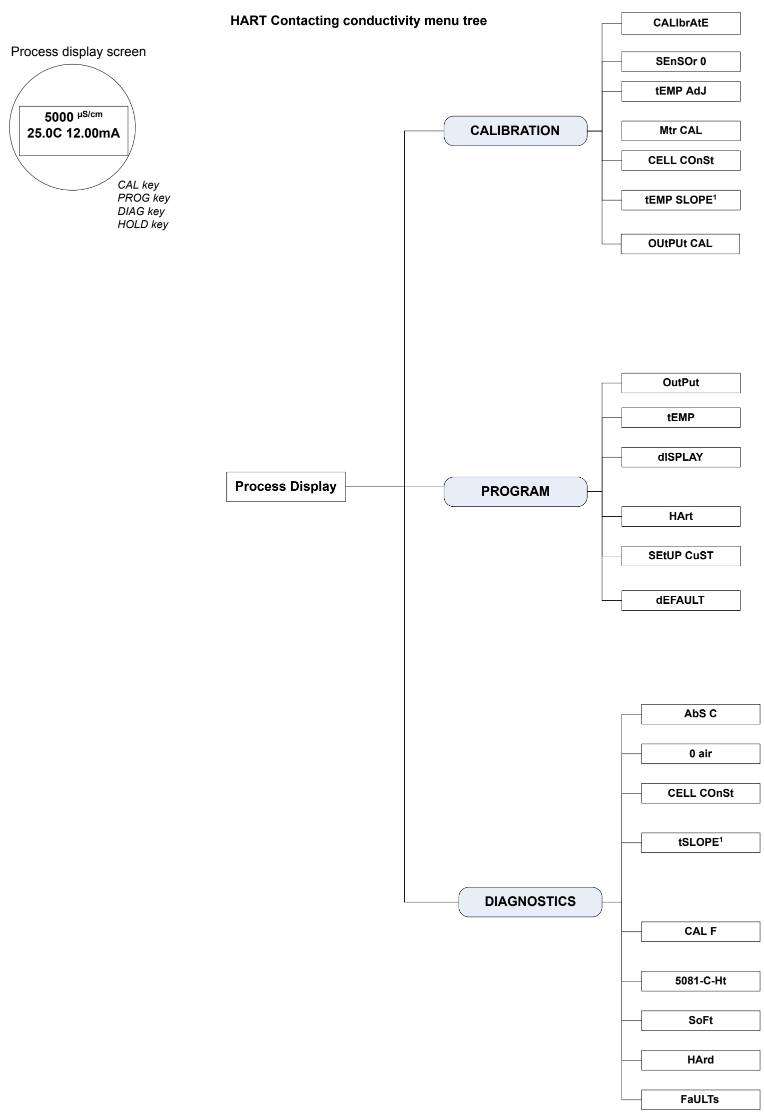


Figure 5-7: HART toroidal conductivity menu tree

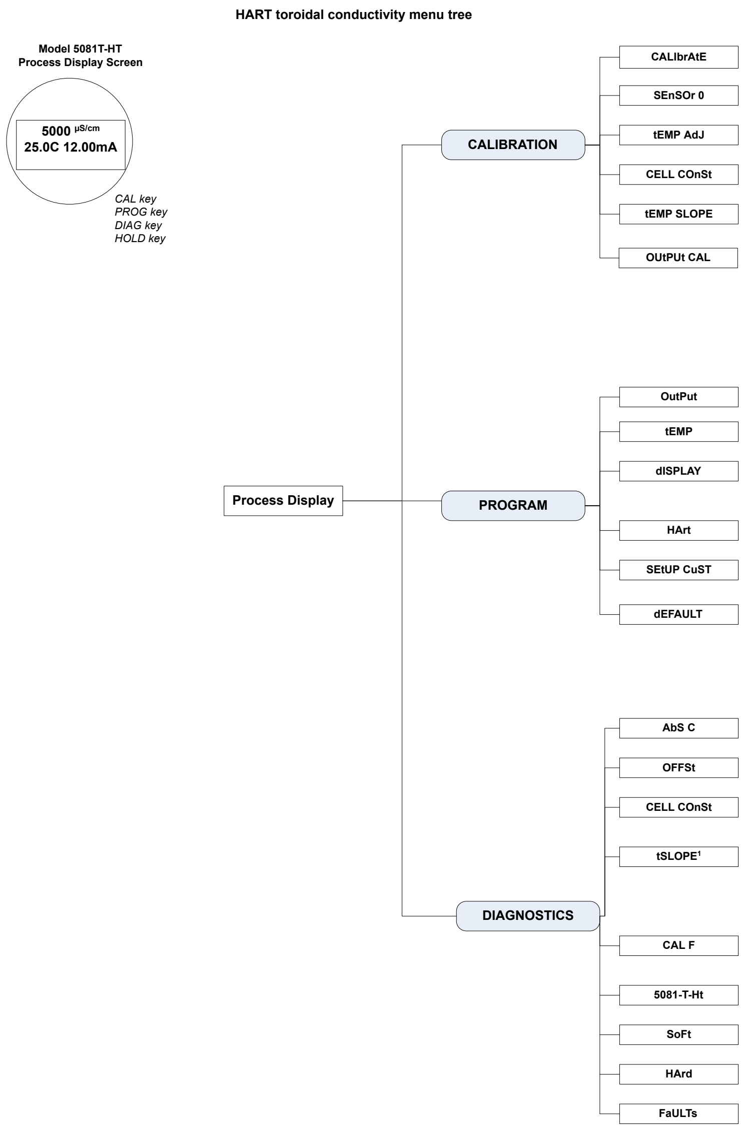


Figure 5-8: HART chlorine, dissolved oxygen, and ozone menu tree

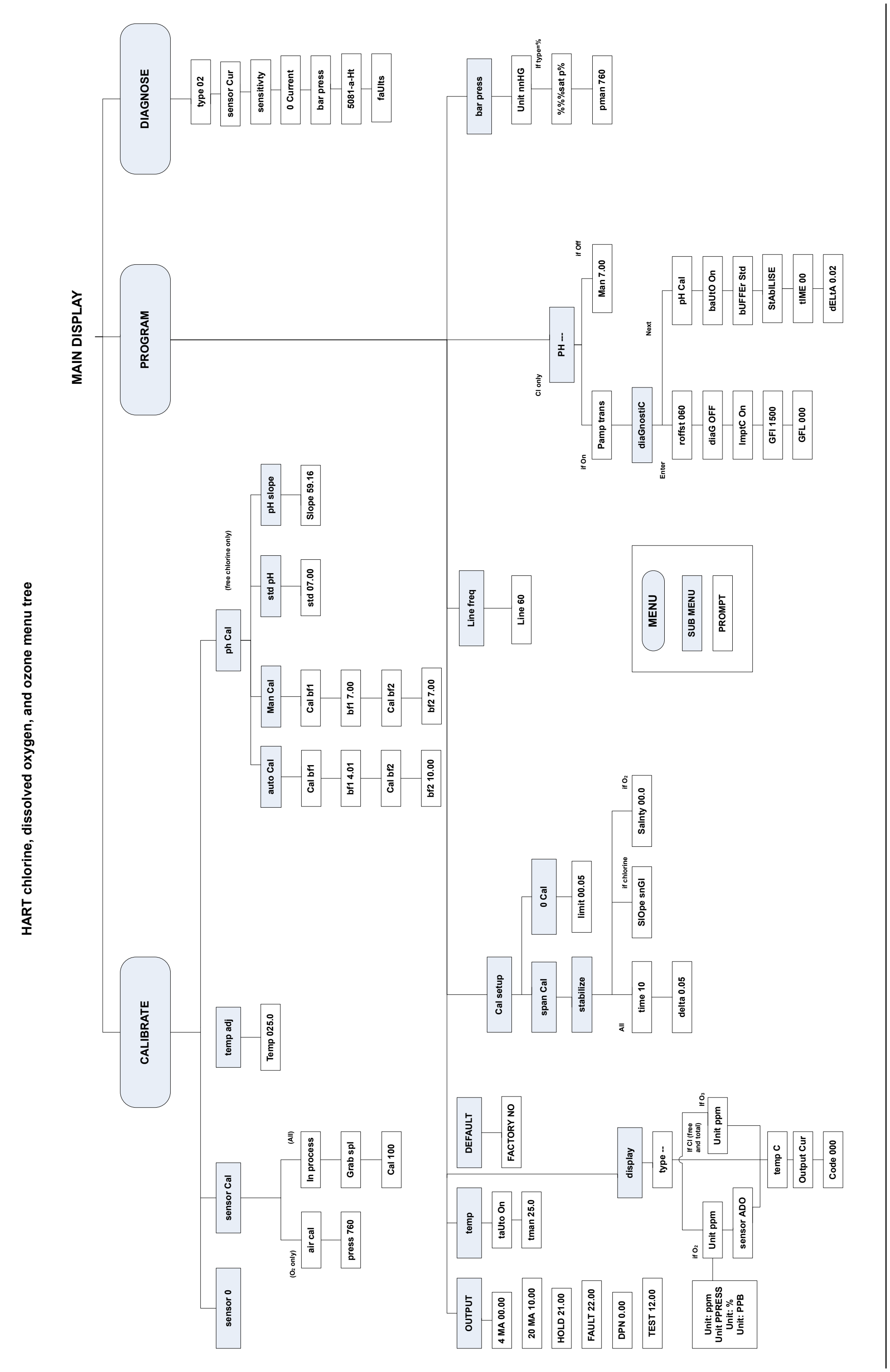


Figure 5-9: FOUNDATION Fieldbus pH menu tree

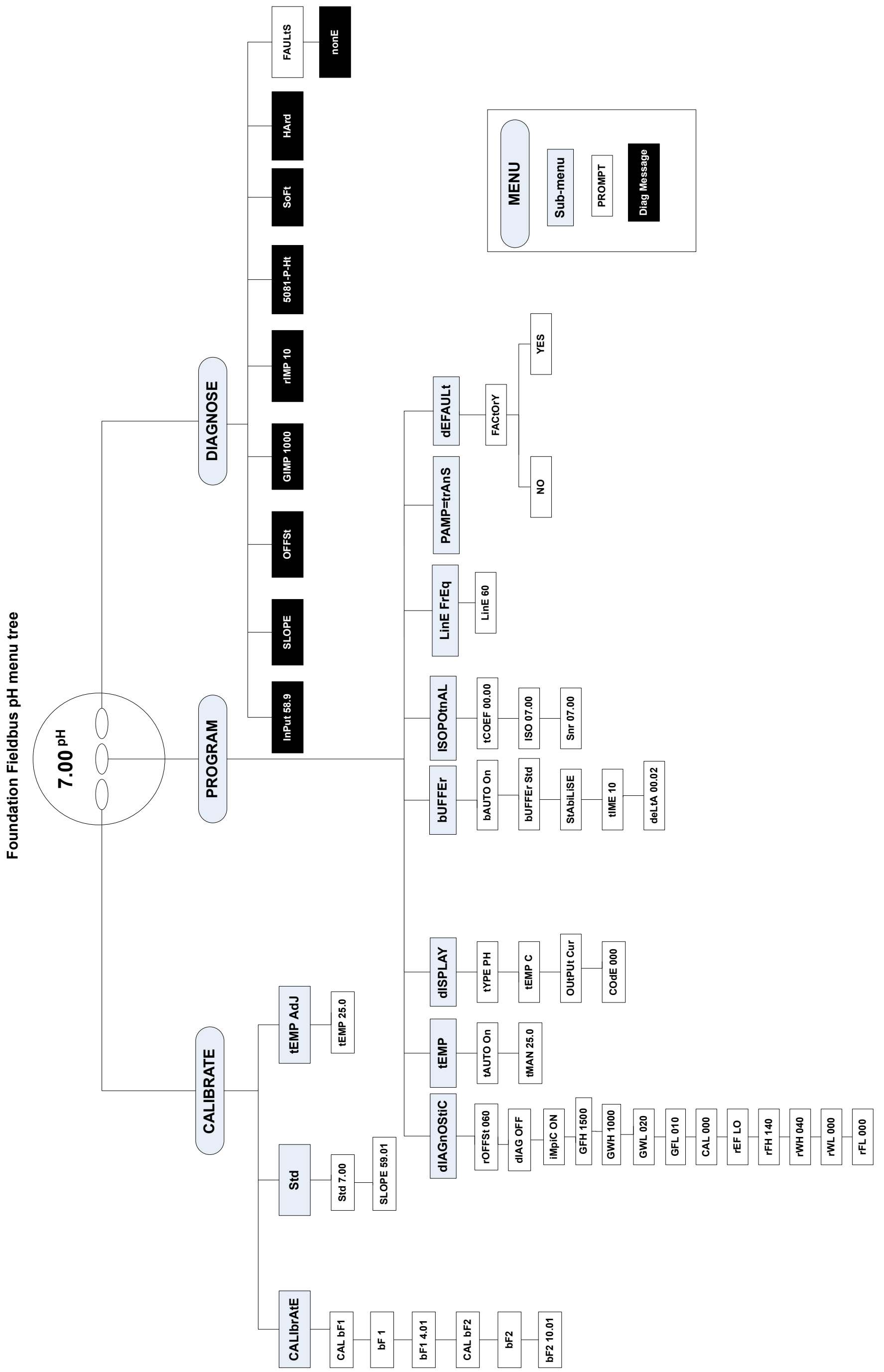


Figure 5-10: FOUNDATION Fieldbus ORP menu tree

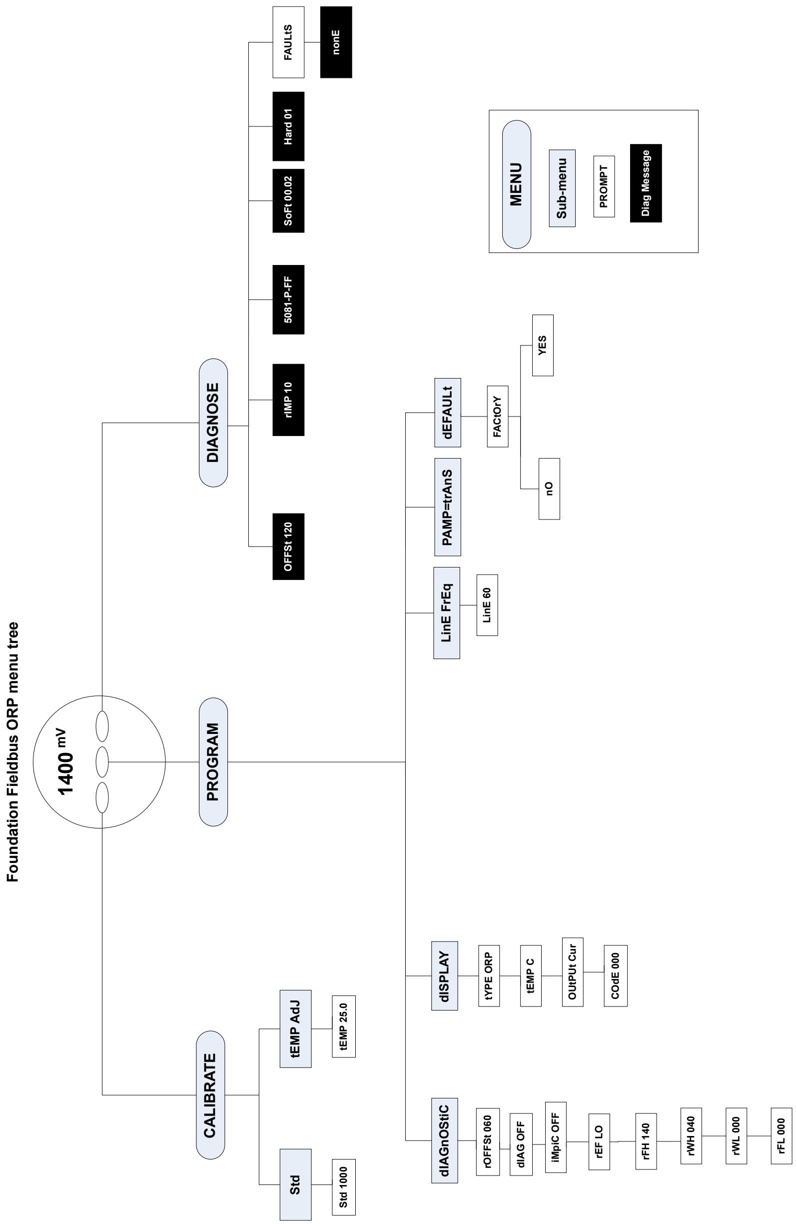


Figure 5-11: FOUNDATION Fieldbus contacting conductivity menu tree

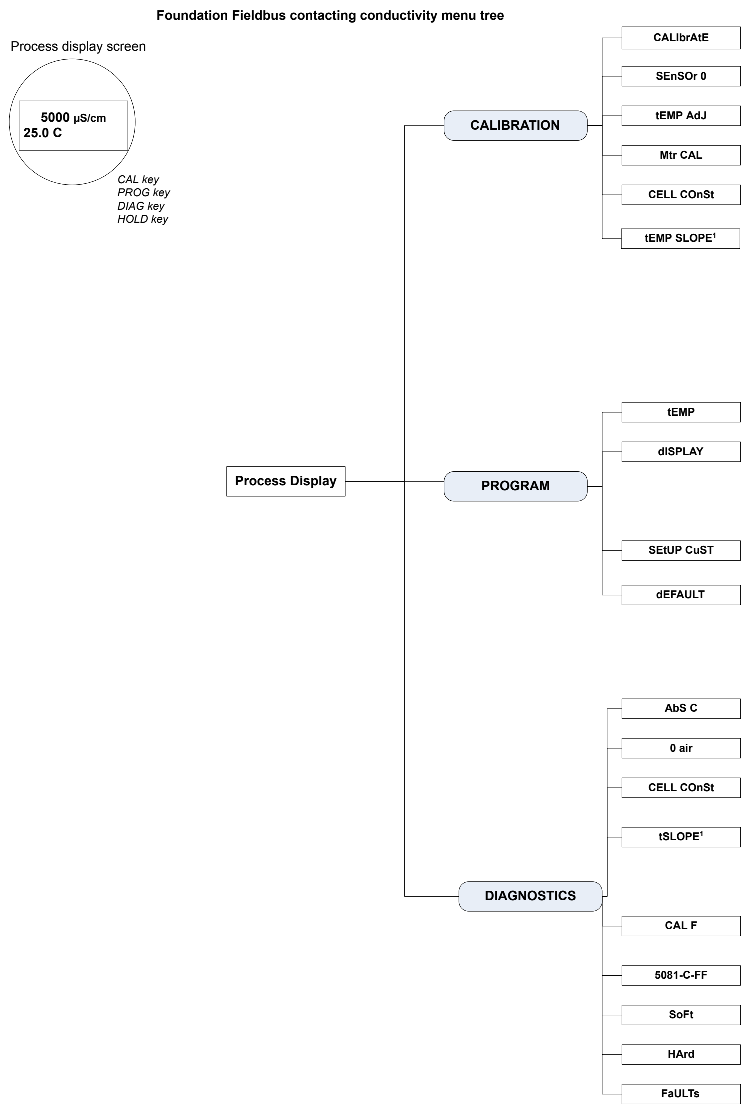


Figure 5-12: FOUNDATION Fieldbus toroidal conductivity menu tree

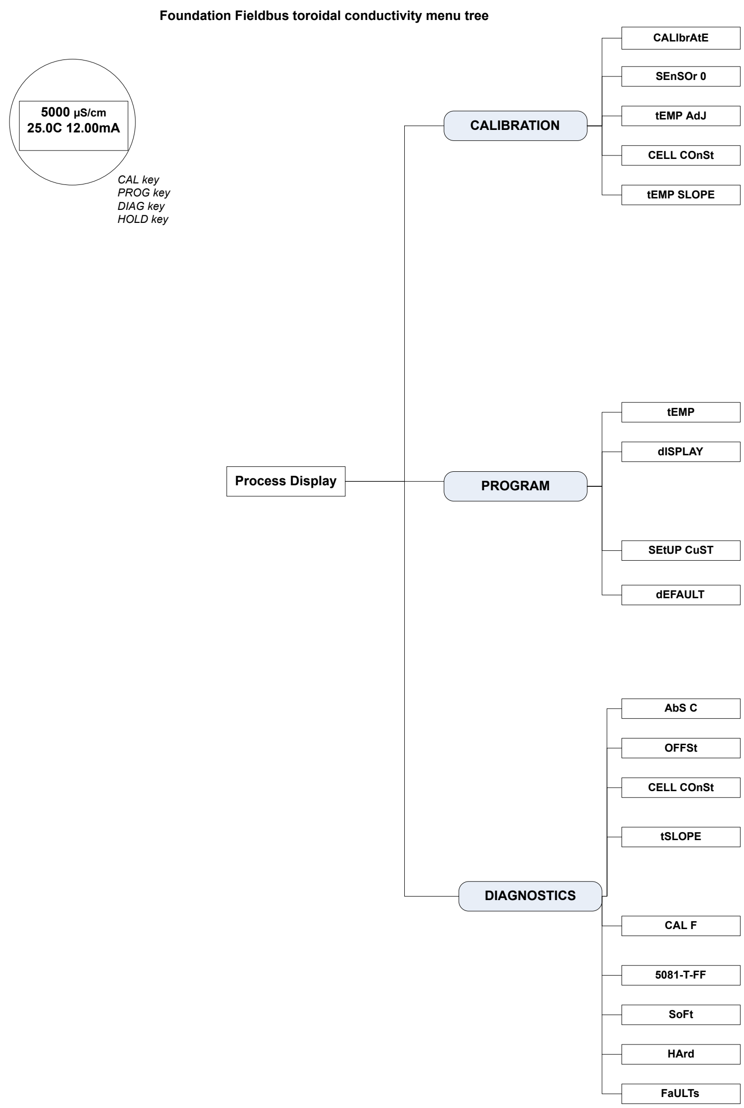
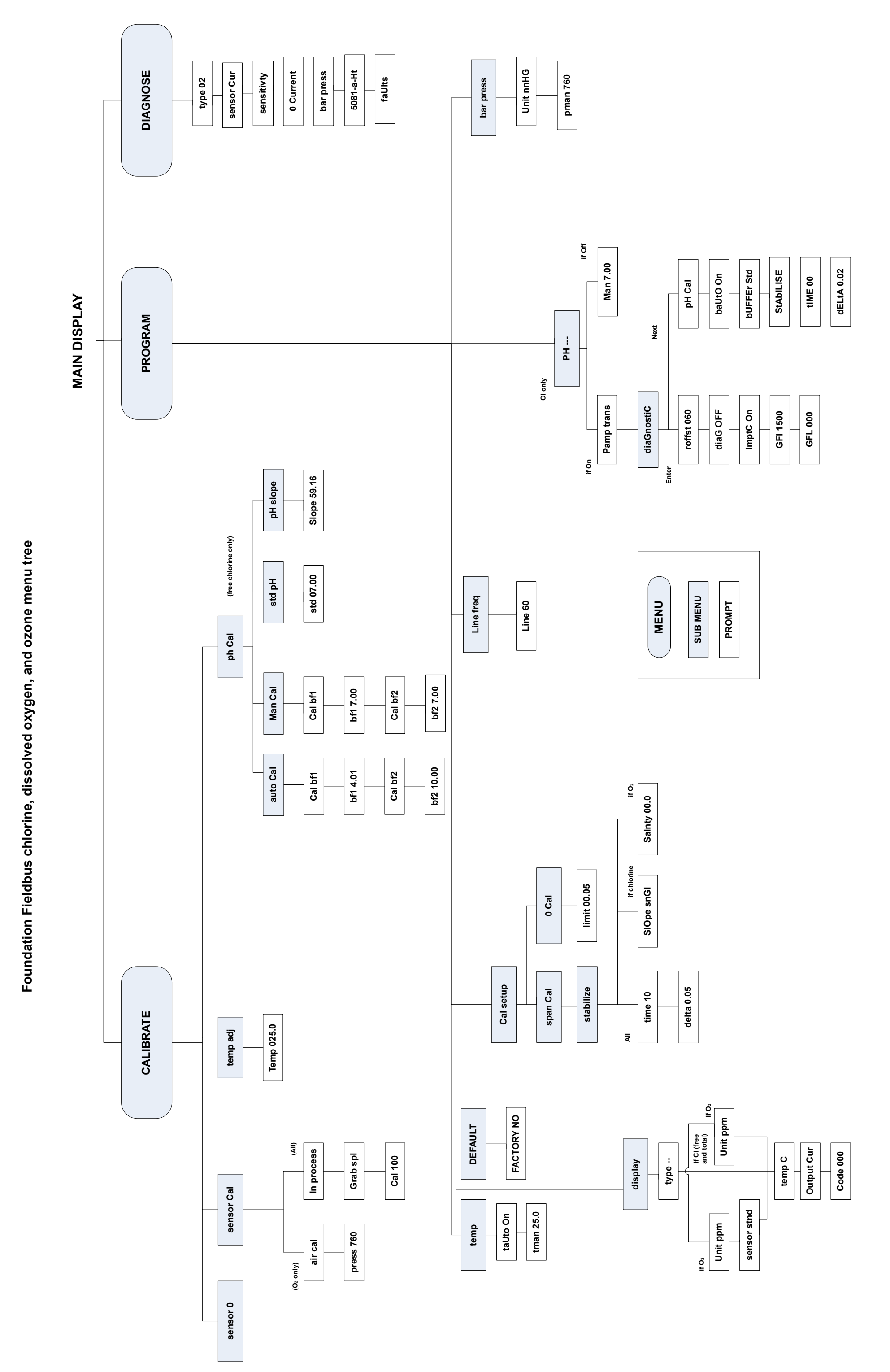


Figure 5-13: FOUNDATION Fieldbus chlorine, dissolved oxygen, and ozone menu tree



6 Programming - basics

6.1 5081 programming

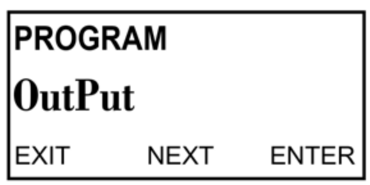
The following can be programmed in the 5081:

1. 4-20 mA outputs
2. Current generated by the transmitter during hold
3. Current generated by the transmitter when fault is detected
4. Automatic temperature correction (enable or disable)
5. Type of measurement
6. Measurement range
7. Factory default setting

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

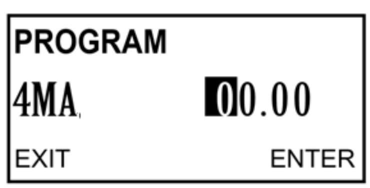
1. Press *PROG* on the remote controller.

   The *OUTPUT* submenu appears.



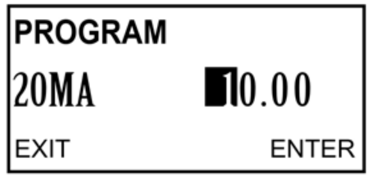
2. Press *ENTER*.

   The screen displays the 4mA prompt.



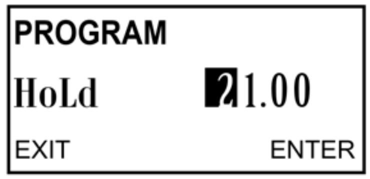
3. Use the arrow keys to change the setting. Press *ENTER* to save.

   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.



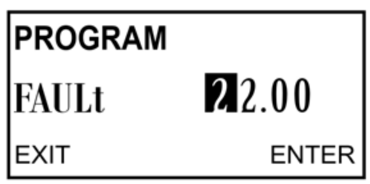
5. Use the arrow keys to change the setting to the output desired when the transmitter is in hold mode.

   The range is 3.80 to 22.0 mA. If 00.00 is selected, the transmitter will hold the output value.
6. Press *ENTER* to save.

NOTICE

The hold setting overrides the fault setting.

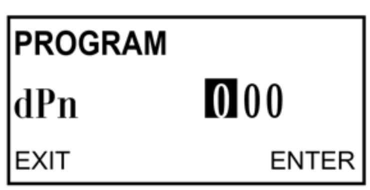
The screen displays the FAULT prompt.



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 00.00 is selected, the transmitter will hold the output value.
8. Press *ENTER* to save.

   The screen displays the DPN prompt.

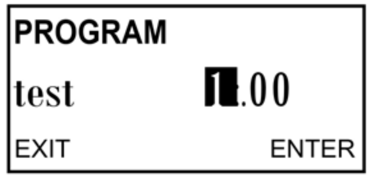


9. Use the arrow keys to change the setting.

   The range is 0 to 225.

10. Press *ENTER* to save.

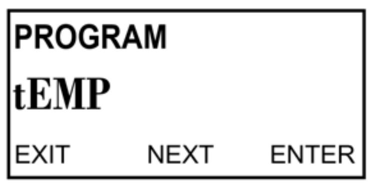
    The screen displays the TEST prompt.



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.

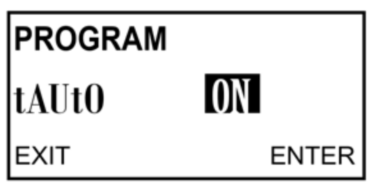
6.3 Temperature correction

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



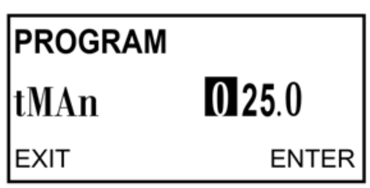
2. Press *ENTER*.

   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 *T MAN* prompt is displayed.



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 -5.0 to 130 °C.

5. Press *ENTER* to save. Press *RESET* to return to the main display.

NOTICE

If *T AUTO* was disabled in step 3, then the temperature entered in this step will be used in all subsequent measurements, no matter the actual process temperature.

6.4 Set up custom curves (conductivity measurements only)

Custom curves are used to correlate conductivity to concentration of the measured liquid. The 5081 has programmable custom curves that can create a curve (second order) from three to five user supplied points. If only two points are used, then a linear curve (straight line) will be created. In order for the curve to be accurate, the data points acquired should be taken from the liquid having the same reference temperature.

Best results are obtained by selecting data points that are representative of the typical operating range and have at least 5% difference in conductivity values. It is recommended that the graph of conductivity vs. concentration for the particular liquid is observed 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.

The first point entered *COND 1* should be at the normal operating condition. Other points above and below *COND 1* can then be entered. Nonlinear conductivity curves will 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).

NOTICE

The default values for the custom curve are three data points: reference temperature of 25 °C (77 °F) and a linear temperature slope of 2%/°C. This combination will yield the best results in most applications. If the normal temperature is over 40 °C (104 °F) or under 10 °C (50 °F), the reference temperature should be changed to the normal process temperature. If the temperature slope at the reference temperature is known, then it can be used.

6.4.1 Setting up a custom curve

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: uS (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. Selecting 2 will generate a linear relationship for conductivity and concentration at the given reference temperature.

   a. Enter the concentration for Pt. 1 (displayed as uS 1). Press *ENTER*.
   b. Enter the known conductivity for Pt. 1 in uS/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 CUST is selected in the display menu for measurement type.

6.5 Restore to default factory settings

6.5.1 Configuration overview

All user-defined configurations can be erased to return the transmitter to the factory default settings.

6.5.2 Returning to factory default settings

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 Setting access (security) code

6.6.1 Security overview

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

6.6.2 Entering the access (security) code

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 Retrieving a lost security code

1. If the security code has been forgotten, 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 Using HOLD

6.7.1 HOLD overview

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. HOLD can be deactivated when the sensor is reinstalled in the process stream and the readings have relatively stabilized.

6.7.2 Activating or deactivating HOLD

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. Calibrations can be performed using 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.
- It is recommended 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.
- Used buffer solutions should not be reused. Buffers should also be protected 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-calibration procedure

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 *Chapter 8* 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 4 and 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 the *Chapter 8* for assistance.

NOTICE

The electrode slope can be displayed by pressing 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 Manual calibration

Prerequisites

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

Procedure

1. Enter the CALIBRATE menu by pressing *CAL* on IRC.

   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. 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 3 and 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 *Chapter 8* for assistance.

NOTICE

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 Standardization for pH

Standardization overview

Standardization is used to match the transmitter values with that of another transmitter. The difference between the two pH values is converted 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.

Standardization procedure

1. Enter the CALIBRATE menu by pressing CAL on the IRC.

   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 ORP sensors

7.2.1 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. Suspected error in temperature measurement

7.2.2 Calibrating temperature with an ORP sensor

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. 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.

   NOTICE

   The reading cannot be changed more than 15 °C.

6. Press *ENTER*.

   The value is saved, 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 or +15 °C than the water used for calibration.

7.2.3 Standardization

Preparation of ORP standard solutions

ASTM d 1498-93 gives procedures for making iron (ii) - iron (iii) and quinhydrone ORP standards. The iron (ii) - iron (iii) standard is recommended. 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 25 °C (77 °F).

Standardizing with an ORP sensor

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. 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 Matching transmitter to ORP sensor's temperature element

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 Calibrating with contacting and conductivity sensors

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 Zeroing the sensor

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 Adjusting the temperature

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 In-process calibration

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 Temperature slope

1. From the CAL menu, press *NEXT* until TEMP SLOPE is shown.
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 the temperature slope of the process is not known, then refer to the below guide:

   a. Acids: 1.0% to 1.6% per °C

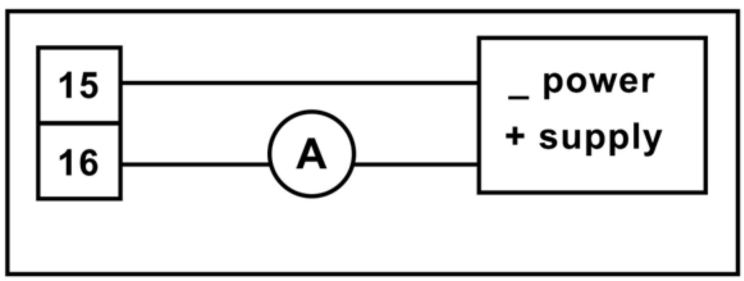
   b. Bases: 1.8% to 2.2% per °C
   c. Salts: 2.2% to 3.0% per °C
   d. Water: 2.0% per °C

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 Output calibration

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

Amperometric sensors can be calibrated in multiple ways: zeroing, air calibrations, dual slope calibrations, and in process calibrations.

7.4.2 Zeroing the sensor procedure

Complete the following steps to zero a dissolved oxygen, free chlorine, total chlorine, or ozone sensor.

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 Air calibration procedure (dissolved oxygen)

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 1/2 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 In-process calibration procedure (dissolved oxygen)

The sensor can be calibrated against a standard instrument.

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 Full scale calibration procedure (free chlorine, total chlorine, ozone)

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 Dual slope calibration (free chlorine, total chlorine)

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 pH/ORP diagnostics and troubleshooting

8.1.1 5081-P warning and fault messages

The 5081-P pH/ORP transmitter continuously monitors the measurement loop (sensor and transmitter) for conditions that cause erroneous 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 the condition causing the problem is not corrected, there is a high probability that the system will soon fail. A fault alerts you that a system disabling condition exists. If a fault message is showing, all measurements should be regarded as erroneous.

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 *Section 8.1.4* 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 *Section 8.1.4* 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 disabling condition, 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.

8.1.2 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 *Section 8.1.4* for an explanation of the error messages and suggested ways of correcting the problem.

8.1.3 Troubleshooting - general

Follow the steps below to troubleshoot your transmitter.

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

   Refer to *Section 8.1.4* for an explanation of the message and a list of the possible problems that triggered it.
2. Refer to *Section 8.1.5* for common measurement problems and the recommended actions to resolve them.
3. Follwo the step-by-step troubleshooting approach, offered in *Section 8.1.6*, to diagnose and correct less common or more complex problems.

8.1.4 Troubleshooting when a diagnostic message is showing

The 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 error message*

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.

NOTICE

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

Troubleshooting flowchart - GLASSFAIL

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 *Section 8.1.7* 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 Step 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...
          a. The sensor is in good condition, but the Glass Fail Low (GFL) limit is set too high.
          b. Lower the GFL limit to about 10 megohms below the glass impedance value (GIMP) measured in Step 2.
          c. 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:
        a. 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).

        NOTICE

        TB-8 means terminal 8 on the terminal board.

        b. 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.

c. 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.

d. 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 Step 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...
  a. The sensor is in good condition.
  b. Return the calibrated sensor to service.
- If cleaning does not lower the glass impedance and the sensor can be calibrated...
  a. 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.

  b. 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.
  c. 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.

- if the glass impedance is moderate (between 40 and 800 megohms)...

a. The sensor may be dirty, in which case cleaning it will lower the impedance reading. The sensor may also be in good condition. The warning and fail limits are simply set too low.

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...
  a. The sensor is in good condition.
  b. Return the calibrated sensor to service.
- If cleaning does not lower the glass impedance and the sensor can be calibrated...
  a. 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.

  b. 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.
  c. 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 Glas 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 previoulsy 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.

NOTICE

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 measurement system was previously commissioned and operating correctly, *rEF FAIL* 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 FAIL* could be caused by a miswired sensor or by programmed limits that are not correct for the sensor.

NOTICE

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

Troubleshooting flowchart - rEF FAIL

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.

   NOTICE

   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 *Section 8.1.7*.
   - 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 instruction manual for details. Check the reference impedance again.

   - If cleaning the sensor reduces the impedance...

     a. The sensor is in good condition. Calibrate the sensor and return it to the process.

     b. 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...

     a. Try the reference junction rejuvenation procedure.

     b. The rejuvination procedure may not work. At best, it will get a little more life out of a sensor with a plugged reference.

     c. Whether or not the rejuvenation procedure worked, go to Step c.

c. Recalibrate the sensor using the autocalibration procedure.

   - If the sensor can be calibrated...

     a. The sensor is in good condition. Return it to the process.

     b. 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.

NOTICE

***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.

Troubleshooting flowchart - tEMP HI and tEMP LO

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).

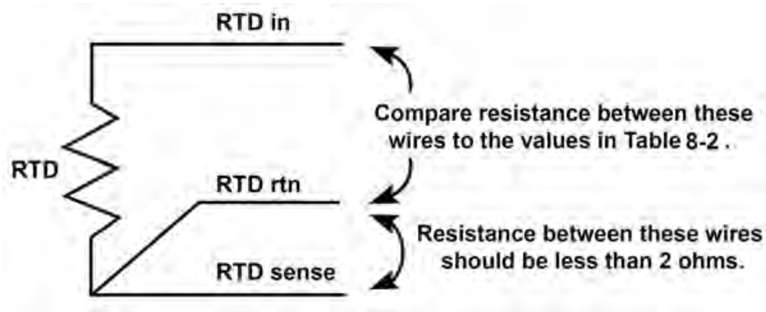
   NOTICE

   TB-3 means terminal 3 on the terminal board.

   b. Be sure the software settings match the type of 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 1%. If the measured resistance is appreciably different (between 1 and 5%) from the value shown, the discrepancy can be calibrated out.

Figure 8-3: Three-wire RTD



Consult the table for resistance-temperature data. Lead resistance is about 0.05 ohm/ft at 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.

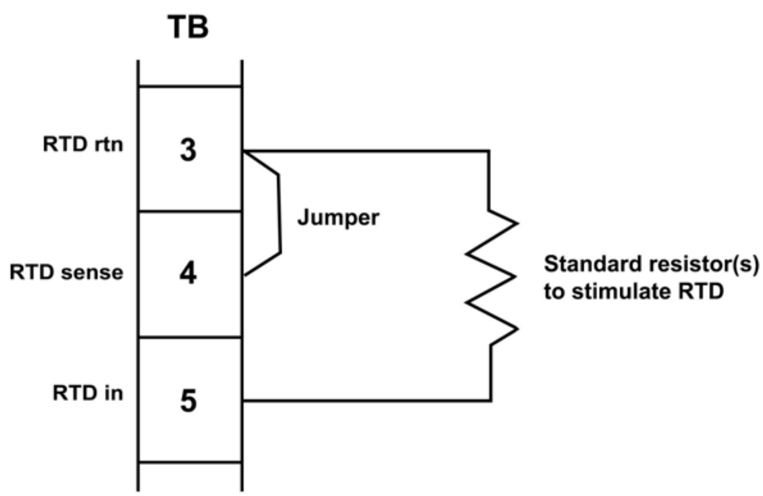
Table 8-1: RTD resistance values

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 5081-P pH/ORP transmitter



- 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 25 °C (77 °F). 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 (RTD RTN) and TB-4 (RTD SNS). These terminals are critical connections for the three-wire RTD measurement. *Figure 8-3* shows a three-wire RTD connection.

Troubleshooting flowchart for LiNE FAIL

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 B and C) for temperature simulation and *Section 8.4.11* 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 greather than 16.

Troubleshooting InPUt WArn

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 *Section 8.1.7*.
   - 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. Wire the pH sensor directly to the transmitter. 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 remians, 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.

Troubleshooting SLOPE Err LO

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 a high pH buffer was used 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 senor. 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 *Section 8.1.7*.

  - 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 *Section 8.1.7*.
   - 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.

Troubleshooting SLOPE Er HI

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 a high pH buffer was used 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 *Section 8.1.7*.
   - 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.

Flowchart-Std Err

Troubleshooting depends on the type of sensor.

- 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.
- 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. 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.

Troubleshooting AdCWArn or CyCLE PWr

1. Check transmitter performance by simulating pH inputs. See *Section 8.1.7*.
   - 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.

Troubleshooting WritE Err

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.* 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 error message

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.

8.1.5 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	*Section 8.1.4*
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 auto calibration*
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 not responding to 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*

Symptom	Section
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

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 six feet from the transmitter and not more than 15 degrees from the center.
   c. Hold the IRC closer (within two feet) in case the batteries are getting weak.
2. If Step 1 fails, check the IRC.
   a. If a second 5081-P 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 auto calibration

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

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 transmitter.
    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

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 the 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.

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.

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.
   c. 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.
   a. 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.
   b. Ground the piping or tank to a local earth ground. Metal tees, grounding rings, or grounding rods may be required.
   c. 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.
   d. If the problem persists, simple grounding is not the problem. Noise is probably being carried into the instrument through the sensor wiring. Go to Step 3.
3. Simplify the sensor wiring.
   a. Disconnect all sensor wires at the transmitter except: TB-4 (RTD SNS), TB-5 (RTD IN), TB-7 (REF IN), and TB-10 (pH/ORP IN). If a remote preamplifier is being used, 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 RTN) and TB-4 (RTD-SNS). Connect a second jumper wire between TB-7 (REF IN) and TB-8 (SOL GND).

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.

   a. 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.

   b. 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.

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

   d. 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.

   e. If ground loop problems persist, consult the factory. A visit from an experienced service technician may be required to solve plant-induced problems.

Temperature reading is inaccurate

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 communications problems

1. If the 375 or 475 communicator software does not recognize the 5081 pH/ORP transmitter, order an upgrade from Rosemount at 800 999 9307.
2. Be sure the HART load and voltage requirements are met.

   a. HART communications requires a minimum 250 ohm load in the current loop.

   b. Install a 250 - 500 ohm resistor in series with the current loop. Check the actual resistor value with an ohmmeter.

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

3. Be sure the HART communicator is properly connected.
   a. The communicator leads must be connected across the load.
   b. The communicator can be connected across the power terminals (TB-15 and TB-16).
4. Verify that the 375 or 475 is working correctly by testing it with another HART Smart device.
   a. If the communicator is working, the transmitter electronics may have failed. Call Rosemount for assistance.
   b. If the communicator seems to be malfunctioning, call Rosemount at 800 999 9307 for assistance.

No display

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

Replace the display board.

Transmitter locks up

1. Turn the dc power off; then turn it back on.
2. If the problem persists, replace the electronic board stack (PN 23992-02, HT; PN 23992-03, FF).

Transmitter periodically restarts itself.

If the transmitter periodically restarts itself, complete the following steps.

1. The problem is usually related to improperly wired 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 the RTD connections have been jumpered as described in step a, automatic temperature compensation must be turned off and the transmitter operated 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.

8.1.6 Displaying diagnostic variables

Purpose

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*).

NOTICE

Displays are read only.

Displaying diagnostic variables

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.

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

6. Press *NEXT*.

   The *ShoW Fit* submenu appears.

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.

8.1.7 Testing the transmitter by simulating the pH

Overview of simulating a pH input

This section describes how to simulate a pH input into the 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	*pH simulation when the preamplifier is located in the transmitter*
Remote junction box	*pH simulation when the preamplifer is located in a remote junction box or in a sensor-mounted junction box*
Sensor-mounted junction box	*pH simulation when the preamplifier is located in a remote junction box or in a sensor-mounted junction box*
Sensor (model 381+ only)	*pH simulation with 381+ sensor*
Sensor (all other models)	*pH simulation when preamplifier is in sensor*

pH simulation when the preamplifier is located in the transmitter

1. Program PAMP to *transmitter*.
2. Turn off sensor diagnostics.
3. Turn off automatic temperature compensation. Set manual temperature compensation to 25 °C (77 °F).

4. Disconnect the sensor and wire transmitter as shown in *Figure 8-5*.
5. Attach a jumper between TB-7 (REF IN) and TB-10 (pH IN).
6. Measure the voltage. Press *DIAG* on the IRC.

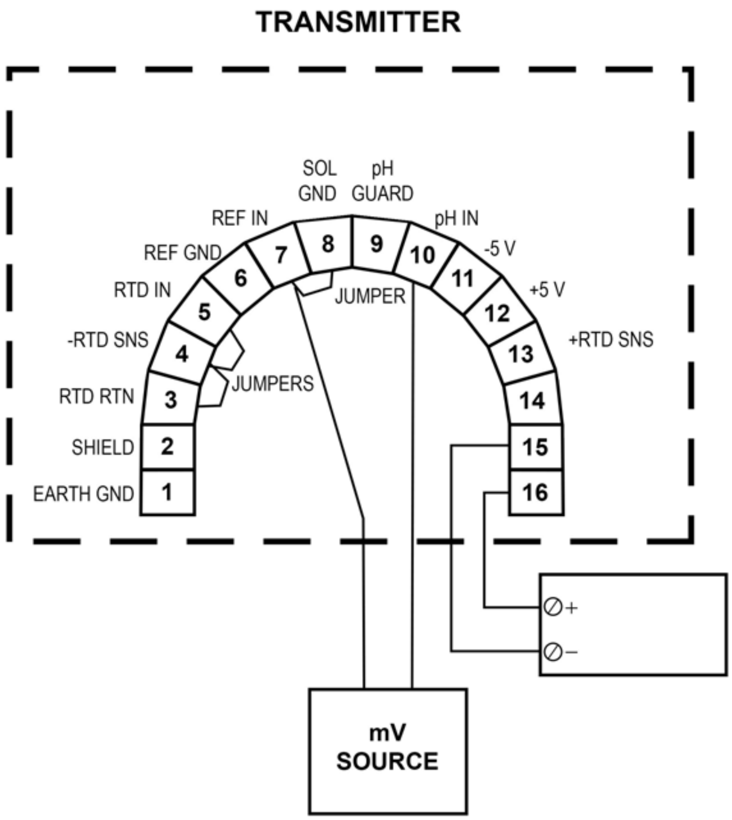
   The InPut voltage in millivolts appears in the temperature-output area. The main display continues to show pH. The measured voltage should be 0 mV, and the pH should be approximately 7. Because the calibration data in the transmitter may be offsetting the input voltage, the displayed pH may not be exactly 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

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

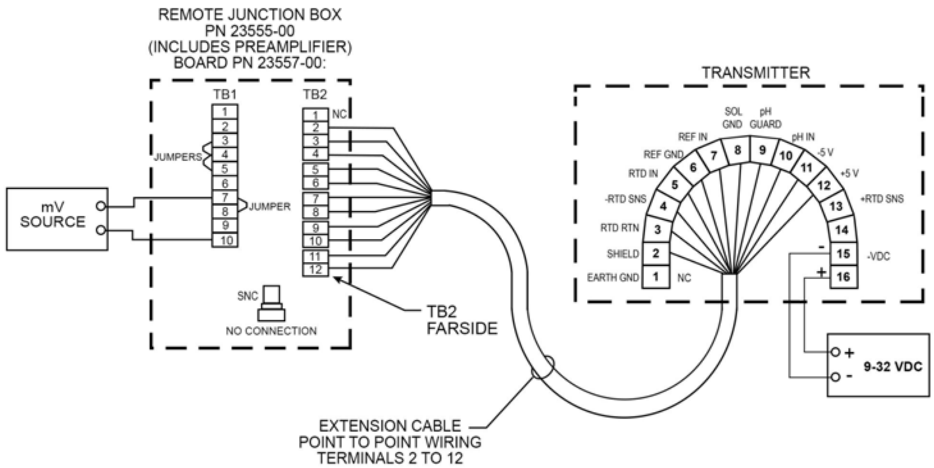


pH simulation when the preamplifer is located in a remote junction box or in a sensor-mounted junction box

1. Program PAMP to *sensor*.
2. Turn off sensor diagnostics.
3. Turn off automatic temperature compensation. Set manual temperature compensation to 25 °C (77 °F).
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 (REF IN) and TB1-10 (pH IN)
6. From this point on, continue with steps 6 through 9 in *pH simulation 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.

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



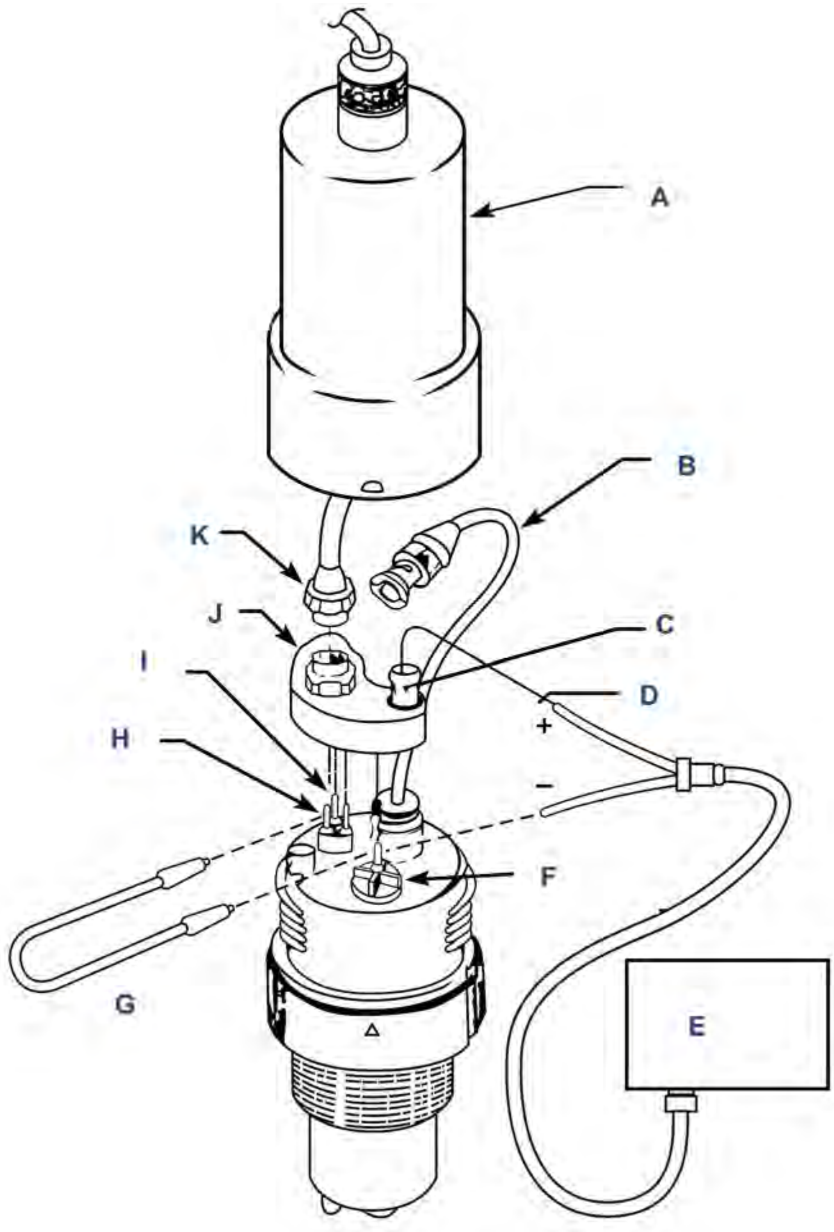
pH simulation with 381+ sensor

1. Verify that switch s-1 is set to *sensor or junction box*.
2. Turn off sensor diagnostics.
3. Turn off automatic temperature compensation. Set manual temperature compensation to 25 °C (77 .
4. Refer to *Figure 8-7* for connections to the sensor.
5. Remove the cover from the sensor. Leave the sensor cable attached.
6. Remove the glass electrode cable form the BNC connection at the preamplifier.
7. Connect one end of a jumper wire to the solution ground pin and connect the other end to the reference electrode pin.

   Both pins are underneath the preamplifier. Leave the preamplifier installed on the pins.
8. Connect one end of a second jumper wire to the reference electrode pin. Be sure the preamplifer remains connected to the pins.
9. Press *DIAG* on the IRC.

   The InPut voltage in millivolts appears in the temperature-output area. The main display shows pH.

Figure 8-7: Simulate pH through 381+ sensor preamplifier



A. *Cover P/N 23552-00*
B. *Glass electrode cable*
C. *Preamp BNC connector*
D. *To center conductor of BNC*
E. *Power supply or millivolt source*
F. *Reference electrode*
G. *Jumper wire*
H. *Solution ground connector*

I. T.C. element connections
J. Preamplifier P/N 23561-00
K. Sensor cable connector

Important

Do not connecto anything to outside of preamp BNC connector.

10. Touch the other end of the second jumper to the center pin of the BNC connector on the preamplifier.

NOTICE

Do not let the wire touch the outside of the BNC connector.

11. Measure the voltage.

    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 working fine.
12. If a standard millivolt source is available, use it to perform a simulated calibration.
13. Remove the jumper used to connect the reference pin to the center pin of the BNC. Connect the negative terminal of the standard millivolt source to the reference pin and connect the positive terminal to the center pin of the BNC.

NOTICE

Do not let the wire touch the outside of the BNC connector.

14. 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.
15. 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

pH simulation when preamplifier is in sensor

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

8.1.8 Factory assistance and repairs

Troubleshooting assistance

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

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

8.2 Contacting and toroidal conductivity diagnostics and troubleshooting

8.2.1 Overview of Diagnose menu

The 5081 transmitters automatically monitor for fault conditions. The Diagnose menu allows the current variable settings to be reviewed and shows fault messages indicating problems detected. The figure below illustrates the relationship between the Diagnose menu and its submenus. The mnemonics are defined in *Table 8-2*.

Troubleshooting contacting conductivity analyzers

1. Look for a diagnostic fault message on the display to help pinpoint the problem. Refer to *Table 8-3* for an explanation of the message and a list of the possible problems that triggered it.
2. Refer to the Quick troubleshooting guide, *Table 8-4*, for common loop problems and the recommended actions to resolve them.
3. Follow the step-by-step troubleshooting flow chart, offered in *Section 8.2.5*, to diagnose less common or more complex problems.

Displaying diagnostic values

The *DIAG* key on the IRC is used to access the Diagnosis menu. The menu flow is shown in the figure above, and the mnemonics are defined in *Table 8-2*.

The FAuLtS submenu can be entered to show the last three faults/warnings. The most recent is displayed first. *NEXT* scrolls through the remaining faults. Pressing *EXIT* clears 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

8.2.2 Fault conditions

Three classes of error conditions/problems are detected and differentiated between by the diagnostic program. 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

The following things happen when a disabling fault occurs.

1. Both FAULT and HOLD annunciation fields become active (*Figure 8-8*).
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 8-8*).
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 applciation information.

Figure 8-8: 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 8-9*).

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 8-9: Warning annunciation

8.2.3 Diagnostic messages

The 5081 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 *Table 8-3* for a description of possible problems that may have triggered the diagnostic message.

Table 8-3: Diagnostic fault messages

Message	Description	Action
Faults		
tEmP LO	Temperature is too low.	Check wiring or sensor/process temp. Check RTD.
tEmP HI	Temperature is too high.	Check wiring or sensor/process temp. Check RTD.
rtd FAIL	The RTD sensor line fault limits have been exceeded for the sensor.	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.	Recycle. If persistent, contact the factory.
FACt FAIL	The transmitter has not been accurately factory calibrated.	Contact factory.
rOm FAIL	The PROM failed the check-sum test.	Contact factory.
CyCLE PoWr	A wrong value was detected during power-up.	Recycle the power.
Warnings		
InPut bwArn	The compensated conductivity limit of 9999 ms/cm is exceeded.	Verify the conductivity range setting.
OvEr rAnGE	The current range setting has been exceeded.	Verify the 4 and 20 mA settings in the Program/output menu.
AdC Error	An analog to digital conversion error has occurred. (This may come up normally while readings are changing quickly).	Recycle the power.
Errors		
CAl Err or OFFSEt Err	A calibration error has occurred between the standard and process.	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.	Press *RESET* and repeat the calibrate/temp. slope menu setting.
-0- Err	Sensor zero limit has been exeeded.	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.

8.2.4 Quick troubleshooting guide

Table 9-8 identifies some of the more common symptoms and suggests actions to help resolve a problem. In general, wiring is the most common cause.

Table 8-4: Quick troubleshooting guide

Symptom	Action
Wrong temperature reading. Suspected temp. compensation problem.	Perform a temperature standardization. Verify sensor's RTD. Resistance vs. temp. Check wiring.
Display segments missing. Display inoperable.	Replace display board.
Analyzer locks up; won't respond.	Replace PCB stack. Press *RESET*. Check batteries in IRC.
Erratic displays	Check sensors in process.
Transmitter won't respond to IRC key presses.	Verify and clean ribbon cable connection on CPU board. Check batteries in IRC.
Key press gives wrong selection.	Replace IRC. Check ribbon cable connection on CPU board.
Wrong or no current output.	Verify that output is not being overloaded; remove load; replace PCB stack.
No display or indicators.	Replace PCB stack.
Excess Input *Reverse Input*	Check sensor wiring. Perform sensor zero.
Check sensor zero	Analyzer will not zero. Place sensor in air and access zero routine.

Field troubleshooting

When it is apparent by grab sample analysis that the transmitter is giving inaccurate readings, the following procedure should be followed.

Prerequisites

The sensor surfaces need to be totally wetted by the process and air bubbles must not be trapped in the vicinity of electrodes. If air bubbles are found, the installation technique should be altered to eliminate the source of this error.

Procedure

1. A quick visual inspection of the installation may identify the problem. Check to be sure that the transmitter is mounted securely and that its internal parts are properly connected. Next check all input and output wiring.

   If the previous step did not indicate the source of the problem, the next step is to isolate the problem to either the transmitter or the sensor.
2. The first step in troubleshooting the sensor is to disconnect it from the transmitter, remove the sensor from the process, and thoroughly dry the sensor electrodes.

   Refer to sensor manual for additional troubleshooting checks.

3. 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.

8.2.5 Systematic troubleshooting

If the quick troubleshooting guide does not resolve the error, try the step-by-step approach offered in in the flowchart below.

1. Follow the troubleshooting flowchart.
2. Refer to the tests and instructions indicated by the flowchart to diagnose the problem.

8.2.6 RTD resistance values

Table 8-5 is a ready reference of RTD resistance values at various temperatures. These are used for testing and evaluation of the sensor.

NOTICE

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 8-5: RTD resistance values

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

Figure 8-10: Conductivity determination

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

Formula:

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

Example:

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

8.2.7 5081C warning and fault messages

The 5081 transmitter continuously monitors the sensor and transmitter for conditions that cause erroneous measurements. When a problem occurs, the transmitter displays either a warning or a fault message. A warning alerts you that a potentially disabling condition exists. There is a high probability that the measurement is in error. A fault alerts the user that a disabling condition exists. If a fault message is showing, all measurements should be regarded as erroneous.

When a warning condition exists:

1. The main display remains stable; it does not flash.
2. A warning message appears alternately with the temperature and output readings in the second line of the display. See *Section 8.2.3* for an explanation of the warning messages and suggested ways of correcting the problem.

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 and output readings in the second line of the display. See *Section 8.2.3* for an explanation of 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 a 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 ouput 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 main display, and the display flashes.

8.2.8 Troubleshooting contacting and toroidal conductivity analyzers when a fault or warning message is showing

Message	Explanation	See section
OuEr rAnGe	Over range, measurement exceeds display limit	*OuEr rAnGE and AMP FAIL*
SEnSor FAIL	Bad sensor, sensor current is a large negative number	*SEnSor FAIL*
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*
rtd FAIL	Bad temperature reading	*rtd FAIL, TEMP HI, and TEMP LO*
TEMP HI	Temperature reading exceeds 275 °C (527 °F) when auto temp is selected	*rtd FAIL, TEMP HI, and TEMP LO*
TEMP LO	Temperature reading is less than -25 °C (-13 °F) when auto temp is selected	*rtd FAIL, TEMP HI, and TEMP LO*
SenSE OPEn	Sense line is not connected	*SenSE OPEn*
OFFSEt Err	Zero offset during standardization exceeds programmed limit	*OFFSEt Err*
FACt FAIL	Unit has not been factory calibrated	*FAct FAIL procedure*
CPU FAIL	Internal CPU tests have failed	*CPU FAIL and ROM FAIL*
ROM FAIL	Internal memory has failed	*CPU FAIL and ROM FAIL*
AdC Error	Analog to digital conversion failed	*AdC Error*

OuEr rAnGE and AMP FAIL

These error messages appear if the sensor current is too high. Normally, excessive sensor current implies that the sensor is miswired or the sensor has failed.

1. Verify that the wiring is correct and connections are tight. Be sure to check connections at the junction box if one is being used.
2. Replace the sensor membrane and electrolyte solution and clean the cathode if necessary. See the sensor instruction sheet for details.
3. Replace the sensor.

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.

Procedure

1. Observe the sensor current (go to SEnSor Cur under the Diagnostic menu).

   If the sensor is moving in the positive direction, there is probably nothing wrong, and 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 measurement.

   Configuring the measurement sets (among other things) 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 instruction sheet for details.
5. 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.

nEEd 0 CAL

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

1. Check the zero current (go to 0 CurrEnt under the Diagnostic 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 for the sensor for more information.

rtd FAIL, TEMP HI, and TEMP LO

These messages usually mean that the RTD is open or shorted or there is an open or short in the connecting wiring.

1. Verify all wiring connections, including wiring in a junction box if one is being used.
2. Disconnect the RTD IN, RTD SENSE, and RTD RETURN leads or the thermistor leads at the transmitter.

   Be sure to note the color of the wire and where it was attached.

3. Measure the resistance between the RTD IN and RETURN leads. For a thermistor, measure the resistance between the two leads.
4. If the temperature is open or shorted, replace the sensor.
5. In the meantime, use manual temperature compensation.

SenSE OPEn

Most Rosemount sensors use a Pt100 or Pt1000 in a three-wire configuration. The in and return leads connect the RTD to the measuring circuit in the analyzer. A third wire, called the sense line, is connected to the return lead. The sense line allows the analyzer 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.

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 the sensor is to be used at approximately constant ambient temperatures, the lead wire resistance error can be eliminated 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.

OFFSEt Err

The OFFSEt Err message appears if the zero offset (in mV) exceeds the programmed limit. Before increasing the limit to make the OFFSEt Err message disappear, check the following:

1. Verify that the reference meter is working properly and is properly calibrated.
2. Verify that the process sensor is working. Check its response in a solution of known conductivity.
3. If the transmitter is standardized against the conductivity determined in a grab sample, be sure to measure the conductivity 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 not properly measure the conductivity of the process liquid.
5. Check the sensor for cleanliness. If the sensor looks fouled or dirty, clean it.

   Refer to the sensor instruction manual for cleaning procedures.

FAct FAIL procedure

FACt FAIL appears if the transmitter factory calibration message has been triggered. A stray noise spike can cause this message to appear. If the pH reading seems acceptable, reset the calibration flag.

1. Enter the factory calibration menu by pressing *2* on the IRC ten times.

   The display does not change.

2. Immediately press *3*.

   FActorYCAL appears in the display.

3. Press *NEXT*.

   rEPAir appears in the display.

4. Press *NEXT*.

   ConFIG appears in the display.

5. Press *NEXT*.

   rESEt appears in the display.

6. Press *ENTER*.

   rESEtCFG appears in the display.

7. Press *ENTER*.

   rESEt appears again.

8. Press *NEXT*.

   FActorYCAL reappears.

9. Press *ENTER*.

   FactOn appears in the display.

10. Press *3*.

    FactOFF appears.

11. Press *ENTER* to store the settings.
12. 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.

CPU FAIL and ROM FAIL

CPU FAIL means that the processing unit has failed internal tests. ROM FAIL means that the internal memory has failed.

1. Cycle the power. Leave the transmitter off for at least 30 seconds before returning power to it.

   If cycling the power fails to clear the error message, the CPU board probably needs replacing.
2. Call the factory for assistance.

AdC Error

AdC Error means the analog to digital converter has failed.

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. Call the factory for assistance.

8.3 5081-A Diagnostics

8.3.1 Diagnostics overview

The 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 mnemonic for the desired information appears. Refer to the appropprieate section below for more information.

8.3.2 Diagnostic messages for dissolved oxygen

TYPE O2	Transmitter is measuring oxygen. Press *NEXT* to view diagnostics.
SEnSor Cur	Press *ENTER* to display raw current from sensor.
SEnSitvtY	Press *ENTER* to display sensitivity. Sensitivity is calculated during calibration. It is the measured current divided by the concentration.
O CurrEnt	Press *ENTER* to display the zero current measured during calibration (note units).
bAr PreSS	Press *ENTER* to display the barometric pressure used by the transmitter during air calibration.
5081-A-Ht	This is the model number. Press *ENTER* to display the software revision (SFtr) level. Press *NEXT* to show the hardware revision (HArdr) level.

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

8.3.3 Diagnostic messages for ozone and total chlorine

TYPE O3 or tCL	Transmitter is measuring ozone (or total chlorine). Press *NEXT* to view diagnostics.
SEnSor Cur	Press *ENTER* to display raw current from sensor (note units).
SEnSitvtY	Press *ENTER* to display sensitivity. Sensitivity is calculated during calibration . It is the measured current divided by concentration.
O CurrEnt	Press *ENTER* to display the zero current measured by calibration (note units).
5081-A-Ht	This is the model number. Press *ENTER* to display the software revision (SFtr) level. Press *NEXT* to show the hardware revision (HArdr) level.
FAULtS	Press *ENTER* to scroll through existing fault messages.

8.3.4 Diagnostic messages for free chlorine

TYPE FCL	Transmitter is measuring free chlorine. Press *NEXT* to view diagnostics.
SEnSor Cur	Press *ENTER* to display raw current from sensor (note units).
SEnSitvtY	Press *ENTER* to display sensitivity. Sensitivity is calculated during calibration. It is the measured current divided by concentration.
O CurrEnt	Press *ENTER* to display the zero current measured during calibration (note units).
PH	Press *ENTER* to view pH diagnostics. 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.
5081-A-Ht	This is the model number. Press *ENTER* to display the software revision (SFtr) level. Press *NEXT* to show the hardware revision (HArdr) level.
FAULtS	Press *ENTER* to scroll through existing fault messages.

8.4 5081-A troubleshooting

8.4.1 5081-A warning and fault messages

The 5081 transmitter continuously monitors the sensor and transmitter for conditions that cause erroneous measurements. When a problem occurs, the transmitter either displays a warning or fault message. A warning alerts you that a potentially disabling condition exists.

There is a high probability that the measurement is in error. A fault alerts you that a disabling condition exists. If a fault message is showing, all measurements should be regarded as erroneous.

When a warning condition exists:

1. The main display remains stable. It does not flash.
2. A warning message appears alternately with the temperature and output readings in the second line of the display. See *Section 8.3.4* for an explanation of the warning messages and suggested ways of correcting the problem.

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 and output readings in the second line of the display. See *Section 8.3.4* for an explanation of the 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.

8.4.2 Troubleshooting fault or warning messages

The following table explains the fault or warning messages displayed on the 5081-A transmitter.

Message	Explanation	See section
OuEr rAnGe	Over range, measurement exceeds display limit	*OuEr rAnGE and AMP FAIL*
AMP FAIL	Amperometric sensor failure, sensor current is too high	*OuEr 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*

Message	Explanation	See section
bAd rtd	Bad temperature reading	*bAd rtd, TEMP HI, TEMP LO, and rtd OPEn*
TEMP HI	Temperature reading exceeds 150 °C (302 °F)	*bAd rtd, TEMP HI, TEMP LO, and rtd OPEn*
TEMP LO	Temperature reading is less than -15 °C (5 °F)	*bAd rtd, TEMP HI, TEMP LO, and rtd OPEn*
rtd OPEn	RTD or thermistor is open	*bAd rtd, TEMP HI, TEMP LO, 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*
SLOPE HI	pH sensor slope exceeds 62 mV/pH	*SLOPE HI or SLOPE LO*
SLOPE LO	pH sensor slope is less than 40 mV/pH	*SLOPE HI or SLOPE LO*
-0- OFFSEt	Zero offset during standardization exceeds programmed limit	*-0- OFFSEt*
GLASSFAIL	Measured glass impedance is less than pro-grammed limit	*GLASSFAIL*
FACt FAIL	Unit has not been factory calibrated	*FACt FAIL error message*
CPU FAIL	Internal CPU tests have failed	*9.4.2.13*
ROM FAIL	Internal memory has failed	*9.4.2.13*
AdC	Analog to digital conversion failed	*AdC*
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 (go 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.

Procedure

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 instruction sheet 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 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.

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

   Refer to the appropriate Calibration section for details.
3. Replace the sensor membrane and electrolyte solution and clean the cathode if necessary.

   See the sensor instruction sheet for details.
4. Replace the sensor.

bAd rtd, TEMP HI, TEMP LO, and rtd OPEn

These messages usually mean that the RTD (or themistor in the case of the Hx438 and GX448 sensors) is open or shorted or there is an open or short in the connecting wiring.

1. See *Section 8.4.12*
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. Be sure to 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 the table in Section 8.4.12. If the temperature element is open or shorted, replace the sensor. In the meantime, use manual temperature compensation.

   For oxygen measurements using the HX438, the Gx448, or other steam-sterilizable sensor using a 22kNTC, the TEMP HI error will appear if the controller was not properly configured.

pH In

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

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 instruction manual for cleaning procedures.

4. Replace the sensor.

SLOPE HI or SLOPE LO

Once the two-point (manual or automatic) pH calibration is complete, the transmitter automatically calculates the sensor slope at 25 °C. If the slope is greather than 62 mV/pH, the transmitter displays the SLOPE HI error. If the slope is less than 45 mV/pH, the transmitter displays the SLOPE LO error. The transmitter will not update the calibration.

1. Check the buffers. Inspect the buffer solutions for obvious signs of deterioration, such as turbidity or mold growth.

   Neutral and slightly acidic buffers are highly susceptible to molds. Alkaline buffers (pH 9 and greater), if they have been exposed to air for long periods, may also be inaccurate. Alkaline buffers absorb carbon dioxide from the atmosphere, which lowers the pH.
2. If a high pH buffer was used in the failed calibration, repeat the calibration using fresh buffer. If fresh buffer is not available, use a lower pH buffer.

   For example, use pH 4 and pH 7 buffer instead of pH 7 and pH 10 buffer.
3. Allow adequate time for temperature equilibration. If the sensor was in a process liquid substantially hotter or colder than the buffer, place it in a container of water at ambient temperature for at least 20 minutes before starting the calibration.
4. If manual calibration was done, verify that the correct pH values were entered.
5. Verify all wiring connections, including connections at a junction box.
6. Check the pH sensor for cleanliness. If the sensor looks fouled or dirty, clean it.

   Refer to the sensor instruction manual for cleaning procedures.
7. 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:

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 instruction 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 *Section 8.4.13*.

AdC

AdC means the analog to digital converter has failed.

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.

To simulate	See Section
Dissolved oxygen	*Section 8.4.9*
Ozone or chlorine	*Section 8.4.10*
pH	*Section 8.4.11*
Temperature	*Section 8.4.12*

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

3. Call the factory for assistance.

bAd Gnd

bAd Gnd usually means a problem with the analog PCB. Contact the factory.

In too biG

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

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

Program settings in the 5081-A can be protected against accidental changes by setting a three-digit security code. Settings can be further protected by removing a jumper (JP-1) from the CPU board. If JP-1 has been removed, program settings cannot be changed.

8.4.3 Temperature measurement and calibration problems

Temperature different from transmitter

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

8.4.4 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 different from below*
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.	
Sensor does not respond to changes in oxygen level.	*Sensor not responding to oxygen changes*
Readings are too low.	*Oxygen readings too low*

Zero current too high

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

Sensor	Zero current
499ADO	< 50 nA
499ATrDO	< 5 nA
Hx438 and Gx448	< 1 nA

1. Is the sensor properly wired to the transmitter?
2. Is the membrane completely covered with zero solution, and are air bubbles not trapped against the membrane? Swirl and tap the sensor to release air bubbles.

3. Is the zero solution fresh and properly made? Zero the sensor in a solution of 5% sodium sulfite in water. Prepare the solution immediately before use. It has a shelf life of only a few days.
4. If the sensor is being zeroed 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 the 499ADO or 499ATrDO sensor contains no air bubbles, carefully follow the procedure in the sensor manual for filling the sensor. If the electrolyte solution has been replaced, allow several hours for the zero current to stabilize. On rare occasions, the sensor may require as long as overnight to zero.
6. Check the membrane for damage and replace the membrane if necessary.

Zero reading unstable

1. Is the sensor properly wired to the transmitter? Verify that all wiring connections are tight.
2. Readings are often erratic when a new or rebuilt sensor is first placed in service. Readings usually stabilize after an hour.
3. Is the space between the membrane and cathode filled with electrolyte solution, and is the flow path between the electrolyte reservoir and the membrane clear? Often the flow of electrolyte can be started by simply holding the sensor with the membrane end pointing down and sharply shaking the sensor a few times as though shaking down a clinical thermometer. If shaking does not work, perform the checks below. Refer to the sensor instruction manuals for additional information.
    - For 499ADO and 499ATrDO sensors, verify that the holes at the base of the cathode stem 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 instruction manual for the detailed procedure.
    - For Gx438 and Hx438 sensors, the best way to ensure that there is an adequate supply of electrolyte solution is to simply add fresh electrolyte solution to the sensor. Refer to the sensor instruction manual for details.

Sensor current different from below

Sensor	nA/ppm
499ADO	1,800 - 3,100
499ATrDO	3,600 - 6,100
Hx438 and Gx448	4.8 - 9.8

1. Is the sensor properly wired to the sensor? Verify that all connections are tight.

2. Is the membrane 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 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 instruction manual. To replace a torn membrane, refer to the sensor instruction manual.
4. Is the temperature low? Sensor current is a strong function of temperature. The sensor current decreases about 3% with for every °C drop in temperature.
5. Is the membrane fouled or coated? 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 instruction sheet 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.

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

Process readings erratic

1. 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.
2. Is the sample flow within the recommended range? High sample flow may cause erratic readings. Refer to the sensor instruction manual for flow rates.
3. Gas bubbles impinging on the membrane may cause erratic readings. Orienting the sensor at an angle away from vertical may reduce the noise.
4. The holes between the membrane and electrolyte reservoir might be plugged (applies to 499ADO and 499ATrDO sensors only). Refer to *Zero reading unstable*.
5. Verify that wiring is correct. Pay particular attention to shield and ground connections.
6. Is the membrane in good condition, and is the sensor filled with electrolyte solution? Replace the fill solution and electrolyte. Refer to the sensor instruction manual for details.

Readings drift.

1. Is the membrane 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.
2. Is the sensor in direct sunlight? If the sensor is in direct sunlight during air calibration, readings will drift as the sensor warms up. Because the temperature reading lags behind the true temperature of the membrane, calibrating the sensor in direct sunlight may introduce an error.
3. Is the sample flow within the recommended range? Gradual loss of flow will cause downward drift.
4. Is the sensor new or has it been recently serviced? New or rebuilt sensors may require several hours to stabilize.

Sensor not responding to oxygen changes

1. If readings are being compared with a portable laboratory instrument, verify that the laboratory instrument is working.
2. Is the membrane 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 too low

1. 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.

   Eaxample: The true residual (zero) current for a 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.
2. 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 instruction 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.

8.4.5 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.	*Chlorine 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.	
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.

1. Is the sensor properly wired to the transmitter?
2. Is the zero solution 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. Has adequate time been allowed 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.

Chlorine zero reading unstable

1. Is the sensor properly wired to the transmitter? Verify that all wiring connections are tight.
2. Readings are often erratic when a new or rebuilt sensor is first placed in service. Readings usually stabilize after about an hour.
3. Is the conductivity of the zero solution greater than 50 µS/cm? *Do not use deionized or distilled water to zero the sensor.* The sensor should contain at least 0.5 grams of sodium chloride per liter.
4. Is the space between the membrane and cathode filled with electrolyte solution, and is the flow path between the electrolyte reservoir and the membrane clear? Often the flow of electrolyte can be started by simply holding the sensor with the membrane end pointing down and sharply shaking the sensor a few times as though shaking down a clinical thermometer.

If shaking does not work, try clearing the holes around the cathode stem. Hold the sensor with the membrane end pointing up. Unscrew the membrane retainer and remove the membrane assembly. 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.

Verify that the sensor is filled with electrolyte solution. Refer to the sensor instruction manual for details..

Sensor current too low

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

1. Is the temperature low, or is the pH 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. 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 instruction sheet for recommended sample flows.
3. Low current can be caused by lack of electrolyte flow to the cathode and membrane. See step 4 in *Chlorine zero reading unstable*.
4. Is the membrane 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. *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 instruction sheet for details.

Chlorine process readings erratic

1. 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.
2. Is the sample flow within the recommended range? High sample flow may cause erratic readings. Refer to the sensor instruction sheet for recommended flow rates.
3. Are the holes between the membrane and the electrolyte reservoir open? Refer to *Chlorine zero reading unstable*.
4. Verify that wiring is correct. Pay particular attention to shield and ground connections.
5. If automatic pH correction is being used, check the pH reading. If the pH reading is noisy, the chlorine reading will also be noisy. If the pH sensor is the cause of the noise, use manual pH correction until the problem with the pH sensor can be corrected.
6. Is the membrane in good condition, and is the sensor filled with electrolyte solution? Replace the fill solution and electrolyte. Refer to the sensor instruction manual for details.

Chlorine readings drift

1. Is the sample temperature changing? Membrane permeability is a function of temperature. The time constant for the 499ACL-01 sensor is about five minutes. Therefore, the reading may drift for a while after a sudden temperature change.
2. Is the membrane clean? For the sensor to work properly, chlorine must diffuse freely through the membrane. A coating on the membrane will interfere with the passage of chlorine, resulting in slow response. Clean the membrane by rinsing it with a stream of water from a wash bottle. *Do not* use a tissue to wipe the membrane.
3. Is the sample flow within the recommended range? Gradual loss of sample flow will cause a downward drift.
4. Is the sensor new, or has it been recently serviced? New or rebuilt sensors may require several hours to stabilize.
5. Is the pH of the process changing? If manual pH correction is being used, a gradual change in pH will cause a gradual change in the chlorine reading. As pH increases, chlorine readings will decrease, even though the free chlorine level (as determined by a grab sample test) remains constant. If the pH change is no more than about 0.2, the change in the chlorine reading will be no more than about 10% of reading. If the pH changes are more than 0.2, use automatic pH correction.

Sensor not responding to chlorine changes

1. Is the grab sample test accurate? Is the grab sample representative of the sample flowing to the sensor?
2. Is the pH compensation 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. Is the membrane clean? 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.

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

1. Was the sample 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. See *Oxygen readings too low* for more information.
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 instruction manual for recommended flows.Verify that the chlorine sensor is installed in the correct flow cell. See Figure and Figure. Verify that the liquid level in the constant head sampler is level with the central overflow tube and that excess sample is flowing down the tube. If necessary, disassemble and clean the overflow sampler. See *Section*.

8.4.6 Total chlorine measurement and calibration problems

Refer to the instruction manual for the SCS921 for a complete troubleshooting guide.

8.4.7 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 25 °C (77 °F).	*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.	*Ozone readings too low*

Ozone zero current outside range

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

1. Is the sensor properly wired to the transmitter?
2. Is the zero solution ozone free? Test the zero solution for ozone level. The concentration should be less than 0.02 ppm.

3. Has adequate time been allowed 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 neccessary.

Ozone zero reading unstable

1. Is the sensor properly wired to the transmitter? Verify that all wiring connections are tight.
2. Readings are often erratic when a new or rebuilt sensor is first placed in service. Readings usually stabilize after about an hour.
3. Is the space between the membrane and cathode filled with electrolyte solution, and is the flow path between the electrolyte reservoir and membrane clear? Often the flow of electrolyte can be started by simply holding the sensor with the membrane end pointing down and sharply shaking the sensor a few times as though shaking down a clinical thermometer.

   If shaking does not work, try clearing the holes around the cathode stem. Hold the sensor with the membrane end pointing up. Unscrew the membrane retainer and remove the membrane assembly. Be sure the wood ring remains with the membrane assembly. Use the end or a straightened paper clip to clear the holes at the base of the cathode stem. Replace the membrane.

   Verify that the sensor is filled with electrolyte solution. Refer to the sensor instruction manual for details.

Sensor current less than 350 nA/ppm

If the sensor current is less than 350 nA/ppm at 25 °C (77 °F), see the following information.

1. Sensor current is a strong function of temperature. The sensor current decreases about 3% for every °C drop in temperature.
2. Sensor current depends on the rate of 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. Low current can be caused by lack of electrolyte flow to the cathode and membrane. See Step 3 in *Ozone zero reading unstable*.
4. Is the membrane fouled or coated? A dirty membrane inhibits diffusion of ozone 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 or gently wipe 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 instruction sheet for details.

Ozone process readings erratic

If the ozone process readings are erratic, see the information below.

1. 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.
2. Is the sample flow within the recommended range? High sample flow may cause erratic readings. Refer to the sensor instruction sheet for recommended flow rates.
3. Are the holes between the membrane and the electrolyte reservoir open? Refer to *Ozone zero reading unstable*
4. Verify that wiring is correct. Pay particular attention to shield and ground connections.
5. Is the membrane in good condition, and is the sensor filled with electrolyte solution? Replace the fill solution and electrolyte. Refer to the sensor instruction manual for details.

Ozone readings drift

1. Is the sample temperature changing? Membrane permeability is a function of temperature. The time constant for the 499AOZ sensor is about five minutes. Therefore, the reading may drift for a while after a sudden temperature change.
2. Is the membrane clean? For the sensor to work properly, 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. Is the sample flow within the recommended range? Gradual loss of sample flow will cause a downward drift.
4. Is the sensor new, or has it been recently serviced? New or rebuilt sensors may require several hours to stabilize.

Sensor not responding to ozone changes

1. Is the grab sample test accurate? Is the grab sample representative of the sample flowing to the sensor?
2. Is the membrane clean? Clean the membrane and replace it 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.
3. Replace the sensor.

Ozone readings too low

1. Was the sample tested as soon as it was taken? Ozone solutions are highly unstable. Test the sample immediately after collecting it.

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 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 too low* for more information.
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 instruction manual for recommended flows.

8.4.8 pH measurement and calibration problems

Problem	**See Section**
SLOPE HI or SLOPE LO message is showing.	*pH SLOPE HI or SLOPE LO*
-0- OFFSEt message is showing.	*pH -0- OFFSEt message*
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*

pH SLOPE HI or SLOPE LO

Refer to *SLOPE HI or SLOPE LO* for assistance.

pH -0- OFFSEt message

Refer to *-0- OFFSEt* for assistance.

Transmitter not accepting manual slope

If the sensor slope is known from other sources, it can be entered directly into the transmitter.

The transmitter will not accept a slope (at 25 ° (77 °F)) 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

1. Did the expected pH change really occur? If the process pH reading was not what was expected, check the performance of the sensors in buffers. Also, use a second pH meter to verify the change.
2. Is the sensor properly wired to the transmitter?
3. Is the glass bulb cracked or broken? Check the glass electrode impedance.
4. Is the transmitter working properly? 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 399 pH sensor recommended for use with the 5081-A transmitter has some degree of flow sensitivity, i.e., changing the sample flow causes the pH reading 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 399 pH sensor in a rapidly (16 gph) and slowly (<2 gph) flowing sample is less than about 0.05. If the change is greater than 0.05, the pH and chlorine sensors should be installed 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:

1. Is a ground loop 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.
   c. If offsets and noise appear after making the connection, a ground loop exists.
2. Is the process grounded?

a. 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.

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

c. If noise still persists, simple grounding is not the problem. Noise is probably being carried into the instrument through the sensor wiring.

3. Simplify the sensor wiring.

   a. First, 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.

   e. 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

1. What is the conductivity of the sample? Measuring pH in samples having conductivity less than about 50 µS/cm can be very difficult. Special sensors (for example, the 320HP) are often needed and special attention must be paid to grounding and sample flow rate.

NOTICE

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. Is the sensor dirty or 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. Is the sensor properly wired to the transmitter?
4. Is a ground loop present? Refer to *Process pH grossly wrong or noisy*

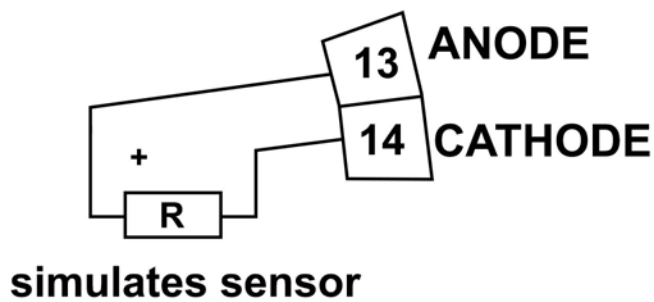
8.4.9 Simulating input currents - dissolved oxygen

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

1. Disconnect the anode and cathode leads from terminals 13 and 14 and connect a decade box as shown in *Figure 8-11*.

   It is not necessary to disconnect the RTD leads.

Figure 8-11: Simulate dissolved oxygen



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

Sensor	Polarizing voltage	Resistance	Expected current
499ADO	-675 mV	34 kΩ	20 µA
499ATrDO	-800 mV	20 kΩ	40 µA
Hx438 and Gx448	-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:

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

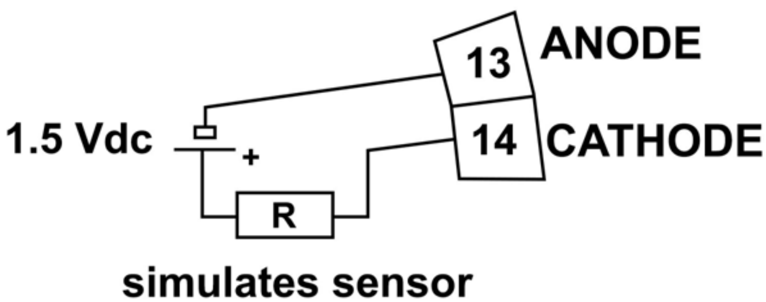
8.4.10 Simulating input currents - chlorine and ozone

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.

1. Disconnect the anode and cathode leads from terminals 13 and 14 and connect a decade box and battery as shown in *Figure 8-12*.

   It is not necessary to disconnect the RTD leads.

Figure 8-12: Simulate chlorine and ozone



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

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

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

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

8.4.11 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.

Preamplifier in transmitter

To simulate a pH input when the preamplifier is in the transmitter, complete the following steps.

1. Turn off automatic temperature correction and set the manual temperature to 25 °C (77 °F).
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.

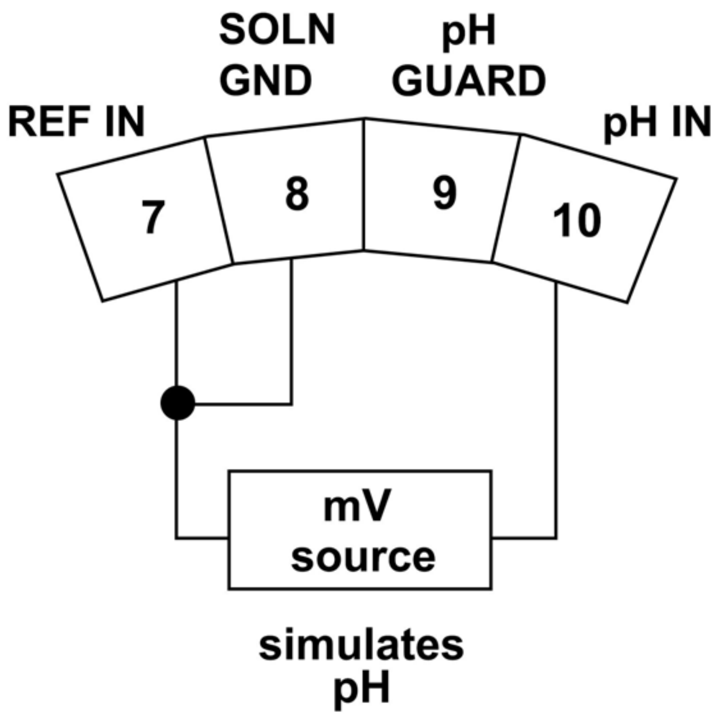
   a. Go to the main display.

   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 analyzer 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 8-13*.

Figure 8-13: Simulate 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 analyzer 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 verify that the pH and millivolt readings match the values in the table.

Voltage (mV)	pH (at 25 °)
295.8	2.00
177.5	4.00
59.2	6.00
59.2	8.00
177.5	10.00
295.8	12.00

Preamplifier in a junction box

The procedure is the same as described in *Preamplifier in transmitter*. Keep the connection between the analyzer 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.

Preamplifier in sensor

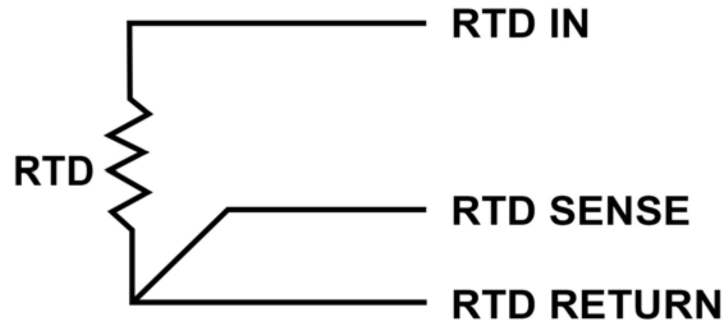
The preamplifier in the sensor converts the high impedance signal into a low impedance signal without amplifying it. To simulate pH values, follow the procedure in *Preamplifier in transmitter*.

8.4.12 Simulating temperature

General information about simulating temperature

The transmitter accepts either a Pt100 RTD (used in pH, 499ADO, 499ATrDO, 499ACL-01, 499ACL-02, and 499AOZ sensors) or a 22k NTC thermistor (used in Hx438 and Gx448 DO sensors and most steam-sterilizable sensors from other manufacturers). The Pt100 RTD has a three-wire configuration. See *Figure 8-14*. The thermistor has a two-wire configuration.

Figure 8-14: Three-wire RTD configuration

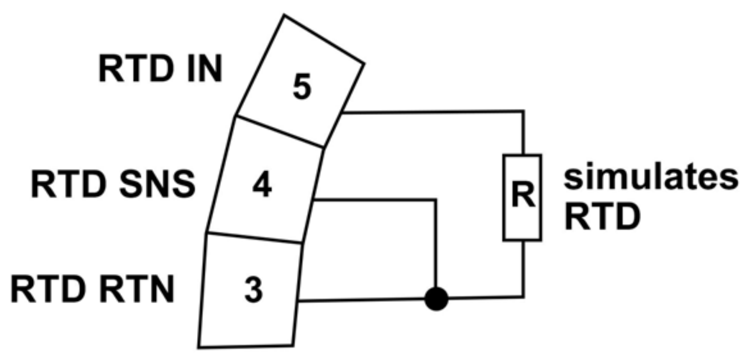


Although only two wires are required to connect the RTD to the analyzer, using a third wire allows the analyzer to correct for the resistance of the lead wires and for changes in the lead wire resistance with temperature.

Simulating temperature procedure

To simulate the temperature input, wire a decade box to the analyzer or junction box as shown in *Figure 8-15*.

Figure 8-15: Simulating RTD inputs



The figure shows wiring connections for sensors containing a Pt 100 RTD. For sensors using a 22k NTC thermistor (Hx438 and Gx448 sensors), wire the decade box to terminals 1 and 2 on TB6.

To check the accuracy of the temperature measurement, set the resistor to simulating the RTD to the values indicated in the table and note the temperature readings. The measured temperature might not agree with the value in the table. During sensor calibration, an offset might have been applied to make the measured temperature agree with a standard thermometer. The offset is also applied to the simulated resistance. The 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.

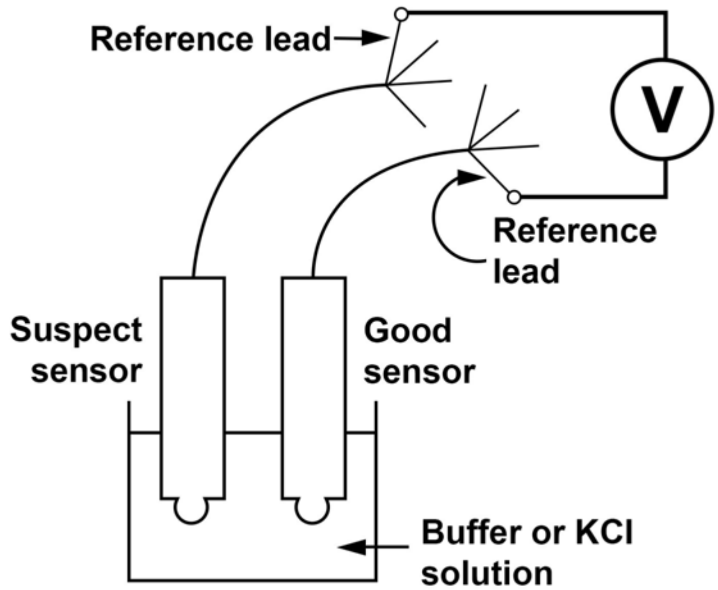
For example, start with a simulated resistance of 103.9 Ω, which corresponds to 10.0 °C (50 °F). Assume that the offset from the sensor calibration was -0.3 Ω. Because of the offset, the analyzer calculates temperature using 103.6 Ω. The result is 9.2 °C. Now change the resistance to 107.8 Ω, which corresponds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

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
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

8.4.13 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 8-16*. 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 8-16: Checking for a poisoned reference electrode



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.

9 Digital communications

9.1 HART communications

9.1.1 Overview of HART communication

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.

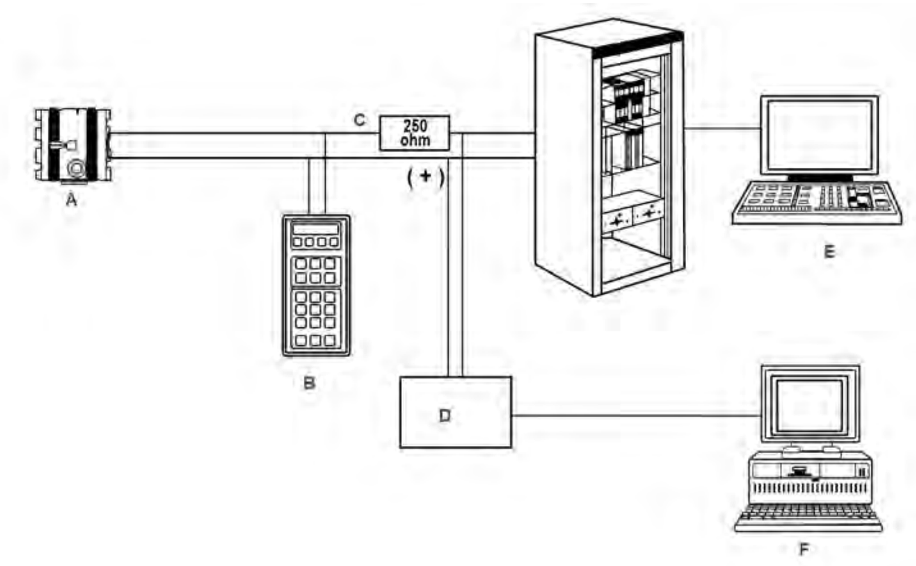
The HART protocol, originally developed by Fisher-Rosemount, is now overseen by the independent HART Communication Foundation. The foundation ensures that all HART devices can communicate with one another. For more information about HART communications, call the HART Communication Foundation at (512)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

9.1.2 HART interface devices

HART communicators allow you to view measurement data (pH, ORP, and temperature), program the transmitter, and download information from the transmitter for transfer to a computer for analysis. Downloaded information can also be sent to another HART transmitter. Either a hand-held communicator, such as the Rosemount Model 375, or a computer can be used. 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 5081 transmitter, the device description library may need updating. Call the manufacturer of your HART communication device for updates.

Figure 9-1: HART communicators



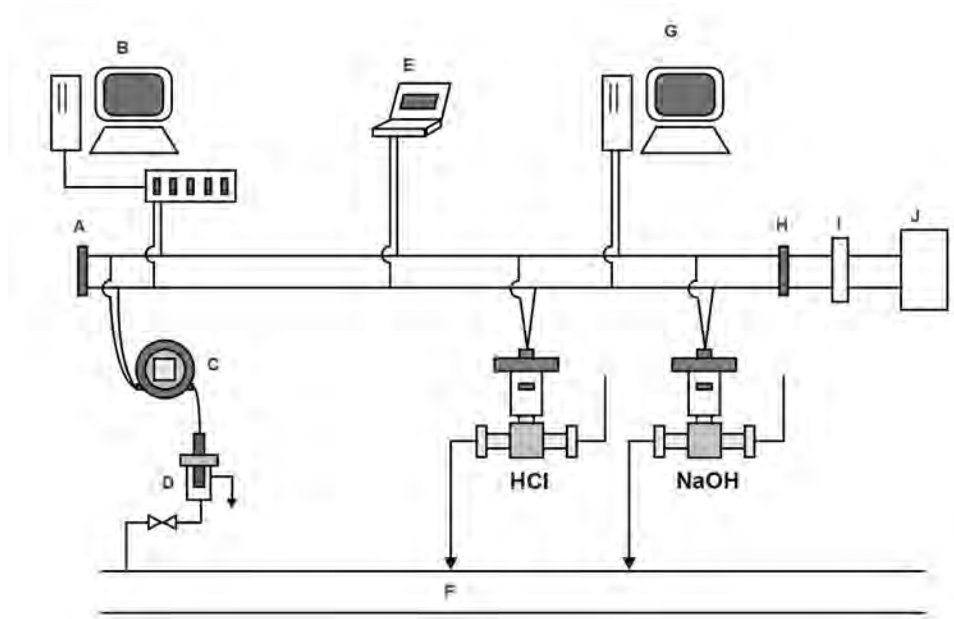
A. Model 5081-C-HT two-wire transmitter
B. Handheld communicator (configurator)
C. 4-20 mA + digital
D. Bridge
E. Control system
F. Computer

Both the Rosemount Model 375 (or 475) and a computer can be used to communicate with a HART transmitter. The 250 ohm load (minimum) must be present between the transmitter and the power supply.

9.2 Foundation Fieldbus communication

Figure 9-2 shows the 5081-C-FF being used 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 Model 5081-C transmitter with Foundation Fieldbus



A. *Terminator*
B. *DeltaV configurator and host*
C. *5081-C-FF*
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	5081-C-FF Fieldbus Transmitter
Type	Contacting conductivity 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
VCR's 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 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 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 375 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 about returning material

To expedite the repair and return of instruments, proper communication between the customer and the factory is important. Call 1-949-757-8500 for a Return Materials Authorization (RMA) number.

10.2 Warranty repair

The following is the procedure for returning instruments still under warranty.

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, the serial number on the unit must be supplied.
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
   Rosemount
   c/o A.F. Romero
   1749 Stergios Road
   Calexico, CA 92231
   Attn: Factory Repair

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

   Model No. __________

10.3 Non-warranty repair

The following is the procedure for returning instruments that are no longer under warranty for repair.

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 *Section 10.2*.

NOTICE

Consult the factory for additional information regarding service or repair.

Appendix A
Engineering drawings

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

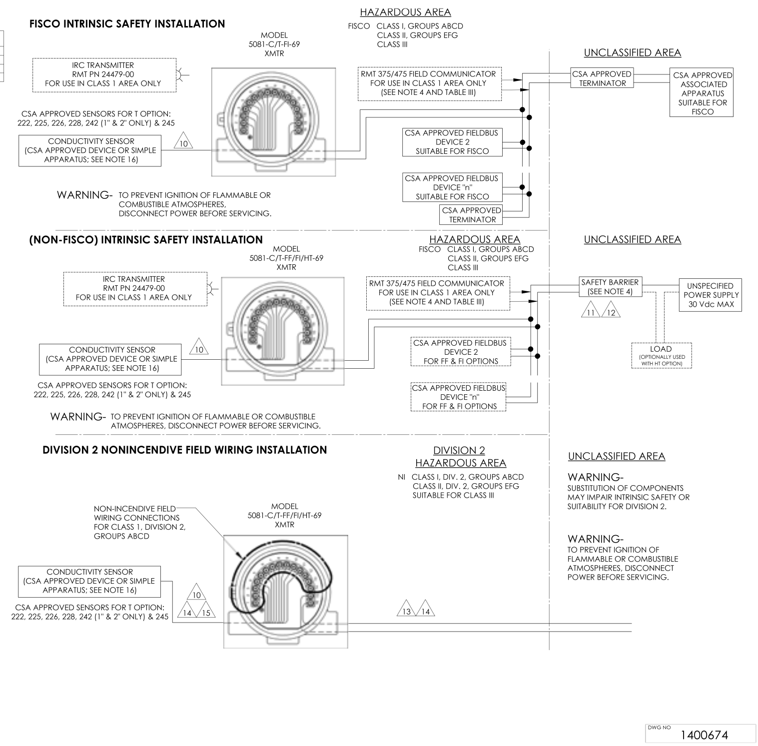


TABLE I

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

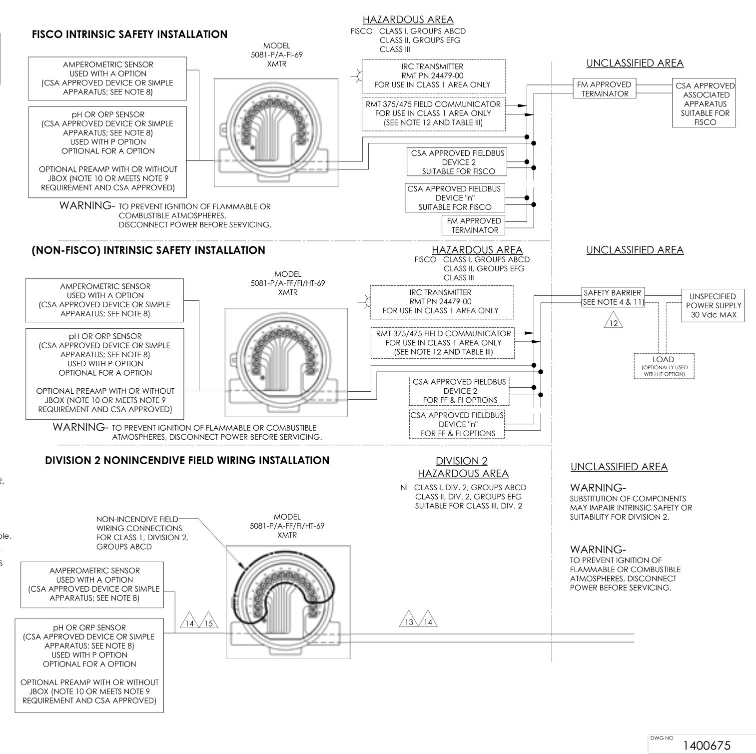


TABLE I

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	≤	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

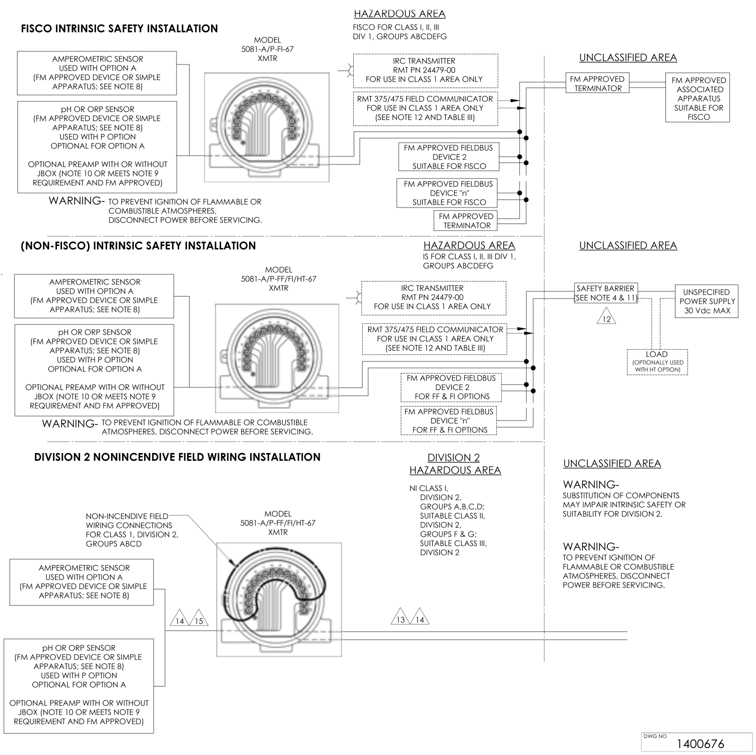


TABLE I

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:

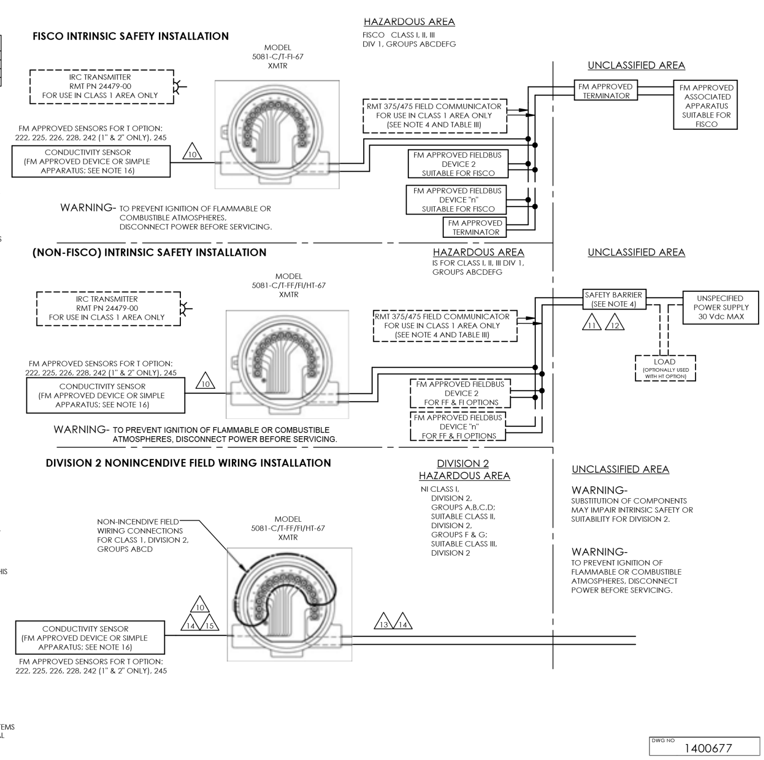
FIELD DEVICE INPUT		ASSOCIATED APPARATUS OUTPUT
Vmax OR Ui	≥	Voc, Vt OR Uo
Imax OR Ii	≥	Isc, It OR Io
Pmax OR Pi	≥	Po
3Ci + 3Ccable	≤	Ca, Ct OR Co (FOR FISCO INSTALLATIONS)
3Li + 3Lcable	≤	La, Lt OR Lo; Lc/Rc ≤ (La/Ra OR Lo/Ro) AND Li/Ri ≤ (La/Ra OR Lo/Ro) (FOR FISCO INSTALLATIONS)
Ci + Ccable	≤	Ca,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

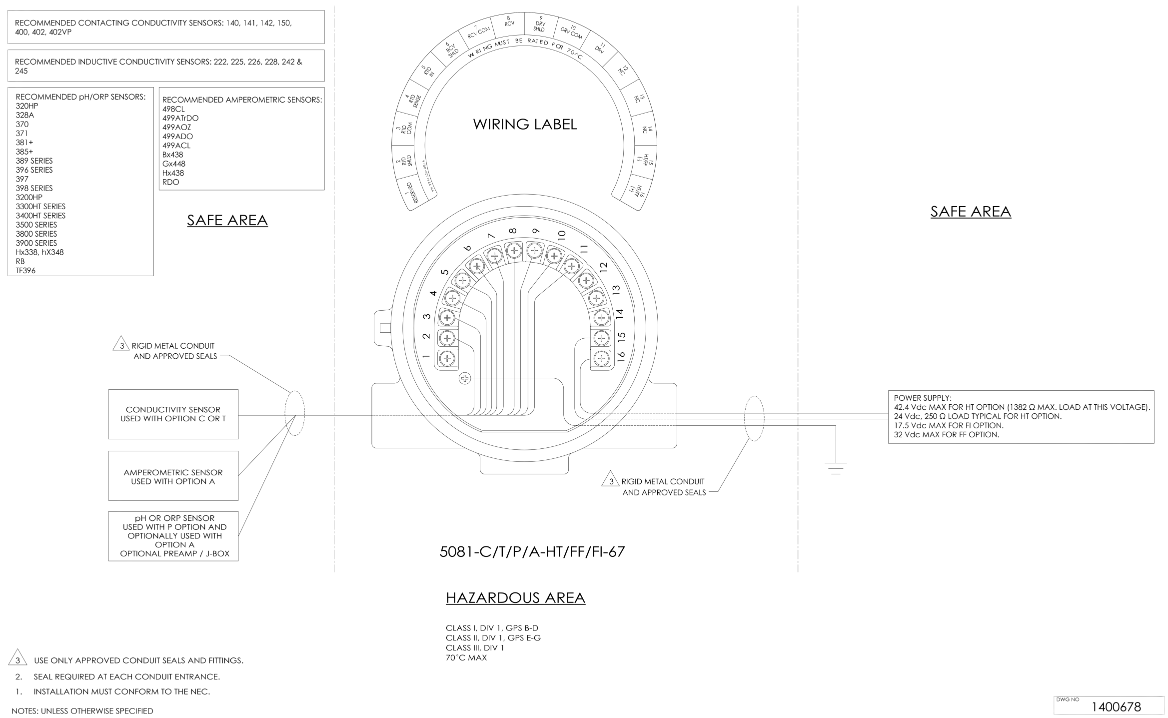
3. RESISTANCE BETWEEN INTRINSICALLY SAFE GROUND AND EARTH GROUND MUST BE LESS THAN 1.0 Ohm.

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

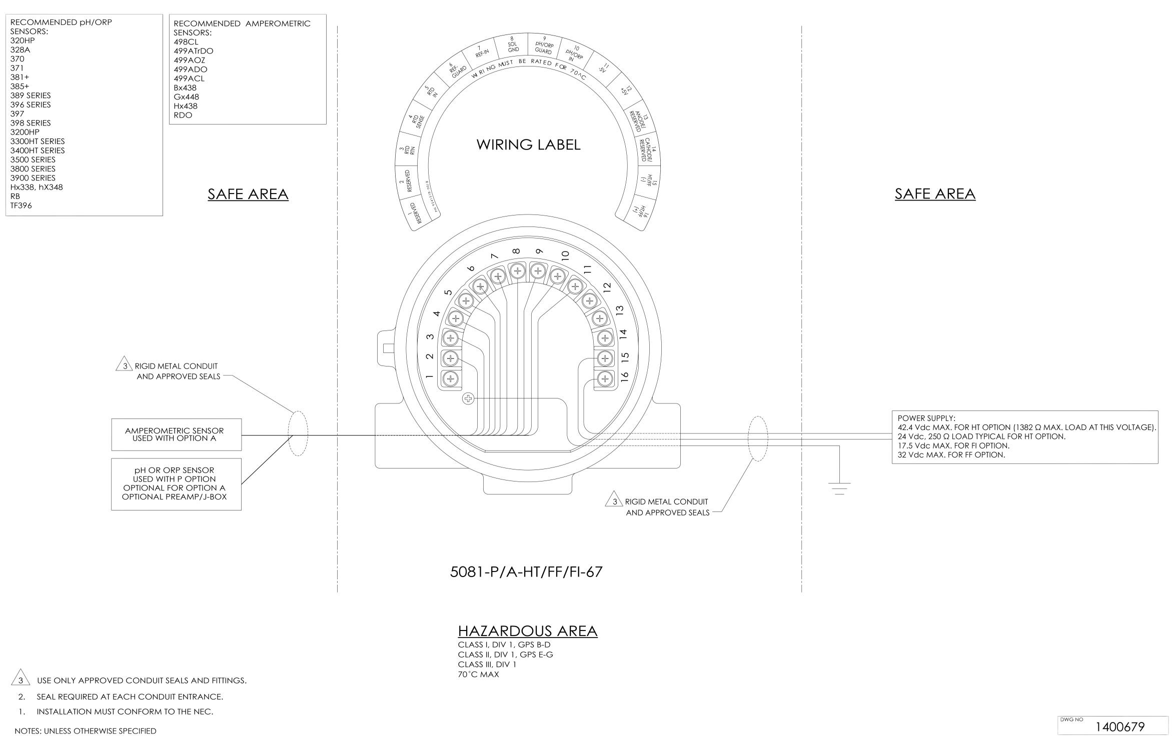
1. INSTALLATION SHOULD BE IN ACCORDANCE WITH ANSI/ISA RP12.06 "INSTALLATION OF INTRINSICALLY SAFE SYSTEMS FOR HAZARDOUS (CLASSIFIED) LOCATIONS" (EXCEPT CHAPTER 5 FOR FISCO INSTALLATIONS) AND THE NATIONAL ELECTRICAL CODE (ANSI/NFPA 70) SECTIONS 504 AND 505.

NOTES: UNLESS OTHERWISE SPECIFIED

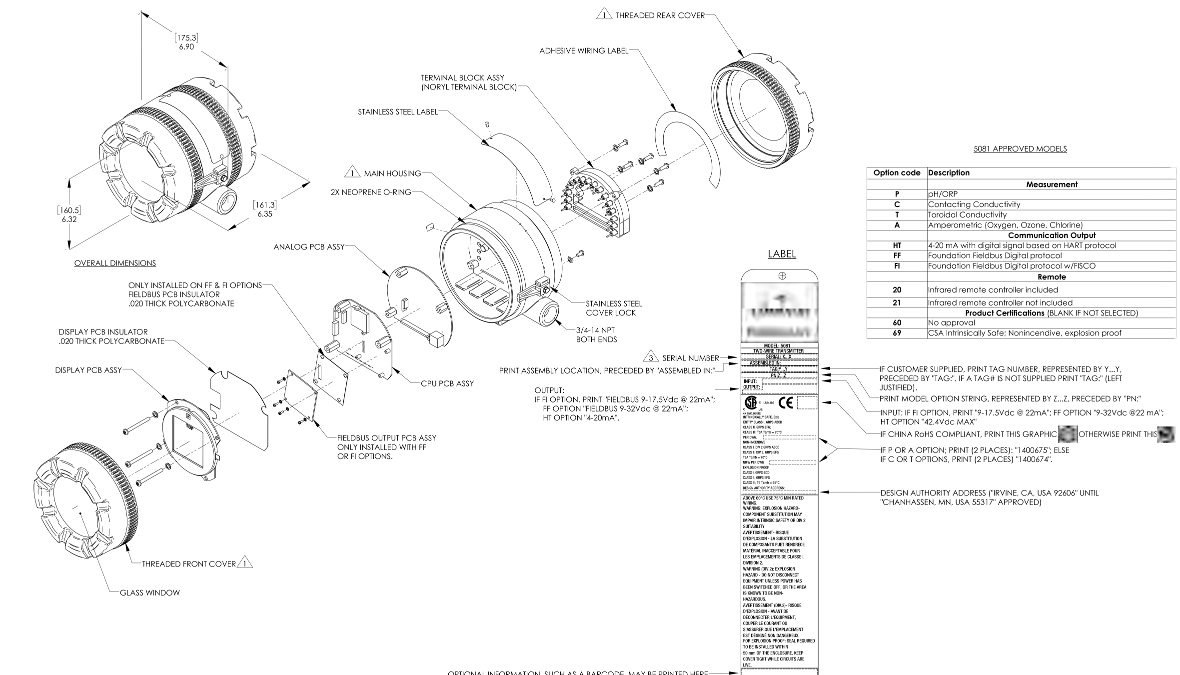




RECOMMENDED CONTACTING CONDUCTIVITY SENSORS: 140, 141, 142, 150, 400, 402, 402VP
RECOMMENDED INDUCTIVE CONDUCTIVITY SENSORS: 222, 225, 226, 228, 242 & 245
RECOMMENDED pH/ORP SENSORS: 320HP 328A 370 371 381+ 385+ 389 SERIES 396 SERIES 397 398 SERIES 3200HP 3300HT SERIES 3400HT SERIES 3500 SERIES 3800 SERIES 3900 SERIES Hx338, hX348 RB TF396
RECOMMENDED AMPEROMETRIC SENSORS: 498CL 499ATrDO 499AOZ 499ADO 499ACL Bx438 Gx448 Hx438 RDO
WIRING LABEL
WIRING MUST BE RATED FOR 70°C
SAFE AREA
SAFE AREA
3 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.
3 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



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
WIRING LABEL
WIRING MUST BE RATED FOR 70°C
SAFE AREA
SAFE AREA
3 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
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.
3 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
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 1400679



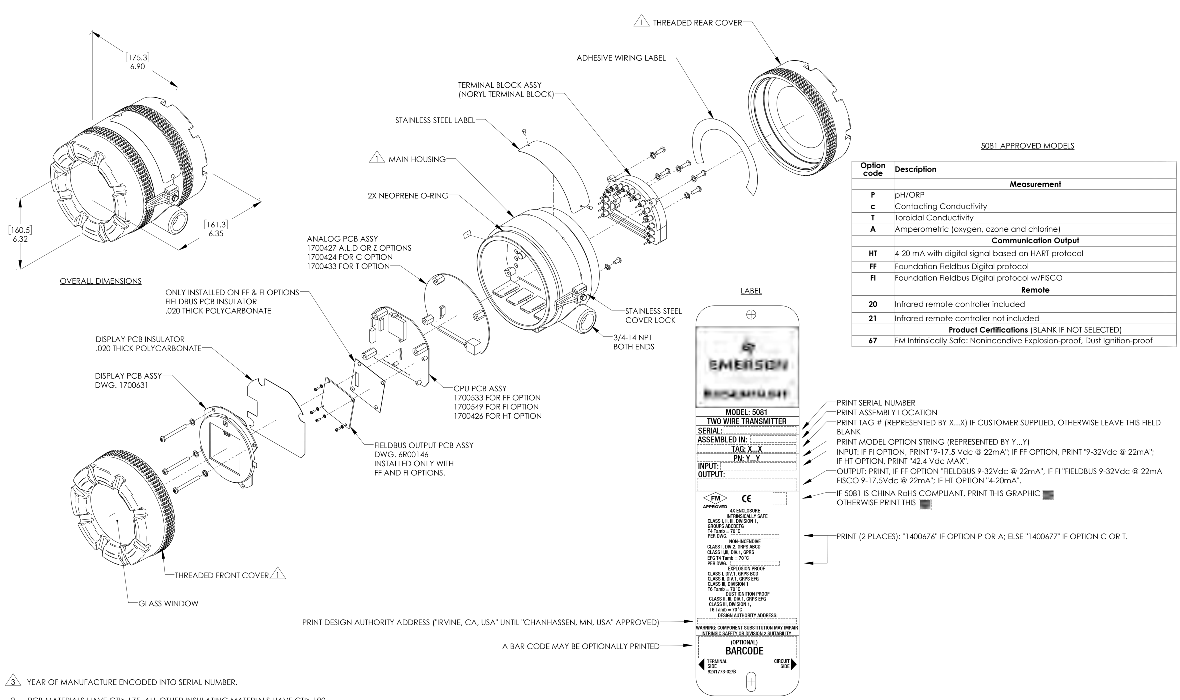
5081 APPROVED MODELS

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



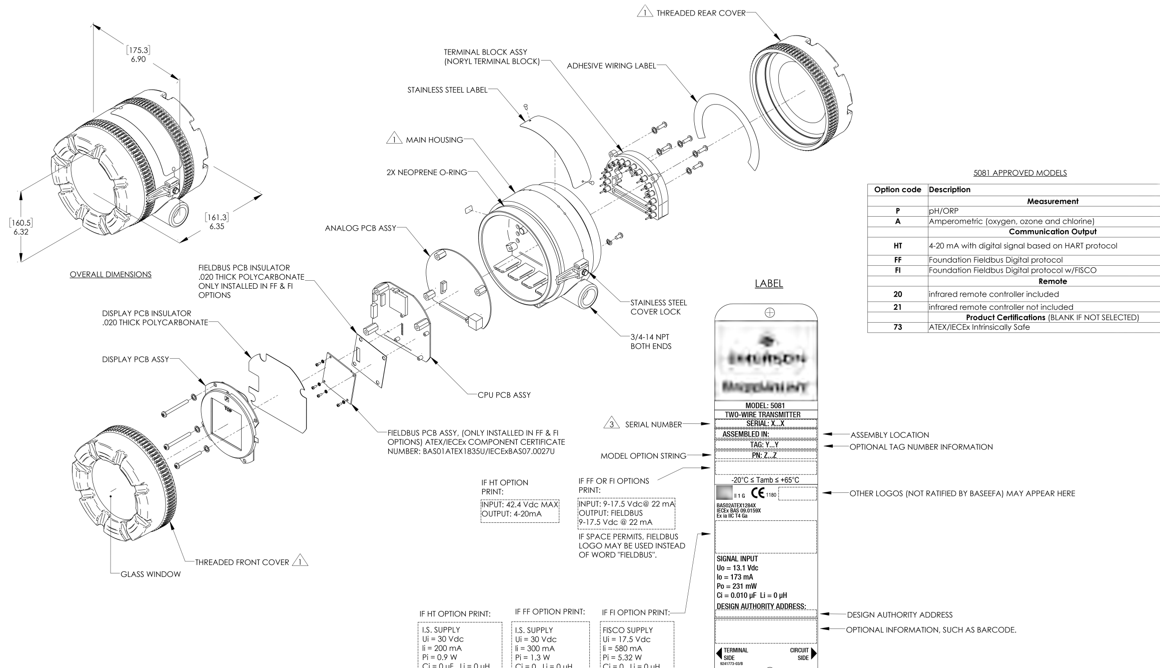
5081 APPROVED MODELS

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

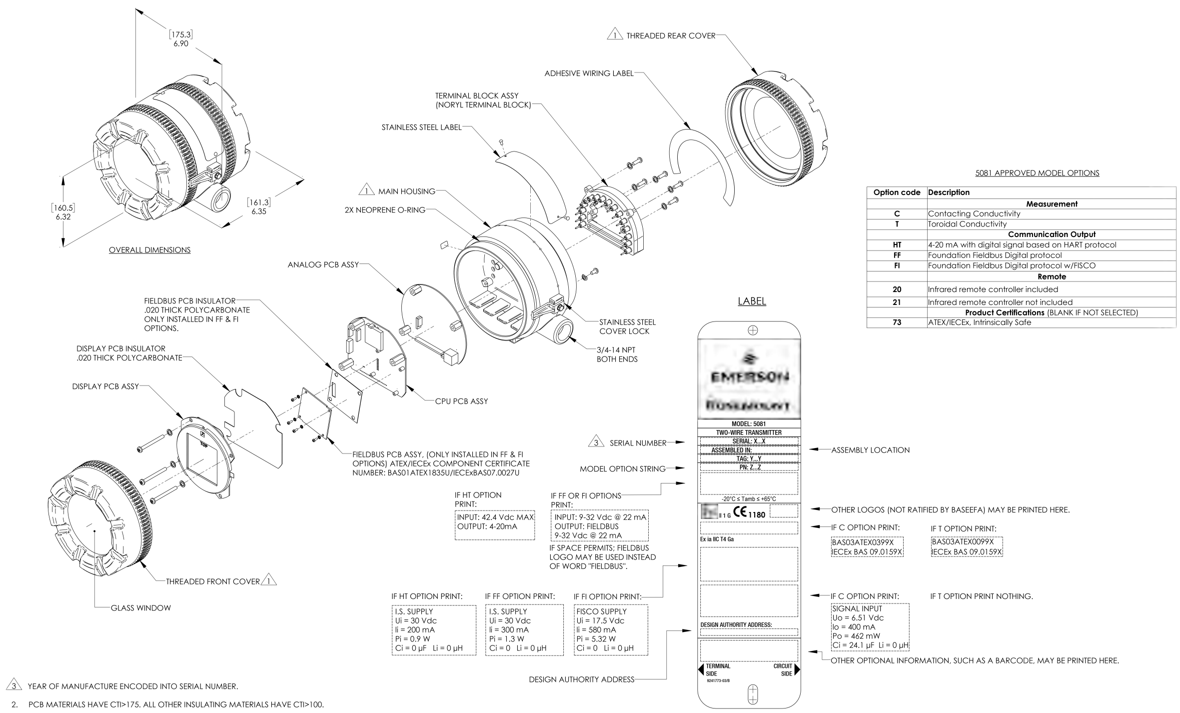


5081 APPROVED MODELS

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



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

DWG NO 1700786

Appendix B
EU Declarations of Conformity

The following pages are the EU Declarations of Conformity for the 5081-T, 5081 P/A, and 5081-C.

EU Declaration of Conformity

(No. 1700908)

5081-T

This declaration is issued under the sole responsibility of the manufacturer:
Rosemount Inc., 8200 Market Blvd., Chanhassen, MN 55317 USA
The product, **Rosemount Toroidal Conductivity Transmitter model 5081-AA-BB-CC-DD**

Where

AA is:		CC is:	
T	Toroidal conductivity measurement	20	Infrared remote controller included
		21	Infrared remote controller not included
BB is:		DD is:	
HT	Analog/HART communications	60	No approval
FF	Fieldbus communications	67	FM,Intrinsically Safe, NonIncendive, Explosion-proof, Dust Ignition proof
FI	FISCO Communications	69	CSA, Intrinsically Safe, NonIncendive, Explosion -proof
		73	ATEX / IECEx, Intrinsically Safe

to which this declaration relates, is in conformity with relevant Union harmonization legislation:

(2014/30/EU) EMC Directive

(2014/34/EU) ATEX Directive (The ATEX Directive is only valid if option 73 is selected)
Provisions of the directive fulfilled by the equipment:
Equipment Group II, Category 1 G Ex ia IIC T4 Ga (-20°C ≤ Ta ≤ +65°C)

Intrinsically Safe, EC Type Examination Certificate: Baseefa03ATEX0399X
Special Condition for use:
The equipment enclosure may contain light metals. The apparatus must be installed in such a manner as to minimize the risk of impact or friction with other metal surfaces.

ATEX Notified Body for EC Type Examination Certificate & Quality Assurance:
SGS Baseefa[Notified Body Number:1180], Rockhead Business Park, Staden Lane, Buxton SK17 9RZ UNITED KINGDOM

Assumption of conformity is based on the application of the harmonized standards:

EN 61326-1:2006	Electrical equipment for measurement, control and laboratory use. EMC requirements. General requirements
EN 60079-0:2012+A11:2013	Explosive atmospheres. Equipment. General requirements
EN 60079-11:2012	Explosive atmospheres. Equipment protection by intrinsic safety "i"

K Freeman
(Signature)

Director of Global Quality
(Function name)

Kim Freeman
(Name printed)

March 23, 2017
(Date of issue)

CE marking first applied to this product in 2002

EMERSON

EU Declaration of Conformity

(No. 1700906)

CE

5081-P/A…

This declaration is issued under the sole responsibility of the manufacturer:
Rosemount Inc., 8200 Market Blvd., Chanhassen, MN 55317 USA
The product,

Rosemount Amperometric/pH Transmitter model 5081-AA-BB-CC-DD

Where

AA is:		CC is:	
P	pH/ORP Measurement	20	Infrared remote controller included
A	Amperometric (oxygen, ozone, chlorine)	21	Infrared remote controller not included

BB is:		DD is:	
HT	Analog/HART communications	60	No approval
FF	Fieldbus communications	67	FM,Intrinsically Safe, NonIncendive, Explosion-proof, Dust Ignition proof
FI	FISCO communications	69	CSA, Intrinsically Safe, NonIncendive, Explosion -proof
		73	ATEX / IECEx, Intrinsically Safe

to which this declaration relates, is in conformity with relevant Union harmonization legislation:

(2014/30/EU) EMC Directive

(2014/34/EU) ATEX Directive (The ATEX Directive is only valid if option 73 is selected)
Provisions of the directive fulfilled by the equipment:
Equipment Group II, Category 1 G Ex ia IIC T4 Ga (-20°C ≤ Ta ≤ +65°C)
Intrinsically Safe Certificate: BAS02ATEX1284X
Special Condition for safe use:
The equipment enclosure may contain light metals. The apparatus must be installed in such a manner as to minimize the risk of impact or friction with other metal surfaces.

ATEX Notified Body for EC Type Examination Certificate & Quality Assurance:
SGS Baseefa[Notified Body Number:1180], Rockhead Business Park, Staden Lane, Buxton SK17 9RZ UNITED KINGDOM

Assumption of conformity is based on the application of the harmonized standards:
EN 61326-1:2006 Electrical equipment for measurement, control and laboratory use. EMC requirements. General requirements
EN 60079-0:2012+A11:2013 Explosive atmospheres. Equipment. General requirements
EN 60079-11:2012 Explosive atmospheres. Equipment protection by intrinsic safety "i"

K Freeman

(Signature)

Director of Global Quality
(Function name)

Kim Freeman
(Name printed)

March 23, 2017
(Date of issue)

CE marking first applied to this product in 2002

EU Declaration of Conformity

(No. 1700907)

5081-C

This declaration is issued under the sole responsibility of the manufacturer:
Rosemount Inc., 8200 Market Blvd., Chanhassen, MN 55317 USA
The product,

Rosemount Contacting Conductivity Transmitter model 5081-AA-BB-CC-DD

Where

AA is:		CC is:	
C	Contacting Conductivity measurement	20	Infrared remote controller included
		21	Infrared remote controller not included
BB is:		DD is:	
HT	Analog/HART communications	60	No approval
FF	Fieldbus communications	67	FM,Intrinsically Safe, NonIncendive, Explosion-proof, Dust Ignition proof
FI	FISCO communications	69	CSA, Intrinsically Safe, NonIncendive, Explosion -proof
		73	ATEX / IECEx, Intrinsically Safe

to which this declaration relates, is in conformity with relevant Union harmonization legislation:

(2014/30/EU) EMC Directive

(2014/34/EU) ATEX Directive (The ATEX Directive is only valid if option 73 is selected)

Provisions of the directive fulfilled by the equipment:

Equipment Group II, Category 1 G Ex ia IIC T4 Ga (-20°C ≤ Ta ≤ +65°C)

Intrinsically Safe, EC Type Examination Certificate: Baseefa03ATEX0099X

Special Condition for use:

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

ATEX Notified Body for EC Type Examination Certificate & Quality Assurance:

SGS Baseefa[Notified Body Number:1180], Rockhead Business Park, Staden Lane, Buxton SK17 9RZ UNITED KINGDOM

Assumption of conformity is based on the application of the harmonized standards:

EN 61326-1:2006 Electrical equipment for measurement, control and laboratory use. EMC requirements. General requirements

EN 60079-0:2012+A11:2013 Explosive atmospheres. Equipment. General requirements

EN 60079-11:2012 Explosive atmospheres. Equipment protection by intrinsic safety "i"

K Freeman

(Signature)

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(Function name)

Kim Freeman
(Name printed)

March 23, 2017
(Date of issue)

CE marking first applied to this product in 2002

LIQ-MAN-5081
Rev A
2017

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