Instruction

MI 611-190
June 2004

873DPX Dual pH/ORP/ISE Electrochemical Analyzer

Style C

Invensys®
FOXBORO®

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1. Introduction

Description

The 873DPX Dual pH/ORP/ISE Analyzer is an addition to the 873 family of electrochemical analyzers that extends capabilities to ion-specific measurements as well as pH and ORP. The 873DPX analyzer interprets the pH/ORP or specific ion concentration of aqueous solutions and displays measurement values in pH, mV, or ppm of the selected ion. It also measures solution temperatures for both cells, which may be displayed on demand, for automatic temperature compensation of pH and ISE (ion selective electrode) measurements.

The 873DPX can make dual (similar or different) measurements in a single solution. It can also make dual (similar or different) measurements in different solutions if the difference in potential between solutions does not exceed 5 V dc or 3.5 V ac. This capability allows for:

- Dual pH measurement
- Dual ORP measurement
- Dual ISE measurement
- Simultaneous pH and ORP measurement
- Simultaneous pH and ISE measurement
- Simultaneous ORP and ISE measurement
- pH corrected ISE measurement

The analyzer can accept inputs from two independent process measurement sensors (pH, ORP, or ion-specific) plus RTD temperature detectors for both sensors. The unit can also output two isolated analog signals proportional to any of the following:

- Measured values of both sensors
- Solution temperatures for both sensors
- Average of measured values for both sensors
- Ratio of measured values (Cell 1/Cell 2)
- Difference between measured values of both sensors (Cell 1 – Cell 2)

Instrument Features

Some of the features of the 873DPX Analyzer are:

- Metal Field Enclosure
- Dual Alarms
- Dual Analog Outputs
- EEPROM Memory
- Instrument Security Code
- Hazardous Area Classification

- Front Panel Display
- Application Flexibility
- Storm Door Option

Enclosure

The metal enclosure is designed for field or control room locations and may be panel, pipe, or surface mounted. It is constructed of cast aluminum coated with a tough epoxy-based paint. The enclosure is watertight, dusttight, and corrosion-resistant, meeting the enclosure rating of NEMA 4X, CSA Enclosure 4X, and IEC Degree of Protection IP-66. The unit fits in a 92 x 92 mm (3.6 x 3.6 in) panel cutout (1/4 DIN size). The enclosure also provides inherent protection against radio frequency interference (RFI) and electro-magnetic interference (EMI).

Dual Alarms

Dual, independent, Form C dry alarm contacts, rated 5 A noninductive, 125 V ac/ 30 V dc are provided. The alarm status is alternately displayed with the current measurement value on the LED (light-emitting diode) display.

! CAUTION

When the contacts are used at signal levels of less than 20 W, contact function may become unreliable over time due to the formation of an oxide layer on the contacts. See “Alarm Contact Maintenance” on page 79.

No Battery Backup Required

Non-volatile EEPROM memory is used to protect all operating parameters and calibration data in the event of a power interruption.

Instrument Security Code

A combination code lock method, user configurable, provides protection of operational parameters from accidental or unauthorized access.

Hazardous Area Classification

The instrument is designed to meet Class I, Division 2, Groups A, B, C, and D hazardous locations.

Front Panel Display

The instrument display consists of a 4-digit bank of red LEDs, as shown on the next page. The 14.2 mm (0.56 in) display height provides visibility at a distance up to 6 m (20 ft) through a red-tinted, nonreflective, protective window on the front panel.

The measurement value is the normally displayed data. If other data is displayed due to prior keypad operations, the display automatically defaults to the measurement value 10 seconds after the last key is pressed. This feature is called “timing out.” The “timeout” time may be adjusted to any time between 3 and 99 seconds. You can prevent the "timeout" from occurring by pressing and holding the SHIFT key.

If no fault or alarm conditions are detected in the instrument, the measurement value is displayed steadily. If, however, fault or alarm conditions do occur, the display alternately shows the measurement and a fault or alarm message on a 1-second cycle.

Front Panel Keypad

The front panel keypad consists of eight keys. Some keys handle specific fixed functions; others perform split functions. You can select the upper function (green legend) of a fixed function key by pressing and holding the shift key as you press the split function key.

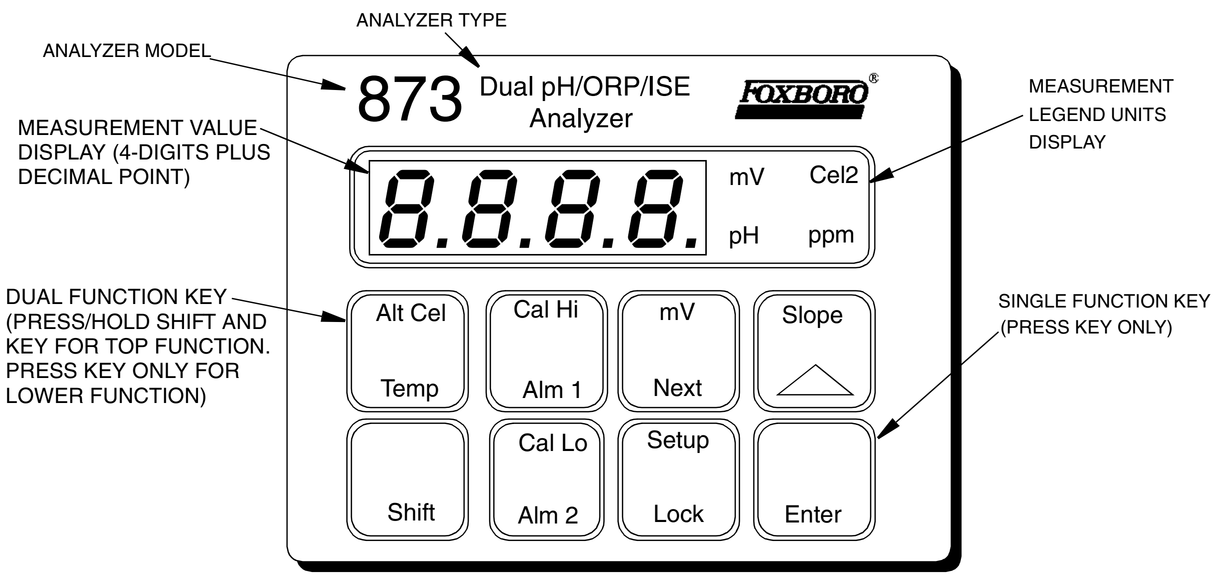


Figure 1. Front Panel Keypad and Display

Application Flexibility

The 873DPX Analyzer offers application flexibility through its standard software package. The software, which runs on the internal microprocessor, allows you to define and set operating parameters specific to your application. Such parameters fall into four general categories:

1. Measurement Range
2. Alarm Configuration
3. Diagnostics
4. Output Characterization

These parameters are stored in EEPROM nonvolatile memory and are maintained in the event of a power interruption.

Storm Door Option

This door is attached to the top front surface of the enclosure. It is used to prevent accidental or inadvertent actuation of front panel controls, particularly in field mounted applications. The transparent door, hinged for easy access to front panel controls, permits a clear view of the display when closed.

Analyzer Identification

A data label, fastened to the side of the enclosure, provides model number and other information pertinent to the specific instrument. An example is shown in the figure below.

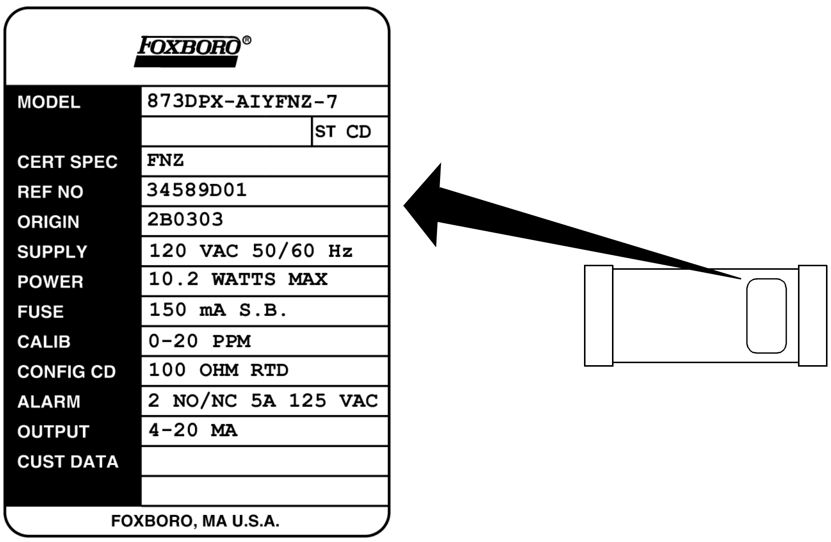


Figure 2. Typical Data Label

Model Code

Dual pH/ORP/ISE Electrochemical Analyzer	873DPX
Supply Voltage and Frequency	
120 V ac, 50/60 Hz	-A
220 V ac, 50/60 Hz	-B
240 V ac, 50/60 Hz	-C
24 V ac, 50/60 Hz	-E
100 V ac, 50/60 Hz	-J
Measurement Output	
0 to 20 mA dc, isolated	E
4 to 20 mA dc, isolated	I
0 to 10 V dc, isolated	T
Enclosure	
Field, Metal, Panel Mounting	W
Field, Metal, Surface Mounting — Fixed	X
Field, Metal, Pipe Mounting	Y
Field, Metal, Surface Mounting — Movable	Z
Electrical Certification (see Product Safety Specifications Section)	
CSA, Ordinary Locations (except 220 and 240 V ac options)	CGZ
FM, Ordinary Locations	FGZ
FM, Nonincendive, Division 2 Locations	FNZ
CSA, Nonincendive, Division 2 Locations (except 220 and 240 V ac options) (a)	CNZ
Optional Selections	
Storm Door	-7
Special per Engineering Order	-0

(a) Not available at time of printing.

Standard Specifications

Supply Voltages	-A 120 V ac -B 220 V ac -C 240 V ac -E 24 V ac -J 100 V ac
Supply Frequency	50 or 60 Hz, ±3 Hz
Output Signals	I: 4 to 20 mA isolated T: 1 to 10 V dc isolated E: 0 to 20 mA isolated
Ambient Temperature Limits	-25 to +55°C (-13 to +131°F)
Measurement Ranges	pH: -2 to +16 pH ORP: -999 to +1400 mV ISE: 300 mV span with range limits of -999 and +1000 mV (displayed as ppm)
Temperature Measurement Range	-17 to +199 °C (0 to 390°F)
Temperature Compensation Range	-5 to +105 °C (23 to 221°F)
Relative Humidity Limits	5 to 95%, noncondensing
Accuracy of Analyzer Display	±0.1% of upper range limit
Accuracy of Analyzer Outputs	±0.25% of upper range limit
Analyzer Identification	Refer to Figure 2.
Dimensions	96(H) x 96(W) x 259(L) mm
Enclosure Mounting Options	-W : Metal Field Mount/Panel Mount -X : Metal Field Mount/Surface Mount -Y : Metal Field Mount/Pipe Mount -Z : Metal Field Mount/Movable Surface Mount
Approximate Mass	Metal Field Enclosure (with brackets) Panel Mounting 1.28 kg (3.9 lb) Pipe Mounting 2.54 kg (5.6 lb) Fixed Surface Mounting – 2. 46 kg (5.4 lb) Movable Surface Mounting –3.38 kg (7.4 lb)
Instrument Response	2 seconds maximum (when zero measurement damping is selected in Configuration Code). Temperature Response is 15 seconds maximum.
Measurement Damping	Choice of 0, 10, 20, or 40 second, configurable from keypad. Damping affects displayed parameters and analog outputs.

Alarms	Two alarms configurable via keypad. Individual set points continuously adjustable 0 to full scale via keypad. Hysteresis selection for both alarms; 0 to 99% of full scale value, configurable via keypad. Dual timers for both alarms, adjustable 0 to 99 minutes, configurable via keypad. Allows for on/off control with delay. Timers can be set to allow chemical feed, then delay for chemical concentration control.
Alarm Contacts	Two independent, nonpowered Form C contacts. Rated 5 A noninductive, 125 V ac/30 V dc (minimum current 1 A). Inductive loads can be driven with external surge-absorbing devices installed across contact terminations. **CAUTION**: When the contacts are used at signal levels of less than 20 W, contact function may become unreliable over time due to the formation of an oxide layer on the contacts. See "Alarm Contact Maintenance" on page 79.
Alarm Indication	Alarm status alternately displayed with measurement on LED display.
RFI Susceptibility	10 V/m from 27 MHz to 1000 MHz, when all sensor and power cables are enclosed in a grounded conduit.
Electromagnetic Compatibility (EMC)	The Model 873DPX Electrochemical Analyzer, 220 V ac, or 240 V ac systems with Metal Enclosure, comply with the requirements of the European EMC Directive 89/336/EEC when the sensor cable, power cable, and I/O cables are enclosed in rigid metal conduit. See Table 1. The plastic case units comply with the European EMC Directive 89/336/EEC when mounted in a solid metal enclosure and the I/O cables extending outside the enclosure are enclosed in solid metal conduit. See Figure 1.

Electrical Safety Specifications

Testing Laboratory, Types of Protection, and Area Classification	Application Conditions	Electrical Safety Design Code
FM for use in general purpose (ordinary) locations.		FGZ
FM nonincendive for use in Class I, Division 2, Groups A, B, C, and D; and suitable for Class II, Division 2, Groups F and G, hazardous locations.	Temperature Class T6.	FNZ
CSA (Canada): for use in general purpose (ordinary) locations.	24 V, 100 V, and 120 V ac (Supply option -A, -E, -J) only.	CGZ
CSA (Canada): Suitable for use in Class I, Division 2, Groups A, B, C, and D.		CNZ

— NOTE

The analyzer has been designed to meet the electrical classifications listed in the table above. For detailed information on the status of agency approvals, contact Invensys Foxboro.

— ⚠ CAUTION

1. When replacing covers on the 873DPX case, use Loctite (Part No. S0106ML) on the threads of screws for the front cover and Lubriplate (Part No. X0114AT) on the threads of screws for the rear cover. Do not mix.
2. Exposure to some chemicals may degrade the sealing properties of Polybutylene Teraethalate and Epoxy Magnacraft 276XAXH-24 used in relays K1 and K3. These materials are sensitive to acetone, MEK, and acids. Periodically inspect relays K1 and K3 for any degradation of properties and replace if degradation is found.

2. Installation

Mounting to a Panel (873DPX-xxWxxx)

The metal field-mounted enclosure can also be mounted to a panel. The procedure is as follows:

1. Refer to DP 611-162 for panel cutout data.
2. Make cutout in panel in accordance with DP 611-162.
3. Remove rear bezel and insert analyzer through panel cutout. Temporarily hold in place.
4. From rear of panel, slide plastic clamp onto enclosure until clamp latches (2) snap into two opposing slots on longitudinal edges of enclosure. See Figure 3.
5. Tighten screws (CW) on clamp latches until enclosure is secured to panel.
6. Reassemble rear bezel to enclosure using the four captive screws.

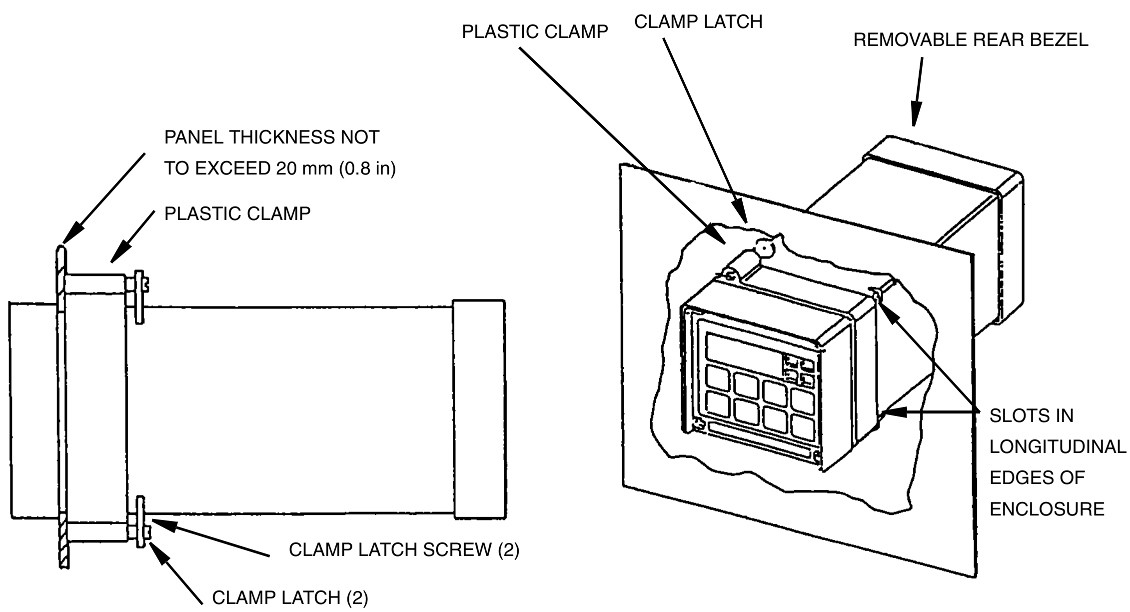


Figure 3. Mounting to a Panel

Mounting to a Pipe (873DPX-xxYxxx)

1. Locate horizontal or vertical DN 50 or 2-inch pipe.
2. Assemble universal mounting bracket as follows:
   - a. Place hex bolts (5) through spacer (3) into support bracket (2).
   - b. Slide nylon washers (11) over bolts (5).
   - c. Slide bolts through pipe mounting bracket (1) and fasten assembly tightly with hardware designated 7, 6, and 13.
   - d. Attach pipe mounting bracket (1) to pipe with U-bolts (12) using hardware designated 6, 7, and 13.
3. Slide analyzer into support bracket and slide strap clamp (4) onto analyzer. Using two screws. nuts, and washers, attach strap clamp to support bracket and secure analyzer.
4. Lift entire assembly of Step 3 and, secure mounting bracket to pipe, using two U-clamps, nuts and washers.

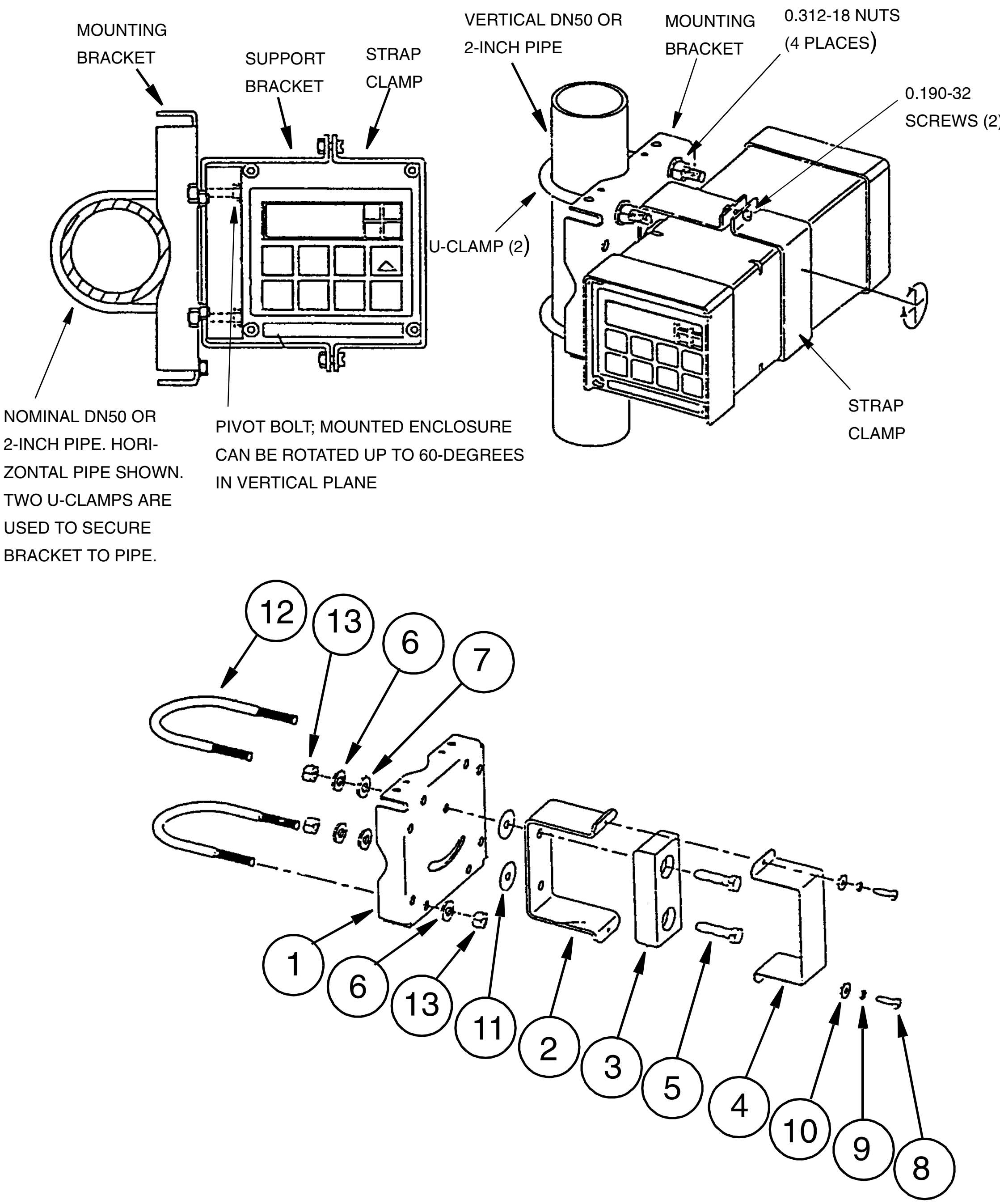


Figure 4. Mounting to a Pipe (Horizontal or Vertical)

Mounting to a Surface — Fixed Mount (873DPX-xxXxxx)

1. Locate mounting surface for analyzer.
2. Referring to Figure 5, use mounting bracket as template for drilling four holes into mounting surface. Notice that holes in the mounting bracket are 8.74 mm (0.344 in) in diameter. Do not attach mounting bracket to surface at this time.
3. Assemble universal mounting as follows:
   - **a.** Place hex bolts (5) through spacer (3) into support bracket (2).
   - **b.** Slide nylon washers (11) over bolts (5).
   - **c.** Slide bolts through universal mounting bracket (1) and fasten assembly together with hardware designated 7, 6, and 12.
   - **d.** Attach universal mounting bracket (1) to wall.
4. Slide analyzer into support bracket and slide strap clamp (4) onto analyzer. Using two screws, nuts, and washers, attach strap clamp to support bracket and secure analyzer.
5. Lift entire assembly of Step 4, align mounting bracket holes with mounting surface holes and use four user-supplied bolts, nuts, and washers to attach mounting bracket to surface.

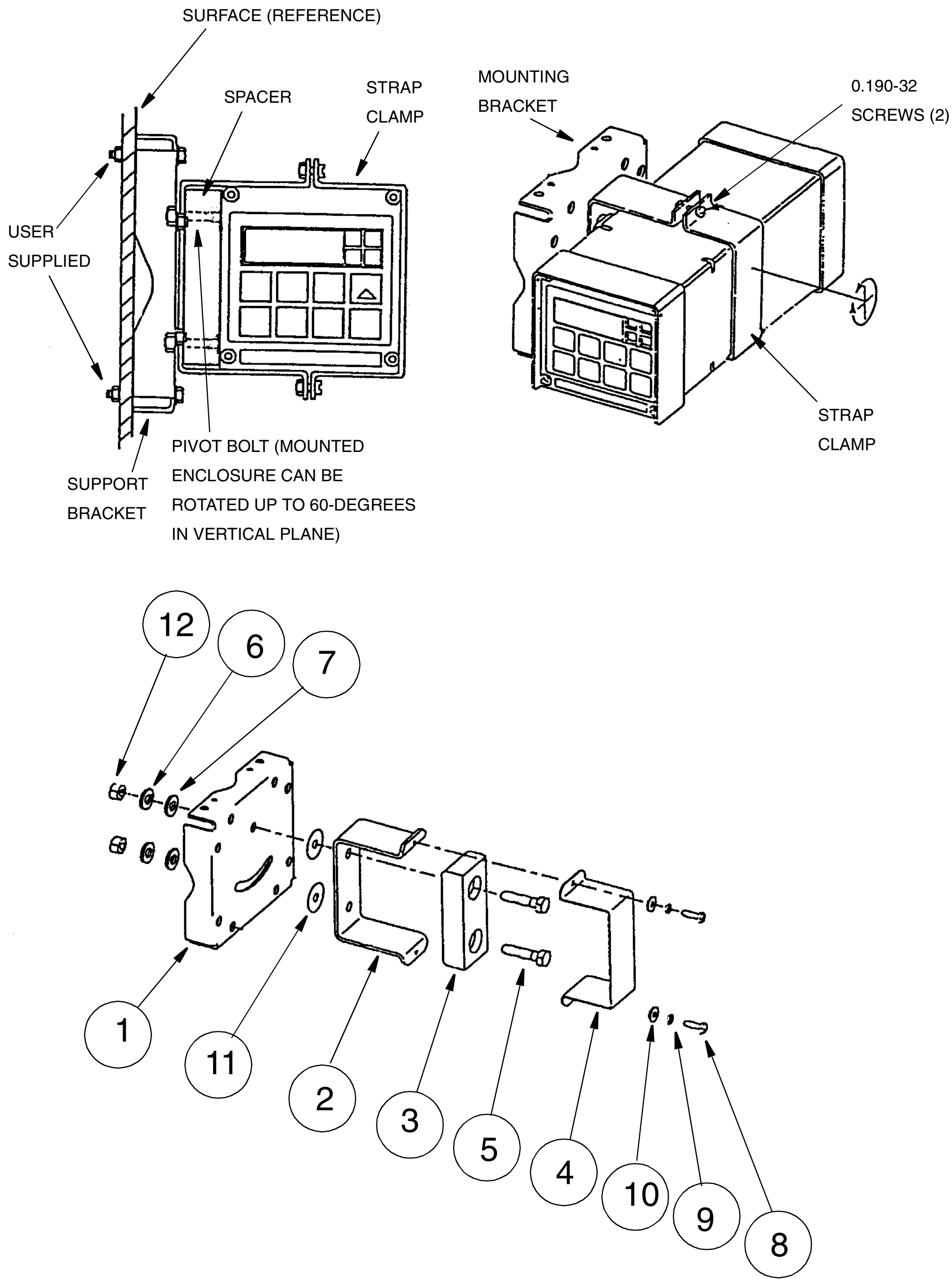


Figure 5. Mounting to a Surface, Fixed Mount

Mounting to a Surface — Movable Mount (873DPX-xxZxxx)

1. Locate surface on which to mount the analyzer. Also refer to PL 611-016.
2. Referring to Figure 6, use wall bracket (12) as a template for drilling four holes into mounting surface. Note that the holes in the wall bracket are 9.53 mm (0.375 in) in diameter.
3. Attach wall bracket (12) to surface using four user-supplied bolts, washers, and nuts.
4. Assemble universal mounting as follows:
   a. Insert hex bolts (5) through spacer (3) into support bracket (2).
   b. Slide nylon washers (11) over bolts (5).
   c. Slide bolts through universal mounting bracket 91) and fasten assembly finger tight with hardware designated 9, 10, and 16.
5. Slide analyzer into support bracket and slide strap clamp (4) onto analyzer. Using two screws, nuts, and washers, attach strap clamp to support bracket and secure analyzer.
6. Lift entire assembly of Step 5, align mounting bracket and wall bracket pivot bolt holes, and then insert pivot bolt through wall and mounting bracket into nylon washer and locking nut.
7. Rotate bracket and analyzer assembly in horizontal plane to desired position. Lock in place using screw and washer.

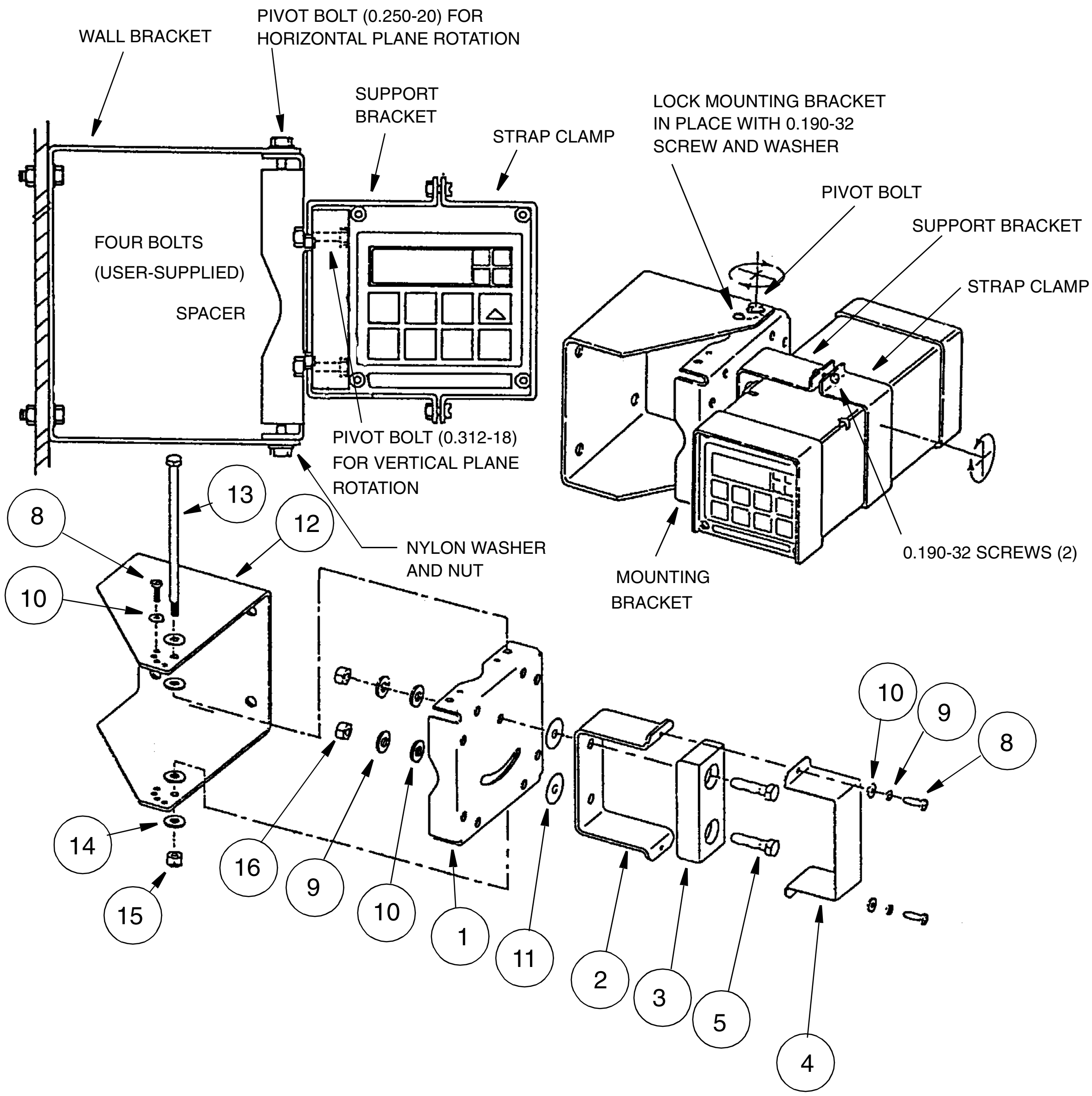


Figure 6. Mounting to a Surface — Movable Mount

Wiring Connections

Wiring installation must comply with any existing local regulations.

— NOTE

To maintain a rating (NEMA 4X, CSA Enclosure 4X, or IEC Degree of Protection IP-66), conduits with the proper fitting must be used (see Table 1 on page 22). Alarm wires should run through the same conduit as the power wires. Sensor wires should run through the same conduit as analog output wires.

The 873DPX Analyzer is equipped with a rear cover terminal board to facilitate sensor wiring. The rear cover terminal strips are connected by a ribbon cable to the terminal blocks inside the analyzer. Wiring can be installed by removing the rear cover for the 873 and making sensor connections outside of the analyzer housing.

— NOTE

The rear cover terminal strip may only be used with preamplified (or low impedance) sensors such as the 871PH or the 871A-2. The 871A-1, the 222F, or any non-Invensys Foxboro sensor without a preamplifier (high impedance) may NOT be connected to this terminal board unless a remote preamplifier is used (Part No.PS290AA or PS290AB). Otherwise, non-preamplified sensors must be wired directly to the terminal strips inside the analyzer. It is recommended that the remote terminal board be removed from the rear cover if it is not in use. First, disconnect the ribbon cable from the terminal blocks and then unscrew terminal board on rear cover and remove.

— ⚠ CAUTION

When the contacts are used at signal levels of less than 20 W, contact function may become unreliable over time due to the formation of an oxide layer on the contacts. See “Alarm Contact Maintenance” on page 79.

Invensys Foxboro Sensors with Integral Preamplifiers (871PH, 871A-2)

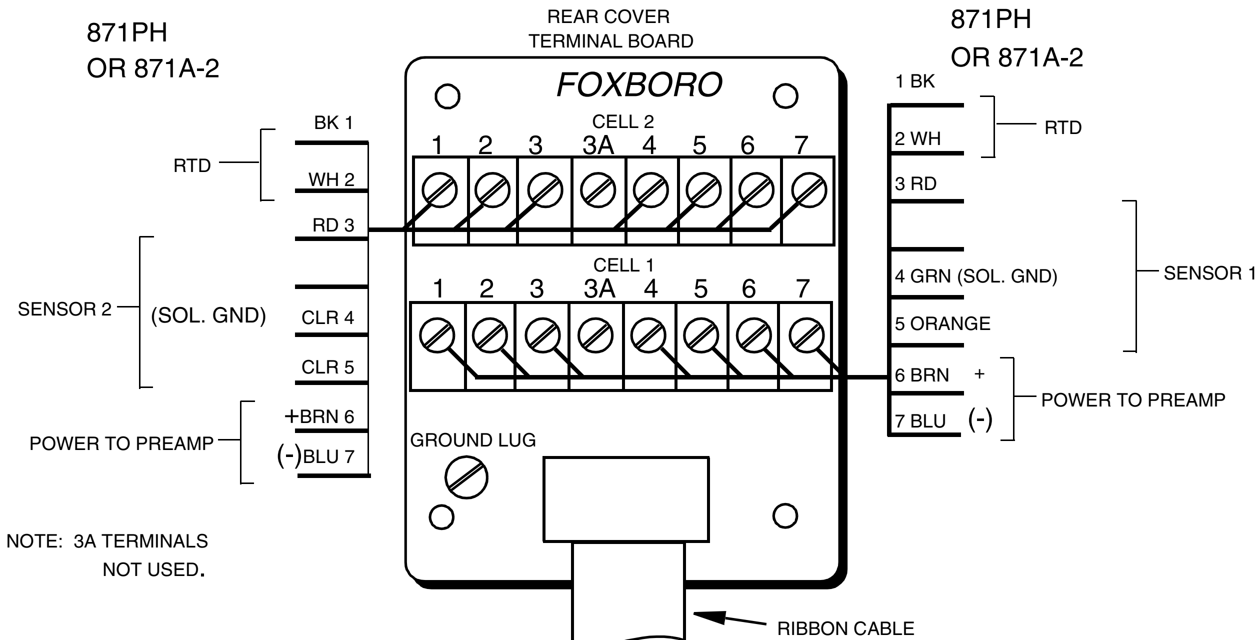
Use the following procedure to connect Invensys Foxboro sensors with preamplifiers to terminal blocks on the Rear Cover Terminal Board and the Instrument Terminal Board (see Figure 7):

1. Remove back cover to provide access to rear cover terminal board.
2. Route sensor wires through conduit openings at bottom of case.
3. On the Instrument Terminal Board, connect Alarm 1 and Alarm 2 wires to TB3, as shown in the diagram. Failsafe operation requires that connections be made between contacts NC and C, and that the alarms be configured active.
4. On the Instrument Terminal Board, connect wires for analog outputs to TB4 as shown in the diagram.
5. On the Rear Cover Terminal Board, connect signal wires from Sensor 1 to the terminal block marked Cell 1 as shown in the diagram.
6. On the Rear Cover Terminal Board, connect signal wires from Sensor 2 to the terminal block marked Cell 2 as shown in the diagram.

7. On the Instrument Terminal Board, connect power wires to terminal block TB1, as shown in the diagram. The earth (ground) connection from the power cord should be connected to the ground stud located on the bottom of the enclosure.

— NOTE

To obtain pH correction when measuring pH and ion-selective activity simultaneously, the pH sensor MUST be connected to Cell 1.



RIBBON CABLE-TO-TERMINAL BOARD WIRE CONNECTION

Terminal No.	Cable Color
TB2:	
1	gray
2	violet
3	blue
3A	green
4	yellow
5	orange
6	red
7	brown
TB5:	
1	blue/white
2	green/white
3	yellow/wht
3A	orange/wht
4	red/white
5	brown/wht
6	black
7	white

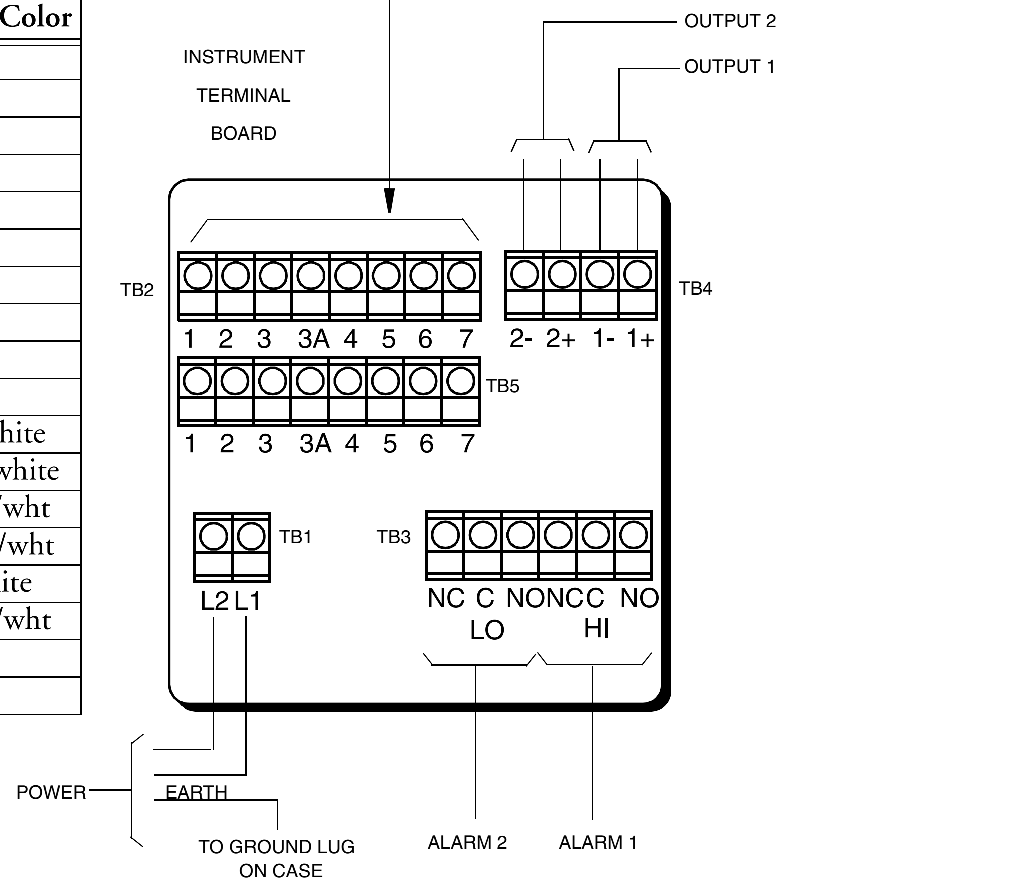


Figure 7. Wiring Diagram for Invensys Foxboro Sensors With Preamplifiers

Invensys Foxboro Sensors without Preamplifiers (871A-1 or 222F)

Use the following procedure to connect Invensys Foxboro sensors without preamplifiers to terminal blocks on the Instrument Terminal Board (see Figure 8):

1. Remove back cover to provide access to rear cover terminal board. (*Do not connect anything to the Rear Cover Terminal Board.*)
2. Remove all ribbon cable connections from the Instrument Terminal Board terminal blocks. It is recommended that the rear cover terminal board be unscrewed and removed from the rear cover.
3. Route sensor wires through conduit opening at bottom of case.
4. On the Instrument Terminal Board, connect Alarm 1 and Alarm 2 wires to TB3, as shown in the diagram. Failsafe operation requires that connections be made between contacts NC and C, and that the alarms be configured active.
5. On the Instrument Terminal Board, connect wires for analog outputs to TB4 as shown in Figure 8.
6. On the Instrument Terminal Board, connect signal wires from Sensor 1 to terminal block TB2 as shown in Figure 8.
7. On the Instrument Terminal Board, connect signal wires from Sensor 2 to terminal block TB5 as shown in Figure 8.
8. On the Instrument Terminal Board, connect power wires to terminal block TB1, as shown in Figure 8. The earth (ground) connection from the power cord should be connected to the ground stud located on the bottom of the enclosure.

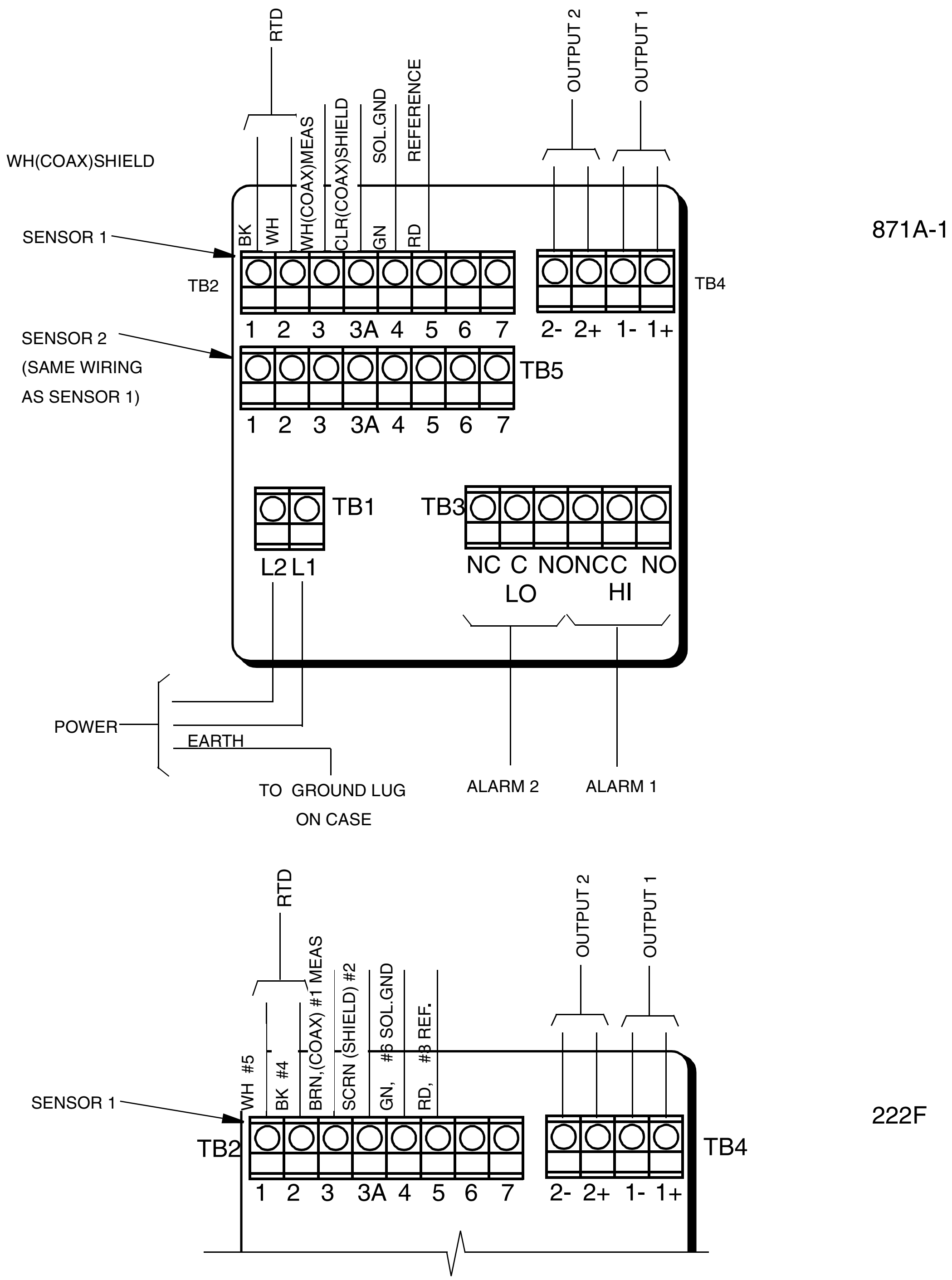


Figure 8. Rear Panel (Instrument) Wiring for Invensys Foxboro Sensors without Preamplifiers

Non-Invensys Foxboro Sensors

Use the following procedure to connect non-Invensys Foxboro sensors without preamplifiers to terminal blocks on the Instrument Terminal Board:

1. Remove back cover to provide access to rear cover terminal board. (*Do not connect anything to the Rear Cover Terminal Board.*)
2. Remove all ribbon cable connections from the Instrument Terminal Board terminal blocks. It is recommended that the rear cover terminal board be unscrewed and removed from the rear cover.
3. Route sensor wires through conduit opening at bottom of case.
4. On the Instrument Terminal Board, connect Alarm 1 and Alarm 2 wires to TB3, as shown in Figure 9. Failsafe operation requires that connections be made between contacts NC and C, and that the alarms be configured active.
5. On the Instrument Terminal Board, connect wires for analog outputs to TB4 as shown in Figure 9.
6. On the Instrument Terminal Board, connect signal wires from Sensor 1 and its RTD to the terminal block TB2 as shown in Figure 9.
7. On the Instrument Terminal Board, connect signal wires from Sensor 2 and its RTD to the terminal block TB5 as shown in Figure 9.
8. On the Instrument Terminal Board, connect power wires to terminal block TB1, as shown in Figure 9. The earth (ground) connection from the power cord should be connected to the ground stud located on the bottom of the enclosure.

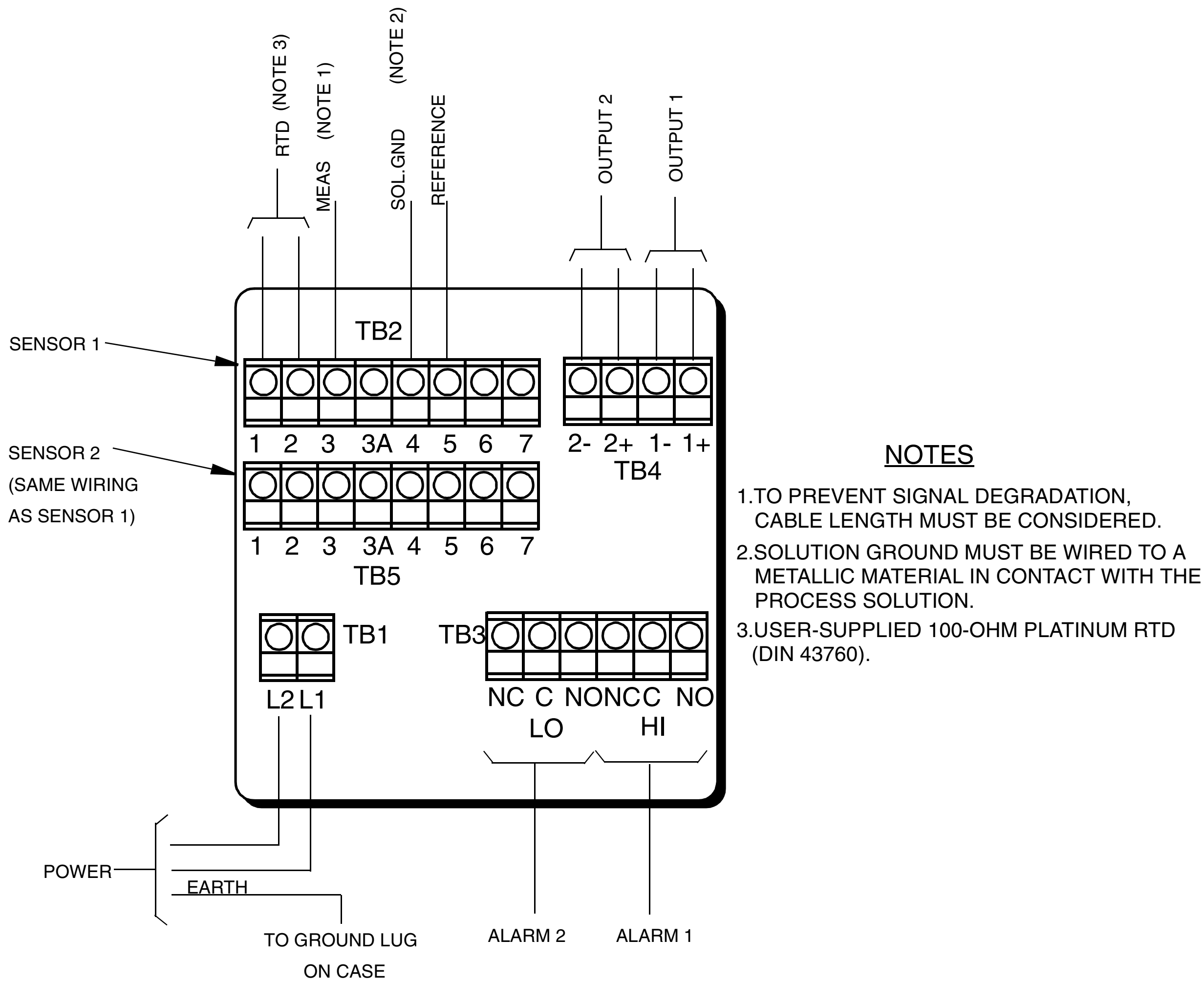


Figure 9. Rear Panel (Instrument) Wiring for non-Invensys Foxboro Sensors (without Preamplifiers)

Table 1. Recommended Conduit and Fitting
(Due to Internal Size Constraints)

	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 T&B #5362
Semi-Rigid Plastic Metal Core	Anaconda Type HC, 1/2-inch	T&B #LT 50P or T&B #5362
Flexible Plastic	T&B #EFC 050	T&B #LT 50P or T&B #5362

*Thomas & Betts Corp., 1001 Frontier Road, Bridgewater, NJ 08807-0993

3. Operation

Overview

The 873DPX functions in either of two modes, OPERATE or CONFIGURE (Setup). In the OPERATE mode, the instrument automatically displays a measurement (or temperature) value and outputs two analog signals proportional to two user-selected measurement or temperature values. In the OPERATE mode, you can display the solution temperature or any parameter setting. In the CONFIGURE mode, you can enter and/or modify any previously entered parameter. All 873 analyzers are shipped configured with either factory default settings or user-defined parameters, as specified by the sales order. To use either mode, you must understand the functions of the keypad and the display.

Display

The instrument display, as shown in Figure 10, consists of two parts: (1) a measurement/parameter settings display, and (2) a backlit display of measurement units. The measurement value may be displayed as any one of following:

- pH — expressed in pH units
- ORP — expressed in mV
- ISE — expressed in ppm
- Temperature — expressed in °C or °F
- Average of Sensors 1 and 2 — expressed in pH, mV or ppm
- Difference of Sensors 1 and 2 — expressed in pH, mV or ppm
- Ratio of Sensors 1 and 2 — expressed as a %

If you want to change from one display to another or to display anything other than the selections listed above, you must use various keypad functions, as described in the next section. You may also configure the display to toggle between Sensor 1 and Sensor 2 measurement value.

Keypad

The keypad, shown in , consists of eight keys, six of which are dual function. The white lettered keys represent normal functions and the green lettered keys represent alternate functions To operate a white lettered function key, just press the key. To operate a green lettered function key, press/hold the SHIFT key and then press the function key. The notation used to describe this operation is SHIFT + (key). All key functions are described in Table 2 on page 24.

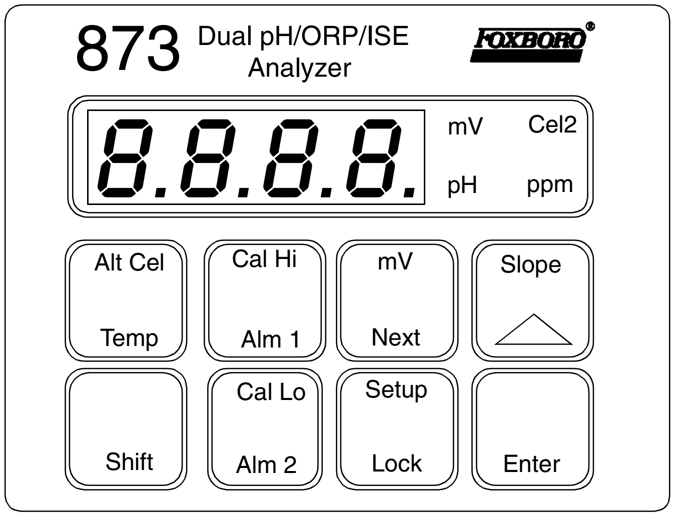


Figure 10. Model 873DPX Keypad and Display

Table 2. Keypad Functions

Key	Function
Shift	Press and hold this key to actuate the green dual-function keys. Holding the SHIFT key after pressing any function key delays the 10-second timeout, allowing you to view the display as long as you hold the key.
Enter	Press this key to display a value or code for a setup entry. You can also use this key to execute an action or selection or to store a value into memory.
Alt Cel Temp	ALT CEL: Press/hold SHIFT and press this key to display the measurement value of the alternate cell. TEMP: Press this key to display current solution temperature in C or F. If a dot is displayed following the C or F, the value displayed is a manual entry of temperature that overrides the actual measured value for temperature compensation.
Cal Hi Alm 1	CAL HI: Press/hold SHIFT and press this key to access the upper calibration function of the analyzer. ALM 1: Press this key to display and/or change the set point of Alarm 1.

Table 2. Keypad Functions (Continued)

Key	Function
Cal Lo Alm 2	CAL LO: Press/hold SHIFT and press this key to access the lower calibration function of the analyzer. ALM 2: Press this key to display and/or change the set point of Alarm 2.
mV Next	mV: Press/hold SHIFT and press this key to display the measurement value in absolute millivolts. NEXT: Press this key to select a digit or setup entry.
Setup Lock	SETUP: Press/hold SHIFT and press this key to access the configuration entry function. LOCK: Press this key to display and/or change the security lock state of the instrument.
Slope △	SLOPE: Press/hold SHIFT and press this key to display the calibration slope value in millivolts/pH or millivolts/ppm decade. INCREMENT: Press this key to increase the display count by one. Press and hold to increase count at a rate of approximately one per second.

— NOTE

Pressing NEXT and INCREMENT simultaneously allows you to step backward through the Setup program or digit place movement. Note, however, that you cannot reverse number count by this procedure. Pressing and holding SHIFT and ENTER simultaneously overrides the 10-second wait between Setup entries.

Mode

When you turn power on, the 873DPX analyzer runs in the OPERATE mode. The instrument first conducts a self-diagnostic test and then automatically displays the selected display value (see CELL code description, Chapter 4.).

While in the Operate Mode, you may display the measurement, the solution temperature, and all parameter settings as configured in the Configuration Setup Entries and Basic Setup Entries described in Chapter 4.

Temp Key

To view the process temperature, push TEMP. The display then changes from the current display to the solution temperature (or manually entered override value) for the primary sensor.

The display consists of a rounded whole number plus the temperature units (°C or °F). The units display alternately switches between °C (or °F) and the tenths of degrees measurement value. Once the TEMP key has been pressed, the INCREMENT (Δ) key toggles the temperature between °C and °F, and also allows you to activate manual temperature compensation. Pushing Δ while in the TEMP mode causes the display to sequence from the current value through a series of displays similar to that shown in the following example:

(1)	(2)	(3)	(4)
77.F	77.F.	25.C	25.C.
or	or	or	or
77.0	77.0	25.0	25.0

When a decimal point after the C or F is present, this indicates that the process temperature is compensated *manually* at the temperature displayed, thus overriding the *automatic* temperature compensation function (i.e., manual temperature compensation is active). If you want to use another manual compensation temperature value, press NEXT + Δ repeatedly to change the display to the desired temperature and then press ENTER. The process will then be compensated for the new displayed temperature value. To return to automatic compensation, sequence the display (using the Δ button) to remove the decimal point after C or F. Note, however, that you cannot adjust automatic temperature compensation by this procedure. To adjust temperature in the automatic mode, refer to Chapter 5.

When dual sensors are used, you can display the process temperature (or manually adjusted temperature) of the alternate sensor by pressing and holding NEXT before pressing the TEMP key. The Cel2 legend is then illuminated and the process temperature (or manually adjusted temperature) for the alternate sensor appears on the display. Note that you cannot adjust the temperature of the alternate sensor via this procedure.

View Setup Entries

You may display Setup Entries at any time. To view any of the Setup Entries, follow the procedures given in "Configuration Setup Entries" on page 28 or "Basic Setup Entries" on page 43, but do not UNLOCK the instrument.

When viewing Setup Entries, you may page through the parameters as rapidly as you wish by pressing SHIFT + SETUP and then pressing NEXT one or more times. However, once you have pressed ENTER to read a parameter value (value is displayed for 10 seconds), you must wait 10 seconds for the parameter symbol to reappear. The parameter symbols appear for 10 seconds also. If you do not press another key within 10 seconds, the display defaults to the measurement. This feature is called *timing out*. To avoid *timing out* on any display, push and hold SHIFT. The *time out* time may be adjusted to any value between 3 and 99 seconds by using the tOut parameter. To make changes to any Configuration Setup Parameter, see the section on "Configuration" on page 27.

4. Configuration

Overview

This instrument is shipped with either factory settings (default values) or user-defined settings, as specified in the sales order. Table 3, "Configuration Setup Entries," on page 29 lists all the parameters that are frequently changed. Table 4, "Basic Setup Entries," on page 43 lists parameters that are calibration oriented. Both tables list the parameter identifier symbol, the name of the parameter, and a space for you to write your own values.

The configuration process consists of entering and/or modifying parameters to make the Analyzer function to your particular needs. This chapter explains how to enter and change specific items via the keypad. Because reconfiguration may also involve wiring or jumper changes, you must be sure that you check all such items before placing the Analyzer into service either on startup or following a parameter change of any kind.

You enter all parameters as 4-digit numerical codes, selecting the code from tables specific to each parameter. For parameters that are entered as direct 4-digit values, however, no table is supplied.

The configuration process consists of four simple steps:

1. Write down all your parameter settings in the spaces provided in the configuration tables.
2. Unlock the instrument.
3. Select the parameter entry identifier on the display and enter the 4-digit codes.
4. Lock the instrument.

Configure Mode

The Configure Mode is protected through two levels of security, one for *Configuration Setup Entries* and another for *Basic Setup Entries*. Note that every configuration change starts with unlocking the instrument, which is accomplished by entering a security code at the keypad.

Security Code

The Analyzer uses two levels of security. The first level protects against unauthorized change of the parameters *Temp, Alm 1, Alm 2, Cal Lo, Cal Hi*, and all the *Configuration Setup Entries*. The second level protects against the remaining setup entries, called *Basic Setup Entries*. There are 32 such parameters.

Note that any of the parameters discussed above can be viewed (but not changed) when the Analyzer is in the locked state. When displaying a parameter in the locked state, the digits do not flicker. Any attempt to change the parameter while in this mode causes the message *Loc* to appear on the display.

You use the same security code to unlock the unit in both levels of security. When the unit is unlocked at the first level (see *Unlocking Analyzer Using Security Code*), the unit remains unlocked until you take a positive action to lock the unit again (see *Locking Analyzer Using Security Code*).

However, when the unit is unlocked using the *bL* entry at the second level of security (see *Basic Setup Lock Control*), it remains unlocked only as long as you access any one of the Basic Setup Entries. As soon as the Analyzer defaults to the current measurement value (i.e., “times out”), the second level of security automatically locks again. You must execute an unlock procedure, therefore, to reaccess *Basic Setup Entries*.

Unlocking Analyzer Using Security Code

The procedure for unlocking the Analyzer is:

1. Press LOCK. Display will read *Loc.*
2. Press NEXT and then press NEXT + INCREMENT (Δ) repeatedly until the security code is displayed (factory set at 0800).
3. Press ENTER. Analyzer will then read *uLoc*, indicating that it is now in the unlocked state.

Locking Analyzer Using Security Code

The procedure for locking the Analyzer is:

1. Press LOCK. Display will read *uLoc*.
2. Press NEXT and then press the NEXT + INCREMENT (Δ) keys repeatedly until the security code is displayed (set at 0800 by factory).
3. Press ENTER. Analyzer will then read *Loc*, indicating that it is now in the locked state.

Configuration Setup Entries

Configuration setup entries consist of 21 parameters. Because these parameters are process oriented, access to them is passcode protected. Table 3 lists each parameter (entry identifier) in the same sequence as seen on the display, the name of the parameter, and a space for recording your particular setting. A detailed description of each parameter is given in the explanatory text following the table.

Table 3. Configuration Setup Entries

Parameter Identifier	Parameter/Value Accessed	Factory Default Values	User Settings
CELL	Configuration of Display and Damping	1000	
Hold	Hold and sets the Analog value in Hold	0000	
AC 1	Alarm 1 Configuration Measurement Alarm Assignment Low/High/Instrument plus passive/active state Hysteresis	1403	
Att1*	Alarm 1 Trigger Time	00.00	
AFt1*	Alarm 1 Feed Time	00.00	
AdL1*	Alarm 1 Delay Time	00.00	
AC 2	Alarm 2 Configuration Measurement Selection Low/High/Instrument plus passive/active state Hysteresis	1203	
Att2**	Alarm 2 Trigger Time	00.00	
AFt2**	Alarm 2 Feed Time	00.00	
AdL2**	Alarm 2 Delay Time	00.00	
AOUt	Assignment of Analog Outputs	12.00	
H0 1***	100% Analog Output - Output 1	14.00	
L0 1***	0% Analog Output - Output 1	00.00	
H0 2***	100% Analog Output - Output 2	14.00	
L0 2	0% Analog Output - Output 2	00.00	
UL 1	User-Defined Upper Measurement Error - Cell 1	14.00	
LL 1	User-Defined Lower Measurement Error - Cell 1	00.00	
UL 2	User-Defined Upper Measurement Error - Cell 2	14.00	
LL 2	User-Defined Lower Measurement Error - Cell 2	00.00	
Ut L	User-Defined Upper Measurement Error - Both Cells	100.0	
Lt L	User-Defined Lower Temperature Error -Both Cells	000.0	

* Not displayed if disabled via AC1 parameter.
** Not displayed if disabled via AC2 parameter.
*** Not displayed if disabled via AOUt parameter.

Changing Setup Parameters

To change any of the Configuration Setup parameters listed in the table above, use the following procedure:

1. Unlock Analyzer.
2. Press SHIFT + SETUP. Release both keys.
3. Press NEXT one or more times until the parameter you want to change is displayed.
4. Press ENTER. The 4-digit code for that parameter then appears.
5. Press/hold NEXT to select the digit you wish to change and press INCREMENT (Δ) to change the digit. Repeat until the desired code or value is displayed.
6. Press ENTER.
7. Lock Analyzer.

— NOTE

You should set the configuration setup parameters whenever you make any changes to FSC.

Configuration of Display and Damping (CELL)

The CELL parameter determines the type of measurement to be displayed on the Analyzer front panel and the amount of damping applied to the measurement.

The Display Assignment Digit (Digit 1) selects the measurement (or calculated ratio, difference, or average) value to be displayed. In addition, if Digit 1 is set to 0, the display alternates between measurement values of Sensors 1 and 2.

The Dual Cell Configuration Digit (Digit 2) should be set to 0 if operating in dual sensor mode and to 1 in single sensor mode. “0” means normal dual cell operation. “1” means that if a cell is not configured on both alarms, the output and display modes of that cell are ignored. If both cells are configured (ratio is displayed), neither cell is ignored, regardless of the setting of Digit 2.

The Damping Selection Digits (Digits 3 and 4) select the amount of damping applied to each sensor (Digit 3 for Sensor 1 and Digit 4 for Sensor 2). Damping time refers to an interval over which all measurement values are averaged. Damping also affects temperature displays and analog outputs.

CELL Configuration Codes

Digit 1		Digit 2		Digit 3		Digit 4	
Display Assignment		**Dual Cell Configuration**		**Damping Cell 1**		**Damping Cell 2**	
0	Toggle Cell 1 and 2 Measurement	0	Dual Cell Operation	0	No Damping	0	No Damping
1	Cell 1 Measurement	1	Single Cell Operation	1	10 Seconds	1	10 Seconds
2	Cell 2 Measurement	2	Digit Not Used	2	20 Seconds	2	20 Seconds
3	Temperature Cell 1	3		3	40 Seconds	3	40 Seconds
4	Temperature Cell 2	4		4	Digit Not Used	4	Digit Not Used
5	Digit Not Used	5		5		5	
6	Average Cell 1 and Cell 2 Measurement	6		6		6	
7	Ratio (Cell 1/Cell 2) x 100	7		7		7	
8	Digit Not Used	8		8		8	
9	Difference (Cell 1 - Cell 2)	9		9		9	

Holding the Analog Outputs and Alarms (Hold)

This parameter sets the HOLD characteristics for both analog outputs.

When HOLD is activated, the analog outputs freeze at particular values determined by the setting of this parameter. The various codes are shown in the table below.

To use this feature, unlock the Analyzer, press SETUP, and then press NEXT repeatedly until the identifier HOLD is displayed. Set Digit 1 to the value that holds alarms to the value you want, and then set Digits 2, 3, and 4 to the percentage of full scale at which you want the analog output to freeze. Then press ENTER to execute your selection.

When HOLD is activated and the first digit of this code is 1, 2, or 3, the display alternately flashes between the word HOLD and the VALUE measured by the currently selected sensor. The output is frozen at a value corresponding to a percentage of full scale of the analog output. This percentage is determined by the last three digits of the HOLD code. While in any of the HOLD modes, the Analyzer continues to monitor and display the measurement value. Note that while in this mode, you may clean or replace the sensor and recalibrate the system. As shown in the table below, alarms are held in a fixed state (current, ON, or OFF) whenever Hold is activated. The specific state is determined by the setup code you enter.

HOLD Configuration Codes

<table>
<tr><th colspan="2">Digit 1</th><th>Digit 2</th><th>Digit 3</th><th>Digit 4</th></tr>
<tr><th colspan="2">Output Hold</th><th colspan="3">Percentage of Analog Output Range</th></tr>
<tr><td>0</td><td>No Hold</td><td colspan="3" rowspan="10">0 to 100%</td></tr>
<tr><td>1</td><td>Hold — Alarms Held in Current State</td></tr>
<tr><td>2</td><td>Hold — Alarms Held in OFF State</td></tr>
<tr><td>3</td><td>Hold — Alarms Held in ON State</td></tr>
<tr><td>4</td><td rowspan="6">Digit Not Used</td></tr>
<tr><td>5</td></tr>
<tr><td>6</td></tr>
<tr><td>7</td></tr>
<tr><td>8</td></tr>
<tr><td>9</td></tr>
</table>

— NOTE

Trying to enter a digit with no assigned function will result in the code Err.

Alarm Configuration (AC1 and AC2)

Two independent, Form C dry alarm contacts, rated at 3A noninductive, 125 V ac/30 V dc are provided with the Analyzer. They are designated as Alarm 1 and Alarm 2.

— ⚠ CAUTION

When the contacts are used at signal levels of less than 20 W, contact function may become unreliable over time due to the formation of an oxide layer on the contacts. See “Alarm Contact Maintenance” on page 79.

Setting the parameter, AC1, configures Alarm 1 — assigning it to monitor the measurement output of Cell 1 or Cell 2, the average of both cell measurements, the ratio of Cell 1 to Cell 2 measurements, or the difference between the two measurements. The second digit of the code determines whether the alarm output is high or low, active or passive, instrument active or passive, and hold active or passive. The third and fourth digits of the code set the hysteresis of the alarm output, the deadband between set and reset values of alarm activation.

When an alarm condition exists, the display alternately shows alarm status and measurement value, alternating on a 1-second cycle. Wiring information for the alarms may be found in Chapter 2. of this manual.

— NOTE

1. You must reset alarms following any change to FSC because the alarms are set as a percentage of FSC.
2. When power is applied to the instrument, alarm operation is delayed for a time period proportional to the damping time set in CELL1 (Digit 3) or CELL2 (Digit 4). Alarms will remain OFF until the measurement has stabilized.

When used as a measurement alarm, four configurations are possible:

1. Low passive
2. Low active
3. High passive
4. High active

A *low alarm* trips on decreasing measurement. A *high alarm* trips on increasing measurement.

Passive or active (failsafe) configurations are selected by setting Digit 2. When configured as a *passive* alarm, power is not applied to the relay coil when the alarm is OFF. With an *active* alarm, however, power is applied to the relay coil when the alarm is OFF, thus providing failsafe operation. In the *active* (failsafe) configuration, loss of power to the Analyzer causes a change from active to passive relay state, providing contact closure and an indication of a power problem. Correct wiring of the contacts is necessary for true failsafe operation. (Refer to Chapter 2.)

As an alternative to a measurement alarm, one or both alarms may be set up as *instrument alarms*. In this "watchdog" state, the alarm can communicate the existence of any diagnostic error in the system. When used as a diagnostic alarm, however, the alarm cannot also be used as a conventional measurement alarm.

When an alarm is configured as a diagnostic error communicator, it will report any system problem. It cannot, however, selectively report a *specific* type of problem. The hardware/software conditions that can cause a diagnostic (instrument) alarm are:

1. A/D converter error
2. EEPROM checksum error
3. RAM error
4. ROM error
5. Processor task time error (watchdog timer)

In addition to these diagnostics, you may program several temperature and measurement error limits that, if exceeded, will cause an alarm condition. Refer to Table 7, "Error/Alarm Messages," on page 77 for a list of error messages and their meanings.

The alarm may also be configured and used as a HOLD alarm. When used as a HOLD alarm, the alarm cannot be used as a conventional measurement alarm. When so configured, the alarm will trigger whenever HOLD is activated. By using this feature, you can notify a control room or alarm device (light, bell, etc.) that the Analyzer is in a HOLD mode instead of a RUN mode. The ALARM is activated when HOLD is implemented if the first digit in the HOLD code is 1, 2, or 3. A "HOLD" alarm overrides the HOLD state (on, off, current) normally enacted when the unit is placed in HOLD.

Setting Alarm Level(s)

— NOTE

This procedure is relevant only when the alarms have been configured as measurement high or measurement low alarms. When the alarms are configured as Instrument (Watchdog) or Hold alarms, alarm level settings have no relevance.

1. Unlock Analyzer (see “Unlocking Analyzer Using Security Code” on page 28).
2. To set Alarm 1, press Alm 1. Then use NEXT to select the digit and Δ to set the desired value for the digit.
3. When you have set all digits, press ENTER.
4. To set Alarm 2, press Alm 2. Then use NEXT to select the digit and Δ to set the desired value for the digit.
5. When you have set all digits, press ENTER.
6. Lock Analyzer (see “Locking Analyzer Using Security Code” on page 28).

— NOTE

If use of the alarms is not desired, set Digit 1 of AC1 or AC2 to 0.

Alarm 1 Configuration

AC1 Configuration Codes

Digit 1		Digit 2		Digit 3	Digit 4
Alarm Selection		Configuration		Hysteresis	
0	Alarm Not Used (Disables Errors and Parameters, Relay Held OFF/Passive)	0	Digit Not Used	0 to 99% of full scale	
1	Measurement Cell 1	1	Low/Passive		
2	Measurement Cell 2	2	Low/Active		
3	Temperature Cell 1	3	High/Passive		
4	Temperature Cell 2	4	High/Active		
5	Digit Not Used	5	Instrument/Passive		
6	Average Cell 1 and Cell 2 Measurement	6	Instrument/Active		
7	Ratio (Cell 1/Cell 2) x 100	7	Hold/Passive		
8	Digit Not Used	8	Hold/Active		
9	Difference (Cell 1 - Cell 2)	9	Digit Not Used		

— NOTE

When Digit 1 of AC1 is set to 0 (i.e., alarm not used), all error messages associated with the alarm are disabled and timer configuration codes (Att1, AFt1, and Adl1) do not appear when stepping through the setup entries.

Alarm 1 Timers (Att1, AFt1, AdL1)

Three timers are associated with Alarm 1:

- **Att1 — Alarm 1 Trigger Time**

  A programmable timer that prevents the alarm from triggering for a user-defined time.

- **AFt1 — Alarm 1 Feed Time**

  A programmable timer that holds the alarm ON for a user-defined time once the alarm has been activated — to allow time for chemical/reagent feed.

- **AdL1 — Alarm 1 Delay Time**

  A programmable timer that holds the alarm OFF for a user-defined time after the alarm has been held ON by parameter AFt to allow time for mixing or reaction.

Each of these timers is explained in detail in this section. Note, however, that whenever you use any of these timers, the hysteresis function set in parameter AC1 is ignored.

Alarm 1 Trigger Time (Att1) may be used with or without the other alarm timers. Att1 is used only when Alarm 1 is configured as a measurement alarm (high/low) or temperature (high/low). Its purpose is to prevent the alarm from triggering on momentary, non-sustained off-normal conditions. After the timer has timed out, the alarm will activate if the measurement has sustained an off-normal state for the entire trigger time. If the measurement returns to normal at any time, Att1 resets automatically. The table below defines the configuration codes for Att1.

Att1, AFt1, and AdL1 Configuration Codes

Digits 1 and 3	Digit 3	Digit 4
00 to 99 minutes	0 to 9 tenths of minutes	0 to 9 hundredths of minutes

EXAMPLES:

05.15 means 5 minutes, 9 seconds — 5 minutes + 1 /10 of a minute (6 seconds) + 5/100ths of a minute (3 seconds)
20.50 means 20 minutes, 30 seconds — 20 minutes +5/10 of a minute (30 seconds)

Alarm 1 Feed Time (AFt1) and Alarm 1 Delay Time (AdL1) may be used whenever Alarm 1 is configured as a measurement or temperature alarm. Alarm Feed Time (AFt1) works in conjunction with Alarm Delay Time (AdL1) to provide one cycle of pulse-duration on/off control of the Alarm 1 relay (although AFt1 may be used without AdL1). Therefore, these parameters should be set and used together. Note that both take precedence over the hysteresis deadband set in parameter AC1.

When Alarm 1 Feed Time is activated, Alarm 1 remains ON for the length of time set in AFt1 regardless of what the measurement value is — inside or outside of normal range.

Alarm 1 Delay Time (AdL1) is activated by entering a value in parameter AdL1. Upon timeout of AFt1, the alarm is held OFF for this time period. The alarm will not reactivate for the time period set in AdL1 regardless of what the measurement value is. After timeout of AdL1, the 873 reverts to normal run mode. If the instrument has remained in an alarm state for the entire time period

(AFt1 + AdL1), the sequence of AFt1 followed by AdL1 repeats for another cycle without having to wait another Att1 period (see Figure 12), and so on, until the measurement returns to normal range and reset the alarm.

The relationships between Att1, AFt1, and AdL1 are illustrated in the following diagram, where Alarm 1 is configured as a high alarm.

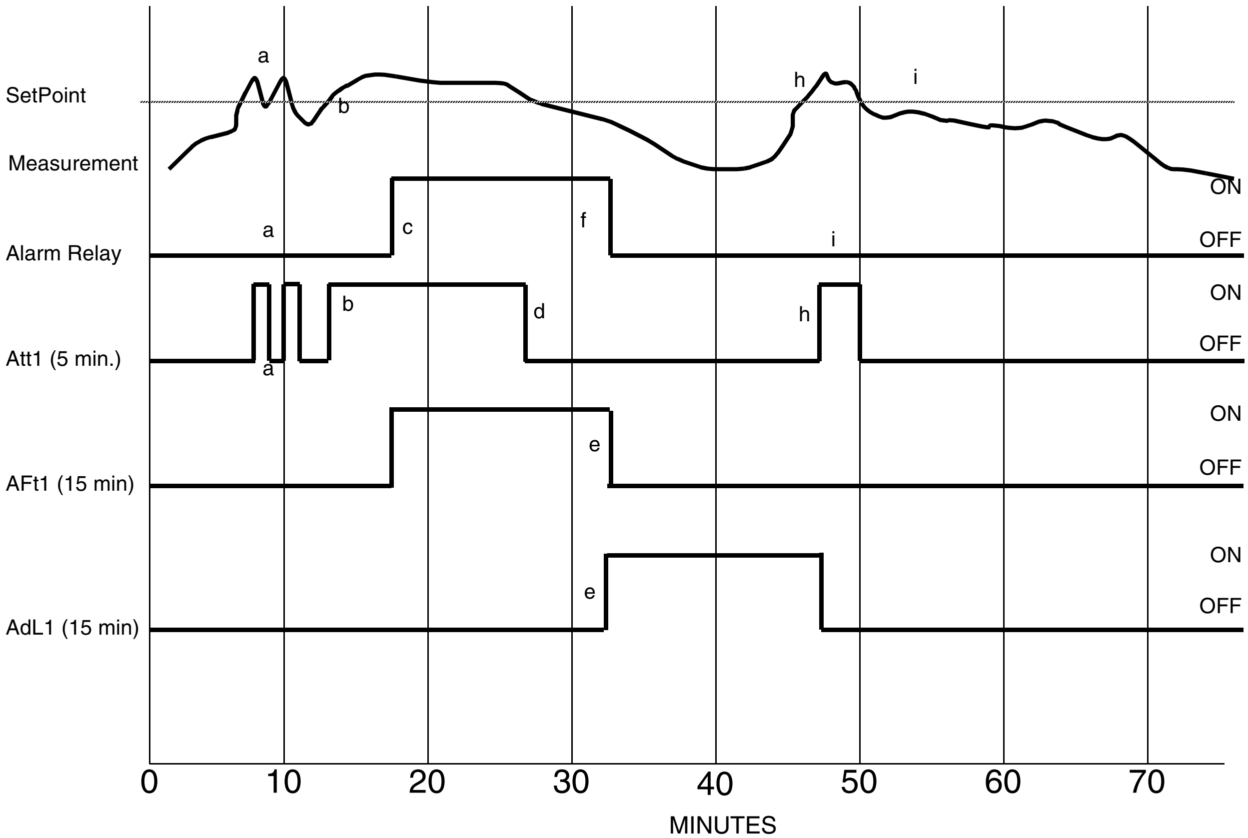


Figure 11. Relationships between Alarm Timers

NOTES:

- **a.** Measurement did not remain above set point for timer period set in Att1. Alarm relay remains inactive. Att1 reset when measurement fell below alarm set point.
- **b.** Measurement stays above alarm setpoint continuously for time set by Att1(5 min). After time set in Att1, alarm relay becomes activated (c) for time period (15 min) set by parameter AFt1.
- **c.** Timer Att1 reset when measurement fell below set point (d).
- **e.** Upon timeout of AFt1, timer AdL1 deactivates Alarm 1 relay (f) for the time period set by this parameter. The alarm remains deactivated even if measurement (g) exceeds the alarm set point during this period of time.
- **h.** Since the measurement exceeds the set point at the end of AdL1, the timer Att1 resets and the alarm relay remains OFF. If the measurement does not exceed the alarm set point for the entire period Att1 (i), the alarm relay does not activate. If the measurement had exceeded the set point for the entire sum of times (AFt1 + AdL1), the feed timer (AFt1) would have been reactivated.

A flow diagram for alarm timer logic follows. Note that the flow diagram and the timing diagram apply to both alarms (AC1 and AC2).

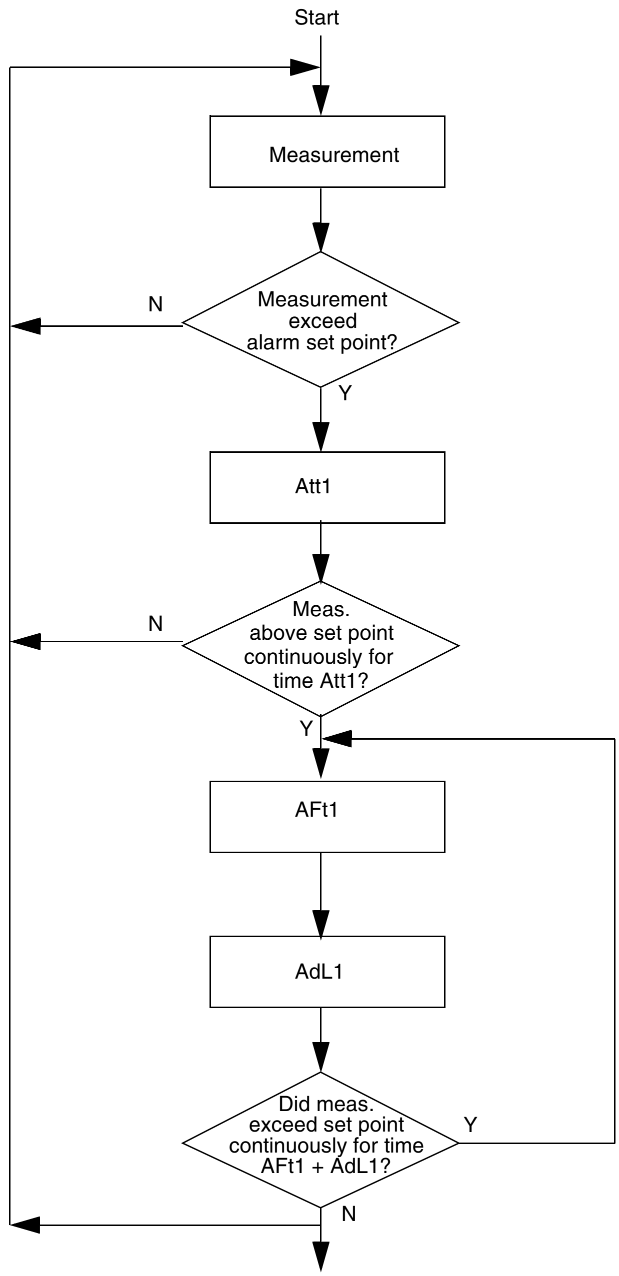


Figure 12. Flow Diagram for Alarm Timer Logic

Alarm 2 Configuration

Alarm 2 is configured in exactly the same manner as Alarm 1. Refer to AC1 setup instructions.

AC2 Configuration Codes

Digit 1		Digit 2		Digit 3	Digit 4
Alarm Selection		Configuration		Hysteresis	
0	Alarm Not Used (Disables Errors and Parameters, Relay Held OFF/Passive)	0	Digit Not Used	0 to 99% of full scale	
1	Measurement Cell 1	1	Low/Passive		
2	Measurement Cell 2	2	Low/Active		
3	Temperature Cell 1	3	High/Passive		
4	Temperature Cell	4	High/Active		
5	Digit not Used	5	Instrument/Passive		
6	Average Cell 1 and Cell 2 Measurement	6	Instrument/Active		
7	Ratio (Cell 1/Cell 2) x 100	7	Hold/Passive		
8	Digit not used	8	Hold/Active		
9	Difference (Cell 1 - Cell 2)	9	Digit Not Used		

— NOTE

When Digit 1 of AC2 is set to 0 (i.e., alarm not used), all error messages associated with the alarm are disabled and timer configuration codes Att2, AFt2, and AdL2 do not appear when stepping through the setup entries.

Alarm 2 Timers (Att2, AFt2, AdL2)

Alarm 2 timers operate in the same manner as Alarm 1 timers. Refer to Alarm 1 timers setup instructions.

Assignment of Analog Outputs (AOUt)

The AOUt parameter defines analog output assignments. Each output signal is linearly proportional to the assigned measurement value (or calculated value such as ratio, average, or difference). Either output may be disabled by setting the appropriate digit to 0. If set to 0, the output is held at 4 mA (or 0 V), all error messages associated with that output are disabled, and the 0% (L01 or L02) and 100% (H01 or H02) configuration codes do not appear in the setup menu. Digit 4 enables or disables local display of an analog error code.

AOUt Configuration Codes

Digit 1 Output 1 Assignment		Digit 2 Output 2 Assignment		Digit 3	Digit 4 Analog Error Enable	
0	Output Disabled, output held at 4 mA or 0 V, no error message.	0	Output Disabled, output held at 4 mA or 0 V, no error message.	Digit Not Used	0	Enabled
1	Measurement Cell 1	1	Measurement Cell 1		1	Disabled
2	Measurement Cell 2	2	Measurement Cell 2			Not Used
3	Temperature Cell 1	3	Temperature Cell 1			
4	Temperature Cell 2	4	Temperature Cell 2			
5	Digit Not Used	5	Digit Not Used			
6	Average of Cell 1 and Cell 2 Measurements	6	Average of Cell 1 and Cell 2 Measurements			
7	Ratio (Cell 1/Cell 2) x 100	7	Ratio (Cell 1/Cell 2) x 100			
8	Digit Not Used	8	Digit Not Used			
9	Difference (Cell 1 - Cell 2)	9	Difference (Cell 1 - Cell 2)			

— NOTE

The analog outputs may swing between the minimum and maximum values immediately after power up, a power interruption, or a reset of the microprocessor.

Scaling of Analog Outputs (H01, L01, H02, L02)

These parameters are used in conjunction with the AOUt code and will not appear in the setup menu when the output assignment is zero.

Both analog outputs may be scaled so as to improve the sensitivity of the analog output in the range of interest. The maximum output span that should be set on the Analyzer is the FSC value. The minimum span allowed is 10% of the FSC value. Although it is possible to set the Analyzer for a smaller span, a loss of accuracy will result.

You may also wish to reverse the analog signal in some situations. The outputs may be scaled so that the value in L01 (or L02) is higher than the value in H01 (or H02), if desired. No special procedures are required to achieve a reverse acting output.

Analog Output 1 — 100% Value (H01)

This parameter sets the full scale value of Analog Output 1. The value set by this parameter corresponds to 100% of the analog output (20 mA or 10 V).

Analog Output 1 — 0% Value (L01)

This parameter sets the zero scale value of Analog Output 1. The value set by this parameter corresponds to 0% of the analog output (0 mA, 4 mA, or 0 V).

Analog Output 2 — 100% Value (H02)

This parameter sets the full scale value of Analog Output 2. The value set by this parameter corresponds to 100% of the analog output (20 mA or 10 V).

Analog Output 2 — 0% Value (L02)

This parameter sets the zero scale value of Analog Output 2. The value set by this parameter corresponds to 0% of the analog output (0 mA, 4 mA, or 0 V).

User-Defined Measurement Error Upper Limit Value, CELL 1 or CELL 2 (UL1, UL2)

These parameters enable you to define an upper measurement limit that, if exceeded, will give an error message on the display (see "Table 7 on page 77). When used in conjunction with the configurable alarms, it provides a relay contact output.

The primary use of UL1 or UL2 is as a sensor diagnostic tool. If a problem develops with a sensor that causes the measurement signal to be ridiculously low or high for the process being monitored (such as a shorted or intermittent connection), an alarm can be triggered. By setting UL1 or UL2 at a value that could never be achieved in a normal process situation, activation of a UL1 or UL2 alarm indicates a severe sensor failure, miscalibration, or a process out-of-control. The upper limit on UL1 or UL2 is 99.99 pH or 9999 mV.

— NOTE
Invensys Foxboro preconfigures the UL1 and UL2 values equal to the specified full scale measurement per Sales Order.

UL1 and UL2 Configuration Codes

Digit 1	Digit 2	Digit 3	Digit 4
Sign	**Upper Limit Value**		
0 to 9 Positive Value	-0.99 to 99.99 for pH -999 to 9999 for ORP and ISE		
– Negative Value			

— NOTE
To make a minus sign appear on the display for either upper limit value or lower limit value, you must enter a digit other than zero.

User-Defined Measurement Error Lower Limit Value, CELL 1 or CELL 2 (LL1, LL2)

These parameters are similar to the previously described UL parameters, except they allow programming of a lower measurement limit. The lower limit on LL1 or LL2 is -0.99 pH or -999 mV.

LL1 or LL2 Configuration Codes

Digit 1	Digit 2	Digit 3	Digit 4
Sign	**Lower Limit Value**		
0 to 9 Positive Value	-0.99 to 99.99 for pH -999 to 9999 for ORP and ISE		
– Negative Value			

User-Defined Temperature Error Upper Limit Value, Both Cells (UtL)

This parameter enables the user to define an upper temperature measurement value that, if exceeded, will give an error message on the display (Table 7 on page 77). When used in conjunction with the configurable high or low alarms, this parameter provides a relay contact output.

The UtL function may be used in several ways. First, you may wish to alarm on high process temperature. For example, in a pH measurement that is normally between 80 and 100 °F, you may wish to set UtL to 120 °F to indicate a problem with the process temperature. Another use of UtL is as a sensor diagnostic tool. If the RTD in the pH sensor develops a fault, it may produce erroneous temperature readings at either extreme of the temperature scale.

By setting UtL at a temperature outside of any conceivable process temperature, an alarm will indicate a problem with the pH sensor temperature transducer. The upper limit on UtL is 200°C or 392°F.

UtL Configuration Codes

Digit 1	**Digit 2**	**Digit 3**	**Digit 4**
Upper Limit Value			
<200°C or 392°F Upper Temperature Limit			

User-Defined Temperature Error Lower Limit Value, Both Cells (LtL)

This parameter is similar to the previously described UtL parameter, except that it allows programming of a *lower* temperature measurement limit. The lower limit on LtL is –20°C or -5°F. Invensys Foxboro preconfigures the LtL value to be 0 °C.

— **NOTE**
To make a minus sign appear on the display, you must enter a digit other than zero.

LtL Configuration Codes

Digit 1	Digit 2	Digit 3	Digit 4
Upper Limit Value			
<0 °C or -5 °F Lower Temperature Limit			

Basic Setup Entries

Basic Setup entries consist of 32 parameters. Because these parameters are calibration oriented, access has two levels of passcode protection. Changes to many of these parameters require that you recalibrate the Analyzer. Do *not* make any changes unless you have read the explanatory text for each parameter.

The table below lists the basic setup parameter identifiers (in the order in which they appear on the display) and the name of the parameter or value accessed by the identifier. Descriptions of how to set each digit of the display for every parameter are presented in the explanatory text following the table.

Table 4. Basic Setup Entries

Parameter Identifier	Parameters and Value Accessed	Factory Default Value	User Value
bL	Basic Setup Lock Control		
FSC1	Full Scale Value Cell 1	16.00 pH	
FSC2	Full Scale Value Cell 2	20.00 ppm	
C0 1	Compensation Cell 1	0000	
C0 2	Compensation Cell 2	2010	
ISO1	Isopotential Cell 1	-0.01	
ISO2	Isopotential Cell 2	0000	
OF	Offset Voltage	00.00	
PF	Log of Function	00.00	
UPH	User-entered pH	-0.01	
tCF1	Temperature Cell Factor - Cell 1	25.00	
tCF2	Temperature Cell Factor - Cell 2	25.00	
tCt	Custom Curve Temperature	0000	
PCt	Custom Curve pH	0000	
tCL1	RTD Low Temp. Electronics Calibration Cell 1	100.0	
tCC1	RTD Mid Temp. Electronics Calibration Cell 1	150.0	
tCH1	RTD High Temp. Electronics Calibration Cell 1	200.0	
tCL2	RTD Low Temp. Electronics Calibration Cell 2	100.0	
tCC2	RTD Mid Temp. Electronics Calibration Cell 2	150.0	
tCH2	RTD High Temp. Electronics Calibration Cell 2	200.0	
LCO1	Analog Out 1 Calibration Low	00.00	
HCO1	Analog Out 1 Calibration High	100.0	
LCO2	Analog Out 2 Calibration Low	00.00	
HCO2	Analog Out 2 Calibration High	100.0	
PC*	Probe Calibration	0000	
dCL*	Drive Calibration Low	N/A	
dCH*	Drive Calibration High	N/A	
tout	Timeout Time	0010	
LCC	Lock Code Change	0800	
SFt**	Software Version Number		
SOH**	Sales Order High		
SOL**	Sales Order Low		

* These parameters are factory calibrated at Foxboro to appropriate values. Do *not* alter these parameters in the field.
** These parameters are factory preset at Foxboro for informational purposes only. They cannot be changed in the field.

Unlocking Basic Setup Entries (bL)

To change any of the Basic Setup Entries, use the following procedure.

1. Unlock Analyzer at the first security level (see “Unlocking Analyzer Using Security Code” on page 28).
2. Press SHIFT + SETUP. Release both keys.
3. Press NEXT repeatedly until bL is displayed.
4. Press ENTER. LOC appears on the display.
5. Press NEXT.
6. Use NEXT and Δ until security code is displayed (0800 from factory).
7. Press ENTER. ULOC appears on the display.
8. When display returns to bL, press NEXT one or more times until parameter to be changed appears on the display.
9. Press ENTER.
10. Use NEXT and Δ until the desired value is displayed.
11. Press ENTER.
12. When the display defaults (times out) to the current measurement value, the Analyzer is automatically locked at the second level (bL) of security.
13. Lock Analyzer (see “Locking Analyzer Using Security Code” on page 28).

bL Configuration Codes

Digit 1	Digit 2	Digit 3	Digit 4
Basic Setup Enable			
4-digit LOCK # (enables changing of setup values for entries following a bL entry. Basic Lock is reactivated automatically when SETUP is exited via a default timeout.)			

Selecting and Changing the Full Scale Range (FSC1 and FSC2)

The FSC1 and FSC2 parameters permit you to select the mode of operation for each channel of the 873DPX — pH, ORP, or one of several ISE ranges. The FSC range choices are listed in the following table.

FSC1 and FSC2Configuration Codes

Digit 1	Digit 2	Digit 3	Digit 4
Units of Measurement			
16.00 — pH 1400 — mV 2.000 — ppm 20.00 — ppm 200.0 — ppm 2000 — ppm			

FSC1 is the full scale range for Sensor 1 and FSC2 is the full scale range for Sensor 2. You can use any combination of FSC1 and FSC2 codes. Note, however, that pH-corrected ISE measurements require that Sensor 1 be a pH sensor (i.e., FSC1 = 16.00 pH) and Sensor 2 be the appropriate ISE (i.e., FSC2 = 2, 20, 200, or 2000 ppm).

NOTE

1. Altering the FSC range via the Keypad will require that you bench calibrate the unit before use.
2. Pressing ENTER in FSC mode (even if range was not changed) will require the unit to be bench calibrated before use. If the range is set at the FSC you require, allow unit to time out. Do not press ENTER.

After changing FSC, Configuration Setup Entries should be checked and altered if necessary. Invensys Foxboro preconfigures the FSC value per Sales Order.

The procedure to change FSC is as follows:

1. Unlock Analyzer (see *Unlocking Analyzer Using Security Code*).
2. Press SHIFT + SETUP. Release both keys.
3. Press NEXT several times until the code bL (Basic Setup Lock) is displayed.
4. Press ENTER, then use NEXT and Δ until the personal security code is displayed (0800 from factory).
5. Press ENTER.
6. When the display returns to bL, press NEXT. The code FSC1 (Full Scale Range Change) will be displayed. If FSC2 is desired, press NEXT again.
7. Press ENTER. The present full scale range will be displayed. If this is your desired FSC, allow unit to time out. DO NOT PRESS ENTER. Entering any FSC at this point will cause Er4 to flash on the display. A bench calibration then must be performed.
8. Press Δ until the desired range is displayed.

9. Press ENTER.
10. Lock Analyzer (see *Locking Analyzer Using Security Code*).

— NOTE
Calibration is required after full scale range is changed. Error code Er4 will flash until calibration is accomplished. Refer to the Calibration section in Chapter 5.

Temperature Compensation (CO1 and CO2)

CO1 and CO2 are used to select the type of temperature compensation to be applied to the measurement. Temperature compensation is applied to pH and ISE measurements only and is not available for ORP measurements. If FSC1 (or FSC2) is configured for ORP measurement, the entries in C01 (or C02) are ignored. CO1 sets the compensation for Sensor 1 and CO2 set the compensation for Sensor 2.

pH Compensation Selection (Digits 1 and 2)

Digit 1 is used for choosing the type of electrode — glass, antimony, or variable isopotential. If glass or antimony is chosen (0 or 1), the isopotential point of the electrode is fixed at 7 pH for glass and at 1 pH for antimony. You may vary the isopotential point by selecting 2 for this digit and setting the ISO1 (or ISO2) configuration code to the desired isopotential. See the section on“Isopotential Points (ISO1 and ISO2)” on page 48 for a more detailed discussion.

Digit 2 is used for choosing the type of temperature compensation applied to the measurement. Choosing 0 applies the standard Nernstian compensation, which is appropriate for most pH applications. With this type of compensation, the Analyzer uses the temperature reading from the process (or a manually entered temperature) to adjust the Nernst slope factor and, hence, the pH value. *The pH displayed is the actual pH of the process at the temperature of measurement.* This type of temperature compensation adjusts for temperature effects on the electrodes, but does not correct for the fact that the actual solution pH may vary with temperature. Choosing 1 not only applies the standard Nernstian compensation, but also applies an additional correction for water samples with 1 ppm ammonia. This correction provides a pH value referenced to 25°C to compensate for the variations of solution pH due to the presence of ammonia. Choosing 9 applies a custom temperature compensation curve that corrects for temperature-related variations in solution pH. Custom curves, which are application dependent, require you to determine and enter process-specific pH versus temperature data. See *Custom Temperature Compensation (tCt)* for details.

Digits 1 and 2 are ignored if the corresponding FSC is set to ORP or ISE.

ISE Compensation Selection (Digits 3 and 4)

Digit 3 sets the ion polarity. If the ion to be measured is a positive ion (such as sodium, potassium, calcium, or silver), Digit 3 should be set to zero. If it is a negative ion (such as fluoride, chloride, cyanide, or bromide), Digit 3 should be set to 1.

Digit 4 is used to set the type of compensation applied to the measurement. As with pH, setting the digit to 0 provides the standard Nernstian temperature compensation. Choosing 1, 2, or 3 in CO2 only, allows you to correct the ISE measurement for acid, base, or selectivity coefficient errors. For this type of correction, a pH sensor must be used as Sensor 1 and an ISE used for

Sensor 2. The 873DPX will use the pH reading from Sensor 1 to make the appropriate correction on a ISE reading from Sensor 2. You must also enter the appropriate constant in the PF configuration code (see “Log of Function (PF)” on page 49 for details.). If a pH sensor is not used with the 873DPX, this type of correction can still be performed by using a manually entered constant pH value in the UPH configuration code and selecting either a 4, 5, or 6 (for Manual Acid, Base, or Selectivity Coefficient). The 873DPX performs these corrections using the UPH value as the pH of the process. (Refer to “User Entered pH (UPH)” on page 50 for details.) Finally, custom temperature and ppm curves may be used to compensate the ISE measurement by selecting 7 (custom temperature and ppm curves), 8 (custom ppm only), or 9 (custom temperature only). Refer to “Generating and Entering Custom Curves in the 873DPX” on page 55 for details.

Digits 3 and 4 are ignored if the corresponding FSC is set to ORP or pH.

CO1 Configuration Codes

Digit 1		Digit 2		Digit 3		Digit 4	
Electrode Type		**pH Compensation**		**Ion Polarity**		**ISE Compensation**	
0	Glass (fixed isopotential = pH 7)	0	Standard Nernstian Compensation	0	Positive Ion	0	Standard Nernstian Compensation
1	Antimony (fixed isopotential = pH 1)	1	Ammonia	1	Negative Ion	1	Not Used
2	ISE, variable potential selected by ISO1	2	Digits 2 - 8 Not Used	2	Digits 2-9 Not Used	2	
3	Digits 3-9 Not Used	3		3		3	
4		4		4		4	Manual Acid
5		5		5		5	Manual Base
6		6		6		6	Manual Selectivity Coefficient
7		7		7		7	Custom Temperature and ppm Compensation
8		8		8		8	Custom ppm Compensation Only
9		9	Custom Temperature Compensation	9		9	Custom Temperature Compensation Only

CO2 Configuration Codes

Digit 1		Digit 2		Digit 3		Digit 4	
Electrode Type		**pH Compensation**		**Ion Polarity**		**ISE Compensation**	
0	Glass (fixed isopotential = pH 7)	0	Standard Nernstian Compensation	0	Positive Ion	0	Standard Nernstian Compensation
1	Antimony (fixed isopotential = pH 1)	1	Ammonia	1	Negative Ion	1	Acid
2	ISE, variable potential selected by ISO2	2	Digits 2-8 Not Used	2	Digits 2-9 Not Used	2	Base
3	Digits 3-9 Not Used	3		3		3	Selectivity Coefficient
4		4		4		4	Manual Acid
5		5		5		5	Manual Base
6		6		6		6	Manual Selectivity Coefficient
7		7		7		7	Custom Temperature and ppm Compensation
8		8		8		8	Custom ppm Compensation Only
9		9	Custom Temperature Compensation	9		9	Custom Temperature Compensation Only

Isopotential Points (ISO1 and ISO2)

These parameters set the isopotential point for Sensor 1 (ISO1) and Sensor 2 (ISO2). When the corresponding FSC is configured for ISE measurement and CO1 and CO2 have been set to variable isopotential, this code allows you to enter an isopotential point (a millivolt value that reads the same at every temperature) of an ISE. This value is also called the isothermal point. The code can be set anywhere between -999 and +1000 mV. Unless the isopotential point of an ISE is known or has been experimentally determined, this value should be left at 0 mV. When the FSC is configured for pH measurement, this code allows you to adjust the isopotential pH of the sensor if CO1 (or CO2) is configured for a pH electrode with an adjustable isopotential.

ISO1 and ISO2 Configuration Codes

Digit 1	Digit 2	Digit 3	Digit 4
Isopotential Temperature Compensation			
-999 to +1000 mV			
-9.99 to 99.99 pH			

Offset Voltage (OF)

The 873DPX configured for ISE measurement has a 300 mV span with range limits of -999 to +1000 mV. This 300 mV span can be shifted anywhere the range. The offset voltage, set by the OF parameter, determines where that span is to be centered. If, for example, you selected an OF of 700, the 300 mV span of the instrument would be 550 to 850 mV. The default value of OF is 0 mV, providing a range of -150 mV to +150 mV.

OF Configuration Codes

Digit 1	Digit 2	Digit 3	Digit 4
Offset voltage to center 300 mV ISE range			
-850 to +850 mV			

Log of Function (PF)

This parameter is used for entering the constant needed for calculation of acid, base, and selectivity coefficient compensation of ISE measurements.

Acid Compensation

Acid compensation is used when the ion to be measured can complex with hydrogen ions. For example, fluoride ions in acidic solutions can complex with hydrogen ions to form HF or HF_2. These complexes will not be detected by the fluoride electrode. By measuring the pH of the solution or by using a manually entered pH value in the UPH parameter, however, the 873DPX can calculate the proportion of fluoride ions that are complexed with hydrogen, thus providing a means for correcting this error. This calculation requires a constant (pKa) to be entered in the PF parameter. You can obtain the pKa from standard literature or determine it experimentally [pKa = -log(Ka)].

Base Compensation

Base compensation is used when the ion to be measured can complex with hydroxide ions and not be detected by the ISE. As with acid correction, the 873DPX can compensate for this effect by measuring solution pH or by using a manually entered pH value from the UPH parameter, and then calculating the proportion of ions complexed with hydroxide. This calculation requires a constant (pKb) to be entered in the PF parameter. You can obtain the pKb from standard literature or determine it experimentally [pKb = -log(Kb) = -log(14 - Ka)].

Selectivity Coefficient Compensation

Selectivity coefficient compensation is used when an interfering ion can cause errors in an ISE measurement. For example, a fluoride electrode is also sensitive to the presence of hydroxide ions. In basic solutions, a fluoride sensor will react to hydroxide ions as well as fluoride ions, giving an abnormally high reading. By measuring the pH of the solution or by using a manually entered pH value from the UPH parameter, the 873DPX can compensate for the interfering effect of hydroxide ions. This calculation requires a constant to be entered in the PF parameter. The PF constant is determined experimentally.

PF Configuration Codes

Digit 1	Digit 2	Digit 3	Digit 4
Constant for Compensation of ISE			
00.00 to 99.99			

User Entered pH (UPH)

This parameter is used with manual acid, base, or selectivity coefficient compensation of an ISE measurement. Instead of correcting an ISE measurement for a pH value obtained from a pH sensor, the 873DPX can use a manually entered pH value from this parameter. If you want to use acid, base, or selectivity coefficient correction of an ISE measurement and you know the pH of your process, you may enter it in this parameter and then select manual acid, manual base, or manual selectivity coefficient compensation using CO1 or CO2. (See "Temperature Compensation (CO1 and CO2)" on page 46 for details.) The 873DPX will perform the appropriate correction using the UPH value instead of an actual pH measurement value.

— NOTE

To use this parameter, the pH of the process must be known and must also remain stable.

UPH Configuration Codes

Digit 1	Digit 2	Digit 3	Digit 4
User-entered pH			
0000 to 16.00			

Temperature Cell Factors (tCF1, tCF2)

These parameters set the temperature correction factors for Sensors 1 and 2. These factors are used to compensate for extended cable length. Refer to "Temperature Cell Factor" on page 70 for more detail.

RTD Temperature Calibration (tCL1, tCC1, tCH1, tCL2, tCC2, tCH2)

RTD temperature electronics are factory calibrated to compensate for calibration errors caused by thermal effects in the electronic equipment. This calibration aligns the electronics to the theoretical temperature transducer values at 25°C. It should not be necessary to perform these procedures in the field unless:

1. You suspect a problem with the temperature calibration.
2. You wish to verify temperature electronics calibration.

For Sensor 1, use tCL1, tCC1, and tCH1. For Sensor 2, use tCL2, tCC2, and tCH2.

To perform this calibration, execute the following procedure:

1. Connect a 100-ohm precision resistor between sensor input terminals 1 and 2.
2. Unlock Analyzer using security code.
3. Press SHIFT + SETUP. Release both keys.
4. Press NEXT several times until the code *bL* (Basic Lock Setup) is displayed.
5. Press ENTER, and then use NEXT and Δ until the personal security code is displayed (0800 from factory).
6. Press ENTER.
7. When display returns to *bL*, press NEXT until tCL1 (or tCL2) is displayed. Press ENTER.

NOTE
Holding the SHIFT key will keep the display from timing out.

8. Display will show 100.0 ohms. Press SHIFT and hold for 20 seconds, then press ENTER.
9. Repeat Steps 1 - 8 using tCC1 (or tCC2) and a 150-ohm precision resistor.
10. Repeat Steps 1 - 8 using tCH1 (or tCH2) and a 200-ohm precision resistor.

Changing the Analog Output

To change one or both of the analog outputs from those ordered with the Analyzer, you must reposition jumpers and recalibrate the instrument.

To Reposition Jumpers

1. Remove power from the instrument.
2. Remove four front panel screws holding the display panel in place. Remove rear cover. Disconnect the green earth (ground) cable and feed wire from the sensors and power connection through seals to allow free movement of the circuit boards.

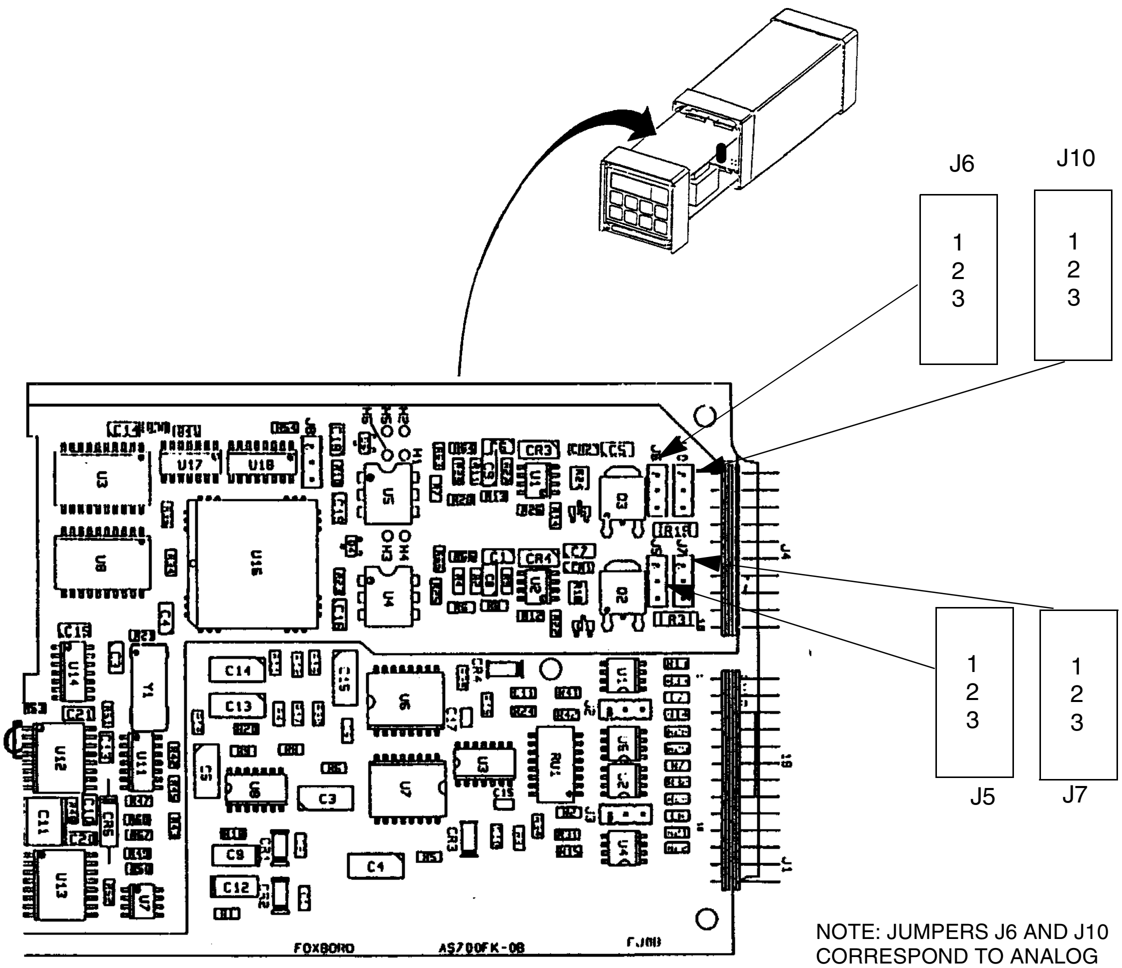
⚠ CAUTION
Since the four screws are self-tapping, they have a limited number of taps. Do not remove and tighten these screws repeatedly.

3. To access the upper circuit board designated AS700DZ-02, slide the circuit assembly out the front of the housing.
4. Refer to Figure 13 on page 53 to identify jumper locations.

5. Use the following table to determine appropriate jumper positions.

Output	J5	J7	J6	J10
4 - 20 mA	2 - 3	2 - 3	2 - 3	2 - 3
0 - 20 mA	2 - 3	2 - 3	2 - 3	2 - 3
0 - 10 V dc	1 - 2	1 - 2	1 - 2	1 - 2

6. Move each jumper to the appropriate position.
7. Replace board assembly inside unit.
8. Replace cover. Use Loctite (Part No. S0106ML) and Lubriplate (Part No. X0114AT) on threads of screws of all metal enclosures.
9. Perform an analog output calibration, using procedures described in the next section.
10. Make appropriate changes to the Analyzer identification label.



NOTE: JUMPERS J6 AND J10 CORRESPOND TO ANALOG OUTPUT #1. JUMPERS J5 AND J7 CORRESPOND TO ANALOG OUTPUT #2.

Output	J5	J6	J7	J10
4 -20 mA	2 - 3	2 - 3	2 - 3	2 - 3
0 - 20 mA	2 - 3	2 - 3	2 - 3	2 - 3
0 -10 Vdc	1 - 2	1 - 2	1 - 2	1 - 2

Figure 13. Jumpers for Changing Analog Outputs

Analog Output Calibration (LCO1, HCO1, LCO2, HCO2)

These parameters set the minimum or maximum values of the analog outputs as a percentage of full scale value (10.0 V or 20.0mA).

Since the instrument was calibrated at the factory, it should not require recalibration unless the type of output has been changed. To calibrate Analog Output 1, execute the following procedure:

1. Connect an ammeter/voltmeter to the analog output terminals.
2. Unlock the Analyzer using the security code.
3. Press SHIFT + SETUP. Release both keys.
4. Press NEXT several times until the code bL is displayed. Press ENTER.
5. Use NEXT and Δ until the personal security code is displayed (0800 from the factory). Press ENTER.
6. When display returns to bL, press NEXT until LC01 is displayed. Press ENTER.
7. Calculate the low % input required by using the following formula:

   % = (Observed Reading - Desired Reading)/ (Analog High) x 100
8. Use NEXT and Δ until the calculated value from Step 7 is displayed. When finished, press ENTER.

— NOTE

Iteration of the above procedure may be required. Repeat Steps 7 and 8 until Observed Value is equal to the Desired Value.

---

9. When the display returns to LCO1, press NEXT once to display HCO1. Press ENTER.
10. Calculate the high % input required, using the following formula:

    % = [(Observed Reading/Desired Reading)] x 100
11. Use NEXT and Δ until the calculated value from Step 10 is displayed. When finished, press ENTER.

— NOTE

Iteration of the above procedure may be required. Repeat Steps 10 and 11 until Observed Value equals Desired Value.

---

12. To calibrate Analog Output 2, repeat the above procedure substituting LCO2 and HCO2 for LCO1 and HCO1.

Generating and Entering Custom Curves in the 873DPX

Custom temperature compensation and process-specific concentration data may be entered into 873DPX Analyzers via the *Curve Generation Program*. This section explains how to generate and enter custom curve data into your 873DPX Analyzer. To use the data after entering it, you must set up parameters CO1 and CO2.

Custom Temperature Compensation Curve (tCt)

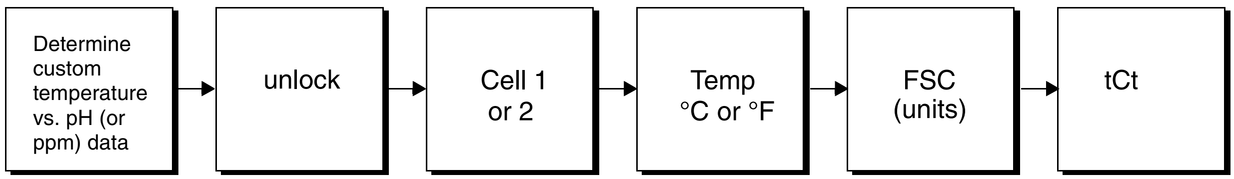


Figure 14. Flow Chart for Custom Temperature Compensation Curve

1. User-supplied process-specific compensation data must be generated or extracted from literature in advance of entering it into the 873DPX. This data must consist of temperature (°F or °C) vs. pH (or ppm) data for a particular concentration of the process (control point suggested). The temperatures should include all temperatures in the target process temperature range and be entered in ascending order. Invensys Foxboro suggests that you plot the data graphically in preparing it for entry into the 873DPX.

EXAMPLE:
The control point of a process is 10.0 pH. The process typically runs at ambient temperatures that fall in the range of 0 to 50°C. A sufficient grab sample of the process is taken and protected from atmosphere. Using a pH (or ISE) sensor and the 873DPX Analyzer set for standard Nernstian temperature compensation (CO1 or CO2 = 0000), pH vs. temperature data is generated. The data results are shown in Figure 15.

---

2. The user-supplied, process-specific compensation data must be reduced to fewer than 25 pairs, using the following general guidelines:
   - **a.** Enter the data into the Analyzer with increasing values of temperature, using the current temperature scale of the unit.
   - **b.** A maximum or minimum temperature difference between successive temperature points is not required and the intervals do not have to be equally spaced. Invensys Foxboro suggests that in a linear region you choose two or three points and that in a region where an exponential (curved) relationship exists, you use more data points.
   - **c.** The maximum number of data pairs you may enter is 25.
3. The process-specific reference temperature must be determined.This is the optimum temperature at which your process runs and is the temperature to which you wish all values corrected. In the example, the reference temperature is 25°C.

4. Access Setup Code tCt.
   - **a.** The first number to enter is the number of pairs of temperature/pH (or ppm) data you wish to enter. Press ENTER.
   - **b.** The second number to enter is the reference temperature, using the temperature units convention set in Step 2. No temperature units will be displayed. Press ENTER.
   - **c.** The third number to enter is the first temperature value.
   - **d.** Use NEXT and Δ to display the corresponding pH (or ppm) value from your table. The legend should display the correct units of measurement. (The legend and decimal point display will show the units of the currently active probe "FSC.") Press ENTER.
   - **e.** Repeat Steps 4c and 4d in sequence. To avoid a timeout while you make the entries, press and hold SHIFT. If a timeout does occur, however, you must restart from Step 4a. However, as all data entered up to the timeout will remain, simply step through the data points via ENTER until you reach the timeout point. The continued example below illustrates the procedure.

EXAMPLE (continued from previous page):
Enter the following numbers into the tCt parameter in the sequence shown.

Item	Value Entered	Action
Number of pairs	11	Press ENTER.
Reference Temperature	25.0	Press ENTER.
First Temperature	0.0	Press ENTER.
First pH (or ppm) value	10.32 pH	Press ENTER.
Second temperature	5.0	Press ENTER.
Second pH (or ppm) value	10.25 pH	Press ENTER.
Third temperature	10.0	Press ENTER.
Third pH (or ppm) value	10.18 pH	Press ENTER.
Fourth temperature	15.0	Press ENTER.
Fourth pH (or ppm) value	10.12 pH	Press ENTER.
Fifth temperature	20.0	Press ENTER.
Fifth pH (or ppm) value	10.06 pH	Press ENTER.
Sixth temperature	25.0	Press ENTER.
Sixth pH (or ppm) value	10.01 pH	Press ENTER.
Seventh temperature	30.0	Press ENTER.
Seventh pH (or ppm) value	9.97 pH	Press ENTER.
Eighth temperature	35.0	Press ENTER.
Eighth pH (or ppm) value	9.93 pH	Press ENTER.
Ninth temperature	40.0	Press ENTER.
Ninth pH (or ppm) value	9.89 pH	Press ENTER.

Item	Value Entered	Action
Tenth temperature	45.0	Press ENTER.
Tenth pH (or ppm) value	9.86 pH	Press ENTER.
Eleventh temperature	50.0	Press ENTER.
Eleventh pH (or ppm) value	9.83 pH	Press ENTER.

5. This completes entry of custom temperature data. To use the information for temperature correction of pH or ppm data, set up CO1 or CO2 to use custom temperature compensation data.

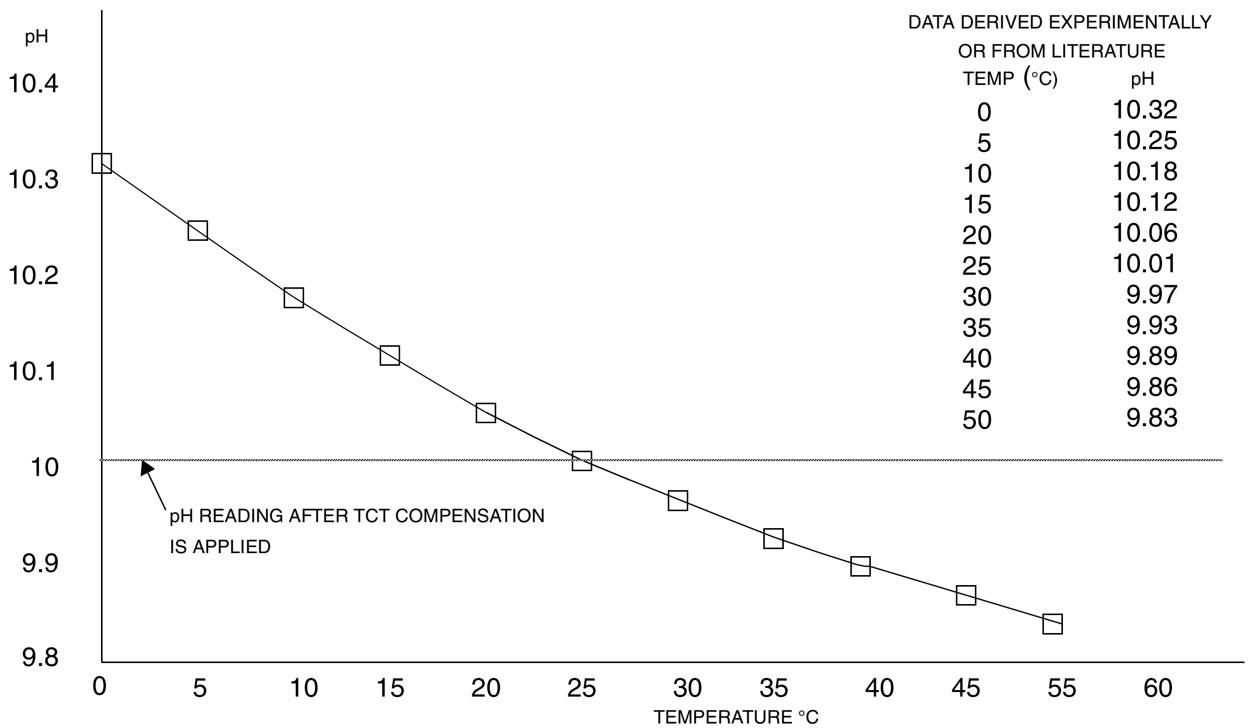


Figure 15. Example of pH vs. Temperature Custom Curve

Custom PPM Curve (PCt)

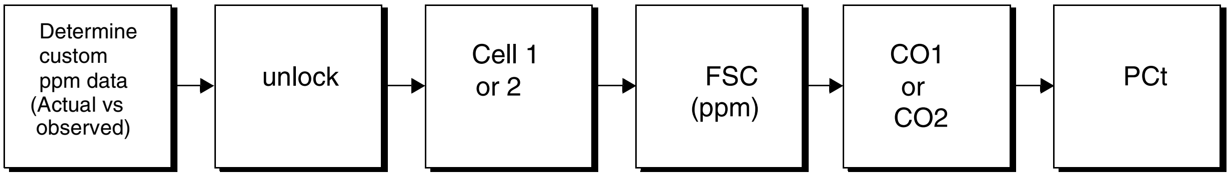


Figure 16. Flow Chart for Custom Percent Concentration

1. User-supplied process ppm data must be generated before you enter it into the 873DPX Analyzer. The data must consist of actual ppm values versus observed ppm values. The concentrations should include the entire range that the process may experience. You must enter the actual ppm values in ascending order and not change the direction of slope of the data. In preparing the data, it is helpful to plot the data as a graph as well as a table.

EXAMPLE:
A series of solutions with known fluoride concentrations ranging from 0.3 ppm to 10 ppm are prepared. Using a fluoride sensor and the 873DPX with standard Nernstian compensation (CO1 or CO2 set to xx10), a set of observed ppm readings versus actual ppm concentrations is collected. Results are shown in Figure 17, with ppm concentrations plotted against millivolts. The graph is plotted on a semilogarithmic scale to illustrate the linear relationship between mV and ppm decades. Note that in the range below 1 ppm actual ppm readings deviate from an ideal linear response. Entering the observed ppm vs. actual ppm data into tCt allows the 873DPX to correct this nonlinearity. The data results are shown in Figure 17.

---

2. The user-supplied ppm data must be reduced to 25 or fewer pairs, using the following guidelines:
   - **a.** The data should be presented and entered into the Analyzer with increasing ppm values.
   - **b.** The slope of the data must not change sign.
   - **c.** A maximum or minimum ppm difference between data points is not required and the intervals between points do not have to be evenly spaced. In a linear region, two or three points is sufficient. In a region where an exponential or curved relationship exists, more data points should be entered.
   - **d.** The maximum number of data pairs is 25.
3. Custom temperature compensation tCt should be entered first. Refer to the preceding section for details. Unlock bL. Press NEXT repeatedly until PCt appears on the display. Then press ENTER.
   - **a.** First, enter the number of data pairs you plan to enter. Press ENTER.

b. Next, enter the first observed ppm value. Use NEXT and Δ to display the first observed ppm value in your table. The display should show the ppm units legend. Press ENTER.

c. Use NEXT and Δ to display the corresponding actual ppm value from your table. Press ENTER. The Cel2 legend should be displayed.

d. Repeat Steps 3b and 3c in sequence. To avoid a timeout while entering data, press and hold SHIFT. If a timeout does occur, however, restart the procedure from Step 3a.

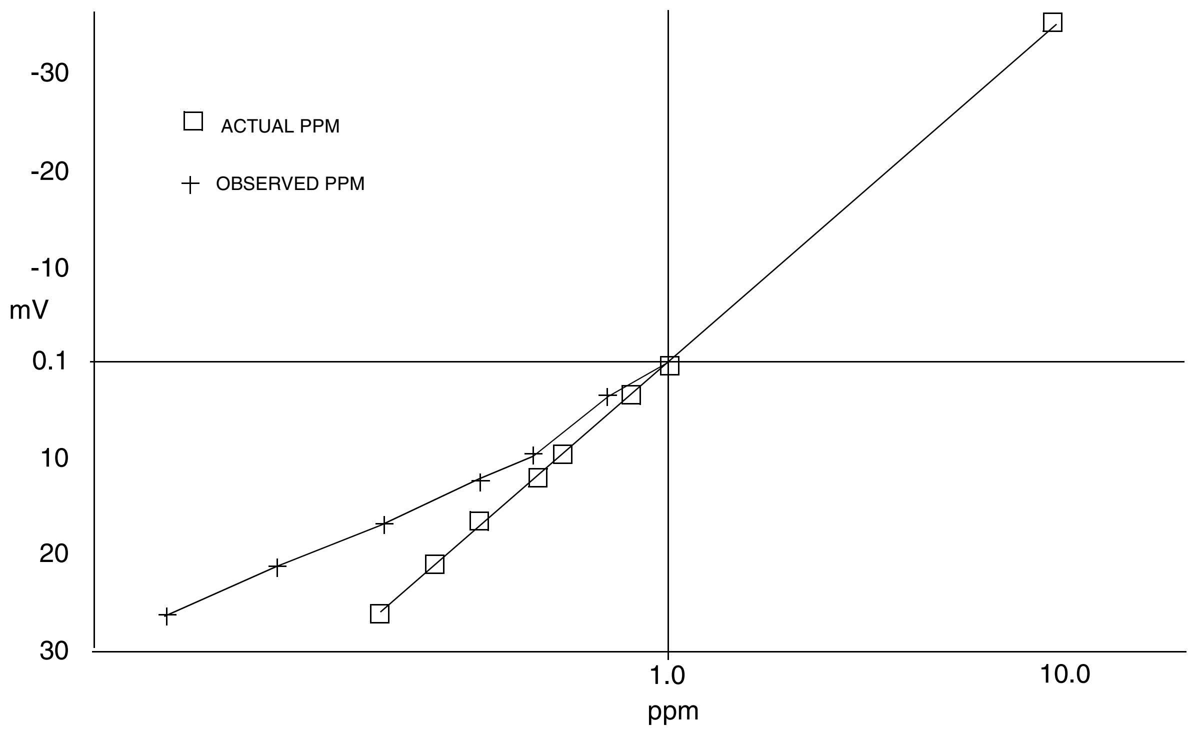


Figure 17. Custom ppm Data

EXAMPLE:
Enter data into the PCt parameter in the following sequence:

Item	Value Entered (legend)	Action
Number of pairs	8	Press ENTER.
Fist observed ppm reading	0.1 (ppm)	Press ENTER.
First actual ppm value	0.03 (Cel2)	Press ENTER.
Second observed ppm reading	0.13(ppm)	Press ENTER.
Second actual ppm value	0.05 (Cel2)	Press ENTER.
Next observed ppm reading	0.18 (ppm)	Press ENTER.
Next actual ppm value	0.1 (Cel2)	Press ENTER.
Next observed ppm reading	0.29 (ppm)	Press ENTER.

Item	Value Entered (legend)	Action
Next actual ppm value	0.2 (Cel2)	Press ENTER.
Next observed ppm reading	0.37 (ppm)	Press ENTER.
Next actual ppm value	0.3 (Cel2)	Press ENTER.
Next observed ppm reading	0.77 (ppm)	Press ENTER.
Next actual ppm value	0.7 (Cel2)	Press ENTER.
Next observed ppm reading	1 (ppm)	Press ENTER.
Next actual ppm value	1 (Cel2)	Press ENTER.
Final observed ppm reading	10 (ppm)	Press ENTER.
Final actual ppm value	10 (Cel2)	Press ENTER.

4. This completes the custom ppm curve entry. To use this information for correcting ppm concentration data, set up CO1 (or CO2) to correspond to xxx7 or xxx8. Refer to “Temperature Compensation (CO1 and CO2)” on page 46 in this chapter.

Timeout Time Adjustment

When the 873DPX is in the SETUP mode and no key is pressed within a 10-second period, the Analyzer automatically exits from SETUP and defaults to OPERATE mode. This feature is called *timing out*. The timeout time is factory-set at 10 seconds. You may, however, change the time to any value between 3 and 99 seconds by setting the *tOut* parameter.

tOut Configuration Code

Digit 1	Digit 2	Digit 3	Digit 4
Adjustable Timeout Time			
3 to 99 seconds			

Instrument Lock Code Change Control (LCC)

This parameter permits you to change the security code to another 4-digit code.

To enter a new code, execute the following procedure:

— NOTE
If you have forgotten the existing security code, you must contact Invensys Foxboro for instructions on how to enter a new one.

1. Leave power on.
2. Press LOCK. Display will show either Loc or uLoc.
3. If *uLoc* is displayed, proceed to Step 4.
4. If *Loc* is displayed, unlock the Analyzer. Display will read uLoc.
5. Press SHIFT + SETUP. Release both keys.
6. Press NEXT several times until the code bL (Basic Setup Lock) is displayed. Press ENTER.

7. Then use NEXT and Δ until existing security code is displayed (0800 from factory).
8. Press ENTER.
9. When display returns to bL, press NEXT several times until the code LCC (Lock Code Change) is displayed.
10. Press ENTER, then use the NEXT and increment (Δ) keys until the desired new security code is displayed.
11. Press ENTER. The new code will now be required for all future entries.
12. Lock the Analyzer using the standard procedure.

LCC Configuration Codes

Digit 1	Digit 2	Digit 3	Digit 4
4-digit Lock Code			
0000 to 9999			

5. Calibration

The Calibration section is divided into two main parts:

1. Electronic Bench Calibration
2. Calibration of a Sensor

The description of *Electronic Bench Calibration* contains the procedures for calibrating the 873DPX Analyzer with theoretical mV inputs.

The description of *Calibration of a Sensor* provides calibration procedures and standardization techniques for individual sensors and solutions. These additional procedures are recommended for verifying individual electrode functions and for achieving best system accuracy.

The section titled *Temperature Cell Factor* fine tunes the RTD temperature signal to agree with actual temperature. This procedure *must* be followed if you use long cable lengths.

⚠ CAUTION

Do not remove the four front panel screws and the electronics package for calibration. The self-tapping screws have a limited number of taps and will not function properly with repeated use.

Electronic Bench Calibration

The procedure for calibrating 873 analyzers with theoretical mV inputs is as follows.

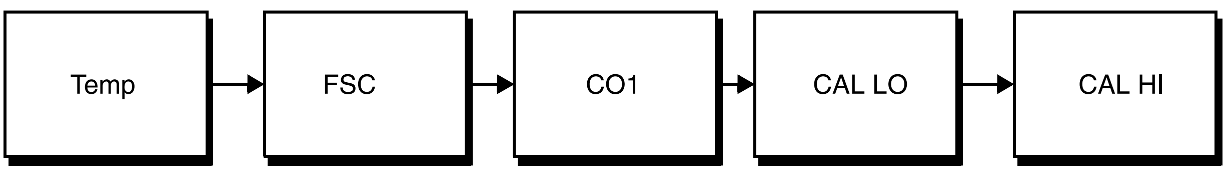


Figure 18. Flow Chart for Electronic Bench Calibration

NOTE

Invensys Foxboro calibrates and configures all 873 analyzers before shipment. You may verify calibration by feeding mV values into the unit. Verification of proper operation of the 873 electronics can be an aid in troubleshooting a problem installation. If the unit operates properly in this calibration, it may be ruled functional in the installation. If the FSC was changed from the factory configured range, the analyzer should be bench calibrated. Do not press ENTER if you are checking the calibration.

Note that once a sensor connected to the 873DPX is calibrated in pH buffers or standard solutions, the theoretical values entered during the electronic bench calibration procedure are removed.

Equipment Required for Calibration

- Precision millivolt standard (0 to 1000 mV dc ±.1%)
- 110-ohm precision resistor for temperature simulation

Procedure

The procedure for performing bench calibration is:

1. Disconnect all sensor leads from analyzer.
2. Unlock analyzer (see “Unlocking Analyzer Using Security Code” on page 28).
3. Check the temperature circuit calibration
   - a. Connect a 110-ohm resistor across sensor input terminals 1 and 2.
   - b. Press TEMP. The unit should then be in the Automatic Temperature mode and no decimal should be visible after the C or F legend. If there is a decimal after the C or F legend, remove it. To do so, press Δ once after pressing TEMP; then press ENTER.
   - c. Reset tCF1 to 25.00 (the theoretical temperature transducer value).
   - d. Press TEMP. The display should read approximately 25°C or 77°F. If the display does not read either of these values, reset the temperature electronics for recalibration.
   - e. The unit should now be put into manual temperature mode. There should be a decimal to the right of the legend. Press TEMP. Press Δ one or more times until the display reads 25°C. Press ENTER.
   - f. Use NEXT + Δ until the display reads (2)5.00 °C. The first digit *2* will not be displayed. Press ENTER.
4. Reset the Full Scale value of the analyzer. Refer to “Selecting and Changing the Full Scale Range (FSC1 and FSC2)” on page 45. Even if the existing Full Scale Value is the desired value, it is important to reenter the same value. When the FSC value is entered, error code *Er4* should begin to flash on the display.

— NOTE —

1. If an Error Code of higher priority is present, it will preempt the Er4 message.
2. Holding the **Shift** key between entries will prevent the analyzer from timing out and leaving the Setup entries.

5. Check and adjust the damping factor of the unit. Refer to CELL configuration in Chapter 4. Set CELL to read “xx00”. The unit should have no damping and should use the standard Nernstian compensation during calibration (CO1 or CO2 = X0X0).
6. Zero and Span Calibration
   - a. Connect a mV power supply to sensor input terminals — positive to 3 and negative to 4 and 5.
   - b. Connect a jumper between sensor input terminals 4 and 5.

c. Adjust the mV supply to the desired low value as determined by the formula in Table 5. Wait at least 15 seconds for the electronics to stabilize.*

d. Press SHIFT and while holding, press CAL LO. Release fingers from both keys. Use NEXT and Δ until the display reads the desired low value. Press ENTER.

e. Calculate the mV input required for Calibrate High Value. The CAL HI value should fall within the range of the FSC that has been chosen. *(For ORP, see note.)

— NOTE
* The Er4 code should stop flashing. An error of lower priority may begin to flash. See Section 6.

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f. Input mV value corresponding to calculated CAL HI value. Wait at least 15 seconds for the electronics to stabilize.

g. Press SHIFT and while holding, press CAL HI. Release fingers from both keys. Use NEXT and Δ until the display reads desired CAL HI value. Press ENTER.

7. Lock analyzer (see "Locking Analyzer Using Security Code" on page 28).

8. This completes the Standard Electronics Bench Calibration procedure.s

Table 5. mV Supply Formulas

Measurement Mode	mV Power Supply Formula	Examples
Glass pH	(pH–7) x –59.16	*pH 0:* (0 – 7) x –59.16 = +414.1 mV *pH 14*: (14 – 7) x –59.16 = –414.1 mV
Antimony pH	(pH–1) x –55	*pH 0:* (0 – 1) x –55.00 = +55.0 mV *pH 7:* (7 – 1) x –55.00 = –330.0 mV
ORP	(mV) *	Input absolute mV
ppm (ISE)	58/n x log[ppm/ppm(known)] + mV known**	Fluoride (F^{-}) Charge is negative and monovalent (n= -1) Known: 1 ppm F^{-} = 0 mV 2 ppm: 58/(-1) x log[2/1] + 0 = -17.5 mV 20 ppm: 58/(-1) x log [20/1] + 0 = -75.5 mV

— NOTE
*ORP: Do not exceed an input voltage of 1700 mV. Suggested ORP calibration range is ±900 mV. The lower limit is –999 mV, the upper limit is 1400 mV. Values up to 1700 mV can be displayed on the unit. Above this value, 9999 is displayed. Input voltages exceeding 2000 mV will cause an Er 1 to occur.

— **NOTE**

**ISE: Electronic calibration of ISEs requires prior knowledge of the charge and valence of the ion (n) and the mV response of the ISE at a given concentration [ppm (known) and mV known]. This data should be available in the literature provided by the electrode manufacturer and may be expressed in a graph such as the example for a fluoride electrode shown in Figure 19. If the calculated voltages do not fall within the -150 to +150 mV span of the 873DPX, it may be necessary to change the offset voltage (OF) to place the 300 mV span in the appropriate place within the range.

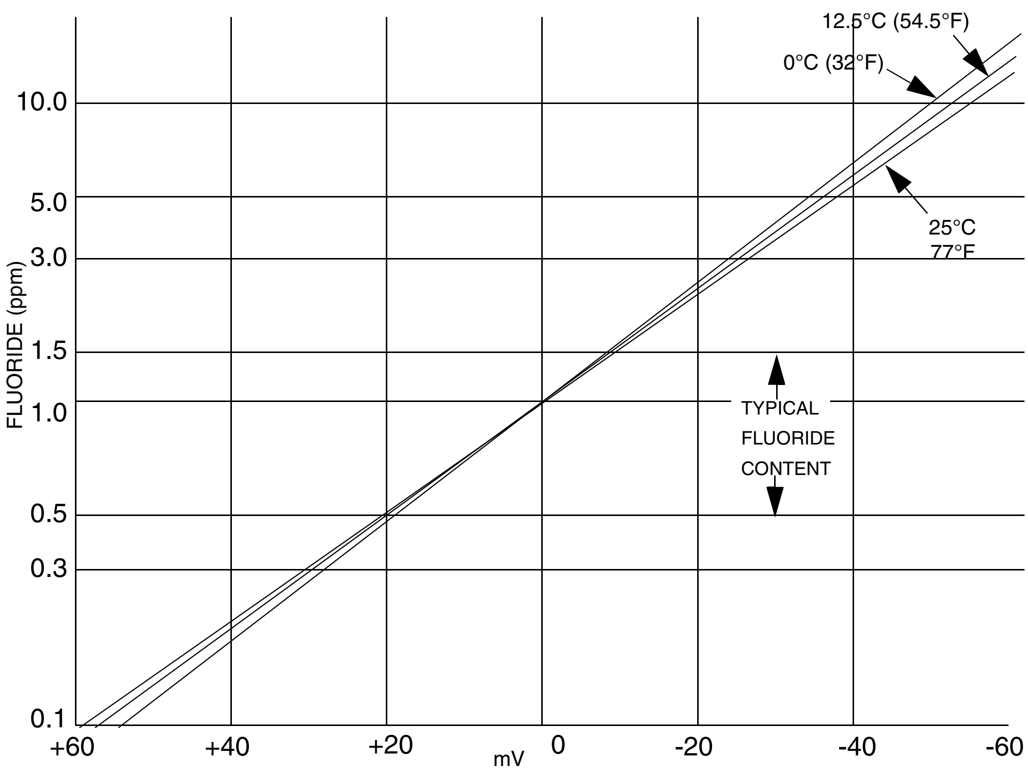

Figure 19. Fluoride Electrode Response as Function of Temperature

Calibration Of A Sensor

General Information

In many circumstances, a sensor used on an analyzer that has been bench calibrated may provide sufficient accuracy to the user. The electronic bench calibration establishes an approximate relationship between pH or ppm values displayed and expected mV output from a sensor. In such cases, you may connect the sensor to the analyzer and use it without further calibration.

A single point standardization using one buffer or standard solution, preferably near the process measurement value, is often suitable for routine measurements. For the best possible system accuracy, use a two point standardization, preferably bracketing the process control point. You may also extract a sample from the process stream (i.e., a grab sample), perform a laboratory analysis, and calibrate the analyzer with the results of the analysis. This is also a convenient way to perform sample calibration as it allows the sensor to remain installed in the process during standardization.

The electronic bench calibration is described earlier in this chapter. The other three commonly used techniques are discussed in the following sections. In addition, a correction should be made to correct temperature measurements that may differ from actual values (such as when sensor cable length exceeds 50 feet). These procedures should be performed *prior* to sensor standardization in buffers.

In all cases, these general guidelines should be observed:

1. Clean sensors thoroughly before standardization.
2. Use fresh pH buffers or standard solutions.
3. Allow enough time for sensor and temperature-compensator to reach thermal equilibrium. The temperature display should indicate the correct temperature of the buffer.
4. For pH standardization, use the correct pH value of the buffer during standardization — pH buffers have different values at different temperatures.
5. Allow sufficient time to reach thermal and chemical equilibrium.
6. Sensors must be properly grounded in solution during the standardization. *The black threads of the Model 871A sensors must be in contact with the solution.*

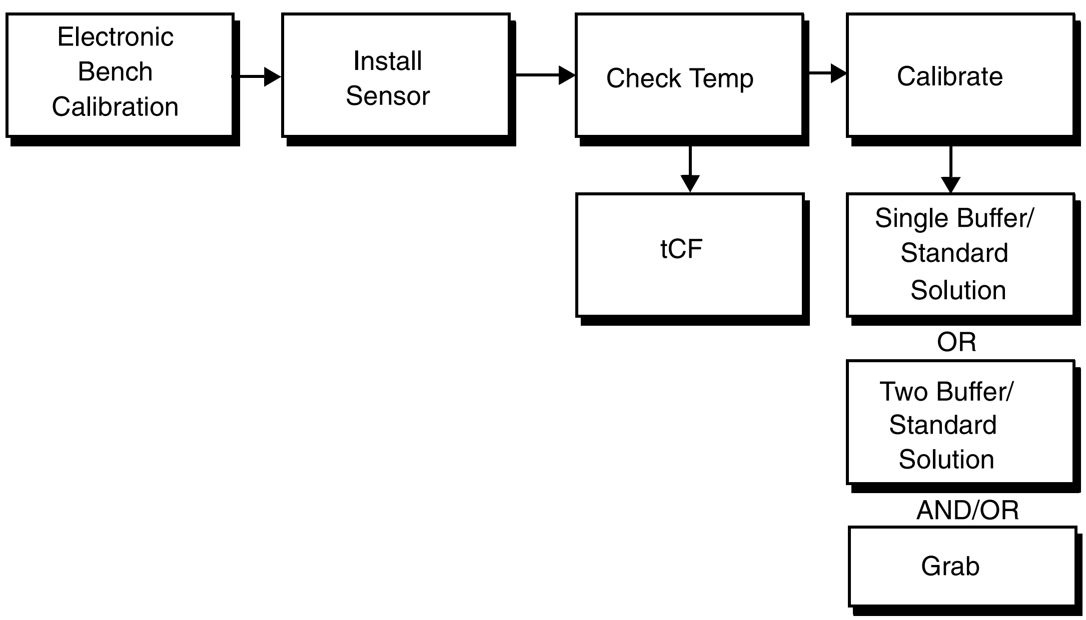

Figure 20. Flow Chart for pH/ORP/ISE Sensor Calibration

One and Two Point Calibration

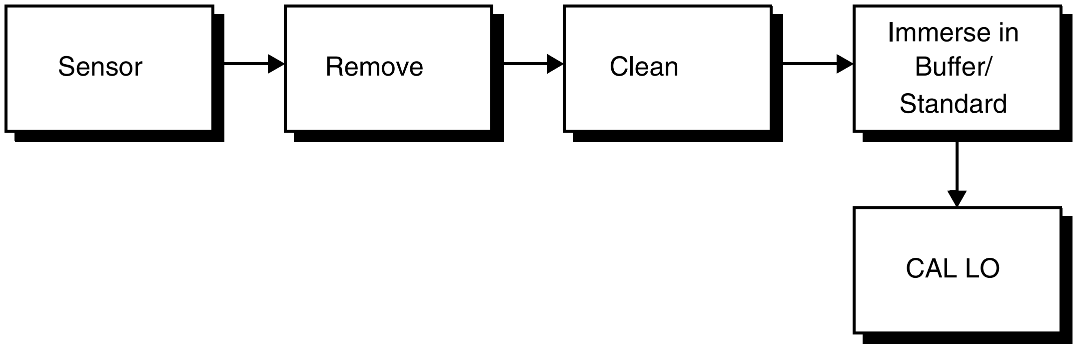

Figure 21. Flow Chart for Single Point Calibration

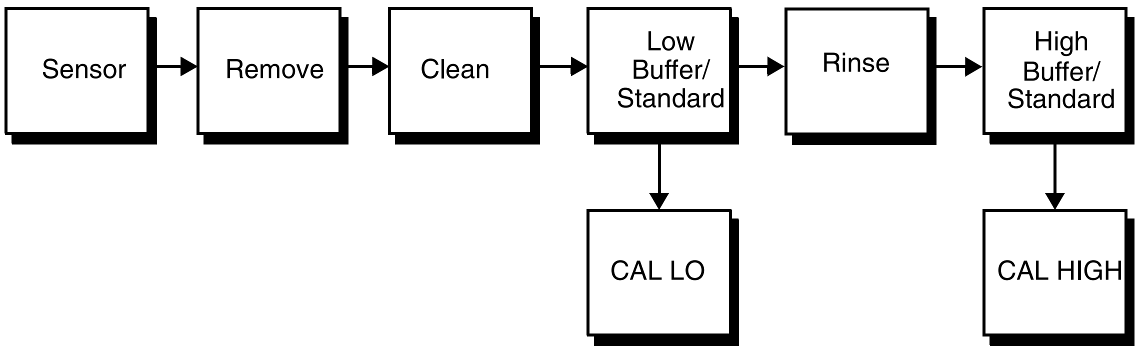

Figure 22. Flow Chart for Two Point Calibration

The procedure for performing one and two point calibration is as follows:

1. Unlock analyzer (see “Unlocking Analyzer Using Security Code” on page 28).
2. Remove the sensor from the process stream. Clean the immersion end and rinse with distilled water.
3. Select buffers or standard solutions near or bracketing the process measurement value. The solutions should be at the same temperature and, for best results, near the process temperature.
4. Immerse the cleaned sensor in the solution with lower known pH, ORP, or ion concentration. Wait until the sensor has reached chemical and thermal equilibrium.
5. Press/hold SHIFT and press CAL LO. Remove fingers from both keys.
6. Press NEXT and Δ repeatedly until the display reads the correct value at the temperature of measurement. Press ENTER.

— NOTE —
For single point standardization, stop here. The slope (gain) from the previous bench or solution calibration will be used.

7. Thoroughly rinse the sensor in distilled water.

8. Immerse the sensor in the second solution with higher known pH, ORP, or ion concentration. Allow the sensor to come to chemical and thermal equilibrium.
9. Press SHIFT and while holding, press CAL HI. Remove fingers from both keys.
10. Use NEXT and Δ until display reads the correct value. Press ENTER.
11. Lock analyzer (see "Locking Analyzer Using Security Code" on page 28).

Grab Sample Standardization

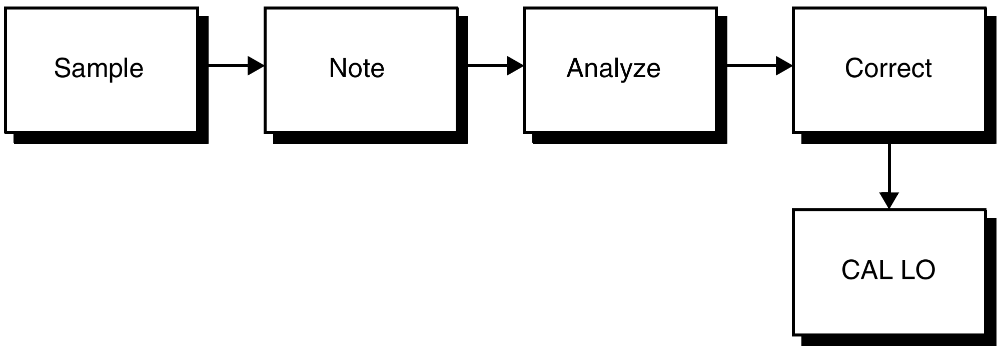

Figure 23. Flow Chart for Grab Sample Calibration

The procedure for grab sample calibration is:

1. Unlock analyzer (see "Unlocking Analyzer Using Security Code" on page 28).
2. Note the present pH, ORP, or ion concentration reading while extracting a sample from the process stream.
3. Determine the pH (ORP or ion content) of the sample using laboratory techniques suitable for the precision required. The laboratory measurement should include precise standardization and temperature compensation of the laboratory sensor, and should protect the sample from atmosphere and temperature change.
4. Determine the difference between the laboratory value and process reading taken when the sample was removed.
5. Using the CAL LO sequence, adjust the present reading by the difference calculated.

EXAMPLE:
When the sample was taken, the analyzer read 8.25 pH. The grab sample was found by the laboratory to be 8.40 pH. When you returned to the analyzer, the display read 8.30 pH. This value should be increased by +.15 pH units (8.40 – 8.25 =.15) to 8.45 using the CAL LO key and Δ.

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6. Press SHIFT and while holding, press CAL LO. Remove fingers from both keys.
7. Use NEXT and Δ until the display reads the corrected measurement value. Press ENTER.
8. Repeat Steps 2 through 7 to verify the standardization.

Temperature Cell Factor

Except for ORP measurements, which do not use temperature compensation, an accurate temperature signal is required, especially when measuring over a large temperature gradient. The temperature cell factors (tCF1 and tCF2) are used to offset a deviation from ideal caused by high cable resistance. The procedures found in the following sections are recommended for installations that require a cable length of 50 feet or greater. The 873 analyzer uses a 100-ohm RTD circuit for automatic temperature compensation. Use this procedure before executing buffer or grab sample calibrations.

Determining tCF

The procedure for determining the temperature cell factor is:

1. Place the sensor and an accurate Centigrade thermometer (with 1.00 °C resolution) into a container of liquid. Allow the system to reach thermal equilibrium.
2. Press TEMP. Put the analyzer into Automatic Temperature Compensation (no decimal after the C). If there is a decimal after the C, remove it. Press Δ once after pressing TEMP; then press ENTER.
3. Read the temperature displayed on the 873 to the hundredths place.
   When TEMP is pressed, the current temperature value with tenths place display will alternate with the C legend. The value read by the 873 may now be viewed to the hundredths place. Press TEMP followed by NEXT five times. Only three numbers may be viewed on the display, and the first digit will not be visible (e.g., 25.20 will be displayed as 5.20).
4. Determine the difference in values between the two temperature devices; e.g., the thermometer reads 24.70 °C, and the 873 reads (2)5.20 °C; the 873 is reading higher by 0.50 °C.
5. Subtract this value from 25.00 (e.g., 25.00 –.50 = 24.50). This is your new tCF value.

— **NOTE**

If the 873 value is **less** than the thermometer reading, add the difference to 25.00.

Entering a tCF Value

To enter a tCF value, execute the following procedure:

1. Unlock analyzer (see “Unlocking Analyzer Using Security Code” on page 28).
2. Press SHIFT + SETUP. Release both keys.
3. Press NEXT several times until the code *bL* (Basic Setup Lock) is displayed.
4. Press ENTER. Then press NEXT and Δ repeatedly until personal security code is displayed (0800 from factory).
5. Press ENTER.
6. When the display returns to *bL*, press NEXT several times until the parameter identifier *tCF1* or *tCF2* is displayed.

7. Press ENTER and then press NEXT and Δ one or more times until desired value is displayed.
8. Press ENTER.
9. Recheck any differences that exist between a thermometer reading and the temperature displayed on the 873, using the technique described earlier in this chapter.
10. Lock analyzer.

6. Diagnostics

Troubleshooting

Using the 873 Analyzer to Troubleshoot a Sensor Problem

The best way to check the health of a sensor is to hook it up to an analyzer and to calibrate it in pH buffers or standard solutions (refer to "One and Two Point Calibration" on page 68). First, make sure that buffers or standard solutions are fresh and uncontaminated. Then, let the sensor reach thermal and chemical equilibrium with the solution. If the sensor calibrates accurately, you can be sure it is fully functional. If it does not, refer to the section on "Additional Troubleshooting" on page 74.

873 Error Codes/Actions

When the sensor is used in conjunction with an 873 analyzer, the analyzer displays an error code if certain fault conditions exist. (Refer to Table 7, "Error/Alarm Messages," on page 77 for an explanation of each.) Use of the error codes in diagnosing sensor problems is described below.

Er 1 (Instrument Fault):

- Disconnect the sensor and power down the analyzer. Try the sensor on another unit.

Er 2 (Temperature Error):

- The temperature sensor used on the 873DPX is a 100 ohm RTD. At temperatures around 25°C (77°F), it should read 110 ohms. Check to see what values (typically 0 to 100) are assigned to tL and LtL. Then press TEMP (Auto mode). If the display reads incorrectly, determine whether the analyzer or sensor is not functioning. To check the analyzer, place a 110-ohm resistor across Terminals 1 and 2 of terminal block TB2 and verify that the analyzer reads 25 °C. If it does not, a fault exists in the analyzer. If it does, proceed to the next step.
- Next, measure the resistance between wires 1 and 2 (black and white) of the sensor. At normal room temperatures, the resistance should be approximately 110 ohms. If the resistance between Leads 1 and 2 of the sensor deviates greatly from 110 ohms, the sensor is not functioning properly and should be replaced. For the short term, if the process measurement does not change temperature and is close to pH 7, or has very wide accuracy specifications, manual temperature compensation may be selected.

Er 4 (Calibration Error):

- During 2-point calibration with *fresh non-contaminated* solutions, a sensor may cause an Er 4 error message to appear if the sensor does not generate a large enough voltage difference between the two measurements. If, however, the sensor is sufficiently conditioned and relatively stable in each solution, additional conditioning time may improve the response. Soak your electrode in dilute KCl solution without silver chloride. To hydrate the glass bulb, soak sensor in pH 4 buffer solution for approximately 15 minutes.

- Note that a new sensor installation may also experience this problem. Recovery may be hastened by immersing the sensor in a warmed KCl solution and then cooling it to room temperature while immersed in this solution. If the sensor reads the same value in every solution after hydration and proper conditioning, replace the sensor.
- The 873DPX analyzer will accept a 2-buffer calibration (Er 4 not activated) as long as the slope (mV/pH or mV/ppm decade) of the calibration curve (see Figure 24) exceeds ~50 mV. Slope value may be accessed by pressing SHIFT + SLOPE. Slope is always displayed at a temperature of 25.0 °C, regardless of the temperature at which calibration occurred. If the slope falls below 50.3, the calibration will still be accepted into the unit, but Er 4 will flash and alternately display the sample value. Invensys Foxboro recommends sensor servicing on all sensors with slopes below 53.3 mV/pH (90% efficiency). See Item 2, “Low Slope”, in the following section.
- Verify that the temperature is reading correctly and the analyzer is in the automatic temperature mode. See Chapter 3.
- Use the correct buffer values at the temperature of measurement.

Table 6. Temperature vs. Resistance Table for Pt 100 RTD

Temperature (°C)	Resistance (ohms)	Temperature (°C)	Resistance (ohms)
–5	98.04	40	115.54
0	100.00	50	119.40
5	101.95	60	123.24
10	103.90	70	127.07
15	105.85	80	130.89
20	107.79	90	134.70
25	109.73	100	138.50
30	111.67	110	142.29
35	113.61		

Additional Troubleshooting

1. SENSOR DOES NOT APPEAR TO BE FUNCTIONING.

For sensors with a preamplifier, leave all sensor leads connected to the analyzer. Leave analyzer power on. Connect a voltmeter first to Leads 4 and 6 of TB2, and then to Leads 4 and 7. The voltmeter should read ±6.2 V. If it does not, disconnect the sensor and repeat the procedure at the analyzer. If ±6.2 V can be measured at the analyzer terminals, a problem exists in the sensor. If ±6.2 V is not present at the analyzer terminals, an analyzer problem exists. If the sensor and analyzer both pass this test, continue to Item 2.

2. LOW SLOPE.

   Leave all sensor leads connected to the powered analyzer. Clean the "business end" of the sensor and place into a beaker of pH 7 buffer. Use the mV key to display the measured absolute voltage generated by the sensing and reference electrodes. The value should be 0 V ±20 mV. When the sensor is cleaned and placed into a second buffer (25 °C), the reading should change approximately 59 mV per pH unit. In a 10.0 pH buffer, the mV reading should be less than the 7 pH buffer reading by approximately 174 mV (177.3 theoretically). In a 4.00 pH buffer, the mV value should be greater than the mV value in the 7 pH buffer by 174 mV. If the sensor passes this test and the problem with the measurement persists, an analyzer problem may exist. Verify that the sensor temperature is in automatic mode and that it is reading correctly.

NOTE

HINT: It is a good idea to keep records of your calibrations. Recording the mV values and Slope can help you establish maintenance and replacement information on your sensors.

3. ERRATIC READING.

   On 871PH pH/ORP/ISE only: Measure the resistance between wire #4 (clear) and the knurled screw on the immersion end of the sensor. The resistance should be 0 (shorted) or very small. If not, you have a grounding problem with your sensor.

   For an 871A, make sure the grounding threads are in contact with the solution. Teflon tape around these threads may prevent a ground connection from being made.

   Troubleshooting a ground loop or grounding problem may also be done in a beaker of buffer. Immerse a sensor in buffer other than pH 7 and note the pH. Attach a wire to a piece of metal (a paper clip will do) and to an earth ground (metal pipe or outlet ground). Next, place the metal piece into the beaker and observe the pH reading of the analyzer. It should not change. A change in pH during this procedure indicates that a problem exists.

4. SLOW RESPONSE.

   If the sensor is very slow in responding, a blockage may have occurred on the reference junction. (To dissolve dried salts, condition the sensor longer. Otherwise, replace the reference solution, especially if it is discolored.) Trapped air bubbles can also cause problems by increasing resistance in this circuit. A firm shakedown and soaking can often help. Slow response can also indicate a coated or dehydrated pH glass. Although cleaning or soaking the sensor in pH 4 buffer or dilute acid may help, replacement of the pH electrode may be required. Also refer to the Er 4 troubleshooting procedures described earlier in this section.

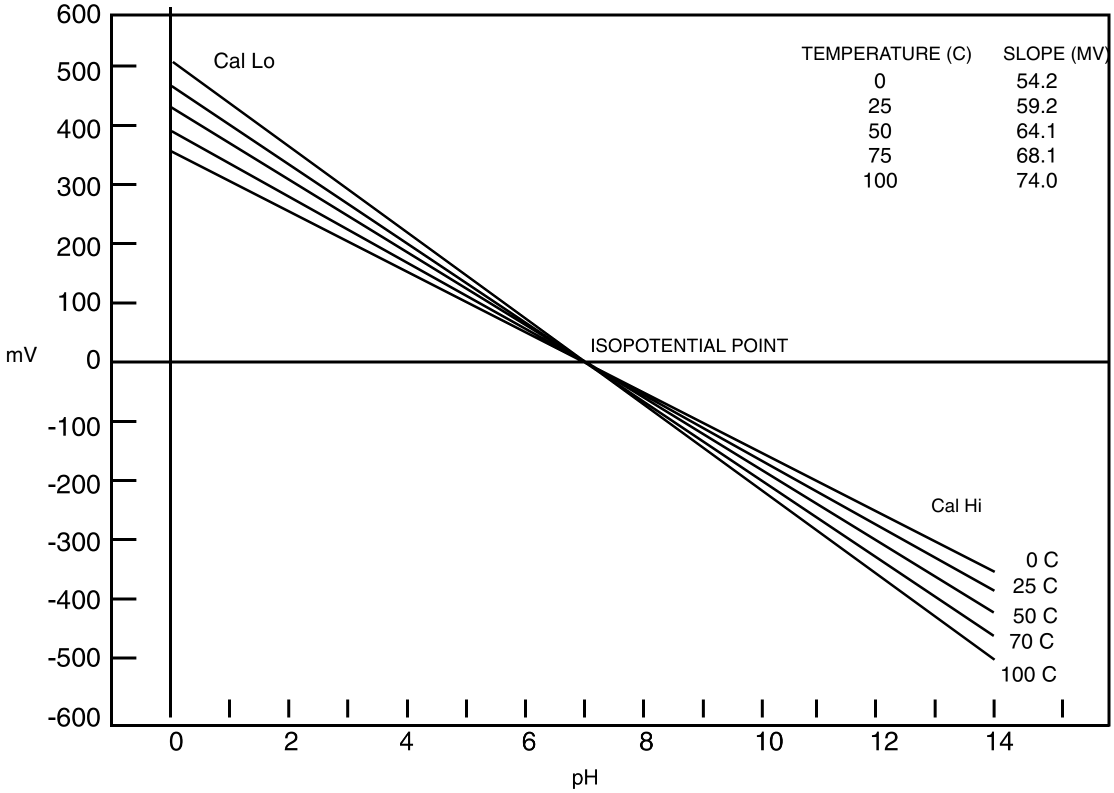

Figure 24. Relationship between pH and mV at Different Temperatures for a Standard Glass pH Sensor and Ag/AgCl Reference Electrode

Error Codes

When the analyzer is operating normally, the measurement value is displayed constantly. If error or alarm conditions exist, the display alternates between the measurement value and the error/alarm message at a one second rate. The alternate (error/alarm) messages are shown in the following tables.

Table 7. Error/Alarm Messages

Alternate Display	Condition	Priority	Action Required to Clear Error Message
Er1	Instrument fault, RAM/ROM, software watchdog timer	1 (highest)	1. Re-enter security code. 2. Power cycle unit.
Er2	User-defined temperature range error or temperature measurement error	6	1. Change user-defined temperature limits, UtL or LtL. 2. Replace sensor. 3. Place temperature in manual mode.
Er3	User-defined measurement range error	7	1. Change user-defined measurement limits, UL or LL. 2. Replace sensor. 3. Ground loop.
Er4	Measurement calibration incorrect	2	1. Recalibrate sensors on both channels.
Al 1	Alarm 1 relay activated	9	
Al 2	Alarm 2 relay activated	9	
A1A2	Both alarm relays activated	8	
....	Measurement over or under range of analog output limits	10	Check analog output limits.
Err	Incorrect code or parameter attempted	2	Check code and re-enter.

7. Alarm Contact Maintenance

The alarm relay contacts are selected to switch loads equal to or greater than 20 watts. The minimum contact current is 1 ampere. The silver alloy contacts rely on the very slight arc generated during switching to eliminate oxide layers that form on the contacts. When the contacts are used at low (signal) levels, contact function may become unreliable over time due to the formation of an oxide layer on the contacts.

When contacts must be used at low levels, attention must be paid to contact condition. The maximum contact resistance for new relays is 100 milliohms. Values above this level or unstable values indicate deterioration of the contact surface as noted above and may result in unreliable alarm function.

The contact surfaces can be restored as follows:

1. Disconnect the alarm wiring from the analyzer.
2. Connect a load of 20 W or more as shown in Figure 25 so that both NO and NC contacts are exercised.
3. Use the analyzer to switch the alarm relay several times.
4. Disconnect the load installed in Step 2 and reconnect the wiring removed in Step 1.
5. Check to ensure that the alarms are functioning properly.

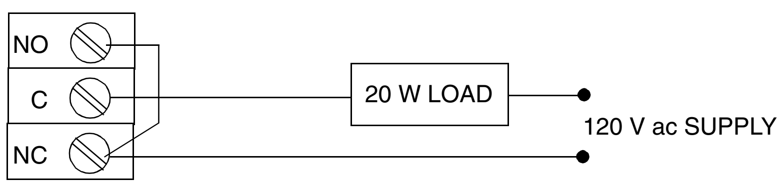

Figure 25. Alarm Contact Reconditioning Circuit

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