

**Model 876PH Intelligent Transmitter  
for pH, ORP, and ISE Measurement  
with HART<sup>®</sup> Communications**



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# 1. Introduction

The 876PH Intelligent Transmitter converts pH, ORP, or ISE measurements to a 4 to 20 mA output signal with a superimposed HART digital signal for remote configuration and monitoring. A human machine interface is integral to the device and provides simplified menu-driven configuration, calibration, status, and diagnostic procedures.

A unique feature of this transmitter is that you can save up to two complete configuration programs and restore them at any time to facilitate a quick and easy change of the transmitter to a presaved configuration.

## Reference Documents

*Table 1. Reference Documents*

| Document Number              | Document Description   |
|------------------------------|--|
| DP 611-260                   | Dimensional Print – 876PH, 876EC, and 876CR Transmitters                     |
| MI 611-206 <sup>(b)</sup>    | Instruction – Intrinsic Safety Connection Diagrams and Nonincendive Circuits |
| MI 611-208 <sup>(a)(b)</sup> | Instruction – Electrochemical Products Safety Information                    |
| PL 611-260                   | Parts List – 876PH, 876EC, and 876CR Transmitters                            |

(a) Available in many languages via our website. For help downloading this document contact our Global Customer Support Center.

(b) Not available with 876PH Transmitter information at this time.

## Factory Default Passcode

The factory default passcode for both Administrator and User is 0800.



## 2. Quick Start

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### — NOTE —

This Quick Start chapter only applies to pH measurements. For ORP or ISE measurements, see other chapters of this manual.

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The purpose of this section is to:

- ◆ Help you wire your transmitter
- ◆ Familiarize you with the instrument configuration as received from the factory
- ◆ Assist you in verifying that your transmitter is in calibration
- ◆ Explain normal operation in Measure mode.

## Wiring

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### — WARNING —

Wiring installation must comply with existing local regulations.

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### — WARNING —

For agency requirements, also see MI 611-206 (FM, CSA) or MI 611-208 (ATEX, IECEx).

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Your 876PH Transmitter is a 2-wire transmitter. As such, it transmits output over the same two wires through which it receives power. Connect this power/output signal to the power terminals at the left of the printed wiring board inside the faceplate of your transmitter and the signal from your measurement sensor to the corresponding numbered terminals at the top of the terminal board. See Figure 1.

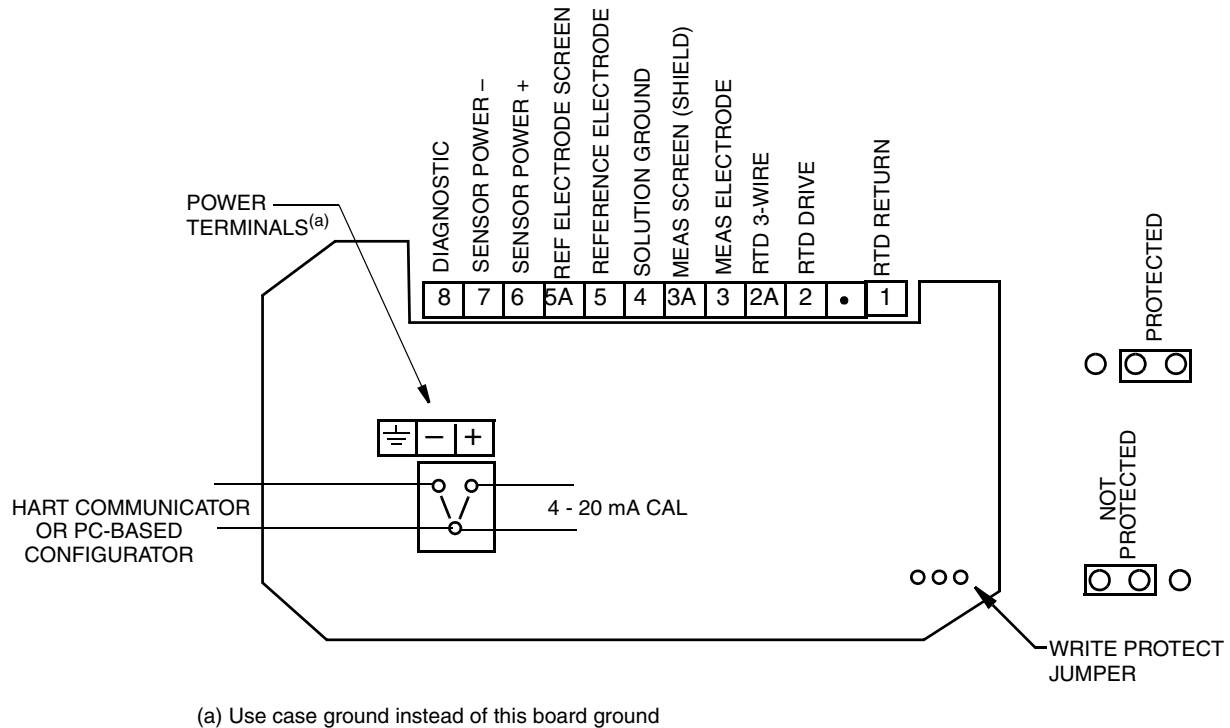
To access these terminals, remove the four screws in the corners of the bezel/keypad and open the hinged bezel/keypad downward.

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### — CAUTION —

The bezel/keypad does not open a full 180°. Do **not** press on it while wiring.

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*Figure 1. Wiring Connections for 876PH Transmitter*

— **NOTE** —

When using non-Foxboro sensors for simultaneous pH and ORP measurement, connect the pH electrode to 3, reference electrode to 5, and ORP electrode to 4.

## Checking Factory Configuration

In Configuration mode, following the structure diagrams in Appendix A and using the arrow keys, you can step through the product structure as configured in the factory. The factory default values are listed in Appendix B. The values in your transmitter may differ from these because your transmitter may have been configured at the factory to your specific requirements. In the table that comprises Appendix B, there is a column provided to make any notations you wish about your specific configuration.

When viewing these values, be sure to check that the Buffer Set parameter configured in your transmitter matches the buffer you intend to use in calibrating your device.

To enter the Configuration mode, press the **Function** key and then the **Config** key. At the prompt, enter the passcode and press **ENTER**.

— **NOTE** —

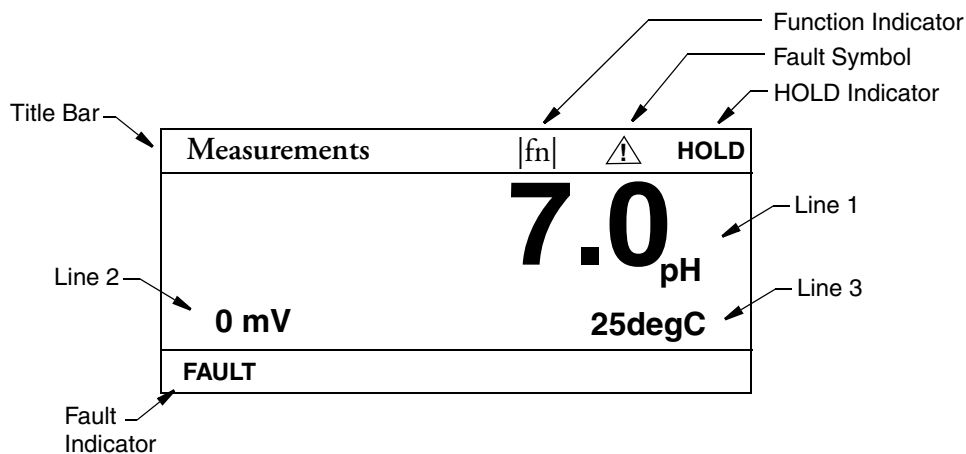
The factory default passcode for both the Administrator and User is 0800.

## Calibration

After wiring your transmitter and checking/changing the configuration, you should perform a 2-Point calibration. To enter the Calibration mode, press the **Function** key and then the **Cal** key. At the prompt, enter the passcode and press **ENTER**. Next, enter the calibrator's name, calibration day, month, and year, pressing **ENTER** after each. Then select **Measurement** from the Calibrate screen and follow the prompts for a 2-point calibration to calibrate your transmitter. At the end of a successful calibration, there should be no faults in the transmitter.

## Basic Operation in Measure Mode

Measure is the normal operating mode of your transmitter. One, two, or three measurements can be displayed depending on the configuration. When the display is configured for single line measurements, the value and unit are usually displayed. Any measurement can be temporarily scrolled onto the display by using the **Up** and **Down** arrow keys. The display returns to the configured values when you press the **Function** key and then the **Measure** key or when the configured timeout period expires. When the transmitter is in Hold mode, a **Hold** indication appears in the upper right of the title bar. If there is a fault, a flashing fault symbol is displayed. If in Measure, Status, or Diagnostic mode, the word **FAULT** also flashes in the lower left of the display. When you press the **Function** key, the function indicator is displayed.



*Figure 2. Sample 3-Line Measurement Display*

## Looking for More Information?

For more detailed information, refer to the following sections of this manual:

- ◆ For detailed installation information, refer to “Installation” on page 11.
- ◆ For detailed explanation of the controls and indicators, refer to “Operation Via Local Display” on page 17.
- ◆ For detailed configuration instructions, refer to “Configuration Mode” on page 33.
- ◆ For detailed calibration instructions, refer to “Calibration Mode” on page 29.

- ◆ For detailed operation from a HART Communicator, refer to “Operation Via HART Communicator” on page 49.

For dimensional information, refer to DP 611-260.

If you need additional help, contact our Global Customer Support Center at 1-866-746-6477 (within U.S.), 1-508-549-2424 (outside U.S.), or contact your local Invensys representative.



# 3. Specifications

## Functional and Physical Specifications

**Sensors:** Virtually any glass or antimony pH, ORP, or ISE sensor including the following:

PH12 Series Sensor

PH10 DolpHin™ Series pH Sensor

ORP10 DolpHin™ Series ORP Sensor

871PH Series pH/ORP Sensor

871A Series pH/ORP Sensor

EP460 pH/ORP Sensor

EP462 pH Sensor

EP466 pH Sensor

EP459A Fluoride Sensor Assembly

Non-Foxboro sensors without integral preamplifiers and with compatible temperature compensation elements

**Maximum Distance Between Sensor and Transmitter:**

With preamplified sensor: 152 m (500 ft)

With non-preamplified sensor that utilizes a driven shield  
(PH12, PH10-.N, 871A-1, -3; 871PH-5, -6): 15.2 m (50 ft)

**Temperature Compensation Inputs:**

100 ohm platinum RTD, 2- and 3-wire

1000 ohm platinum RTD, 2- and 3-wire

3000 ohm Balco 2-wire RTD

**Solution Temperature**

-30 to +200°C (-22 to +392°F)

**Ambient Temperature:**

Electronics: -30 to +70°C (-22 to +158°F)

Display: -20 to +70°C (-4 to +158°F)

**Relative Humidity:** 0 to 90% noncondensing

**Environmental and Corrosion Resistant Protection:** The enclosure is dusttight and weatherproof as defined by IEC IP66, and provides the environmental and corrosion resistant protection of NEMA Type 4X.

**Electromagnetic Compatibility (EMC):** The 876PH Transmitter complies with the requirements of the European EMC Directive 2004/108/EC by conforming to EN 61326-1:2006.

**Power Supply Requirements (for 4 to 20 mA output):** 12.8 to 42 V dc (see Figure 8)

**Load Limitations (for 4 to 20 mA output):** 0 to 1300 ohms (see Figure 8)

**Measurement Range (selectable):**

pH: -2 to +16 pH

ORP: -2000 to +2000 mV

ISE: 0 to 9999 ppm

Solution Temperature: -30 to +200 °C (-22 to +392°F)

**Temperature Compensation Range:**

-30 to +200°C (-22 to +392°F) for pH or ISE

0 to 100°C (32 to 212°F) for ammonia

**Approximate Weight:**

Panel Mounted: 3.1 kg (6.8 lb)

Surface or pipe Mounted: 3.7 kg (8.1 lb) including mounting bracket

## Product Safety Specifications

**— NOTE —**

The 876PH Transmitters have been designed to meet electrical safety descriptions listed in Table 2. For detailed information, or status of testing laboratory approvals/certifications, contact Invensys.

*Table 2. Product Safety Specifications*

| Testing Laboratory, Types of Protection and Area Classification  | Application Conditions                     | Electrical Safety Design Code |
|--|--|-------------------------------|
| <b>ATEX</b> II 1 G, Ex ia IIC, intrinsically safe for Zone 0.  | Temperature Class T4.<br>Ta = -20 to 60°C. | AA                            |
| <b>ATEX</b> II 3 G, Ex ic IIC, intrinsically safe for Zone 2.  | Temperature Class T4.<br>Ta = -20 to 60°C. | AN                            |
| <b>CSA</b> Ex ia IIC; intrinsically safe for Zone 0;<br>and<br><b>CSA</b> intrinsically safe, Class I, II, III,<br>Division 1, Gas Groups A, B, C, D, E, F, G. | Temperature Class T4.<br>Ta = -20 to 60°C. | CA                            |
| <b>CSA</b> Ex nL IIC; energy limited for Zone 2;<br>and<br><b>CSA</b> for Class I, II, III, Division 2, Gas<br>Groups A, B, C, D, E, F, G.                     | Temperature Class T4.<br>Ta = -20 to 60°C. | CN                            |
| <b>FM</b> AEx ia IIC; intrinsically safe for Zone 0;<br>and<br><b>FM</b> intrinsically safe, Class I, II, III,<br>Division 1, Gas Groups A, B, C, D, E, F, G.  | Temperature Class T4.<br>Ta = -20 to 60°C. | FA                            |

*Table 2. Product Safety Specifications*

| Testing Laboratory, Types of Protection and Area Classification   | Application Conditions                     | Electrical Safety Design Code |
|---|--|-------------------------------|
| <b>FM</b> AEx nC IIC; energy limited for Zone 2; and<br><b>FM</b> nonincendive, Class I, II, III, Division 2, Gas Groups A, B, C, D, E, F, G. | Temperature Class T4.<br>Ta = -20 to 60°C. | FN                            |
| <b>IECEx</b> II 1 G, Ex ia IIC; intrinsically safe for Zone 0.  | Temperature Class T4.<br>Ta = -20 to 60°C. | DA                            |
| <b>IECEx</b> II 3 G, Ex ic IIC; intrinsically safe for Zone 2.  | Temperature Class T4.<br>Ta = -20 to 60°C. | DN                            |
| No Certifications   | N/A  | ZZ                            |



# 4. Installation

## Unpacking

1. Remove the transmitter from the shipping container and check for visible damage.
2. Save the container until you determine that no shipping damage has occurred.
  - a. If no damage is observed, proceed to the mounting procedure.
  - b. If transmitter has been damaged, notify the carrier immediately and request an inspection report. Obtain a signed copy of the report from the carrier and contact our Global Client Support Center at 1-866-746-6477 or contact your local Invensys representative.

## Identification

A data label is fastened to the left side surface of the enclosure. This label provides the model number and other information pertinent to your particular transmitter.

| i n v e n s y s<br>Foxboro                                   |  |   |
|--|--|---|
| MODEL / ST   |  | — MODEL AND STYLE                             |
| CERT SPEC  |  | — ELECTRICAL CLASSIFICATION CODE              |
| REF NO   |  | — SALES ORDER / SERIAL NUMBER (IF APPLICABLE) |
| ORIGIN   |  | — PLANT OF MANUFACTURE, DATE, SERIAL NO.      |
| SUPPLY   |  | — SUPPLY VOLTAGE                              |
| POWER  |  | — POWER CONSUMPTION                           |
| CALIB  |  | — MEASUREMENT RANGE                           |
| CONFIG CD  |  | — COMMUNICATIONS                              |
| OUTPUT   |  | — mA OUTPUT                                   |
| CUST DATA  |  | — USER INFORMATION                            |
|  |  |   |
|  |  |   |
|  |  |   |
| INVENSYS PROCESS SYSTEMS INC<br>FOXBORO, MA 02035 U.S.A. [ ] |  |   |

Figure 3. Sample Data Label

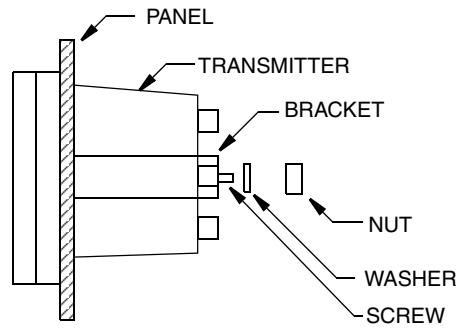
## Mounting

### Panel Mounting

Panel mounting of the transmitter is shown in Figure 4.

1. Cut panel to receive instrument.
2. Insert screws in back of instrument.

3. Place instrument into panel and add bracket, washers and nuts from back side.  
For panel cutout size, space requirements, and other dimensional data, see DP 611-260.



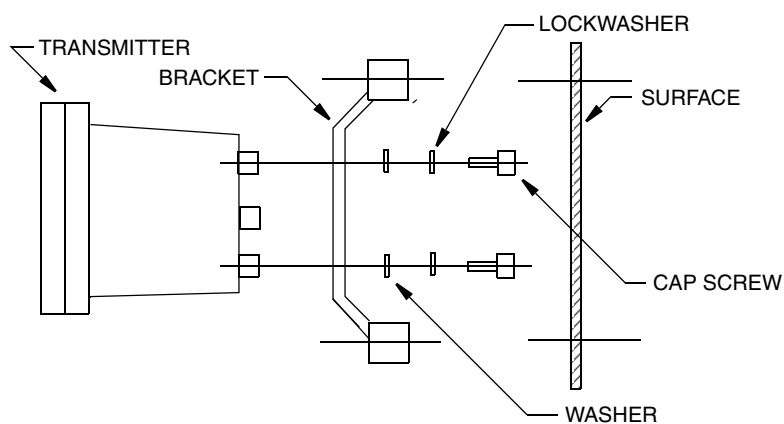
*Figure 4. Panel Mounting*

## Surface Mounting

Surface mounting of the transmitter is shown in Figure 5.

1. Fasten mounting bracket to transmitter using screws, washers, and lockwashers provided.
2. Fasten mounting plate to surface using appropriate hardware.

For space requirements and other dimensional data, see DP 611-260.



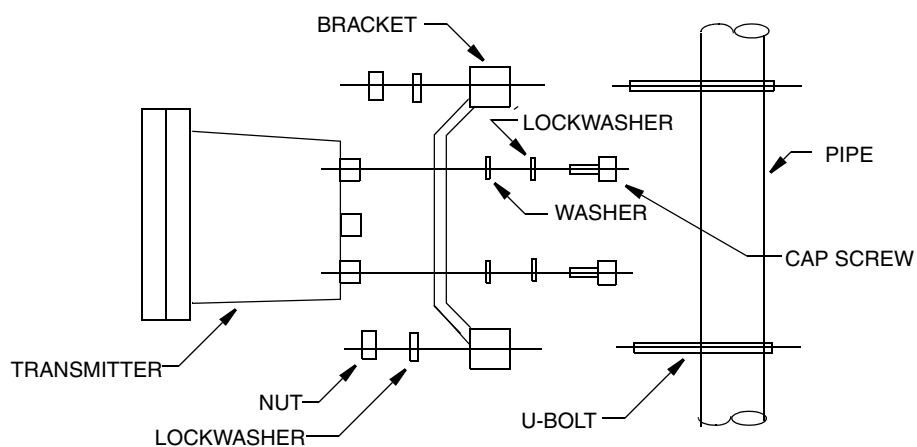
*Figure 5. Surface Mounting*

## Pipe Mounting

Pipe mounting of the transmitter is shown in Figure 6.

1. Fasten mounting bracket to instrument using hardware provided.
2. Securely fasten mounting bracket to a DN50 or 2-in pipe with U-bolts supplied.

For space requirements and other dimensional data, see DP 611-260.



*Figure 6. Pipe Mounting*

# Wiring

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**! WARNING**  
Wiring installation must comply with existing local regulations.

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**! CAUTION**  
The bezel/keypad does not open a full 180°. Do **not** press on it while wiring.

---

Your 876PH Transmitter is a 2-wire transmitter. As such, it transmits output over the same two wires through which it receives power. Connect this power/output signal and the signal from your measurement sensor as follows:

1. Remove the four screws on the corners of the faceplate and open the hinged door downward. install proper fittings in the left and right ports in the bottom of the case.

*Table 3. Recommended Conduit and Fittings*

| Material                         | Conduit                        | Fitting                     |
|----------------------------------|--------------------------------|-----------------------------|
| Rigid Metal                      | 1/2 inch Electrical Trade Size | T&B* #370                   |
| Semi-Rigid Plastic               | T&B #LTC 050                   | T&B #LT 50P or<br>T&B #5362 |
| Semi-Rigid Plastic<br>Metal Core | Anaconda Type HV, 1/2 inch     | T&B #LT 50P or<br>T&B #5362 |
| Flexible Plastic                 | T&B #EFC 050                   | T&B #LT 50P or<br>T&B #5362 |

\*T&B = Thomas & Betts Corp., 1001 Frontier Road, Bridgewater, NJ 08807

2. Bring your power wires in the left opening in the bottom of the case and attach to the power terminals at the left of the printed wiring board. See Figure 7.
3. Bring the sensor wires in the right opening in the bottom of the case and attach to the appropriate terminals at the top of the printed wiring board. See Figure 7.

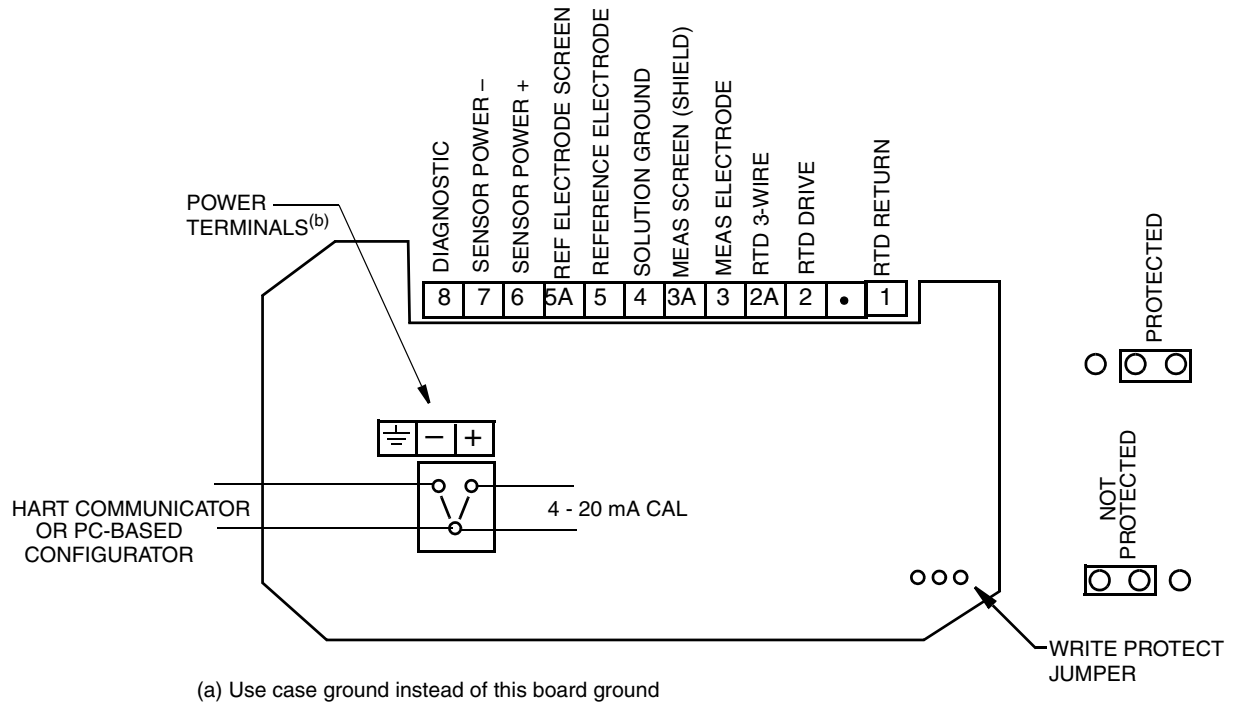
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**NOTE**  
To maintain NEMA Type 4X and IEC IP66 protection, plug any unused openings with the plug, gasket, and locknut shown in PL 611-260.

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4. Set the Write Protect jumper as shown in Figure 7.





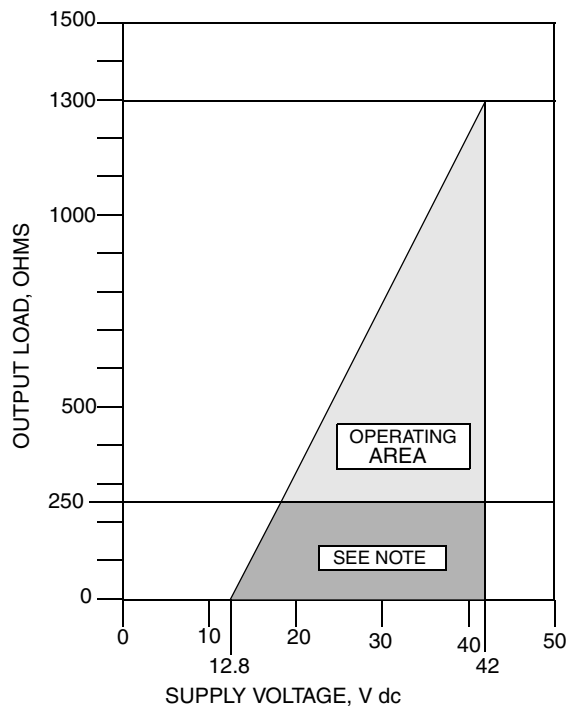
*Figure 7. Wiring Connections for 876PH Transmitter*

**— NOTE**

When using non-Foxboro sensors for simultaneous pH and ORP measurement, connect the pH electrode to 3, reference electrode to 5, and ORP electrode to 4.

## Voltage Load Requirements

The voltage load requirements are given in Figure 8.



**NOTE**  
THE TRANSMITTER CAN FUNCTION WITH AN OUTPUT LOAD LESS THAN 250 OHMS PROVIDED THAT A REMOTE CONFIGURATOR OR HART COMMUNICATOR IS NOT CONNECTED TO IT. CONNECTING A REMOTE CONFIGURATOR OR HART COMMUNICATOR WHILE OPERATING IN THIS AREA COULD CAUSE OUTPUT DISTURBANCES AND/OR COMMUNICATION PROBLEMS.

*Figure 8. Supply Power and Loop Load*

Examples:

1. For a loop load of 800 ohms, the supply voltage can be any value from 31 to 42 V dc.
2. For a supply voltage of 24 V dc, the loop load resistance can be any value from 0 to 517 ohms (250 to 517 ohms with a PC-Based configurator or a HART Communicator connected to the transmitter).

## Sensor Cable Length

The length of the cable between the sensor and the transmitter can be 152 m (500 ft) maximum if using a sensor with an integral preamplifier or used with a remote preamplifier. Without a preamplifier, the length can be 15 m (50 ft) maximum.

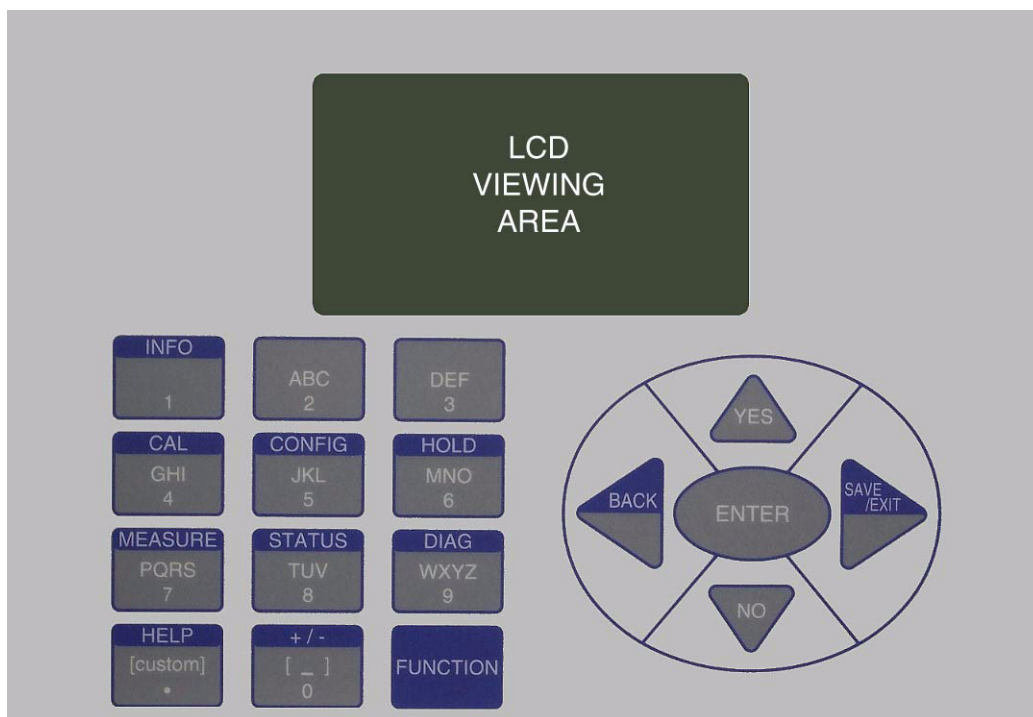
## Write Protection Jumper

Your transmitter has write protection capability which meets the security requirements of ISA-S84.01-1986 for use in safety shutdown systems. This means that the local display and remote electronics can be prevented from writing to the electronics. Write protection is set by moving a jumper that is located on the printed wiring board behind the front panel. To activate write protection, open the front panel and place it in the 'protect' position. See Figure 7. In the 'Not Protected' position, writing to certain functions can be limited by passcode protection.

# 5. Operation Via Local Display

## Controls and Indicators

Operator controls and indicators are located on the front panel. Figure 9 shows the panel arrangement. Table 4 identifies the function of each element.



*Figure 9. Indicators and Controls*

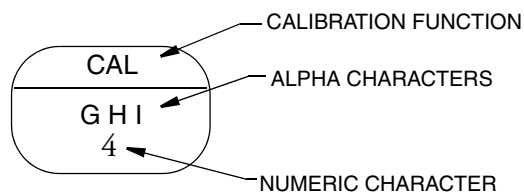
## Controls

*Table 4. Control Keys*

| Control Key       | Function  |
|-------------------|---|
| FUNCTION Key      | Gives you access to the blue function keys.   |
| INFO Key          | Describes the present parameter.  |
| CALibration Key   | Places the transmitter in Calibration mode. This enables you to calibrate the transmitter automatically to your buffer solutions or manually to values entered. |
| CONFIGuration Key | Places the transmitter in Configuration mode. This enables you to configure the value or status of each parameter required for your application.                |

*Table 4. Control Keys (Continued)*

| Control Key            | Function  |
|------------------------|---|
| HOLD Key               | Places the transmitter in Hold mode. This enables you to hold the output at a determined value while configuring or calibrating the transmitter or performing sensor maintenance.                       |
| MEASUREMENT Key        | Places the transmitter in Measurement (normal operation) mode.  |
| STATUS Key             | Places the transmitter in Status mode. This enables you to view the measurement and system parameters and thus assess the performance of the loop.  |
| DIAGNOSTICS Key        | Places the transmitter in Diagnostic mode. This enables you to further identify specific errors and possible solutions to an error flagged in Measurement mode. Also a means to access the history log. |
| HELP Key               | Describes how to use the keypad to do the present operation.  |
| +/- Key                | Changes a + value to a – value and vice versa.  |
| Alpha/Numeric Keys     | See explanation below.  |
| Direction (Arrow) Keys | Moves you through the structure diagram and subsequent menus and values.  |
| ENTER Key              | Enters the menu item or value selected. This is the only key that actually enacts a change.   |
| BACK Key               | Used with the Function key, moves you back one level in the menu structure.   |
| SAVE/EXIT Key          | Used with the Function key, asks you if you want to save your entries and then moves you to Measure mode.   |
| YES Key                | Used to answer Yes to a Yes/No question.  |
| NO Key                 | Used to answer No to a Yes/No question.   |



The alpha/numeric keys have several functions as follows:

- ◆ Access the function shown with a blue background
- ◆ Enter numeric values
- ◆ Enter alpha characters (for example, a HART tag, description, or message).

To enter an alpha character, use the key as you would on a cell phone. For example, to enter the word “Acid”, use the following sequence”

1. Press the “2” key once to enter the “A” and use the Right arrow key to advance to the next character

2. Press the “2” key three times to enter the letter “C” and press the Down arrow key to change it to lower case. Use the Right arrow key to advance to the next character.
3. Press the “4” key three times to enter the letter “I” and press the Down arrow key to change it to lower case. Use the Right arrow key to advance to the next character.
4. Press the “3” key once to enter the letter “D” and press the Down arrow key to change it to lower case.

## Indicators

The display can be configured to display one, two, or three measurements. However, any measurement can be temporarily scrolled onto the display by using the **Up** and **Down** arrow keys. The display returns to the configured values when you press the **Function** key and then the **Measure** key or when the configured timeout period expires. When the transmitter is in Hold mode, a **Hold** indication appears in the upper right of the title bar. When you press the **Function** key, the function indicator is displayed. If there is a fault, a flashing fault symbol is displayed. If in Measure, Status, or Diagnostic mode, the word **FAULT** also flashes in the lower left of the display.

---

### — NOTE —

1. If **FAULT** is displayed, details of the fault are shown in the Diagnostic mode.
  2. If **CHECK STATUS** is displayed (in the Fault Indicator location), go to Status mode to check the status.
- 

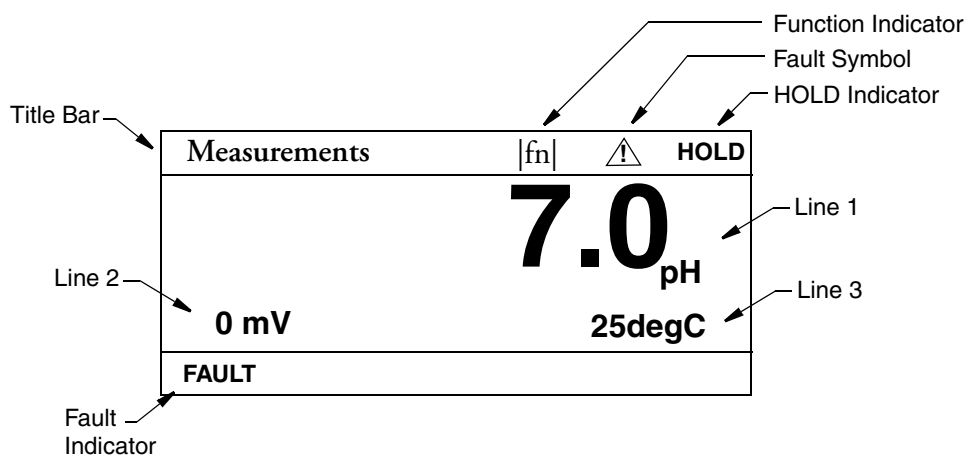


Figure 10. Sample 3-Line Measurement Display

## Passcode Access

Two levels of protection are available. Administrator (**Admin Code**) access permits changing all parameters in Configuration as well as specifying what parameters are accessible by those having User Code access. User (**User Code**) access permits change and viewing access to those areas specified by the administrator. Both are 4-digit passcodes. The passcodes may or may not be the same. They are set as part of configuring the instrument.

Upon entering the Configuration, Calibration, or Hold mode, you may be prompted to enter a passcode. To exit, select another mode.

---

**— NOTE**

---

Every passcode entry is added to the history log.

---

If entering Calibration or Configuration mode and you enter the correct passcode, the transmitter responds in one of three ways depending on how **Automatic Hold** is configured. If **Automatic Hold** is configured **Off**, the display cautions you that the transmitter is not in Hold mode. Press **ENTER** to continue. If **Automatic Hold** is configured **Present**, the display cautions that hold is engaged but that outputs are held at the present level. It then unlocks the mode. If **Automatic Hold** is configured **Manual**, the display briefly displays **Hold Engaged** and then unlocks the mode.

The initial factory default value for both Administrator and User passcodes is 0800.

To bypass the passcode, the administrator must configure a passcode of 0000.

## Timeout

If there are no key presses within the configured timeout period, the transmitter reverts to Measure mode. You can also return to Measure mode by pressing the **FUNCTION** key and then the **MEASURE** key. If in Configuration or Calibration mode and the automatic hold feature was employed, the output becomes live when the transmitter times out. The timeout feature can be turned off in Configuration mode.

## Viewing and Changing Data

In the Configuration, Calibration, Hold, and Diagnostic modes, you need to move through a structure of parameters (using the arrow keys and **ENTER** key) to view and/or change the value or status of a particular parameter. Structure diagrams, located in Appendix A, will aid you in doing this.

---

**— NOTE**

---

1. The Up and Down arrow keys scroll through a menu in either direction.
  2. Using the Function key with the Up and Down arrow keys takes you to the top and bottom of a menu respectively.
  3. If a menu selection is invalid, you will see a selection in inverted text (white letters on black background). This choice is not selectable. It will disappear after you make your choice. To keep the selection, use the **Back** key.
- 

The following example will show you how to use the keys in moving through the structure. The example used is that of configuring temperature features. For the example, assume Fahrenheit temperature units, an automatic temperature mode, and a fail temp value of 77°F. Refer to Figure 11.

1. To enter the Configuration mode, press the **FUNCTION** key and then the **CONFIG** key. Press **ENTER**.
2. Press the Down arrow key twice to move from **Sensor** to **Temp Config**. Press **ENTER**.
3. The **Temp Config** screen is displayed. **Temp Units** is highlighted. Press **ENTER**.

4. Use the Up or Down arrow key to move to **degF** and press **ENTER**. This enters your Fahrenheit selection and moves the display back to the **Temp Units** screen.
5. Use the Down arrow key to move to **Temp Mode**. Press **ENTER**.
6. The **Temp Mode** screen is displayed. Use the Up or Down arrow key to move to **Auto** and press **ENTER**. This enters your Auto Mode election and moves the display back to the **Temp Mode** screen.
7. Use the Down arrow key to move to **Fail Temp**. Press **ENTER**.
8. The **Fail Temp** screen is displayed.
9. Press the “7” key twice. Press **ENTER**. This enters your selection of 77 and moves the display back one level.
10. Press the **FUNCTION** and **SAVE/EXIT** keys to save your configuration.

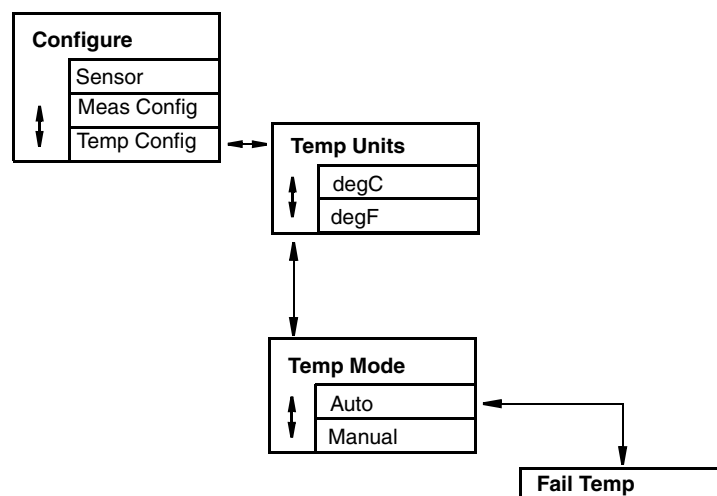
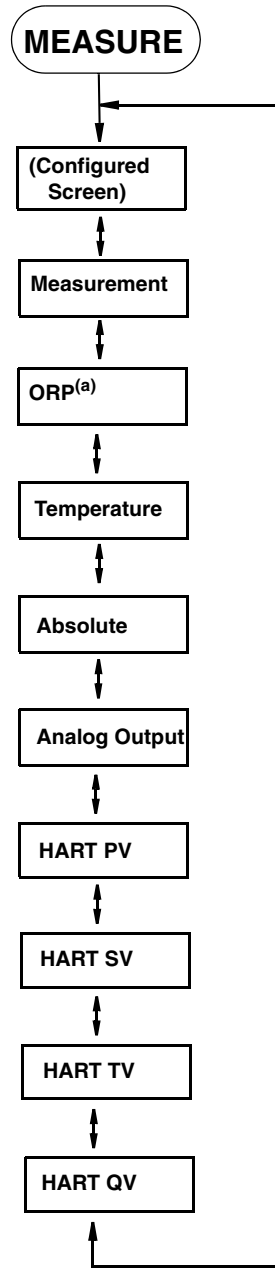


Figure 11. Example of Structure Diagram

## Measure Mode

Measure is the normal operating mode of your transmitter. Depending on your configuration, the display can show 1, 2, or 3 measured values. In Configure mode, you can also configure what to display on each line. The choices are the (pH, ORP, or ISE) measurement, the absolute value of the measurement in millivolts, the temperature, and the analog output (4 to 20 mA). The units are always shown with the measured values.

Any measured values can be temporarily scrolled onto the display by using the Up and Down arrow keys. See Figure 12. The display returns to the configured values when you press the **FUNCTION** key and then the **MEASURE** key or when the timeout period expires. When the transmitter is in Hold, a hold indication appears in the upper right of the display. If there is a fault, a fault symbol is displayed in the title bar and, if in Measure, Status, or Diagnostic mode, the word **FAULT** flashes in the lower left of the display. See Figure 2.



(a) Only if Sensor = pH and ORP

Figure 12. Measure Mode Structure Diagram



## Status Mode

Refer to Figure 13 on page 25.

The Status mode enables you to view the measurement and system parameters and thus assess the performance of the loop. You can not edit them in this mode. All measurements and outputs continue while you are in the Status mode.

To enter the Status mode, press the **FUNCTION** key and then the **STATUS** key. Move through the menu by using the Up and Down arrow keys. See Figure 13 on page 25. The Status menu contains the following parameters:

*Table 5. Status Parameters*

| Parameter                 | Description   | Units                                     | Notes                                   |
|---------------------------|---|---|---|
| Temperature               | Process temperature measurement   | degC, degF                                |   |
| Temp Status               | Status of process temperature   | - - -                                     | See Table 6                             |
| Absolute                  | Uncompensated measurement signal from sensor  | mV  |   |
| Absolute Status           | Status of absolute measurement  | - - -                                     | See Table 6                             |
| Temperature Sensor        | Temperature sensor resistance   | Ohms                                      |   |
| T Sensor Status           | Status of temperature sensor  | - - -                                     | See Table 6                             |
| Measurement               | Compensated measurement   | pH: pH<br>ORP: mV,<br>ISE: ppm,<br>ppb, % |   |
| Meas Status               | Status of measurement   | - - -                                     | See Table 6                             |
| Glass                     | Resistance of glass electrode   | k $\Omega$                                | If Broken Glass diagnostic enabled      |
| Glass Status              | Status of glass electrode resistance  | - - -                                     | See Table 6                             |
| Reference                 | Reference junction resistance   | k $\Omega$                                | If Reference Coating diagnostic enabled |
| Ref Status                | Status of reference junction resistance   | - - -                                     | See Table 6                             |
| Calibrated By             | Name of last operator   | - - -                                     |   |
| Calibration Date          | Date of last calibration (dd/mm/yyyy)   | - - -                                     |   |
| Slope (mV) <sup>(a)</sup> | Change in mV/pH or mV/decade of the most recent calibration                               | mV/pH,<br>mV/decade                       | If pH or ISE                            |
| Slope (%) <sup>(a)</sup>  | Deviation in percent of the slope of the most recent calibration compared to the standard | %   |   |

Table 5. Status Parameters (Continued)

| Parameter                   | Description  | Units               | Notes                |
|-----------------------------|--|---------------------|----------------------|
| Asymmetry                   | Asymmetry potential (mV difference between the theoretical isopotential point and the actual point due to the most recent calibration) | mV                  | If not ORP           |
| Lo Cal Point <sup>(b)</sup> | Values at Calibration Point One  | mV, pH, conc, ORPmV |                      |
| Hi Cal Point <sup>(b)</sup> | Values at Calibration Point Two  | mV, pH, conc, ORPmV |                      |
| Analog Output               | Analog Output  | mA                  |                      |
| Analog Output Status        | Status of analog output  | ---                 | See Table 6          |
| HART PV                     | PV measurement   |                     |                      |
| PV Status                   | Status of PV   | ---                 | See Table 6          |
| HART SV                     | SV measurement   |                     |                      |
| SV Status                   | Status of SV   | ---                 | See Table 6          |
| HART TV                     | TV measurement   |                     |                      |
| TV Status                   | Status of TV   | ---                 | See Table 6          |
| HART QV                     | QV measurement   |                     |                      |
| QV Status                   | Status of QV   | ---                 | See Table 6          |
| Model Code                  | Model code   | ---                 |                      |
| Sales Order                 | Sales order number   | ---                 |                      |
| Xmtr Serial Number          | Transmitter serial number  | ---                 |                      |
| Firmware Revision           | Firmware revision level.   | ---                 |                      |
| Front End Revision          | Front end revision level   | ---                 | For Foxboro use only |
| Boot Revision               | Boot revision level  | ---                 | For Foxboro use only |
| Transmitter Type            | Transmitter type (876PH)   | ---                 |                      |
| In Service                  | Time in service  | Days                |                      |
| HART Tag                    | HART Tag   | ---                 |                      |
| HART Long Tag               | HART Long Tag  | ---                 | HART Versions 6 & 7  |
| Tag Name                    | Tag name   | ---                 |                      |
| Location                    | Location of measurement  | ---                 |                      |
| Device Name                 | Device name  | ---                 |                      |
| HART Descriptor             | HART Descriptor  | ---                 |                      |
| HART Message                | HART Message   | ---                 |                      |

(a) In multiple point calibrations, this is the slope closest to the isopotential point.

(b) In multiple point calibrations, this is the point closest to the isopotential point.

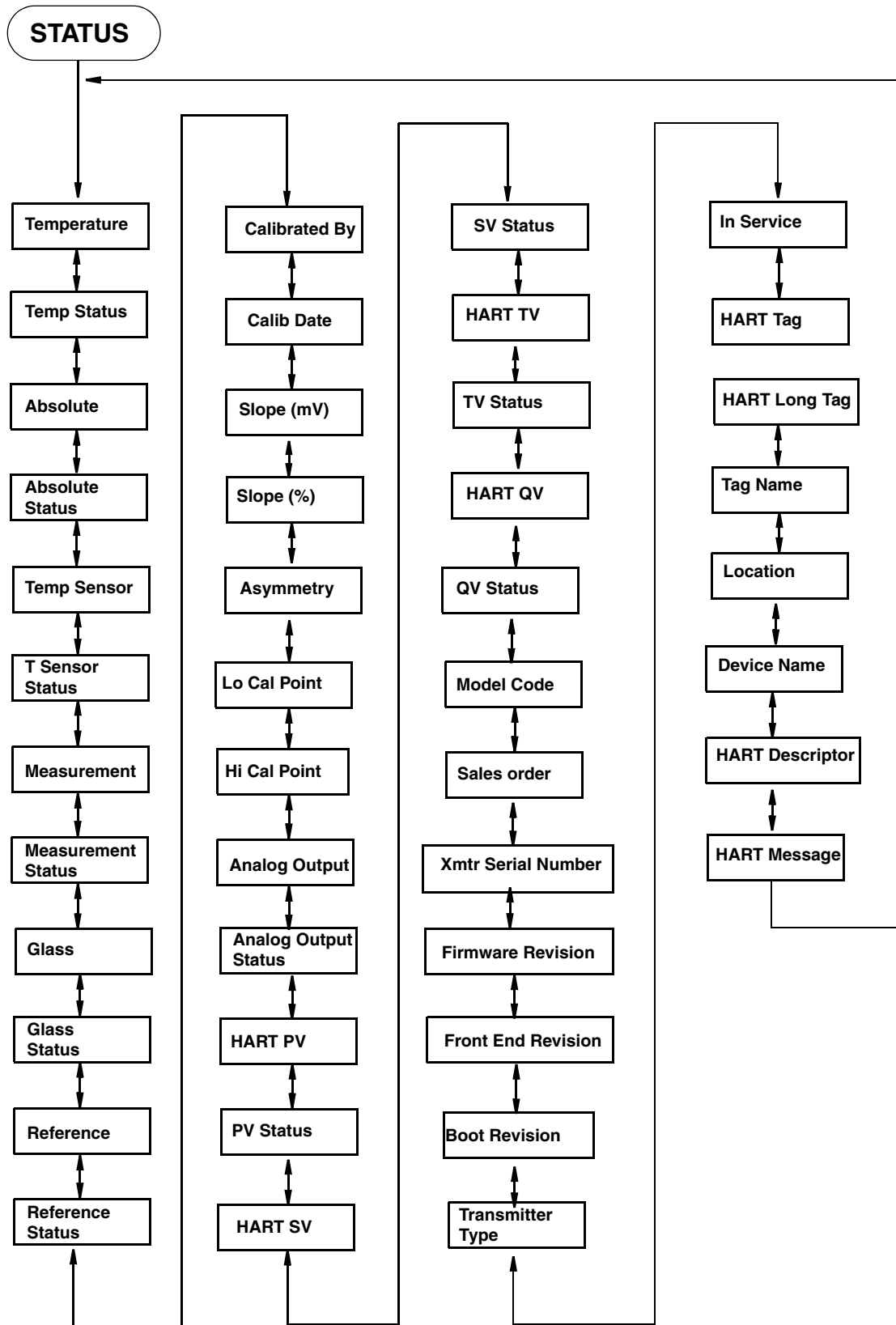


Figure 13. Status Mode Structure Diagram

*Table 6. Status Messages*

| <b>Displayed Message</b> | <b>Meaning</b>                                  | <b>Information on That Error<sup>(a)</sup></b>   |
|--------------------------|---|--|
| Meas OK                  | Measurement OK                                  | OK. All inputs and calculations for the measurement are OK.                            |
| 1 InputFixed             | Input is fixed                                  | OK. Calculation based upon an input is fixed at its manually set value.                |
| Overridden               | Measurement is overridden                       | Measurement has been put into hold mode.   |
| Default                  | Meas is fixed                                   | OK. Measurement is fixed at the manually set value.                                    |
| LimitSoftLow             | The measurement is approaching the lower limit. | Warning. The measurement is approaching the lower limit.                               |
| LimitSoftHi              | The measurement is approaching the upper limit. | Warning. The measurement is approaching the upper limit.                               |
| InputWarning             | Input to meas has a warning                     | Warning. Measurement input has a warning status.                                       |
| LimitHardLow             | Meas below low limit                            | Bad. The measurement has dropped below hard lower limit.                               |
| LimitHardHi              | Meas above upper limit                          | Bad. The measurement has risen above hard upper limit.                                 |
| 1 Input Bad              | Input to meas is bad                            | Bad. An input to the measurement has a bad status.                                     |
| MeasStarting             | Inputs to meas are not ready                    | Bad. A to D converter has not yet measured everything for this individual measurement. |
| InputStarting            | Inputs to meas are not ready                    | Bad. A to D converter has not yet measured everything for this individual measurement. |

(a) Displayed when the Function and Info keys are pressed for that fault

## Hold Mode

Refer to Figure 14.

---

**— NOTE**

---

Hold mode may be protected. See “Passcode Access” on page 19.

---

The Hold mode enables you to manually hold the output at a determined value, thus allowing you to configure or calibrate the transmitter or perform sensor maintenance without disturbing the control system. Outputs are driven to a preconfigured state or held at their current values. During calibration, the transmitter continues performing live measurements.

---

**— ! WARNING**

---

When entering hold, you may want to take your loop out of auto control.

---

To enter the Hold mode, press the **FUNCTION** key and then the **HOLD** key. In the Hold mode menu, select **On Present** to hold all values and states at their current level, **On Manual** to set all values and states at desired levels, or **Off** to release a hold.

If you select **On Present** and press the **ENTER** key, the display briefly reads **Hold Engaged** and proceeds to Measure mode and the outputs are held.

If you select **On Manual** and press the **ENTER** key, the display proceeds to **AO Hold**, the first of a series of parameters to set values and states to desired levels during hold.

---

**— NOTE**

---

Additionally, in Configuration mode, you can use the **Automatic Hold** parameter to automatically activate the Hold feature each time you enter Calibration or Configuration mode. In this Configuration mode parameter, you can select **Off**, **Present**, or **Manual**. However, if you select **Manual**, you must go to Hold mode to set the values.

---

To set the output for the analog output, enter a value from 3.6 to 22 mA.

You can also fix the value for PV, SV, TV, and QV individually. When you have finished making the manual selections, the display briefly reads **Hold Engaged** and returns to the Hold mode menu.

To release Hold, press the **FUNCTION** key and then the **HOLD** key. At the Enter Passcode prompt, enter the correct passcode and press the **ENTER** key. If you enter the incorrect passcode, the display repeats the prompt. If you enter the correct passcode, the display opens the Hold mode. Use the Up or Down arrow key to select **Off** and press **ENTER**. The display briefly reads **Hold Released** and returns to the Hold mode menu.

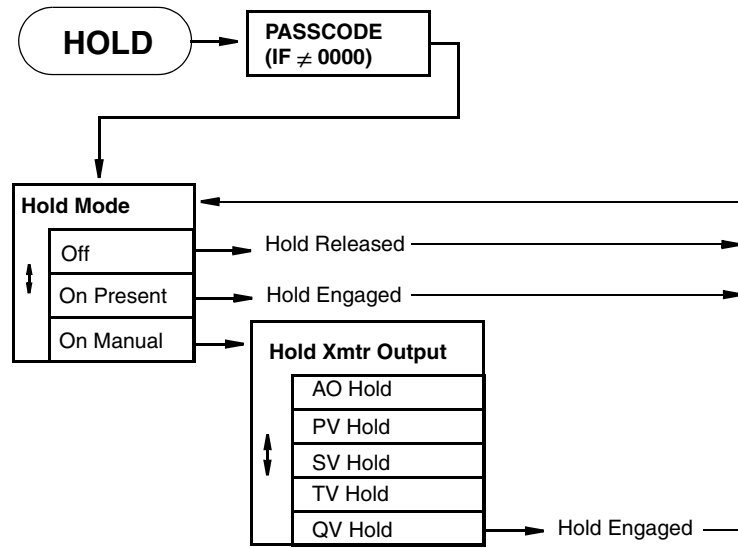


Figure 14. Hold Mode Structure Diagram

## Calibration Mode

Refer to Figure 15

---

### — NOTE

1. Calibration mode may be protected. See “Passcode Access” on page 19.
  2. If using the **Automatic Hold** feature, the outputs are held at the present level or a predetermined level. Returning to Measure mode releases the hold.
- 

Five calibration selections are available; mA Cal, Measurement, Temperature, ORP, and ORP Restore. See Figure 15.

To enter the Calibration mode, press the **FUNCTION** key and then the **CAL** key. Press **ENTER**. The display moves to the first parameter in Calibration mode. At the prompts, enter the name of the person doing the calibration and the calibration day, month, and year.

### mA Cal

---

#### — NOTE

It is not necessary to do a mA Cal (commonly known as mA Trim) unless there is a plant requirement to make the 4 and 20 mA output values exactly match readings on certain plant calibration equipment and the calibration operations done result in a small but unacceptable difference between the transmitter mA output and the test equipment mA readout values.

---

To perform a mA calibration, select **mA Cal** and press **ENTER**.

1. Connect a digital current meter in the loop.
2. At the prompt **4 mA**, press **ENTER**.
3. At the prompt **Known x.xxx**, enter the value measured and press **ENTER**.
4. At the prompt, **20 mA**, press **ENTER**.
5. At the prompt **Known x.xxx**, enter the value measured and press **ENTER**.
6. When calibration is done, the display reads **Cal Complete**. Press **ENTER**.

## Measurement Calibration

Measurement Calibration is used when you selected ‘**pH**’ ‘**ISE**’ or ‘**ORP**’ as your Measurement. See “Sensor” on page 33.

To perform a measurement calibration, select **Measurement** and press **ENTER**.

1. At the prompt, enter the number of calibration points from 1 to 5.
2. At the next prompt, select the standard as **Manual**, **Smart**, or **Process**.

**Manual** presumes no knowledge by the transmitter of the calibration solution being used. You must enter the exact known value at the calibration temperature. No temperature compensation is applied in the firmware.

**Smart** presumes any of the configurable calibration standards. Solutions are recognized automatically so there is no need for you to enter a known value. The temperature response for the recognized solution is used in the calibration. If none of

the solutions provide a unique match ( $\pm 0.5$  pH of nominal buffer value), the calibration reverts to a **Manual** calibration.

**Process** presumes a grab sample of the process. You must enter a known value at the reference temperature (usually 25°C) from laboratory measurements. The configured application temperature compensation is applied.

---

— **NOTE** —

---

Process only appears in the menu if you selected **Ammonia** or **Custom** as your type of temperature compensation (See “Temperature Compensation” on page 36).

---

3. At the prompt, put the sensor in the first solution and press **ENTER**.
4. If you selected **Manual** in Step 2:
  - a. Measurement/Temperature is temporarily displayed while process is stabilizing.
  - b. At the prompt, enter the known measurement value at the current temperature and press **ENTER**.
5. If you selected **Smart** in Step 2,
  - a. Measurement/Temperature is temporarily displayed while process is stabilizing.
  - b. You do not need to enter the known pH values as you did in **Manual**.
6. If you selected **Process** in Step 2:
  - a. Measurement/Temperature is temporarily displayed while process is stabilizing.
  - b. At the prompt, enter the known measurement value at the reference temperature (25°C) and press **ENTER**.
7. Repeat Steps 3 and 4, 3 and 5, or 3 and 6 as applicable for each calibration point.
8. When calibration is done, the display reads **Cal Complete**. Press **ENTER**.

## Temperature Calibration

To perform a Temperature calibration, select **Temperature** and press **ENTER**.

1. At the prompt, enter the number of calibration points as 1 or 2.
2. At the prompt, place the sensor in solution at the low temperature and press **ENTER**.
3. Temperature is temporarily displayed while process is stabilizing.
4. At the prompt, enter the known low temperature and press **ENTER**.
5. If a 2-point calibration, at the prompt, place the sensor in solution at the high temperature and press **ENTER**.
6. At the prompt, enter the known high temperature and press **ENTER**.
7. Temperature is temporarily displayed while process is stabilizing.
8. When calibration is done, the display reads **Cal Complete**. Press **ENTER**.

## ORP Calibration

ORP Calibration is only used when you selected ‘**pH and ORP**’ as your Measurement. See “Sensor” on page 33.



To perform an ORP calibration, select **ORP** and press **ENTER**.

1. At the prompt, apply the solution and press **ENTER**.
2. ORP is temporarily displayed while process is stabilizing.
3. At the prompt, enter the known measurement value and press **ENTER**.
4. When calibration is done, the display reads **Cal Complete**. Press **ENTER**.

## ORP Restore

ORP Restore enables you to erase an ORP calibration.

To perform an ORP Restore, select **ORP Restore** and press **ENTER**. At the prompt **Erase Calibrations?**, respond **Yes** to erase the calibration and restore the ideal mV calibration performed at the factory; respond **No** to keep the present calibration.

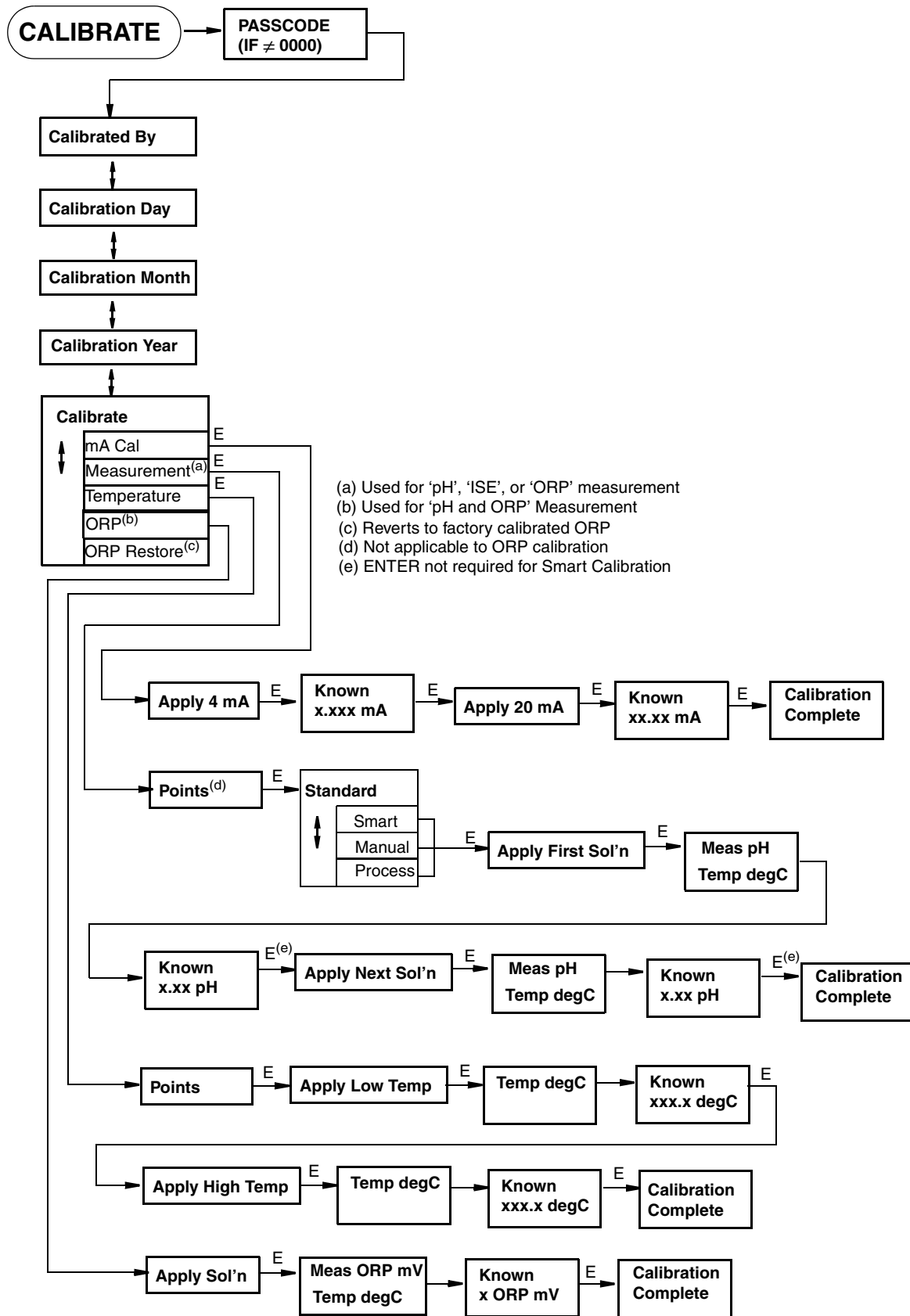


Figure 15. Calibration Menu Structure

## Configuration Mode

---

### — NOTE —

1. Configuration mode may be protected. See “Passcode Access” on page 19.
  2. If using the **Automatic Hold** feature, the outputs are held at the present level or a predetermined level. Returning to Measure mode releases the hold.
- 

Configuration is the process of establishing functional capability in the transmitter firmware for your application. This section helps you to systematically determine and configure the value or status of each parameter required for your application. Invensys recommends that you make configuration changes from the beginning of the menu structure forward. This is because menus are forward referencing meaning that if you start at the beginning and work to the end, you achieve a valid configuration. Also, the transmitter validates the configuration when attempting to exit configuration and directs you to any invalid parameters.

To enter the Configuration mode, press the **FUNCTION** key and then the **CONFIG** key. After gaining access to Configuration, the first category in the top level configuration structure, **Sensor**, is displayed. To view or change another configuration category, press the Up or Down arrow key. When you have located the desired category, press the **ENTER** key. Each category of parameters is shown in subsequent structure diagrams.

---

### — CAUTION —

If there are no key presses within the configured Timeout period, the transmitter reverts to Measure mode and all changes are lost.

---

## Sensor

Refer to Figure A-2 on page 62.

This section of the configuration structure begins by asking you to specify your type of measurement as **pH**, **pH and ORP**, **ISE Concentration**, or **ORP**.

---

### — NOTE —

Whenever the Measurement type or Electrode is entered and saved, any user calibration is erased and the transmitter reverts to an ideal sensor calibration.

---

### pH

If you selected **pH**, you must specify the electrode as **Glass**, **Antimony**, or **Other**. **Glass** sets the isopotential point at 7 pH. **Antimony** sets it at 1 pH. **Other** allows the isopotential point to be set manually from -2.0 through +16.0 pH. If you selected **Other**, you must also enter the **Slope**.

Next specify the temperature (RTD) type as **2-Wire Pt 100 Ω**, **2-Wire Pt 1000 Ω**, **3-Wire Pt 100 Ω**, **3-Wire Pt 1000 Ω**, or **Balco 3 kΩ**

*Table 7. RTD Type for Foxboro Sensors*

| Foxboro Sensor | RTD Type                         |
|----------------|----------------------------------|
| PH12           | 3-Wire Pt 100 Ω 3-Wire Pt 1000 Ω |

Table 7. RTD Type for Foxboro Sensors

| Foxboro Sensor        | RTD Type   |
|-----------------------|--|
| PH10 pH Sensor        | 2-Wire Pt 100 $\Omega$ 3-Wire Pt 1000 $\Omega$ 2-Wire 3 k $\Omega$ Balco |
| ORP10 ORP Sensor      | 2-Wire Pt 100 $\Omega$ 3-Wire Pt 1000 $\Omega$ 2-Wire 3 k $\Omega$ Balco |
| 871A pH/ORP Sensor    | 2-Wire Pt 100 $\Omega$ 2-Wire Pt 1000 $\Omega$ 3-Wire Pt 1000 $\Omega$   |
| EP460 pH/ORP Sensor   | 3-Wire Pt 100 $\Omega$   |
| EP462 pH Sensor       | 3-Wire Pt 100 $\Omega$   |
| EP466 pH Sensor       | 3-Wire Pt 100 $\Omega$   |
| EP459 Fluoride Sensor | 2-Wire Pt 100 $\Omega$   |

(a) In order to select a 3-wire RTD type, the RTD third wire must be connected to Terminal 2A.

### *pH and ORP*

This allows simultaneous measurement of both pH and ORP using a single reference electrode. Ideally, this would use a single sensor having all three required electrodes, but could use two distinct sensors. Connect the pH electrode to terminal 3, the ORP electrode to terminal 4, and one reference electrode to terminal 5.

When using this configuration, the  $\pm 2000$  mV range applies independently to both terminals 3 and 5 relative to terminal 4. In other words, pH mV – ORP mV must remain within the  $\pm 2000$  mV range.

If you selected **pH and ORP**, you must specify the pH electrode as **Glass**, **Antimony**, or **Other**. **Glass** sets the isopotential point at 7 pH. **Antimony** sets it at 1 pH. **Other** allows the isopotential point to be set manually from -2.0 through +16.0 pH. If you selected **Other**, you must also enter the **Slope**.

Next specify the temperature (RTD) type as **Balco 3 k $\Omega$  2-Wire Pt 100  $\Omega$  2-Wire Pt 1000  $\Omega$  3-Wire Pt 100  $\Omega$**  or **3-Wire Pt 1000  $\Omega$**  See Table 7.

---

#### — NOTE —

When using non-Foxboro sensors for pH and ORP measurement, see wiring note on page 15.

---

### *ISE Concentration*

If you selected ISE Concentration, you must configure the following:

1. Specify the ion polarity (Electrode) as **Positive** or **Negative**. A positive ion selective mV value gets more positive as the concentration increases (for example, Na<sup>+</sup>, K<sup>+</sup>). A negative ion selective mV value gets more negative as the concentration increases (for example, F<sup>-</sup>, S<sup>-2</sup>). For fluoride measurements, this parameter should be set to negative.
2. Enter the **Isopotential** point from 0.0001 to 9999.9 in concentration units selected in “ISE Concentration” on page 35.
3. Specify the **Valence** as **Monovalent** (for example, F<sup>-</sup>) or **Divalent** (for example, S<sup>-2</sup>)

4. Specify the temperature (RTD) type as **2-Wire Pt 100  $\Omega$**  **2-Wire Pt 1000  $\Omega$**  **3-Wire Pt 100  $\Omega$**  **3-Wire Pt 1000  $\Omega$**  or **Balco 3 k $\Omega$**  See Table 7.

### *ORP*

If you selected ORP, you only have to specify the temperature (RTD) type. The choices are **Balco 3 k $\Omega$** , **2-Wire Pt 100  $\Omega$** , **2-Wire Pt 1000  $\Omega$** , **3-Wire Pt 100  $\Omega$**  or **3-Wire Pt 1000  $\Omega$**  See Table 7.

## Measurement Configuration

Refer to Figure A-3 on page 63.

As in the previous parameter, the structure of Meas Config is dependent on the type of measurement you selected.

### *pH*

If your Measurement selection was pH, specify your **pH Resolution** as **0.1 pH** or **0.01 pH**.

Then enter the **Damping** response time (for 90% recovery from a step change). You can enter a time up to 300 seconds expressed in seconds. To increase damping, use a higher response time. Damping applies only to compensated measurement data, not to temperature or absolute data.

### *pH and ORP*

If your Measurement selection was pH and ORP, specify your **Resolution** as **0.1 pH** or **0.01 pH**.

Then enter the **Damping** response time (for 90% recovery from a step change). You can enter a time up to 300 seconds expressed in seconds. To increase damping, use a higher response time. Damping applies only to compensated measurement data, not to temperature or absolute data.

### *ISE Concentration*

If your Measurement selection was ISE Concentration, specify the **ISE Units** as **ppb**, **ppm**, **%**, or **Custom**.

Next, specify the **ISE Scale** as **0.9999**, **9.999**, **99.99**, **999.9**, or **9999**.

If you selected **Custom** as your **ISE Unit**, you must name (text) that unit in **Custom Units**.

Then enter the **Damping** response time (for 90% recovery from a step change). You can enter a time up to 300 seconds expressed in seconds. To increase damping, use a higher response time. Damping applies only to compensated measurement data, not to temperature or absolute data.

## Temperature Configuration

Refer to Figure A-4 on page 63.

### *Temp Unit*

Specify **Temp Unit** as **degC** or **degF**. All references to temperature appear in the specified units within the transmitter software.

## Temp Mode

Specify the **Temp Mode** as **Auto** or **Manual**.

In **Auto** mode, the temperature follows the temperature input RTD and you can set a temperature fail signal value (**Fail Temp**), in case the RTD fails, at the temperature at which you expect the process to be operating.

In **Manual** mode, the temperature can be set at a fixed temperature value (**Manual Temp**) and resistance inputs on the temperature terminal are ignored.

## Temperature Compensation

Refer to Figure A-5 on page 64.

This section of the structure asks you to specify the temperature compensation if you are measuring pH or ISE.

---

### — NOTE —

This section does not appear if you selected **ORP** as your **Measurement**.

---

If **pH** or **pH and ORP** was chosen as your **Measurement**, specify **Standard**, **Ammonia**, or **Custom**. **Standard** assumes a glass or antimony electrode and applies the Nernst equation. The nominal temperature compensation range is -30 to +200° C (-22 to +392° F). **Ammonia** compensates for traces of ammonia in addition to the standard compensation. **Custom** allows you to specify particular solution characteristics into the transmitter's memory. When using Ammonia or Custom compensation, all measurements are corrected back to a reference temperature measurement value. Therefore, you are asked to specify a reference temperature. The reference temperature (**Reference Temp**) can be set within the temperature compensation range. For Custom, a number of points needs to be specified. The number of points (**Points**) can be specified from 2 to 21 points. Each point specifies a value at a certain temperature. The temperatures can be set from -30 through + 200°C (-22 through +392°F). The temperature units were specified in the previous section. The values can be specified within the current scale.

---

### — NOTE —

The temperature values must be entered in increasing or decreasing order or the display will read **Slope Error**.

---

If **ISE Concentration** was chosen as your **Measurement**, you must specify **Standard** or **Custom**. **Custom** causes you to specify a reference temperature and a number of points to plot a compensation curve. The procedure is described immediately above.

## Analog Out (PV)

Refer to Figure A-6 on page 64.

This section of the structure enables you to specify what measurement the analog output reflects and the minimum and maximum range values for the output just specified. It also enables you to specify the measurement for the HART secondary, tertiary, and fourth measurements.

First, specify **AO Source Measurement** as **Measurement**, **Temperature**, **ORP**, **Absolute**, **Glass Resistance**, **Reference Res** (reference junction resistance), or **ATC Resistance**.

**— NOTE**

AO Source Measurement selections are limited by your configuration of sensor and diagnostics.

Next, in **Lower Value** enter the value of that measurement that produces an output of 4 mA and in **Upper Value**, the value of the measurement that produces an output of 20 mA. The lower and upper values must differ by a minimum amount. That minimum span amount is 0.5 pH for pH measurement, 32 mV for ORP measurement, and the amount shown in Table 8 for ISE measurement.

*Table 8. Minimum Output Span for ISE Measurement*

| Scale  | Minimum Span |
|--------|--------------|
| 9999   | 80 ppm       |
| 999.9  | 8 ppm        |
| 99.99  | 0.8 ppm      |
| 9.999  | 0.08 ppm     |
| 0.9999 | 0.008 ppm    |

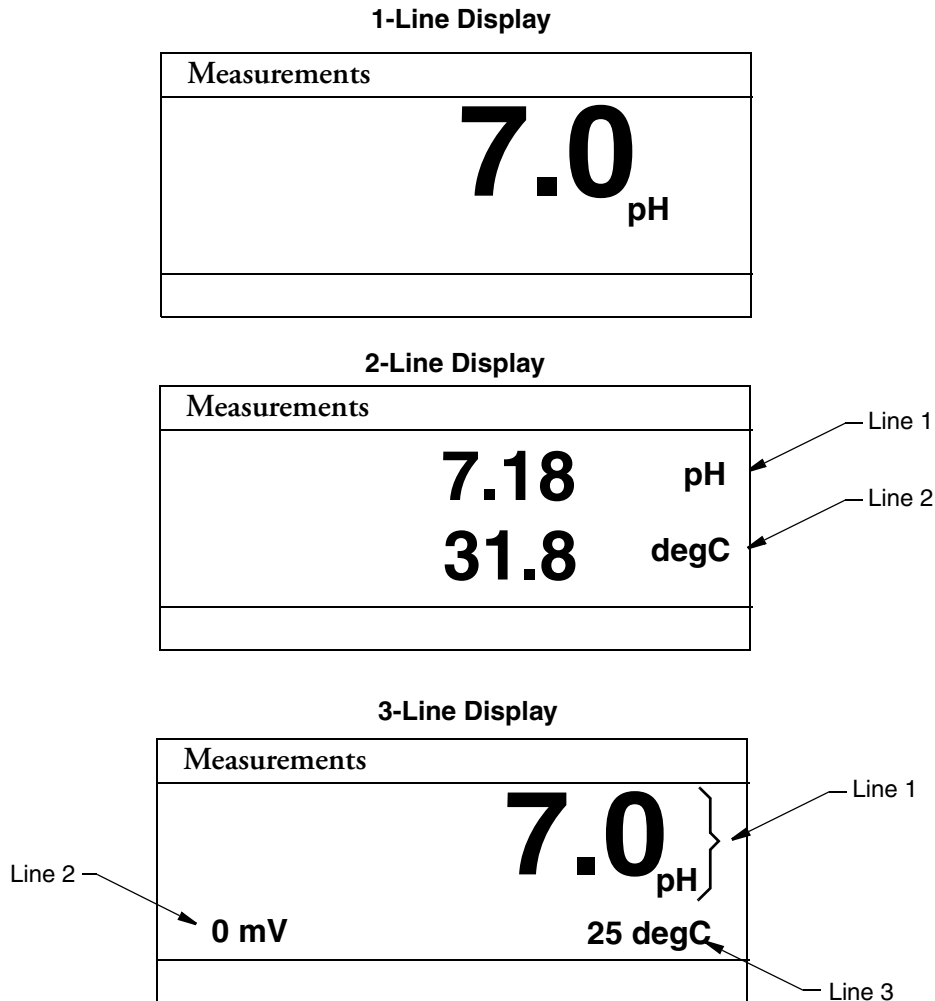
Then specify the measurements of **HART SV**, **HART TV**, and **HART QV** as **Measurement**, **Temperature**, **ORP**, **Absolute**, **Glass Resistance**, **Reference Res**, or **ATC Resistance**. The secondary measurement is frequently configured to temperature, the tertiary measurement to Absolute, and the fourth measurement (if used) to ATC Resistance.

## Display Format

Refer to Figure A-7 on page 65.

The Display Format section of the structure enables you to display one, two, or three measurements. Then you can specify what measurement you want on each line of the display.

In **Display Format**, first specify the number of measurements to be displayed by selecting **Single Line**, **Double Line**, or **Triple Line**. Then specify what measurement you want displayed on **Line 1**, **Line 2** (if Double or Triple), and **Line 3** (if Triple).



*Figure 16. Measurement Display*

## AO Failsafe

Refer to Figure A-8 on page 65.

---

**— NOTE —**

The AO Failsafe parameter is not available with multidrop communication.

---

A fail-safe output is delivered for those diagnostic failures that have been configured **On** as well as other failures. The AO Failsafe section of the structure enables you to specify the analog output under these fault conditions.

In AO Failsafe, select **Fail Low** to drive the analog output to 3.6 mA; select **Fail High** to drive the analog output to 22 mA; select **Off** to omit this feature (continues to follow the measurement). If **Off** is selected, you can continue to monitor failures using the HART protocol.



---

— **! CAUTION** —

Invensys recommends that this feature be configured to protect your process in case of a fault.

---

## HART Digital

Refer to Figure A-9 on page 65.

The HART Digital section of the structure enables you to set parameters for HART communication.

### In **Poll Address**:

Enter a number from 0 through 15 if using HART Version 5.

---

— **NOTE** —

In HART Version 5, address 1 through 15 is reserved for multidrop.

---

Enter a number from 0 through 63 if using HART Version 6 or 7.

If using HART Version 6 and 7, enter the **mA Loop Mode** as **Active** or **Multi-Drop**.

**Preambles**, the number of preambles to be sent in a response message from the transmitter to the host, are read only.

In **HART Version**, enter the version of the firmware being used.

---

— **NOTE** —

The Device Description (DD) must match the HART firmware version.

HART 5 - - - DD  $\leq$  14053F

HART 6 - - - DD  $\geq$  140540

HART 7 - - - DD  $\geq$  140580

---

## Diagnostics

Refer to Figure A-10 on page 66.

This section of the structure allows you to configure fault messages that can appear on your display. In **Diagnostics**, you can elect to enable (**On**) or disable (**Off**) all of the diagnostics or each of the following individually: **Leakage**, **ATC Short**, **ATC Open**, **Comp Range**, **Meas Range**, **Low Slope**, **Preamp**, **Reference Coating**, **Broken Glass**, and **Aging**. Each of these is discussed below. A typical approach is to initially disable all of the messages and to enable selected messages later when you find out that you require them. A fault symbol is displayed if a particular diagnostic is enabled and the fault occurs. If the diagnostics detects a failure, the analog output goes to the failsafe value if **AO Failsafe** was configured **On**.

### *Leakage*

This diagnostic reports a problem of severe liquid leakage into the sensor which causes an ATC short to solution ground. The diagnostic can be enabled or disabled.

### *ATC Short, ATC Open*

This diagnostic reports a problem if the resistance of the temperature compensator is greater or less than the expected resistance of the device configured. The diagnostic for each can be enabled or disabled.

### *Comp Range*

This diagnostic reports that the measurement or temperature is outside the range configured. The diagnostic can be enabled or disabled.

### *Meas Range*

This diagnostic reports that the measurement is over or under the analog output range that is configured. The diagnostic can be enabled or disabled.

### *Low Slope*

This diagnostic reports a problem usually associated with an aging glass electrode. It appears after a multipoint calibration in buffer solutions when the Nernst slope of the sensor becomes less than the user set limit. The limit can be set from 0 through 100 percent. It applies to the slope between any two points. The diagnostic can be enabled or disabled.

---

— **NOTE** —

1. This message does not appear for ORP measurement.
  2. In Diagnostics, Low Slope applies to the slope between any two points. In Status mode, the slope is that closest to the isopotential point. Therefore it is possible to show a fault in Diagnostics mode but not in Status mode.
- 

### *Preamp*

This diagnostic reports a failed preamplifier (in the sensor or junction box). It appears if the preamplifier draws too much power. A shorted preamplifier causes the transmitter to cease functioning.

---

— **NOTE** —

If the transmitter is unresponsive, disconnect terminal 6. If the transmitter begins to function, it is a confirmation that the problem is in the preamplifier.

---

### *Reference Coating*

This diagnostic reports an increase in reference junction resistance possibly resulting from a fouled reference junction. The diagnostics check the resistance against solution ground. The message appears if the resistance is greater than the user set limit. The limit can be set from 0 through 200 k $\Omega$ . The diagnostic can be enabled or disabled.

## Broken Glass

This diagnostic reports a problem in the resistance of a glass electrode in the probe. Resistance of a glass electrode is checked versus solution ground. An error message appears if the resistance is less than user set limit. Besides clearing, enabling, and disabling the message, you can limit the message to resistances below a set value. The **Glass Lo Limit** value may be entered between 0.10 and 1.10 M $\Omega$ . You can also specify a **Cutoff** temperature above which this feature is disabled. **Cutoff** can be set between -30 and +200. The resistance of a glass bulb decreases (roughly is halved) for every 10°C increase in temperature.

---

— **NOTE** —

The diagnostic is disabled for ORP and ISE measurement.

---

## Aging

This diagnostic reports an aging glass electrode. The message appears after a multipoint calibration in pH buffer solutions when the Nernst slope of the sensor closest to the isopotential point has decreased sequentially five times. The diagnostic can be enabled or disabled.

## Auto Hold

Refer to Figure A-11 on page 66.

The Auto Hold section of the structure enables you to use the automatic hold parameter to automatically activate the Hold feature each time you enter Calibration or Configuration mode. In Auto Hold, select **On Present** to hold all values and states at their current level; **On Manual** to set all values and states at desired levels; or **Off** to omit this feature.

---

— **NOTE** —

If you select **On Manual**, go to Hold mode to change the values.

---

## Config Timeout

Refer to Figure A-12 on page 67.

The Config Timeout section of the structure enables you to specify the time in which the instrument brings you back to the Measure mode from another mode when no keyboard input has occurred. In Measure mode, **Timeout** also limits the time to view a display other than that configured in “Display Format” on page 37 that has been temporarily scrolled into view. Timeout can be configured to **Always Timeout**, timeout in online modes only (**Online Only**) or **Never Timeout**. The **Always Timeout** selection is recommended.

The timeout can be configured separately for front panel (**Front Panel**) and (**HART Communications**) operation. The time can be specified from 30 through 999 seconds.

## Transmitter Tags

Refer to “Transmitter Tags Structure” on page 67.

The Transmitter Tags section of the structure enables you to enter tags to identify your transmitter. Each can have a maximum number of characters as described below. When you have

finished entering a tag, press **ENTER**. These identifications appear in Status mode. For details on entering various characters, see page 18.

*Table 9. Transmitter Tags*

| Tag Name        | Characters |
|-----------------|------------|
| HART Message    | 32         |
| HART Tag        | 8          |
| HART Long Tag   | 32         |
| HART Descriptor | 16         |
| Tag Name        | 14         |
| Location        | 14         |
| Device Name     | 6          |

## Passcode Access

Refer to “Passcode Access Structure” on page 68.

The Passcode Access section of the structure enables you to limit access to change and/or view various parameters in the firmware. There are two Passcodes; Administrator Code and User Code. A person possessing the Administrator Code can change and view all parameters as well as establish what a person with User Code can access. A person with a User Code can only change and view what the administrator has allowed. Both codes are four digit codes.

---

— **NOTE** —

1. The initial factory default value for both Administrator and User passcodes is 0800.
  2. To bypass the passcode, the administrator must configure a passcode of 0000.
- 

The configuration of this section is done in four steps.

1. In Admin Code, enter the four digit administrator code from 0 through 9999.
2. In User Code, enter the four digit user code from 0 through 9999.
3. In User Change, you can elect to enable (**On**) or disable (**Off**) user access to each of the following parameters.

|               |             |             |
|---------------|-------------|-------------|
| Calibrate     | Temp Comp   | HART Cfg    |
| Cal Buffers   | Sensor Cfg  | Auto Hold   |
| Hold          | PV Cfg      | Tags Config |
| Suspend Fault | Meas Cfg    | Timeouts    |
| Resume Fault  | Display Cfg | Default Cfg |
| Clear History | Diag Cfg    |             |

---

— **NOTE** —

You can also make one selection to configure access to all the User Change parameters On or Off.

---

4. In User View, you can elect to enable (**On**) or disable (**Off**) user access to each of the following parameters.

|             |           |           |
|-------------|-----------|-----------|
| Cal Buffers | Diags     | Xmtr Tags |
| Temp Comp   | HART      | Timeouts  |
| Temp Table  | Auto Hold | Default   |
| Display     |           |           |

---

— **NOTE**

You can also make one selection to configure access to all the User View parameters On or Off.

---

## Calibration Parameters

Refer to “Calibration Parameters Structure” on page 69.

The Cal Parameters section of the structure enables you to specify:

- ◆ The calibration standard buffer solutions to be used if you are measuring pH and using the **Smart** solution calibration feature.
- ◆ The measurement and temperature stability for all calibrations.

## Buffer Set

You can select between **American**, **NIST**, **European**, **DIN**, **MERCK**, **JIS 8802**, or **User Selectable** as standard buffer set choices.

The pH values of common buffer solutions are shown in Table 10.

*Table 10. pH Value of Common Buffer Solutions*

| Buffer Solution | pH Values                      |
|-----------------|--------------------------------|
| American        | 1.68, 4.01, 7.00, 10.01, 12.45 |
| NIST            | 1.68, 4.01, 6.87, 10.01, 12.45 |
| European        | 4.61, 7.00, 9.18               |
| DIN             | 1.68, 4.01, 6.86, 9.18, 12.45  |
| MERCK           | 4.01, 7.00, 10.00              |
| JIS 8802        | 1.68, 4.01, 6.86, 9.18, 12.45  |

If you select **User Selectable**, you can select up to seven buffers from either standard buffer values from Table 10 or you can pick **Custom** and create a buffer with your own pH values. The pH values of the buffers you select must be a minimum of 2 pH apart. If you create a custom buffer, you must enter a nominal pH value for the buffer and then establish a curve of temperature values vs pH values. See Figure A-15 on page 69.

## Stability

The **Stability** parameter sets the measurement and temperature stability. It can be set from 25 through 1000%. 25% produces the most accurate measurement and temperature calibration. Therefore it causes the longest calibration time. Invensys recommends 100% for new installations.

## Restore Configuration

Refer to “Restore Config Structure” on page 69.

Configuring your transmitter involves the setting of many parameters specific for the application. In some cases, you may wish to employ the transmitter for more than one application (at different times). Rather than having to change several parameters, the 876PH allows you to save up to two unique and complete configuration profiles including the calibrations associated with these profiles. Either of these two profiles can be restored at any time to facilitate a quick and easy change of the transmitter to a presaved configuration. In addition to the two user profiles, the transmitter also includes a “factory default” configuration which allows you to return the transmitter to its original factory configuration at any time.

In **Restore Config**, select **Restore User 1**, **Restore User 2**, or **Restore Factory** and at the question **Restore User 1 Configuration?**, **Restore User 2 Configuration?**, or **Restore Factory Configuration?**, answer **Yes** or **No**.

---

— **NOTE** —

The two user profiles are saved in “Save User Configuration” on page 47.

---

## Diagnostic Mode

Refer to Figure 18.

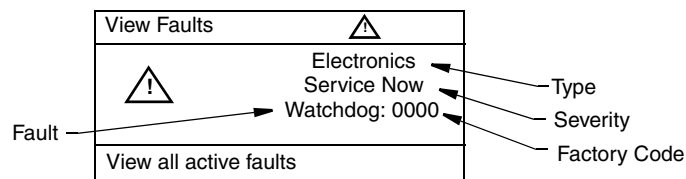
The Diagnostic mode enables you to:

- ◆ View active faults
- ◆ Suspend those faults for one hour
- ◆ Resume any suspended faults
- ◆ View the diagnostic history log
- ◆ Save two user configurations

To enter the Diagnostic mode, press the **FUNCTION** key and then the **DIAG** key. Press **ENTER**. The display returns to Measure mode when you press the **FUNCTION** key and then the **MEASURE** key or when the timeout period expires. If there are no key presses within the configured Timeout period, the transmitter reverts to Measure mode and the outputs remain on hold.

## View Faults

Select **View Faults** to view the most severe fault. Use the Up and Down arrow keys to view other faults. Four pieces of information are given for each fault: The type of fault, the severity of the fault, the fault itself, and a factory code (used only to help our Global Client Service Center identify the cause if you call for help). See Figure 17. If there are no faults, the display reads **No Active Faults**.



*Figure 17. Sample View Faults Display*

Table 11. List of Possible Faults

| Type                 | Fault                     | Severity   | Corrective Action   |
|----------------------|---------------------------|--|---|
| Electronics          | Analog Calibration Lost   | Failed   | Contact our<br>Global Customer Support Center                               |
|                      | Front End Communications  | Service Now  |   |
|                      | Meas Calibration Lost     | Failed   |   |
|                      | Memory Failure            | Most Severe  |   |
|                      | Memory Write Failure      | Most Severe  |   |
|                      | Operating System          | Most Severe  |   |
|                      | Processor Registers       | Most Severe  |   |
|                      | RAM Failure               | Most Severe  |   |
|                      | Software Failure          | Most Severe  |   |
|                      | Solution Ground Potential | Failed   |   |
|                      | Temp Calibration Lost     | Failed   |   |
|                      | Watchdog Failure          | Most Severe  |   |
| Config               | Temp Comp Table           | Failed   | Reconfigure Temp Comp Table Settings.<br>See page 36.                       |
| Sensor               | Analog Overrange          | Failed   | Reconfigure analog output settings.   |
|                      | ATC Open Circuit          | Failed   | 1. Check ATC wiring and configuration.<br>2. Replace sensor                 |
|                      | ATC Short Circuit         | Failed   | 1. Check ATC wiring and configuration.<br>2. Replace sensor                 |
|                      | Measurement Overflow      | Failed   | Contact our Global Customer Support Center                                  |
|                      | Sensor Coating            | Service Soon   | 1. Clean sensor<br>2. Replace sensor.                                       |
|                      | Sensor Glass Aging        | Service Soon   | 1. Perform 2-point calibration.<br>2. Replace sensor.                       |
|                      | Sensor Glass Broke        | Failed   | 1. Check cutoff temperature.<br>2. Inspect electrode.<br>3. Replace sensor. |
|                      | Sensor Leaking            | Failed   | Replace sensor.   |
|                      | Sensor Low Slope          | Service Soon   | 1. Check configuration.<br>2. Repeat calibration.<br>3. Replace sensor.     |
|                      | Temperature Overflow      | Failed   | 1. Check ATC wiring and configuration.<br>2. Replace sensor.                |
|                      | Temp Comp Overrange       | Service Now  | Reconfigure temp comp settings.   |
| Temp Sensor 3rd Wire | Service Now               | 1. Check ATC configuration<br>2. Connect 3rd wire of temp sensor |   |
| Calib                | Calibration Required      | Service Now  | Perform measurement calibration.  |



## History Log

Select **History** Log and press **ENTER** to view or erase the diagnostic history logs. Use the Up and Down arrow keys to select All History Logs, Calibration Log, Error Log, Operation Log. You can also select Clear History. however clearing the history log requires entering your passcode.

## Suspend Faults and Resume Faults

Select **Suspend Faults** to suspend the present faults for one hour. The display asks for your passcode. An incorrect passcode returns you to the start of the Diagnostic menu. A correct passcode causes the prompt **Suspend Fault?** to be displayed. If you answer **Yes**, the message **Faults Suspended** is displayed. After either a **Yes** or **No** reply, the Diagnostic menu is displayed. Each suspended fault is inhibited from reoccurring for one hour from the time the Diagnostic mode is entered.

Select **Resume Faults** to resume all suspended faults.

## Save User Configuration

Configuring your transmitter involves the setting of many parameters specific for the application. In some cases, you may wish to employ the transmitter for more than one application (at different times). Rather than having to change several parameters, the 876PH allows you to save up to two unique and complete configuration profiles including the calibrations associated with these profiles.

Either of these two profiles can be restored at any time to facilitate a quick and easy change of the transmitter to a presaved configuration. See “Restore Configuration” on page 44.

Select **Save Config 1** or **Save Config 2** to save your configuration. The display asks for your passcode. An incorrect passcode returns you to the start of the Diagnostic menu. A correct passcode causes the prompt **Save Config #?** to be displayed. If you answer **Yes**, the message **Configuration Saved** is displayed. If you answer **No**, the message displayed is **Action Cancelled**.

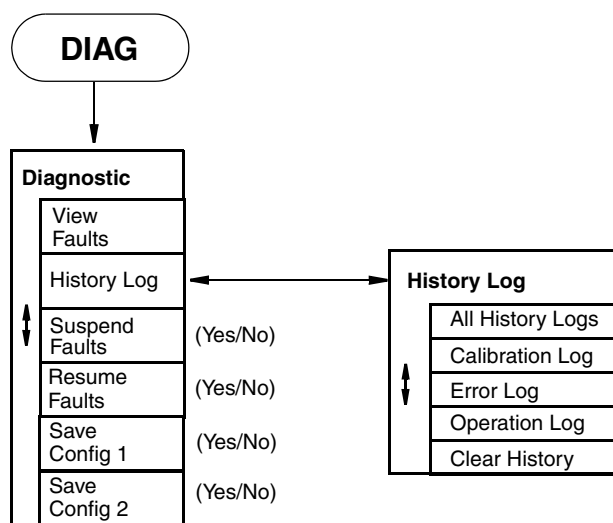


Figure 18. Diagnostic Mode Structure



# 6. Operation Via HART Communicator

---

— **NOTE** —

1. For HART communications, a 250  $\Omega$  load resistor must be present in the power supply loop.
  2. For proper communication with a HART Communicator, the communicator must contain the proper DD for the 876PH Transmitter. This DD is available from Foxboro or any other authorized HART Foundation source.
  3. If the DD shows “access restricted”, start over and re-enter the passcode.
- 

## Entering Modes

From the home menu, select the mode to be entered. If **Save to Xmtr** appears, it must be handled before entering a different mode. If a passcode is required, select **Enter Passcode** before accessing a new mode.

## Saving Changes

Changes must be saved before going to another mode.

If the **Send** soft key appears on the screen, it must be pressed before saving changes.

Press **Home**, select **Save to Xmtr**. Answer the **Save changes?** question by selecting **Yes** or **No**, and pressing **ENTER**. If errors exist, the **Fix Errors?** question appears. **No** discards all changes; **Yes** provides the title of the first parameter with a problem which must then be resolved.

---

— **NOTE** —

The **Save** soft key refers to a local communicator copy of the parameters, not the transmitter's **Save changes**.

---

# HART Online Menu

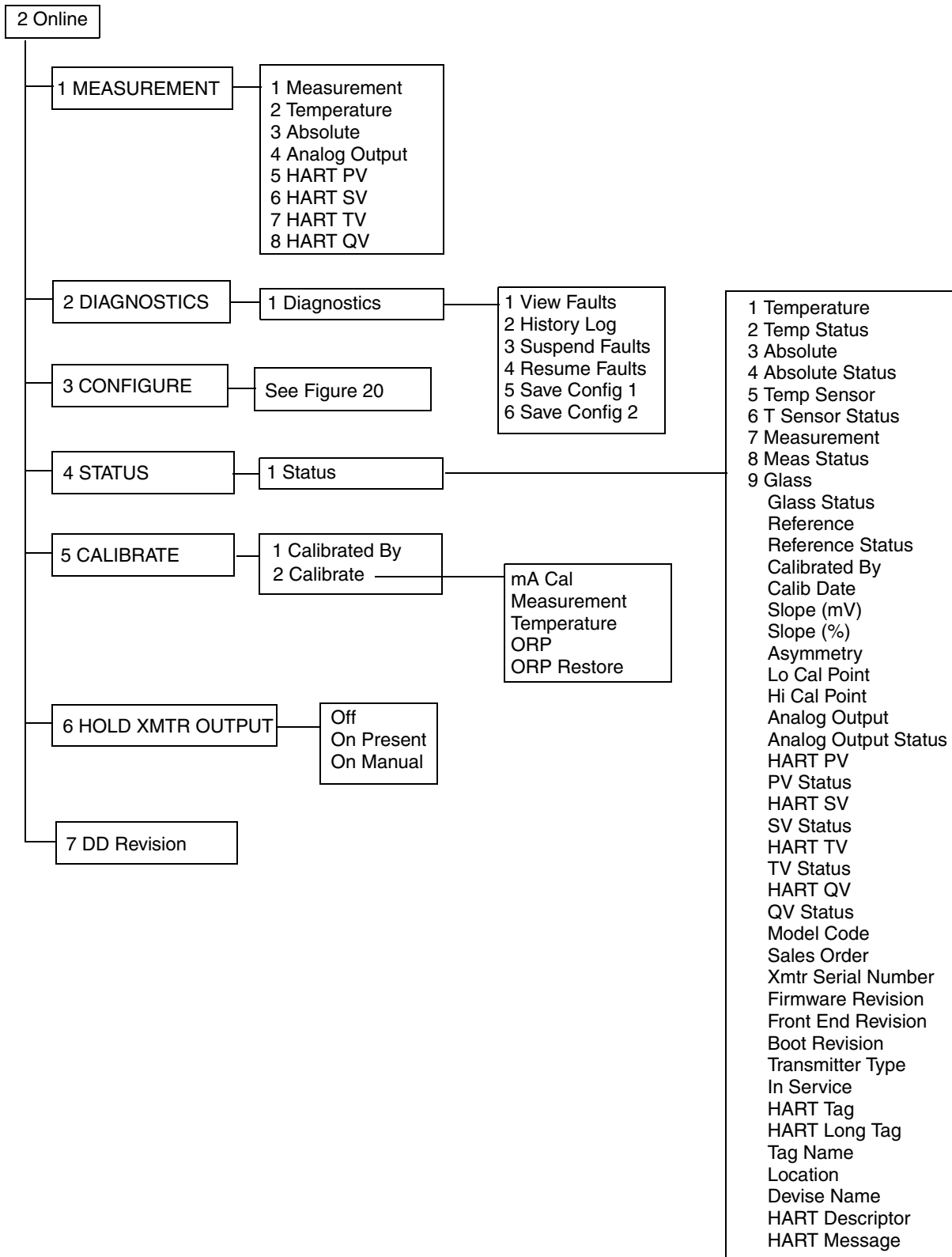


Figure 19. 876PH Transmitter Online Menu Tree (1 of 2)

CONFIGURATION

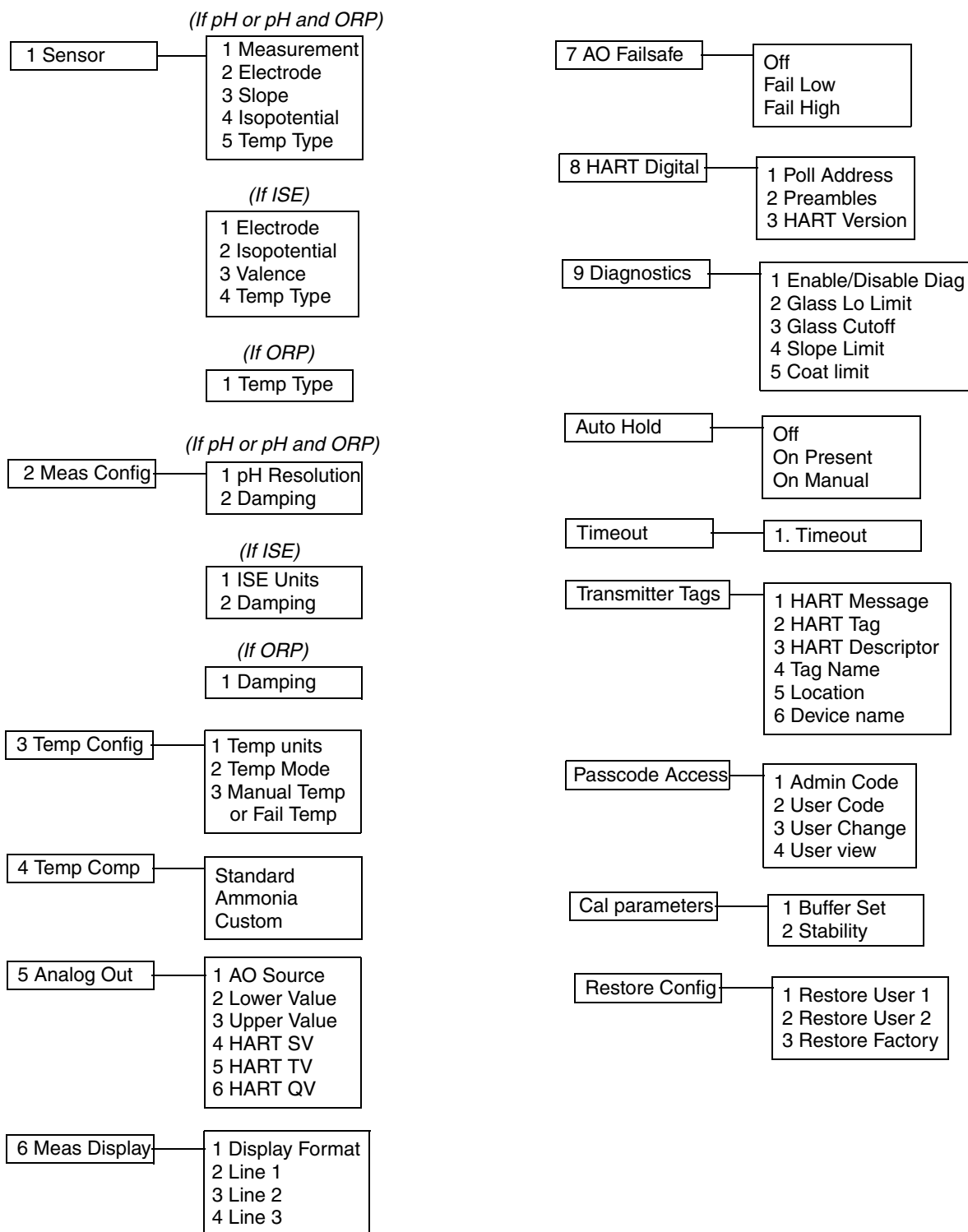


Figure 20. 876PH Transmitter Online Menu Tree (2 of 2)

## Explanation of Parameters

---

### — NOTE —

---

1. The fast-key path shown is based on a frequently used configuration. If certain parameters are configured off or infrequently used parameters configured on, the fast-key path may be different.
  2. For more detailed explanation of parameters, see “Operation Via Local Display” on page 17.
- 

| Parameter               | Fast-Key Path | Explanation  |
|-------------------------|---------------|--|
| <b>Measurement Mode</b> |               |  |
| Absolute                | 1,3           | Displays the absolute (uncompensated) measurement value.   |
| Analog Output           | 1,4           | Displays the analog output in mA.  |
| HART PV                 | 1,5           | Displays the HART primary value.   |
| HART QV                 | 1,8           | Displays the HART fourth value.  |
| HART SV                 | 1,6           | Displays the HART secondary value.   |
| HART TV                 | 1,7           | Displays the HART tertiary value.  |
| Measurement             | 1,1           | Displays the measurement (PV) value.   |
| Temperature             | 1,2           | Displays the temperature value in specified engineering units.   |
| <b>Diagnostic Mode</b>  |               |  |
| History Log             | 2,2           | Used to view or erase one or more diagnostic history logs.   |
| Resume Faults           | 2,4           | Used to resume suspended faults.   |
| Save Config 1           | 2,5           | Used to save your configuration.   |
| Save Config 2           | 2,5           | Used to save your configuration.   |
| Suspend Faults          | 2,3           | Used to suspend faults for one hour.   |
| View Faults             | 2,1           | Displays the most severe fault and other faults if desired.  |
| <b>Configure Mode</b>   |               |  |
| Sensor                  | 3,1           | Path to sensor related parameters.   |
| Measure Config          | 3,2           | Path to measure related parameters.  |
| Temp Config             | 3,3           | Path to temperature related parameters.  |
| Temp Comp               | 3,4           | If measuring pH or ISE, used to specify temperature compensation as Standard, Ammonia, or Custom.  |
| Analog Out (PV)         | 3,5           | Path to analog output related parameters.  |
| Meas Display            | 3,6           | Path to display related parameters.  |
| AO Failsafe             | 3,7           | Used to specify the analog output under fault conditions.  |
| HART Digital            | 3,8           | Path to HART related parameters.   |
| Diagnostics             | 3,9           | Path to diagnostic related parameters.   |
| Auto Hold               |               | Used to configure all values and states to be held at their current level (On Present), at a desired level (On Manual) when triggered by a digital signal or when going into Calibration or Configuration mode. Select Off to omit this feature. |

| Parameter        | Fast-Key Path  | Explanation   |
|------------------|--|---|
| Config Timeout   |  | Used to specify the time in which you are returned to Measure mode when no keyboard input has occurred.   |
| Transmitter Tags |  | Path to tag related parameters.   |
| Passcode Access  |  | Path to passcode related parameters.  |
| Cal Parameters   |  | Path to calibration related parameters.   |
| Restore Config   |  | Path to restoring the transmitter to a user stored or the factory configuration.  |
| Measurement      | 3,1,1  | Select the type of measurement (pH, pH and ORP, ISE Concentration, or ORP).   |
| Electrode        | 3,1,2 (for pH)<br>3,1,1 (for ISE)                    | If Measurement is pH or pH and ORP: select Electrode as Glass, Antimony, or Other.<br>If Measurement is ISE: select Electrode (polarity) as Positive or Negative. |
| Scope            | 3,1,3  | If Electrode is Other: Enter the slope.   |
| Isopotential     | 3,1,4 (for pH)<br>3,1,2 (for ISE)                    | If Measurement is pH, pH and ORP, or ISE: Enter the Isopotential point.   |
| Temp Type        | 3,1,5 (for pH)<br>3,1,4 (for ISE)<br>3,1,1 (for ORP) | Select the Temp Type (RTD) from the picklist provided.  |
| Valence          | 3,1,3  | If Measurement is ISE: Select the Valence as monovalent or Divalent.  |
| pH Resolution    | 3,2,1 (for pH)                                       | If measurement is pH: Select pH Resolution as 0.1 or 0.01 pH.   |
| Damping          | 3,2,2 (for pH)<br>3,2,2 (for ISE)<br>3,2,1 (for ORP) | Enter the damping response time.  |
| ISE Units        | 3,2,1 (for ISE)                                      | If Measurement is ISE: Select the ISE Unit as ppb, ppm, %, or Custom.   |
| Temp Units       | 3,3,1  | Select Temp Units as DegC or DegF.  |
| Temp Mode        | 3,3,2  | Select the Temp Mode as Auto or Manual.   |
| Manual Temp      | 3,3,3  | If Temp Mode is Manual: Enter a fixed temperature.  |
| Fail Temp        | 3,3,3  | If Temp Mode is Auto: Enter a temperature fail signal value.  |
| AO Source        | 3,5,1  | Select the AO Source from the picklist provided.  |
| Lower Value      | 3,5,2  | Enter the measurement value that is to produce 4 mA.  |
| Upper Value      | 3,5,3  | Enter the measurement value that is to produce 20 mA.   |
| HART SV          | 3,5,4  | Select the SV measurement from the picklist provided.   |
| HART TV          | 3,5,5  | Select the TV measurement from the picklist provided.   |
| HART QV          | 3,5,6  | Select the QV measurement from the picklist provided.   |
| Display Format   | 3,6,1  | Select the Display Format as Single, Double, or Triple.   |
| Line 1           | 3,6,2  | Select the measurement to be displayed on Line 1.   |
| Line 2           | 3,6,3  | Select the measurement to be displayed on Line 2.   |
| Line 3           | 3,6,4  | Select the measurement to be displayed on Line 3.   |

| Parameter           | Fast-Key Path | Explanation   |
|---------------------|---------------|---|
| Poll Address        | 3,8,1         | Enter the polling address to a number from 0 through 15. A nonzero number specifies multidrop applications. |
| Preambles           | 3,8,2         | Displays the number of preambles to be sent in a response message from the transmitter to the host.         |
| HART Version        | 3,8,3         | Used to specify the HART version.   |
| Enable/Disable Diag | 3,9,1         | Turn On or Off the various diagnostics.   |
| Glass Lo Limit      | 3,9,2         | If the Glass diagnostic is On: Enter a low resistance limit.  |
| Glass Cutoff        | 3,9,3         | If the Glass diagnostic is On: Enter a Cutoff temperature.  |
| Slope Limit         | 3,9,4         | If the Low Slope diagnostic is On: Enter the Slope Limit.   |
| Coat Limit          | 3,9,5         | If the Reference Coating diagnostic is On: Enter a Coat (resistance) Limit.                                 |
| HART Message        |               | Enter a HART Message (32 characters maximum).   |
| HART Tag            |               | Enter a HART Tag (8 characters maximum).  |
| HART Descriptor     |               | Enter a HART Descriptor (16 characters maximum).  |
| Tag Name            |               | Enter a Tag Name (14 characters maximum).   |
| Location            |               | Enter a Location (14 characters maximum).   |
| Device Name         |               | Enter a Device name (6 characters maximum).   |
| Admin Code          |               | Enter a 4-digit Administrator Code.   |
| User Code           |               | Enter a 4-digit User Code.  |
| User Change         |               | Turn On or Off the various parameters the user is allowed to change.  |
| User View           |               | Turn On or Off the various parameters the user is allowed to view.  |
| Buffer Set          |               | Select the Buffer from the picklist provided.   |
| Stability           |               | Enter a value (%) for measurement/temperature stability.  |
| Restore User 1      |               | Enables you to restore a saved user configuration.  |
| Restore User 2      |               | Enables you to restore a saved user configuration.  |
| Restore Factory     |               | Enables you to restore the factory configuration.   |
| <b>Status Mode</b>  |               |   |
| Temperature         | 4,1,1         | Displays the temperature measurement  |
| Temp Status         | 4,1,2         | Displays the status of the temperature measurement  |
| Absolute            | 4,1,3         | Displays the absolute measurement   |
| Absolute Status     | 4,1,4         | Displays the status of the absolute measurement   |
| Temp Sensor         | 4,1,5         | Displays the temperature sensor resistance  |
| T Sensor Status     | 4,1,6         | Displays the status of the temperature sensor   |
| Measurement         | 4,1,7         | Displays the measurement  |
| Meas Status         | 4,1,8         | Displays the status of the measurement  |
| Glass               | 4,1,9         | Displays the resistance of the glass electrode  |
| Glass Status        |               | Displays the status of the glass electrode  |
| Reference           |               | Displays the reference junction resistance  |
| Reference Status    |               | Displays the statue of the reference junction   |
| Calibrated By       |               | Displays the name of the last operator  |
| Calib Date          |               | Displays the date of last calibration (dd/mm/yyyy)  |



| Parameter             | Fast-Key Path | Explanation   |
|-----------------------|---------------|---|
| Slope (mV)            |               | Displays the change in mV/pH or mV/decade of the most recent calibration  |
| Slope (%)             |               | Displays the deviation in percent of the slope of the most recent calibration compared to the standard  |
| Asymmetry             |               | Displays the asymmetry potential (mV difference between the theoretical isopotential point and the actual point due to the most recent calibration) |
| Lo Cal Point          |               | Displays values at the lower calibration point  |
| Hi Cal Point          |               | Displays values at higher calibration point   |
| Analog Output         |               | Displays the value of the analog output   |
| Analog Output Status  |               | Displays the status of the analog output  |
| HART PV               |               | Displays the HART primary value   |
| PV Status             |               | Displays the status of the HART primary value   |
| HART SV               |               | Displays the HART secondary value   |
| SV Status             |               | Displays the status of the HART secondary value   |
| HART TV               |               | Displays the HART tertiary value  |
| TV Status             |               | Displays the status of the HART tertiary value  |
| HART QV               |               | Displays the HART fourth value  |
| QV Status             |               | Displays the status of the HART fourth value  |
| Model Code            |               | Displays the transmitter model code   |
| Sales Order           |               | Displays the transmitter sales order number   |
| Xmtr Serial Number    |               | Displays the analyzer serial number   |
| Firmware Revision     |               | Displays the firmware revision level  |
| Front End Revision    |               | Displays the front end revision level   |
| Boot Revision         |               | Displays the boot revision level  |
| Transmitter Type      |               | Displays the transmitter type (876PH)   |
| In Service            |               | Displays the time in service in days  |
| HART Tag              |               | Displays the HART Tag name  |
| HART Long Tag         |               | Displays the HART Long Tag name (versions 6 and 7)  |
| Tag Name              |               | Displays the tag name   |
| Location              |               | Displays the location of the measurement  |
| Device Name           |               | Displays the device name  |
| HART Descriptor       |               | Displays the HART descriptor  |
| HART Message          |               | Displays the HART message   |
| <b>Calibrate Mode</b> |               |   |
| Calibrated By         | 5,1           | Enter the name of the person calibrating the device and the date of calibration.  |
| Calibrate             | 5,2           | Path to calibrating parameters.   |
| mA Cal                |               | Used to perform a mA Cal calibration.   |
| Measurement           |               | Used to perform a measurement calibration.  |
| Temperature           |               | Used to perform a temperature calibration.  |
| ORP                   |               | Used to perform an ORP calibration.   |
| ORP Restore           |               | Used to restore an uncompensated ORP output.  |

| Parameter               | Fast-Key Path | Explanation  |
|-------------------------|---------------|--|
| <b>Hold Xmtr Output</b> |               |  |
| Off                     |               | Used to release the transmitter from Hold state.           |
| On Present              |               | Used to hold all values and states at their current level. |
| On Manual               |               | Used to hold all values and states at desired levels.      |
| <b>DD Revision</b>      |               | Displays the DD Revision level.                            |

# 7. Maintenance

---

**! WARNING**

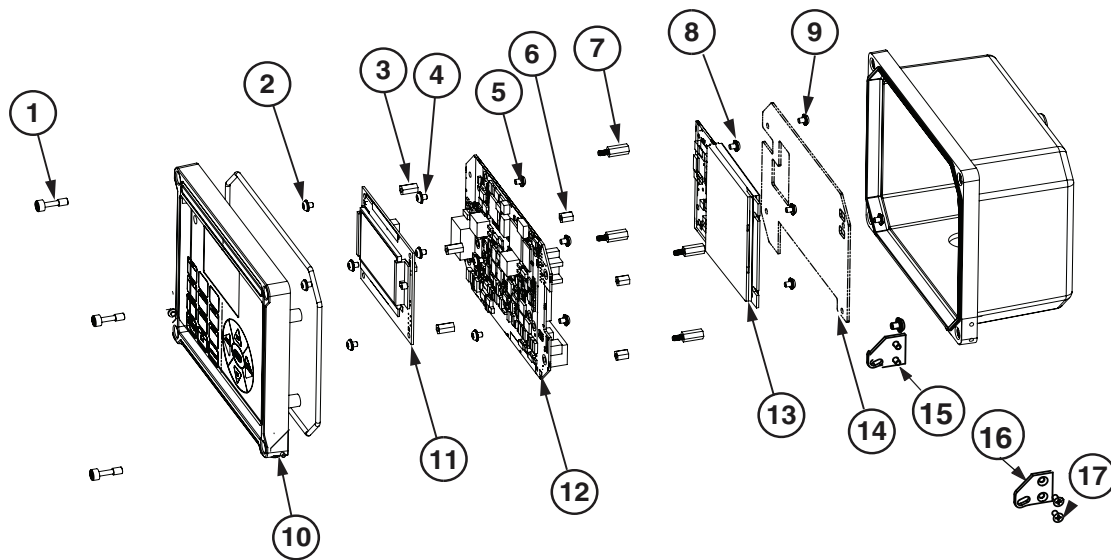
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This product contains components that have critical safety characteristics. **Do not** substitute components. Replace components only with identical factory supplied components. Component substitution may impair the electrical safety of this equipment and its suitability for use in hazardous locations.

---

The maintenance of the 876PH Transmitter is limited to replacement of the bezel/keypad assembly, the display printed wiring assembly (PWA), the processor PWA and the loop power (MAU) PWA. Attempts to repair printed wiring assemblies could result in damage and voiding of the warranty. The recommended repair procedure is return of the transmitter to the factory for repair.

To replace parts, refer to Figure 21.



*Figure 21. Exploded View of 876PH Transmitter*

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**! WARNING**

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Before replacing parts, be sure to turn power off.

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**! CAUTION**

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This unit uses printed wiring assemblies with components that are **highly susceptible to damage from electrostatic discharge (ESD)**. Relatively low static potential can rupture sensitive components resulting in degraded device characteristics or failure.

All printed wiring assemblies **must** be handled with the user grounded via a conductive wrist strap (between 100  $\Omega$  minimum and 1 M $\Omega$  maximum).

---

## Replacing the Bezel/Keypad Assembly (Item 10)

1. Unscrew the four screws (Item 1) on the corners of the bezel/keypad assembly and open the assembly (Item 10) downward.

---

**! CAUTION**

The assembly does not open a full 180°. Do **not** press on it.

---

2. Remove four Screws (Item 9) and remove the Safety Cover (Item 14).
3. Remove four Standoffs (Item 7), disconnect the ribbon cable, and carefully lift off stack of boards.
4. Remove ground wire from the bezel/keypad assembly.
5. Remove one of the two door Hinges (Item 15 or 16) by removing the two Screws (Item 17) that secure it. Remove the door.
6. Install the new door by reversing Steps 1 through 5.

---

**! CAUTION**

When positioning stack of boards on the bezel/keypad assembly bosses, carefully fold the flex ground strap over the lower left boss.

---

## Replacing the Loop Power (MAU) PWA (Item 13)

1. Unscrew the four screws (Item 1) on the corners of the bezel/keypad assembly and open the assembly (Item 10) downward.

---

**! CAUTION**

The assembly does not open a full 180°. Do **not** press on it.

---

2. Disconnect wires from power terminals.
3. Remove four Screws (Item 9) and remove the Safety Cover (Item 14).
4. Remove the four Screws (Item 8) that secures the MAU PWA (Item 13) to the Standoffs (Item 6).
5. Grasping the MAU PWA on both sides, carefully lift it straight up and off.
6. Install the new MAU PWA by reversing Steps 1 through 5.

## Replacing the Processor PWA (Item 12)

1. Remove the MAU PWA as described immediately above.
2. Disconnect wires from sensor terminals.

3. Remove the four Screws (Item 5) that secures the Processor PWA (Item 12) to the Standoffs (Item 3).
4. Remove four Standoffs (Item 7) and save them.
5. Carefully separate the Processor PWA (Item 12) and Display PWA (Item 11).
6. Remove the four Screws (Item 4) and Standoffs (Item 6) from the Processor PWA (Item 12) and save them.
7. Install the new Processor PWA by reversing Steps 1 through 6.

## Replacing the Display PWA (Item 11)

1. Unscrew the four screws (Item 1) on the corners of the bezel/keypad assembly and open the assembly (Item 10) downward.

—  **CAUTION** —

---

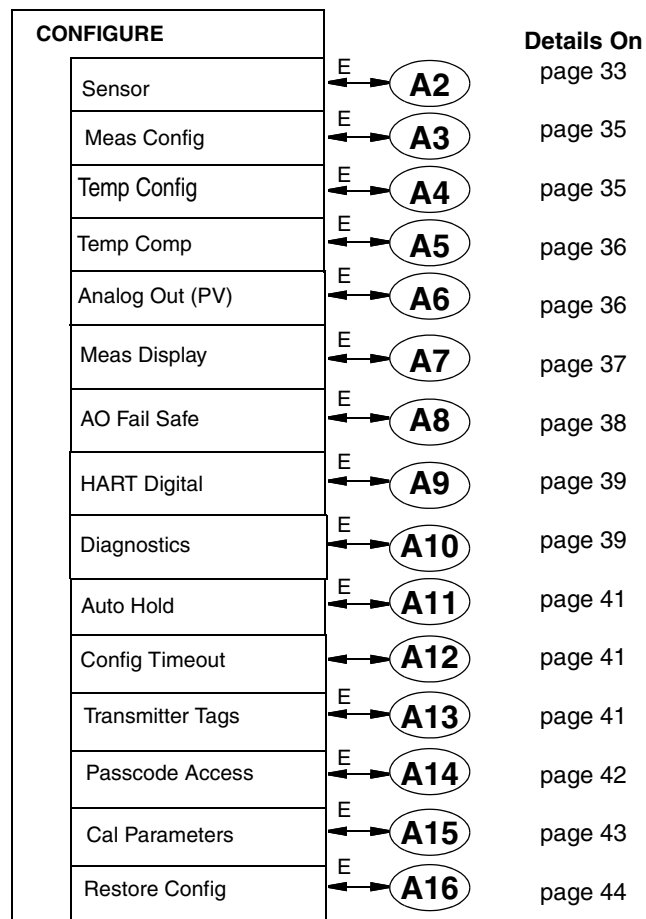
The assembly does not open a full 180°. Do **not** press on it.

---

2. Disconnect wires from power terminals.
3. Remove four Screws (Item 9) and remove the Safety Cover (Item 14).
4. Remove four Standoffs (Item 7), disconnect the ribbon cable, and carefully lift off stack of boards.
5. Remove the four screws (Item 2) that secures the Display PWA to Standoffs (Item 3).
6. Carefully separate the Processor PWA (Item 12) and Display PWA (Item 11).
7. Install the new Display PWA by reversing Steps 1 through 6.



# Appendix A. Configuration Structure Diagrams



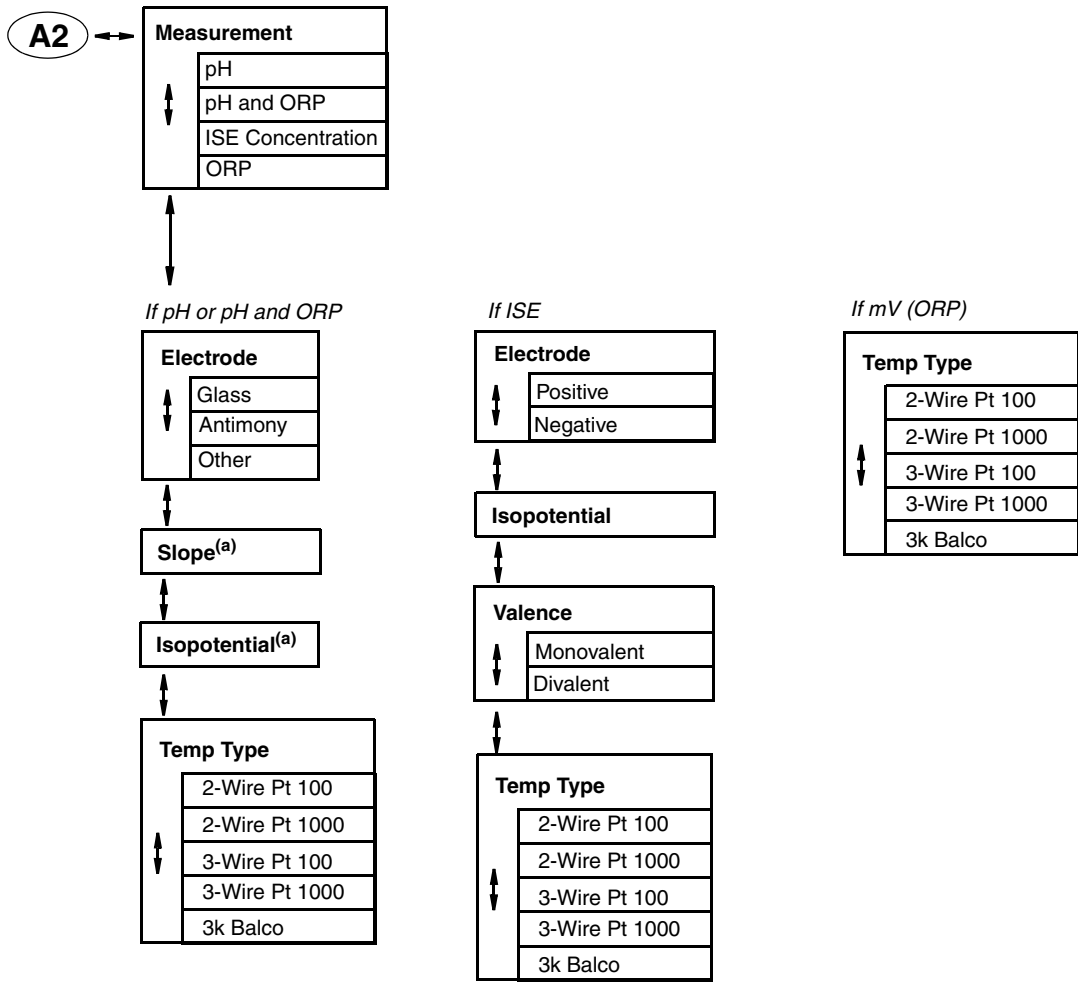

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**NOTE**

Before entering Configuration mode, you must first enter a proper passcode. The factory default passcode is **0800**.

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*Figure A-1. Configuration Top Level Structure*



(a) If Electrode = Other

Figure A-2. Sensor Configuration Structure



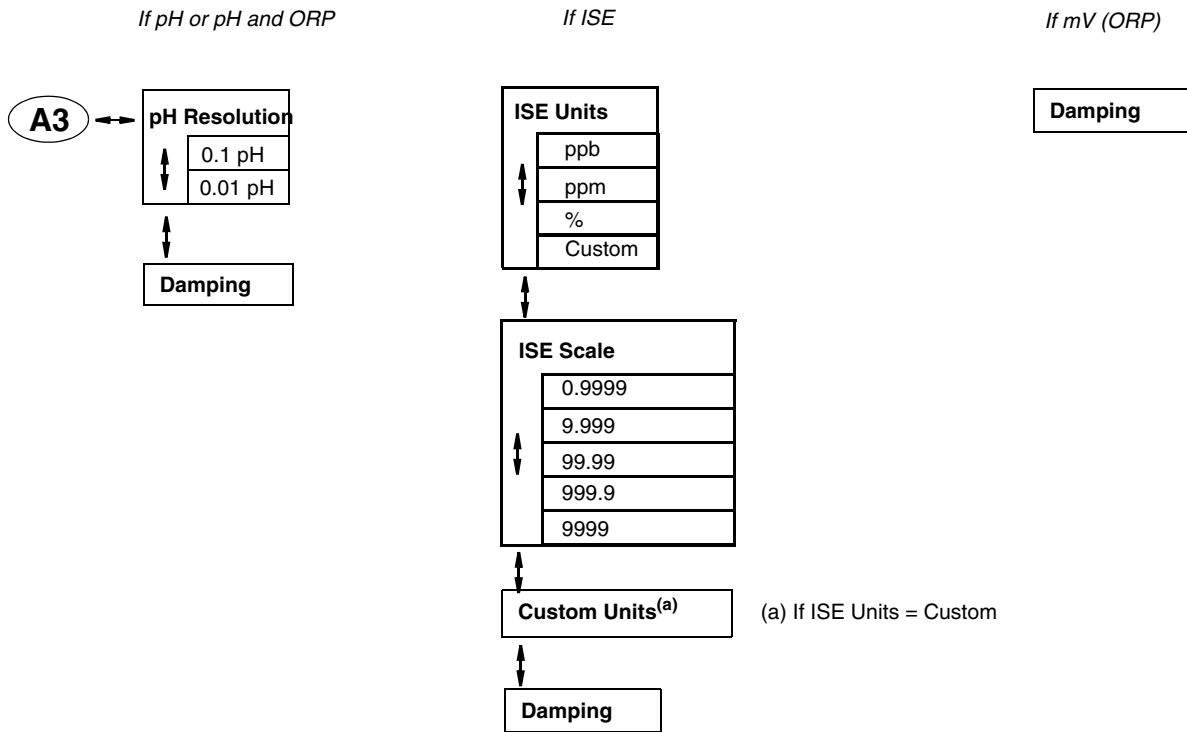


Figure A-3. Measurement Configuration Structure

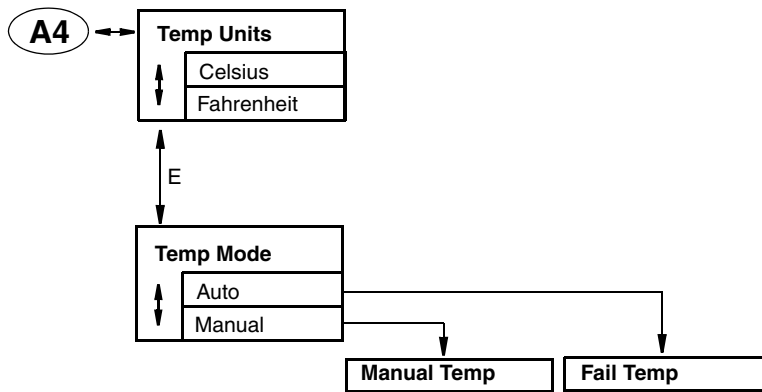


Figure A-4. Temperature Configuration Structure

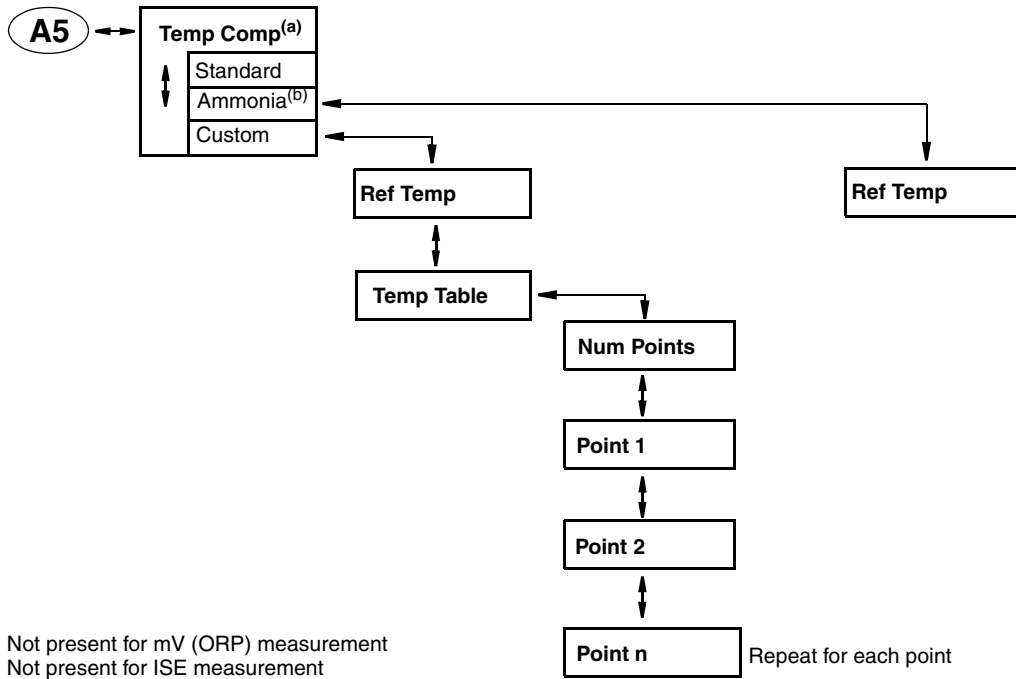


Figure A-5. Temperature Compensation Structure

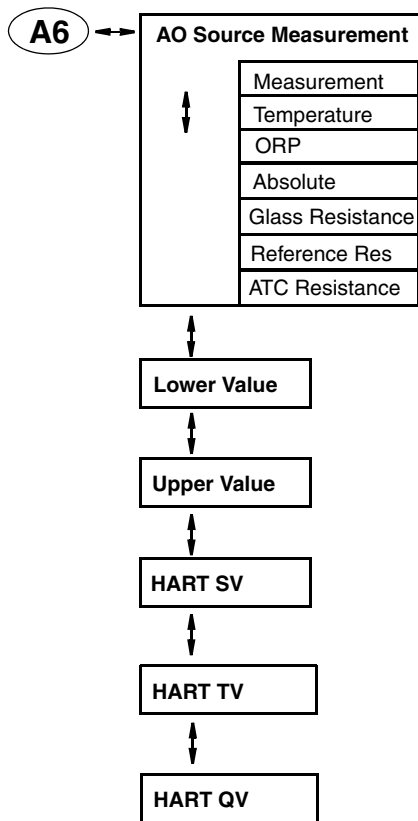


Figure A-6. Analog Output Structure

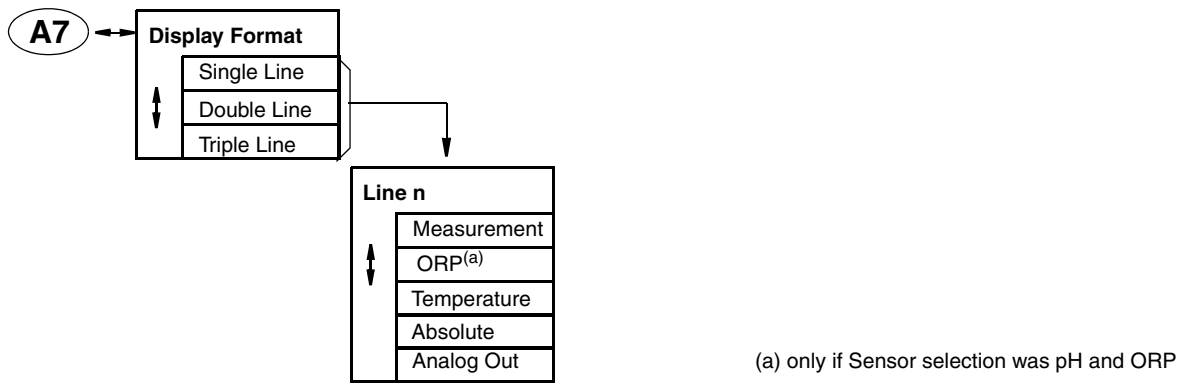


Figure A-7. Measurement Display Structure

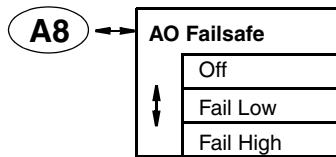


Figure A-8. AO Failsafe Structure

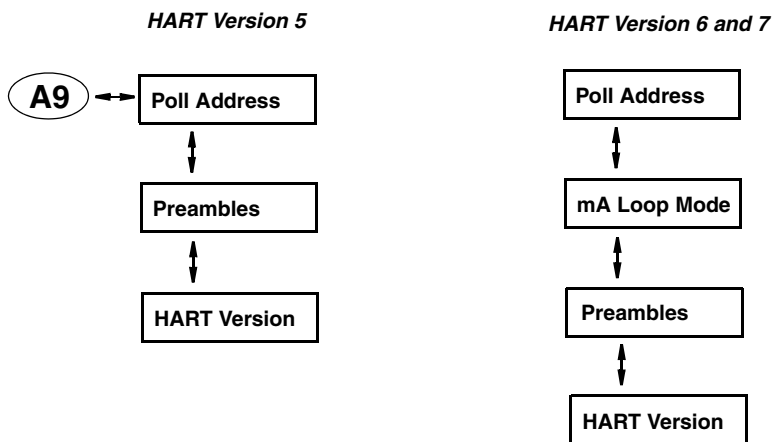
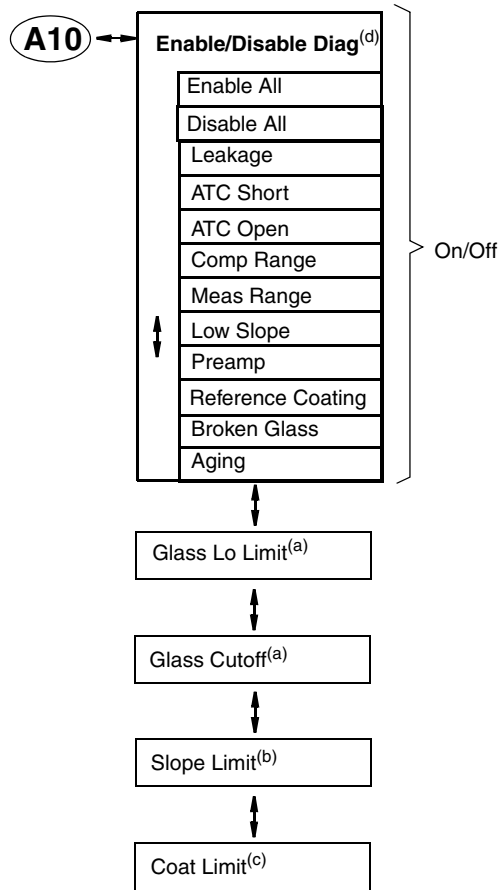


Figure A-9. HART Digital Structure



- (a) If Broken Glass Configured On
- (b) If Slope configured On
- (c) If Reference Coating configured On
- (d) Selections are limited by your configuration of measurement

Figure A-10. Diagnostics Structure

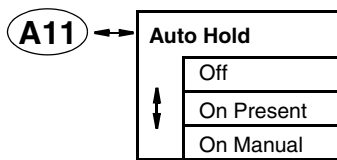


Figure A-11. Auto Hold Structure

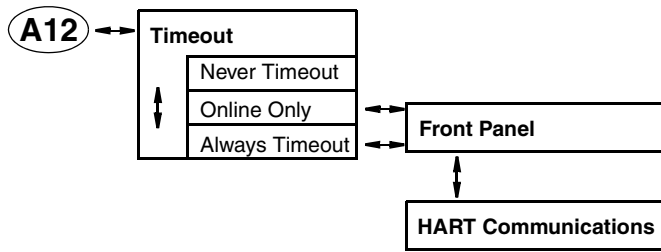


Figure A-12. Timeout Structure

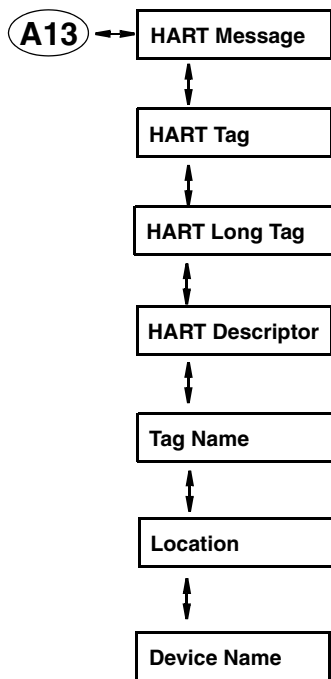


Figure A-13. Transmitter Tags Structure

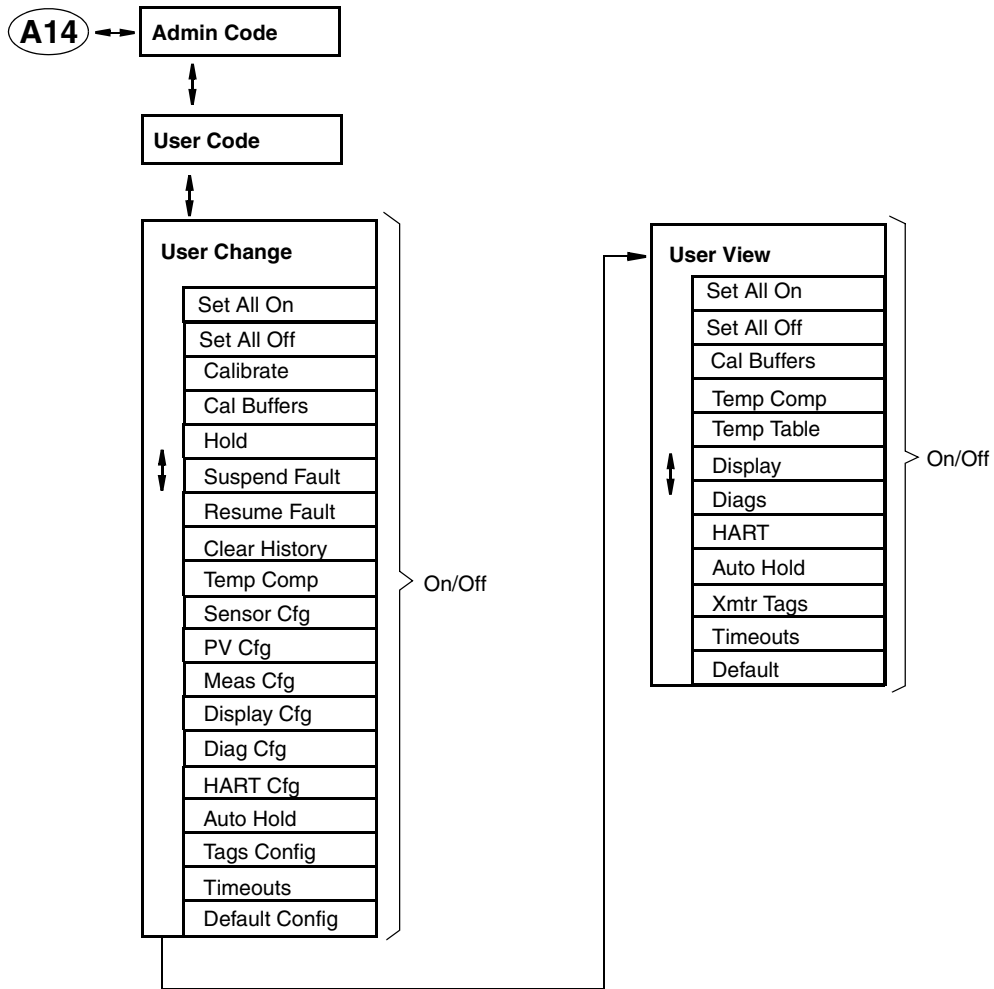


Figure A-14. Passcode Access Structure

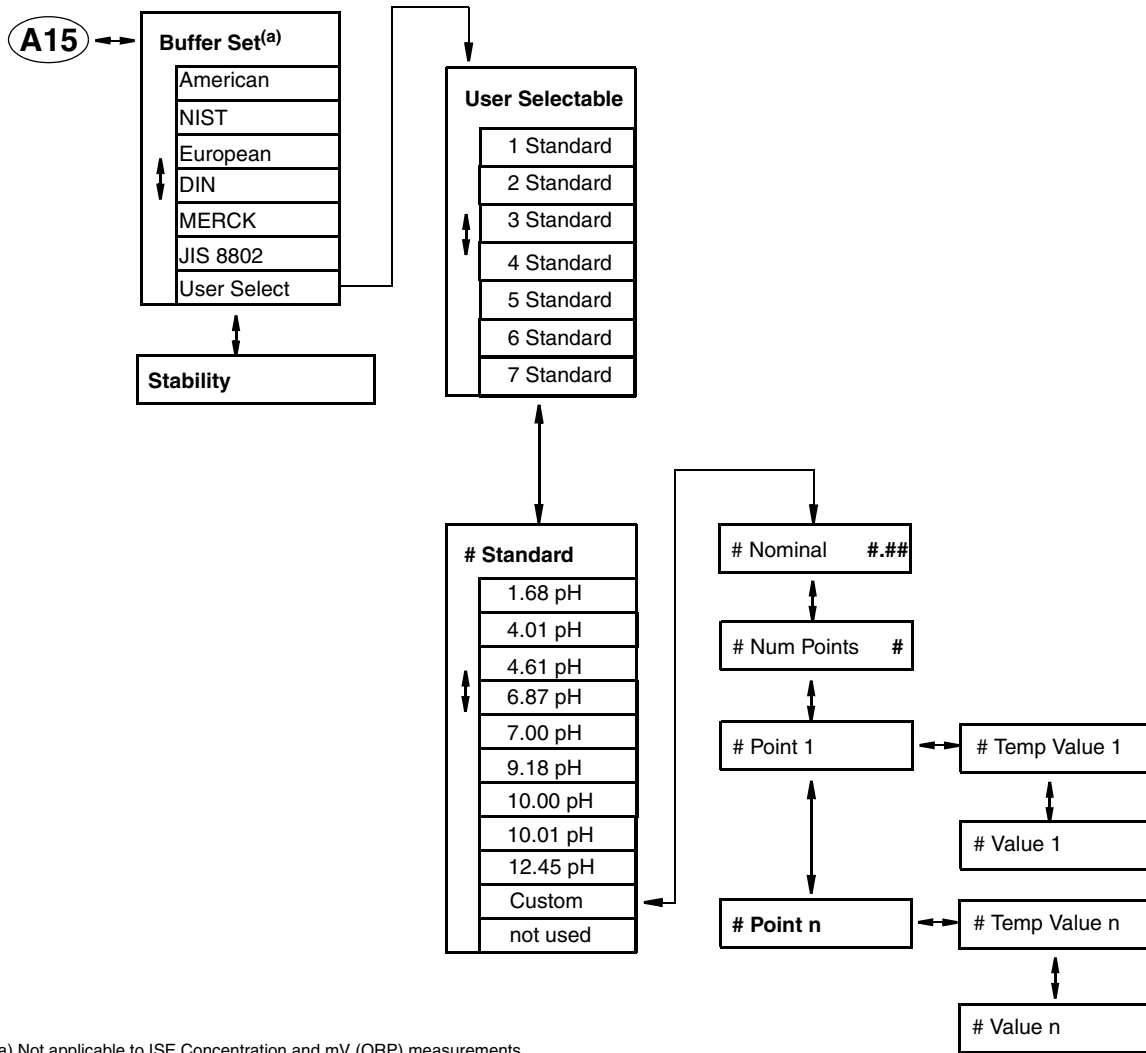


Figure A-15. Calibration Parameters Structure

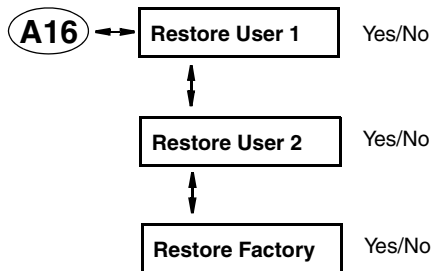


Figure A-16. Restore Config Structure



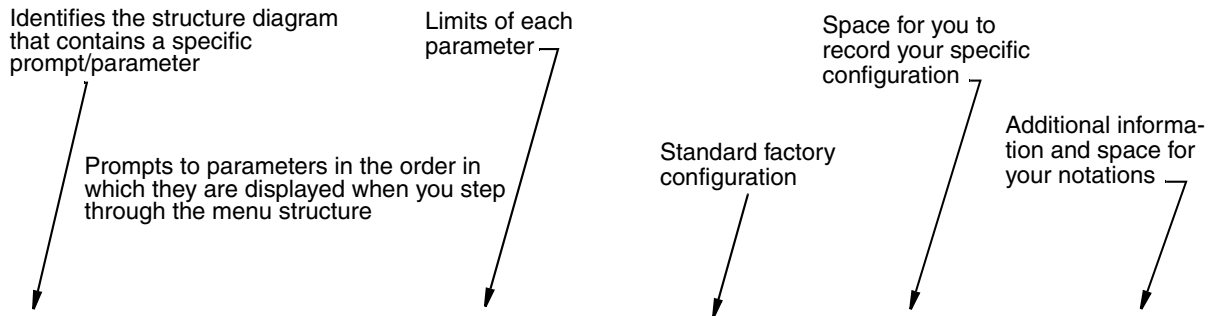


# Appendix B. Configuration Table

This appendix contains information that helps you configure your transmitter. The information is presented in the form of a table containing each prompt/parameter, its limits, and its factory default value. It also provides space for you to record your specific configuration and notations.

**— NOTE —**

Bold print in the Factory Configuration column indicates the configuration resulting from the Configure Factory Defaults menu.



| Figure | Prompt/Parameter | Parameter Limits  | Factory Configuration | User Configuration | Remarks and Notes |
|--------|------------------|---|-----------------------|--------------------|-------------------|
| A-1    | Config           | Sensor<br>Meas Config<br>Temp Config<br>Temp Comp<br>Analog Out (PV)<br>Meas Display<br>AO Fail Safe<br>HART Digital<br>Diagnostics<br>Auto Hold<br>Config Timeout<br>Transmitter Tags<br>Passcode Access<br>Cal Parameters<br>Restore Config |                       |                    |                   |

| Figure                                    | Prompt/Parameter                          | Parameter Limits   | Factory Configuration | User Configuration     | Remarks and Notes      |  |
|---|---|--|-----------------------|------------------------|------------------------|--|
| A-2                                       | Sensor                                    | ---  | ---                   |                        |                        |  |
|   | Measurement                               | pH, pH and ORP, ISE Concentration, ORP   | pH                    |                        |                        |  |
|   | <i>If Measurement = pH or pH and ORP</i>  |  |                       |                        |                        |  |
|   | Electrode                                 | Glass, Antimony, Other   | Glass                 |                        |                        |  |
|   | Slope                                     | -100 to +100 mV/pH   | -59.16                |                        | If Electrode = Other   |  |
|   | Isopotential                              | pH: -2 through +16 pH<br>ISE: 1.0 through 999.00   | 7                     |                        | If Electrode = Other   |  |
|   | Temp Type                                 | 2-Wire Pt 100 Ω<br>2-Wire Pt 1000 Ω<br>3-Wire Pt 100 Ω<br>3-Wire Pt 1000 Ω<br>3 kΩ Balco | 3-Wire Pt 1000 Ω      |                        |                        |  |
|   | <i>If Measurement = ISE Concentration</i> |  |                       |                        |                        |  |
|   | Electrode                                 | Positive, Negative   | Glass                 |                        |                        |  |
|   | Isopotential                              | -2000 to +2000 ppm   | 100                   |                        |                        |  |
|   | Valence                                   | Monovalent, Divalent   | Monovalent            |                        |                        |  |
|   | Temp Type                                 | 2-Wire Pt 100 Ω<br>2-Wire Pt 1000 Ω<br>3-Wire Pt 100 Ω<br>3-Wire Pt 1000 Ω<br>3 kΩ Balco | 3-Wire Pt 1000 Ω      |                        |                        |  |
|   | <i>If Measurement = mV (ORP)</i>          |  |                       |                        |                        |  |
|   | Temp Type                                 | 2-Wire Pt 100 Ω<br>2-Wire Pt 1000 Ω<br>3-Wire Pt 100 Ω<br>3-Wire Pt 1000 Ω<br>3 kΩ Balco | 3-Wire Pt 1000 Ω      |                        |                        |  |
|   | A-3                                       | Meas Config  | ---                   | ---                    |                        |  |
| <i>If Measurement = pH or pH and ORP</i>  |   |  |                       |                        |                        |  |
| pH Resolution                             |   | 0.1 pH, 0.01 pH  | 0.01 pH               |                        |                        |  |
| Damping                                   |   | 0 to 300 seconds   | 0                     |                        | In minutes and seconds |  |
| <i>If Measurement = ISE Concentration</i> |   |  |                       |                        |                        |  |
| ISE Units                                 |   | ppb, ppm, %, Custom  | ppm                   |                        |                        |  |
| ISE Scale                                 |   | 0.9999, 9.999, 99.99, 999.9, 9999  | 99.99                 |                        |                        |  |
| Custom Units                              |   |  | (blank)               |                        | If ISE Units = Custom  |  |
| Damping                                   |   | 0 to 300 seconds   | 0                     |                        | In minutes and seconds |  |
| <i>If Measurement = mV (ORP)</i>          |   |  |                       |                        |                        |  |
| Damping                                   | 0 to 300 seconds                          | 0  |                       | In minutes and seconds |                        |  |
| A-4                                       | Temp Config                               | ---  | ---                   |                        |                        |  |
|   | Temp Units                                | Celsius, Fahrenheit  | Celsius               |                        |                        |  |
|   | Temp Mode                                 | Auto, Manual   | Auto                  |                        |                        |  |
|   | Manual Temp                               |  | 25°C                  |                        | If Temp Mode = Manual  |  |
|   | Fail Temp                                 |  | 25°C                  |                        | If Temp Mode = Auto    |  |

| Figure       | Prompt/Parameter   | Parameter Limits   | Factory Configuration | User Configuration       | Remarks and Notes                          |
|--------------|--------------------|--|-----------------------|--------------------------|--|
| A-5          | Temp Comp          | ---  | ---                   |                          |  |
|              | Temp Comp          | Standard, Ammonia, Custom  | Standard              |                          | Not if Measurement = mV(ORP                |
|              | Ref Temp           | -30 through +200 by 0.1°C<br>-4 through +392 by 0.1°F                                    | 25°C                  |                          | If Temp Comp = Custom                      |
|              | Temp Table         | ---  | ---                   |                          |  |
|              | Num of Points      | 2 through 21   | 2                     |                          |  |
|              | Point n            |  |                       |                          |  |
|              | Temperature        |  | -30°C, +200°C         |                          |  |
|              | Value              |  | 7.1, 7.0              |                          |  |
|              |                    |  |                       |                          |  |
| A-6          | Analog Out (PV)    | ---  | ---                   |                          |  |
|              | AO Source Meas     | Measurement, Temperature, ORP, Absolute, Glass Resistance, Reference Res, ATC Resistance | Measurement           |                          |  |
|              | Lower Value        |  | 0 pH                  |                          | At 4 mA                                    |
|              | Upper Value        |  | 14 pH                 |                          | At 20 mA                                   |
|              | HART SV            | Measurement, Temperature, ORP, Absolute, Glass Resistance, Reference Res, ATC Resistance | Temperature           |                          |  |
|              | HART TV            |  | Absolute              |                          |  |
|              | HART QV            |  | ATC Resistance        |                          |  |
| A-7          | Meas Display       | ---  | ---                   |                          |  |
|              | Display Format     | Single Line, Double Line, Triple Line  | Double                |                          |  |
|              | Line 1             | Measurement, ORP, Temperature, Absolute, Analog Out                                      | Measurement           |                          | ORP only if Measurement = pH and ORP       |
|              | Line 2             |  | Temperature           |                          |  |
|              | Line 3             |  | Absolute              |                          |  |
| A-8          | AO Failsafe        | ---  | ---                   |                          |  |
|              | AO Failsafe        | Off, Fail Low, Fail High   | Off                   |                          |  |
| A-9          | HART Digital       | ---  | ---                   |                          |  |
|              | Poll Address       | 0 - 15 (HART Version 5)<br>0 - 63 (HART Version 6, 7)                                    | 0                     |                          | in HART Version 5, use 1-15 for multi-drop |
|              | mA Loop Mode       | Active, Multi-Drop   |                       |                          | HART Version 6 and 7                       |
|              | Preambles          |  | 7                     |                          |  |
|              | HART Version       | 5, 6, or 7   | 5                     |                          |  |
| A-10         | Diagnostics        | ---  | ---                   |                          |  |
|              | Leakage            | On, Off  | Off                   |                          |  |
|              | ATC Short          | On, Off  | Off                   |                          |  |
|              | ATC Open           | On, Off  | Off                   |                          |  |
|              | Comp Rng           | On, Off  | Off                   |                          |  |
|              | Meas Rng           | On, Off  | Off                   |                          |  |
|              | Low Slope          | On, Off  | Off                   |                          |  |
|              | Preamp             | On, Off  | Off                   |                          |  |
|              | Reference Coating  | On, Off  | Off                   |                          |  |
|              | Broken Glass       | On, Off  | Off                   |                          |  |
|              | Aging              | On, Off  | Off                   |                          |  |
|              | Slope Limit        | 0 through 100%   | 80.0                  |                          | If Low Slope enabled                       |
|              | Coat Limit         | 0 through 200 kΩ   | 40                    |                          | If Coated Ref enabled                      |
|              | Glass Lo Limit     | 0.10 and 1.10 MΩ   | 1.0                   |                          | If Broken Glass enabled.                   |
| Glass Cutoff | -30 through +200°C | 50°C   |                       | If Broken Glass enabled. |  |
| A-11         | Auto Hold          | ---  | ---                   |                          |  |
|              | Auto Hold          | Off, On Present, On Manual   | On Manual             |                          | See end of this table                      |

| Figure | Prompt/Parameter    | Parameter Limits                               | Factory Configuration | User Configuration | Remarks and Notes |
|--------|---------------------|--|-----------------------|--------------------|-------------------|
| A-12   | Config Timeout      | Never Timeout<br>Online Only<br>Always Timeout | Always Timeout        |                    |                   |
|        | Front Panel         | 30 to 999                                      | 600                   |                    |                   |
|        | HART Communications | 30 to 999                                      | 999                   |                    |                   |
| A-13   | Transmitter Tags    | - - -  | - - -                 |                    |                   |
|        | HART Message        | 32 characters                                  | (blank)               |                    |                   |
|        | HART Tag            | 8 characters                                   | (blank)               |                    |                   |
|        | HART Long Tag       | 32 characters                                  | (blank)               |                    |                   |
|        | HART Descriptor     | 16 characters                                  | (blank)               |                    |                   |
|        | Tag Name            | 14 characters                                  | (blank)               |                    |                   |
|        | Location            | 14 characters                                  | (blank)               |                    |                   |
|        | Device Name         | 6 characters                                   | (blank)               |                    |                   |
| A-14   | Passcode Access     | - - -  | - - -                 |                    |                   |
|        | Admin Code          | 0000 to 9999                                   | 0800                  |                    |                   |
|        | User Code           | 0000 to 9999                                   | 0800                  |                    |                   |
|        | User Change         | - - -  | - - -                 |                    |                   |
|        | Calibrate           | On, Off  | On                    |                    |                   |
|        | Cal Buffers         | On, Off  | Off                   |                    |                   |
|        | Hold                | On, Off  | On                    |                    |                   |
|        | Suspend Fault       | On, Off  | Off                   |                    |                   |
|        | Resume Fault        | On, Off  | Off                   |                    |                   |
|        | Clear History       | On, Off  | Off                   |                    |                   |
|        | Temp Comp           | On, Off  | On                    |                    |                   |
|        | Sensor Cfg          | On, Off  | On                    |                    |                   |
|        | PV Cfg              | On, Off  | On                    |                    |                   |
|        | Meas Cfg            | On, Off  | On                    |                    |                   |
|        | Display Cfg         | On, Off  | On                    |                    |                   |
|        | Diag Cfg            | On, Off  | Off                   |                    |                   |
|        | HART Cfg            | On, Off  | Off                   |                    |                   |
|        | Auto Hold           | On, Off  | Off                   |                    |                   |
|        | Tags Cfg            | On, Off  | Off                   |                    |                   |
|        | Timeouts            | On, Off  | Off                   |                    |                   |
|        | Default Cfg         | On, Off  | Off                   |                    |                   |
|        | User View           | - - -  | - - -                 |                    |                   |
|        | Cal Buffers         | On, Off  | On                    |                    |                   |
|        | Temp Comp           | On, Off  | On                    |                    |                   |
|        | Temp Table          | On, Off  | On                    |                    |                   |
|        | Display             | On, Off  | On                    |                    |                   |
|        | Diags               | On, Off  | On                    |                    |                   |
|        | HART                | On, Off  | On                    |                    |                   |
|        | Auto Hold           | On, Off  | On                    |                    |                   |
|        | Xmtr Tags           | On, Off  | On                    |                    |                   |
|        | Timeouts            | On, Off  | On                    |                    |                   |
|        | Default             | On, Off  | On                    |                    |                   |

| Figure | Prompt/Parameter | Parameter Limits  | Factory Configuration | User Configuration | Remarks and Notes |
|--------|------------------|---|-----------------------|--------------------|-------------------|
| A-15   | Cal Parameters   | ---   | ---                   |                    |                   |
|        | Buffer Set       | American, NIST, European, DIN, MERK, JIS 8802, User Select                | American              |                    |                   |
|        | Stability        | 25% through 1000%   | 100                   |                    | pH                |
|        | User Select      | Standard 1, 2, 3, 4, 5, 6, 7  | ---                   |                    |                   |
|        | # Standard       | 1.68, 4.01, 4.61, 6.87, 7.00, 9.18, 10:00, 10.01, 12.45, Custom, not used | American buffer set   |                    |                   |
|        | # Nominal        |   |                       |                    |                   |
|        | # Num Points     | 1 through 21  |                       |                    |                   |
|        | # Point n        |   | ---                   |                    |                   |
|        | # Temp Value n   |   |                       |                    |                   |
|        | # Value n        |   |                       |                    |                   |
| A-16   | Restore Config   | ---   | ---                   |                    |                   |
|        | Restore User 1   | Yes, No   | No                    |                    |                   |
|        | Restore User 2   | Yes, No   | No                    |                    |                   |
|        | Restore Factory  | Yes, No   | No                    |                    |                   |

If Auto Hold is set to On Manual, the transmitter hold output value limits and factory configuration is as follows:

|    |             |              |                 |  |  |
|----|-------------|--------------|-----------------|--|--|
| 14 | Manual Hold | ---          | ---             |  |  |
|    | AO Hold     | 3.6 to 22 mA | 3.6 mA          |  |  |
|    | PV Hold     | (per source) | 7 pH            |  |  |
|    | SV Hold     | (per source) | 25°C            |  |  |
|    | TV Hold     | (per source) | 0 mV            |  |  |
|    | QV Hold     | (per source) | 1097.3 $\Omega$ |  |  |



# Appendix C. Auto Calibration

Auto calibration is provided for advanced users with automated systems for cleaning and re-calibrating the probe. These systems require an external control system to orchestrate the process. The transmitter activates its output hold feature, and performs solution calibrations. Auto-service is initiated by the external control system. There is no scheduling nor time delays in the transmitter.

A typical calibration includes:

- Activate output hold
- Start solution calibration: low, providing known value (or pH auto-buffer)
- Start solution calibration: high, providing known value (or pH auto-buffer)
- Determine when calibration (low or high) is complete
- Release output hold

There are two HART hold commands:

- Activate Output Hold
- Release Output Hold

There are three HART auto-calibration commands:

- Start Calibration
- Check Calibration Status
- Finish Calibration

There are two commands used to save changes

- Write Entity Byte Base
- Read Entity Byte User Attributes

The following calibrations may be performed:

- 1,2,3,4,5 point manual measurement calibration
- 1,2,3,4,5 point smart measurement calibration
- 1,2 point temperature calibration
- 1 point ORP calibration
- 2 point mA calibration

## Calibration Parameters

Use the following values for:

Calibration Type (1 byte)

- Measurement Calibration 1st point - 102
- Measurement Calibration 2nd point - 103

|                                     |  |
|-------------------------------------|--|
| Measurement Calibration 3rd point - | 104  |
| Measurement Calibration 4th point - | 105  |
| Measurement Calibration 5th point - | 106  |
| ORP -                               | 107  |
| Temperature 1st point -             | 110  |
| Temperature 2nd Point -             | 111  |
| mA Calibration 4 mA -               | 112  |
| mA Calibration 20 mA -              | 113  |
| Number of Calibration Points -      | 1,2,3,4 or 5                               |
| Calibration Source                  |  |
| Manual -                            | 2  |
| Smart -                             | 5  |
| Application to calibrate -          | 1  |
| Calibrator's Initials -             | 6 characters                               |
| Calibration Date -                  | Hart Date format (year, month, day + 1900) |
| Calibration Units -                 |  |
| pH -                                | 11   |
| ORP -                               | 14   |
| degC -                              | 4  |
| degF -                              | 3  |
| mA -                                | 2  |
| % -                                 | 1  |
| ppm -                               | 12   |
| ppb -                               | 13   |
| custom -                            | 15   |

## Command Sequence

1. If explicit output hold is required, issue Activate Output Hold (0x92).  
Otherwise, automatic hold ensues.
2. Activate automatic system to provide calibration buffer to the sensor.
3. Send Start Cal (0x94) command
4. Send Cal Status (0x95) command, read until measurement is stable
5. Send Finish Cal (0x96) command (unless Smart Cal)
6. Repeat steps 2-5 for each calibration point
7. Save changes by writing to save changes and check changes entities.



- a. Write 1 to byte entity 10.
  - b. Write 0 to byte entity 11 R
  - c. Read entity attributes (8F02000B)
  - d. Repeat steps b & c until entity goes invisible.
8. Release any output hold (0x93)

## Cmd 148 (0x94): Start Cal

(This command holds off QuickStart)

HART Command Type : Device Specific

HART Versions : 5 6 7

HART Operation Type : COMMAND

Code Section

Support In Boot : False

Support In Main : True

Support Function : StartCal.

Request: 22 (0x16) bytes (plus preambles)

| Size | Type | Fixed/Var | HART Ver # | Example    | Description                             |
|------|------|-----------|------------|------------|---|
| 1    | byte | Fixed     | 567        | 0x82       | Request Delimiter                       |
| 5    | byte | Var       | 567        | 0x???????? | Device Address                          |
| 1    | byte | Fixed     | 567        | 0x94       | Command 148                             |
| 1    | byte | Fixed     | 567        | 0x0D(13d)  | Data Length<br>(not including checksum) |
| 1    | byte | Var       | 567        | 0x??       | CalType                                 |
| 1    | byte | Var       | 567        | 0x??       | CalPoints                               |
| 1    | byte | Var       | 567        | 0x??       | CalSource                               |
| 1    | byte | Var       | 567        | 0x??       | AppIndex                                |
| 3    | date | Var       | 567        | DDMMYY     | CalDate                                 |
| 6    | char | Var       | 567        | xxxxxx     | CalPerson                               |
| 1    | byte | Var       | 567        | 0x??       | HART Checksum                           |

## Response: 24 (0x18) bytes (plus preambles)

| Size | Type | Fixed/Var | HART Ver # | Example    | Description  |
|------|------|-----------|------------|------------|--|
| 1    | byte | Fixed     | 567        | 0x86       | Response Delimiter                                     |
| 5    | byte | Var       | 567        | 0x???????? | Device Address   |
| 1    | byte | Fixed     | 567        | 0x94       | Command 148  |
| 1    | byte | Fixed     | 567        | 0x0F(15d)  | Data Length<br>(not including checksum)                |
| 1    | byte | Var       | 567        | 0x00       | HART Command Status                                    |
| 1    | byte | Var       | 567        | 0x??       | HART Device Status<br>(Configuration Changed Flag set) |
| 1    | byte | Var       | 567        | 0x??       | CalType  |
| 1    | byte | Var       | 567        | 0x??       | CalPoints  |
| 1    | byte | Var       | 567        | 0x??       | CalSource  |
| 1    | byte | Var       | 567        | 0x??       | AppIndex   |
| 3    | date | Var       | 567        | DDMMYY     | CalDate  |
| 6    | char | Var       | 567        | xxxxxx     | CalPerson  |
| 1    | byte | Var       | 567        | 0x??       | HART Checksum  |

## Cmd 149 (0x95): Read Cal Status

(This command holds off QuickStart)

HART Command Type : Device Specific

HART Versions : 5 6 7

HART Operation Type : COMMAND

Code Section

Support In Boot : False

Support In Main : True

Support Function : RdCalStatus.

## Request: 10 (0x0A) bytes (plus preambles)

| Size | Type | Fixed/Var | HART Ver # | Example    | Description       |
|------|------|-----------|------------|------------|-------------------|
| 1    | byte | Fixed     | 567        | 0x82       | Request Delimiter |
| 5    | byte | Var       | 567        | 0x???????? | Device Address    |
| 1    | byte | Fixed     | 567        | 0x95       | Command 149       |

| Size | Type | Fixed/Var | HART Ver # | Example  | Description                             |
|------|------|-----------|------------|----------|---|
| 1    | byte | Fixed     | 567        | 0x01(1d) | Data Length<br>(not including checksum) |
| 1    | byte | Var       | 567        | 0x??     | CalType                                 |
| 1    | byte | Var       | 567        | 0x??     | HART Checksum                           |

Response: 18 (0x12) bytes (plus preambles)

| Size | Type | Fixed/Var | HART Ver # | Example    | Description  |
|------|------|-----------|------------|------------|--|
| 1    | byte | Fixed     | 567        | 0x86       | Response Delimiter                                     |
| 5    | byte | Var       | 567        | 0x???????? | Device Address   |
| 1    | byte | Fixed     | 567        | 0x95       | Command 149  |
| 1    | byte | Fixed     | 567        | 0x09(9d)   | Data Length<br>(not including checksum)                |
| 1    | byte | Var       | 567        | 0x00       | HART Command Status                                    |
| 1    | byte | Var       | 567        | 0x??       | HART Device Status<br>(Configuration Changed Flag set) |
| 1    | byte | Var       | 567        | 0x??       | CalType  |
| 1    | byte | Var       | 567        | 0x??       | CalStable  |
| 1    | byte | Var       | 567        | 0x??       | CalUnits   |
| 4    | real | Var       | 567        | ? 0.0      | CalValue   |
| 1    | byte | Var       | 567        | 0x??       | HART Checksum  |

## Cmd 150 (0x96): Finish Cal

(This command holds off QuickStart)

HART Command Type : Device Specific

HART Versions : 5 6 7

HART Operation Type : COMMAND

Code Section

Support In Boot : False

Support In Main : True

Support Function : FinishCal.

## Request: 15 (0x0F) bytes (plus preambles)

| Size | Type | Fixed/Var | HART Ver # | Example    | Description                             |
|------|------|-----------|------------|------------|---|
| 1    | byte | Fixed     | 567        | 0x82       | Request Delimiter                       |
| 5    | byte | Var       | 567        | 0x???????? | Device Address                          |
| 1    | byte | Fixed     | 567        | 0x96       | Command 150                             |
| 1    | byte | Fixed     | 567        | 0x06(6d)   | Data Length<br>(not including checksum) |
| 1    | byte | Var       | 567        | 0x??       | CalType                                 |
| 1    | byte | Var       | 567        | 0x??       | CalUnits                                |
| 4    | real | Var       | 567        | ? 0.0      | CalValue                                |
| 1    | byte | Var       | 567        | 0x??       | HART Checksum                           |

## Response: 17 (0x11) bytes (plus preambles)

| Size | Type | Fixed/Var | HART Ver # | Example    | Description  |
|------|------|-----------|------------|------------|--|
| 1    | byte | Fixed     | 567        | 0x86       | Response Delimiter                                     |
| 5    | byte | Var       | 567        | 0x???????? | Device Address   |
| 1    | byte | Fixed     | 567        | 0x96       | Command 150  |
| 1    | byte | Fixed     | 567        | 0x08(8d)   | Data Length<br>(not including checksum)                |
| 1    | byte | Var       | 567        | 0x00       | HART Command Status                                    |
| 1    | byte | Var       | 567        | 0x??       | HART Device Status<br>(Configuration Changed Flag set) |
| 1    | byte | Var       | 567        | 0x??       | CalType  |
| 1    | byte | Var       | 567        | 0x??       | CalStable  |
| 1    | byte | Var       | 567        | 0x??       | CalUnits   |
| 4    | real | Var       | 567        | ? 0.0      | CalValue   |
| 1    | byte | Var       | 567        | 0x??       | HART Checksum  |

## Cmd 142 (0x8E): Write Entity Byte Base

(This command holds off QuickStart)

HART Command Type : Device Specific

HART Versions : 5 6 7

HART Operation Type : WRITE

Code Section

Support In Boot : False  
 Support In Main : True  
 Support Function : HARTE\_BytWrBase.

Request: 12 (0x0C) bytes (plus preambles)

| Size | Type | Fixed/V<br>ar | HART<br>Ver # | Example    | Description                             |
|------|------|---------------|---------------|------------|---|
| 1    | byte | Fixed         | 567           | 0x82       | Request Delimiter                       |
| 5    | byte | Var           | 567           | 0x???????? | Device Address                          |
| 1    | byte | Fixed         | 567           | 0x8E       | Command 142                             |
| 1    | byte | Fixed         | 567           | 0x03(3d)   | Data Length<br>(not including checksum) |
| 2    | int  | Var           | 567           | 0          | EntityIndex                             |
| 1    | byte | Var           | 567           | 0x00       | EntityValue                             |
| 1    | byte | Var           | 567           | 0x??       | HART Checksum                           |

Response: 15 (0x0F) bytes (plus preambles)

| Size | Type | Fixed/V<br>ar | HART<br>Ver # | Example    | Description  |
|------|------|---------------|---------------|------------|--|
| 1    | byte | Fixed         | 567           | 0x86       | Response Delimiter                                     |
| 5    | byte | Var           | 567           | 0x???????? | Device Address   |
| 1    | byte | Fixed         | 567           | 0x8E       | Command 142  |
| 1    | byte | Fixed         | 567           | 0x06(6d)   | Data Length<br>(not including checksum)                |
| 1    | byte | Var           | 567           | 0x00       | HART Command Status                                    |
| 1    | byte | Var           | 567           | 0x??       | HART Device Status<br>(Configuration Changed Flag set) |
| 2    | int  | Var           | 567           | ? 0        | EntityIndex  |
| 1    | byte | Var           | 567           | 0x??       | EntityValue  |
| 1    | byte | Var           | 567           | 0x??       | Error  |
| 1    | byte | Var           | 567           | 0x??       | HART Checksum  |

Cmd 143 (0x8F): Read Entity Byte User Attributes

HART Command Type : Device Specific  
 HART Versions : 5 6 7  
 HART Operation Type : READ

## Code Section

Support In Boot : False  
 Support In Main : True  
 Support Function : HARTE\_BytRdUserAtt.

## Request: 11 (0x0B) bytes (plus preambles)

| Size | Type | Fixed/Var | HART Ver # | Example    | Description                             |
|------|------|-----------|------------|------------|---|
| 1    | byte | Fixed     | 567        | 0x82       | Request Delimiter                       |
| 5    | byte | Var       | 567        | 0x???????? | Device Address                          |
| 1    | byte | Fixed     | 567        | 0x8F       | Command 143                             |
| 1    | byte | Fixed     | 567        | 0x02(2d)   | Data Length<br>(not including checksum) |
| 2    | int  | Var       | 567        | 1          | EntityIndex                             |
| 1    | byte | Var       | 567        | 0x??       | HART Checksum                           |

## Response: 20 (0x14) bytes (plus preambles)

| Size | Type | Fixed/Var | HART Ver # | Example    | Description  |
|------|------|-----------|------------|------------|--|
| 1    | byte | Fixed     | 567        | 0x86       | Response Delimiter                                     |
| 5    | byte | Var       | 567        | 0x???????? | Device Address   |
| 1    | byte | Fixed     | 567        | 0x8F       | Command 143  |
| 1    | byte | Fixed     | 567        | 0x0B(11d)  | Data Length<br>(not including checksum)                |
| 1    | byte | Var       | 567        | 0x00       | HART Command Status                                    |
| 1    | byte | Var       | 567        | 0x??       | HART Device Status<br>(Configuration Changed Flag set) |
| 2    | int  | Var       | 567        | ? 0        | EntityIndex  |
| 1    | byte | Var       | 567        | 0x??       | InVisibility = 0x80 bit                                |
| 4    | byte | Var       | 567        | 0x??????   | PicksInVisible   |
| 1    | byte | Var       | 567        | 0x??       | Error  |
| 1    | byte | Var       | 567        | 0x??       | EntityValue  |
| 1    | byte | Var       | 567        | 0x??       | HART Checksum  |

## Cmd 146 (0x92): Activate Output Hold

(This command holds off QuickStart)

HART Command Type : Device Specific  
 HART Versions : 5 6 7  
 HART Operation Type : COMMAND  
 Code Section  
 Support In Boot : False  
 Support In Main : True  
 Support Function : ActivateOutputHold.

Request: 30 (0x1E) bytes (plus preambles)

| Size | Type | Fixed/Var | HART Ver # | Example    | Description                             |
|------|------|-----------|------------|------------|---|
| 1    | byte | Fixed     | 567        | 0x82       | Request Delimiter                       |
| 5    | byte | Var       | 567        | 0x???????? | Device Address                          |
| 1    | byte | Fixed     | 567        | 0x92       | Command 146                             |
| 1    | byte | Fixed     | 567        | 0x15(21d)  | Data Length<br>(not including checksum) |
| 1    | byte | Var       | 567        | 0x??       | Hold Mode                               |
| 4    | real | Var       | 567        | 3.6        | Hold mA                                 |
| 4    | real | Var       | 567        | 7          | Hold PV                                 |
| 4    | real | Var       | 567        | 25         | Hold SV                                 |
| 4    | real | Var       | 567        | 0          | Hold TV                                 |
| 4    | real | Var       | 567        | 109.73     | Hold QV                                 |
| 1    | byte | Var       | 567        | 0x??       | HART Checksum                           |

Response: 32 (0x20) bytes (plus preambles)

| Size | Type | Fixed/Var | HART Ver # | Example    | Description  |
|------|------|-----------|------------|------------|--|
| 1    | byte | Fixed     | 567        | 0x86       | Response Delimiter                                     |
| 5    | byte | Var       | 567        | 0x???????? | Device Address   |
| 1    | byte | Fixed     | 567        | 0x92       | Command 146  |
| 1    | byte | Fixed     | 567        | 0x17(23d)  | Data Length<br>(not including checksum)                |
| 1    | byte | Var       | 567        | 0x00       | HART Command Status                                    |
| 1    | byte | Var       | 567        | 0x??       | HART Device Status<br>(Configuration Changed Flag set) |
| 1    | byte | Var       | 567        | 0x??       | Hold Mode  |

| Size | Type | Fixed/Var | HART Ver # | Example | Description   |
|------|------|-----------|------------|---------|---------------|
| 4    | real | Var       | 567        | 3.6     | Hold mA       |
| 4    | real | Var       | 567        | 7       | Hold PV       |
| 4    | real | Var       | 567        | 25      | Hold SV       |
| 4    | real | Var       | 567        | 0       | Hold TV       |
| 4    | real | Var       | 567        | 109.73  | Hold QV       |
| 1    | byte | Var       | 567        | 0x??    | HART Checksum |

Possible HART Command Status errors returned:

(5) 0x05 Error Too few data bytes received

## Cmd 147 (0x93): Release Output Hold

HART Command Type : Device Specific

HART Versions : 5 6 7

HART Operation Type : COMMAND

Code Section

Support In Boot : False

Support In Main : True

Support Function : ReleaseOutputHold.

Request: 9 (0x09) bytes (plus preambles)

| Size | Type | Fixed/Var | HART Ver # | Example      | Description                             |
|------|------|-----------|------------|--------------|---|
| 1    | byte | Fixed     | 567        | 0x82         | Request Delimiter                       |
| 5    | byte | Var       | 567        | 0x?????????? | Device Address                          |
| 1    | byte | Fixed     | 567        | 0x93         | Command 147                             |
| 1    | byte | Fixed     | 567        | 0x00(0d)     | Data Length<br>(not including checksum) |
| 1    | byte | Var       | 567        | 0x??         | HART Checksum                           |

Response: 11 (0x0B) bytes (plus preambles)

| Size | Type | Fixed/Var | HART Ver # | Example      | Description        |
|------|------|-----------|------------|--------------|--------------------|
| 1    | byte | Fixed     | 567        | 0x86         | Response Delimiter |
| 5    | byte | Var       | 567        | 0x?????????? | Device Address     |



| Size | Type | Fixed/Var | HART Ver # | Example  | Description  |
|------|------|-----------|------------|----------|--|
| 1    | byte | Fixed     | 567        | 0x93     | Command 147  |
| 1    | byte | Fixed     | 567        | 0x02(2d) | Data Length<br>(not including checksum)                |
| 1    | byte | Var       | 567        | 0x00     | HART Command Status                                    |
| 1    | byte | Var       | 567        | 0x??     | HART Device Status<br>(Configuration Changed Flag set) |
| 1    | byte | Var       | 567        | 0x??     | HART Checksum  |



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ISSUE DATES  
MAY 2010

Vertical lines to the right of text or illustrations indicate areas changed at last issue date.

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