

**DolpHin<sup>®</sup> Series**  
**Models PH10 and ORP10 Analog and Smart Electrochemical Sensors and Accessories for pH and ORP Measurements**



**PH10 and ORP10 Analog Versions**



**PH10 Smart Version**

*The Foxboro<sup>®</sup> brand DolpHin<sup>®</sup> Series is a family of precision electrochemical sensors that are used in conjunction with a widely accepted set of mounting accessories to measure pH and ORP. They are rugged, easy-to-use devices that are particularly well suited for use in high temperature installations. Both Analog and Smart versions of the DolpHin Series are available.*

**INTRODUCTION**

The DolpHin Series is a family of high performance pH and ORP sensors with extensive features and accessories.

Breakthrough performance in stability, accuracy, and long life makes DolpHin the premier pH and ORP sensor for on-line process applications.

Extensive and successful field installations have proven DolpHin's superior performance. It outlasts other sensors in high temperature and temperature cycling applications up to 121°C (250°F). It remains fast and accurate, while conventional pH sensors lose sensitivity and are slow to respond to pH changes.

DolpHin products use a unique proprietary electrode glass formulation which makes the DolpHin exceptionally stable, accurate, and long lasting, even in the harshest process applications.

Each component in the DolpHin sensor has been designed to maximize ease-of-use, long life, and accuracy, including:

- ▶ Precision reference junction
- ▶ High-temperature electrolyte
- ▶ Reference electrode with Nafion ion barrier
- ▶ Ultra-fast Automatic Temperature Compensation (ATC)
- ▶ Single, rugged body that fits the widest variety of mounting accessories

The elegant DolpHin design delivers an easy-to-use sensor with unmatched pH and ORP measurement performance.

The PH10-\*S Smart sensor has internal, digital electronics, communicates digitally with a transmitter using low-cost, high-temperature cabling and carries sensor ID, calibration parameters and diagnostic history in its non-volatile memory.

## FEATURE HIGHLIGHTS

- ▶ PH10-\*S Smart sensor with Electronic Configuration code S, provides a means to store the calibration parameters, which include electrode slope and asymmetry potential, in the sensor.
- ▶ Unique pH glass - exceptionally stable, remains fast and accurate after severe temperature cycling (121°C/250°F)
- ▶ Proven high stability, high accuracy, and long life
- ▶ Easy-to-use body design simplifies installation, calibration, maintenance, and replacement
- ▶ More reliable measurements permit tighter process control
- ▶ Longer life plus easy mounting reduces maintenance costs

## GENERAL DESCRIPTION

The DolpHin Series consists of Model PH10 for pH measurements and Model ORP10 for ORP measurements. These Models share many of the same characteristics, such as body type, internal reference electrode, temperature elements, cables, options, and accessories.

The difference between the two Models is in the measuring electrode. Model PH10 offers four pH electrode choices, and Model ORP10 offers two ORP electrode choices. Each of these electrode types is discussed in the "MODEL CODE SELECTION GUIDE".

The commonality of body type allows users to standardize on DolpHin pH and ORP sensors while enjoying the flexibility to install them in any way appropriate for the application. Every DolpHin sensor fits with any of the ball valve insertion assemblies, bushings, tees, and other accessories shown in this document.

DolpHin sensors are easy to use; specifically, easy to install, replace, calibrate, and maintain. The "disposable" design means low cost of maintenance, and elimination of internal spare parts inventories. The sensor is mechanically rugged, chemically and thermally resistant, and can withstand extended exposure to high temperature applications, thereby making it ideally suited for the harshest industrial applications.

## ELECTRONIC CONFIGURATION

Analog sensors are offered with or without an internal preamplifier. The preamplifier converts the high impedance pH signal to a low impedance signal, which is less prone to interference.

Smart pH sensors (PH10-\*S option) convert all signals to digital form and must be used with the Model 876PH-S transmitter. Signal transmission distances for all three electronic configurations can be found in the "PHYSICAL SPECIFICATIONS" section. Refer also to "MODEL CODE SELECTION GUIDE" section.

## BENEFITS OF SMART SENSOR TECHNOLOGY

The largest source of measurement error in electrochemical systems comes from an imperfect field system calibration. Field calibrations can be compromised for many reasons, such as not allowing the readings to stabilize; performing a single point calibration when a two point is called for; calibrating a sensor whose slope indicates it is approaching end of life; using calibration solutions whose temperatures are changing; etc.

Many of these common sources of calibration errors are mitigated by performing a calibration under more controlled conditions, such as those found in an instrument shop or laboratory. However, it is not practical to move the field transmitter to the instrument shop to perform the calibration. This is where the Smart sensors play an important role. A Smart sensor can be calibrated at any time against a "standard" or "reference" transmitter in the instrument shop, or by means of a personal computer (PC) using the Foxboro Smart Sensor PC Interface cable and the Smart Sensor Device Type Manager (DTM) software.

The Smart sensor stores its calibration parameters in an on-board memory chip. When the operator needs to perform a field calibration, he or she simply takes the pre-calibrated Smart sensor to the field, connects it to the transmitter, and allows the transmitter to upload the calibration parameters. By managing the sensor calibrations in the instrument shop environment, the operator is more likely to perform a valid calibration. This process results in an easier, faster and more reliable field calibration.

### SMART SENSOR MANAGEMENT USING A PC

The PH10-\*S Smart sensor may also be connected directly to a PC for viewing measurements, performing calibrations, checking history and diagnostics, trending, and other functions. A Smart Sensor PC Interface Cable and a software package is offered for this function. The software is FDT (Field Device Tool) Group Certified. The software provides an easy to use operator interface, and is ideal for performing calibrations in the instrument shop environment. An enhanced history log is provided, which permits unlimited entries and allows for data export to a spreadsheet program. Sensor health is easily checked, assisting in sensor asset management. Refer to Table 7 for information on the Smart PC Sensor Interface Cable.

### TRANSMITTER/ANALYZER COMPATIBILITY

DolpHin sensors are fully compatible with Foxboro Models 870ITPH and 876PH Intelligent Transmitters and Model 875PH Intelligent Analyzers. The 876PH-S Transmitter is only compatible with the PH10-\*S sensor.

When used with the Foxboro Intelligent devices, DolpHin supports sensor diagnostics, including:

- ▶ Broken glass electrode
- ▶ Coating of sensing surface
- ▶ Aging (slope degradation)
- ▶ Response Time (876PH-S only)
- ▶ Liquid leakage into sensor body
- ▶ Preamplifier failure
- ▶ ATC, temperature element failure.

The coating, aging, and response time diagnostics are useful in scheduling preventive maintenance. All the diagnostics are useful in ensuring a reliable pH or ORP measurement.

DolpHin sensors are also compatible with older Models 873PH and 873DPX analyzers, although with a restriction on temperature elements (see "MODEL CODE SELECTION GUIDE"). Analyzer Model 873APH is compatible with DolpHin Model PH10 with glass electrodes and 100  $\Omega$  temperature elements only, and Model 870PH is compatible with preamplifier and 100  $\Omega$  RTDs only.

### SENSOR BODY

The sensor is offered in a PVDF<sup>(1)</sup> body material. PVDF is an ideal material because of its excellent pressure, temperature, and mechanical properties. It is virtually immune to attack from most chemical solutions.

The sensor body has a single, sealed sensor design, with no replaceable parts, making it a low maintenance sensor.

The glass electrode pH models contain no process wetted metal.

The body has two integral 3/4 NPT mounting threads; one at the cable end for submersion or ball valve insertion mounting, the other near the sensing end for in-line mounting.

In the upper body of the sensor, there are two grooves used to adapt to the Universal mounting adapters shown in "ACCESSORIES". The Universal Adapter set provides an easy means for installing, removing, and replacing the sensor.

### TYPICAL pH AND ATC RESPONSE

The following test data is typical of DolpHin performance and relative to premium process pH sensors supplied by other manufacturers.

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1. PVDF is polyvinylidene fluoride, commercially available as Kynar.

Slope % is a measure of the accuracy and sensitivity of a pH sensor. Slope % is the difference, in mV, of a sensor's output in two different pH buffers as compared to the expected or ideal mV difference between the same two buffers. Sensors are typically 100% of expected value when new, and the slope % deteriorates as the sensor ages; 80% is frequently used as the low limit acceptable for a process application. High temperature and temperature cycles cause pH sensitive glass to lose sensitivity more rapidly. The two significant effects that a pH user sees is loss of Slope % and slowing of the response to pH.

The superiority of the DolpHin high temperature

electrode is clearly demonstrated in Figures 1, 2, and 3.

Accurate pH measurement is also affected by the sensor's ability to provide fast, accurate, temperature measurement for temperature compensation.

The DolpHin sensor includes a temperature element that has been optimized for speed of response; is in close thermal contact with the process liquid, as well as the pH and reference electrodes.

DolpHin superiority for both the standard temperature element and the ultra fast enhanced element is shown in Figure 4.

Figure 1. pH Response Time, 100°C

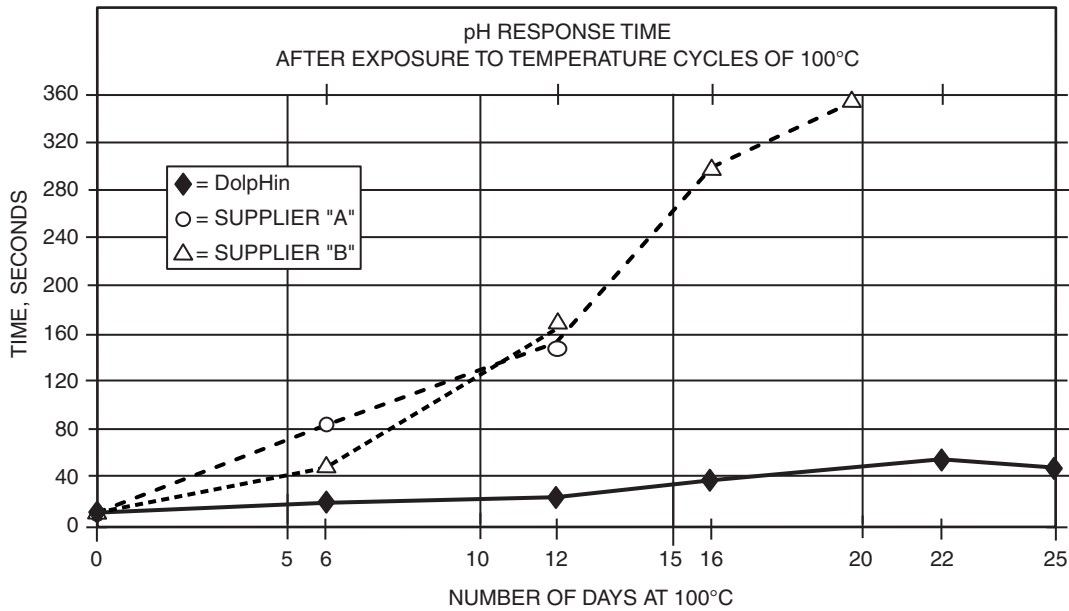


Figure 2. pH Response, Aging, 100°C

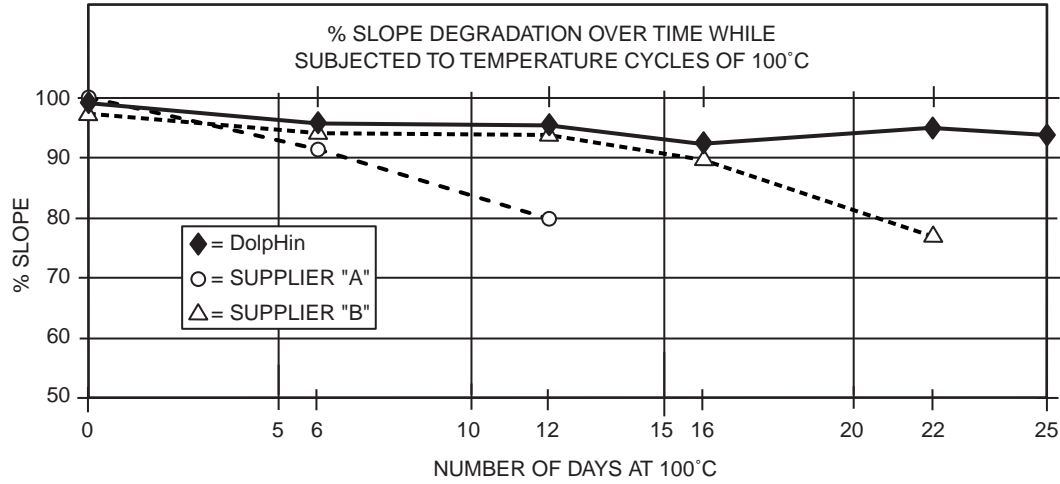


Figure 3. pH Response Time, 121°C

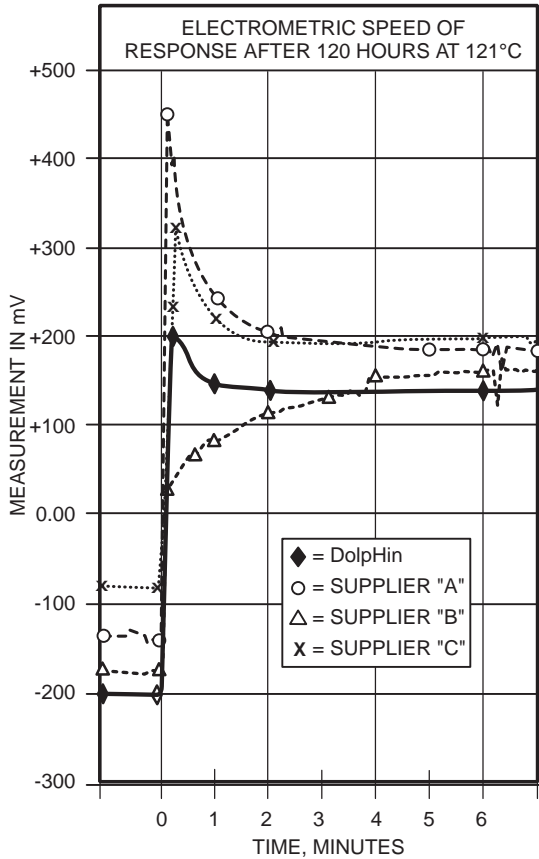
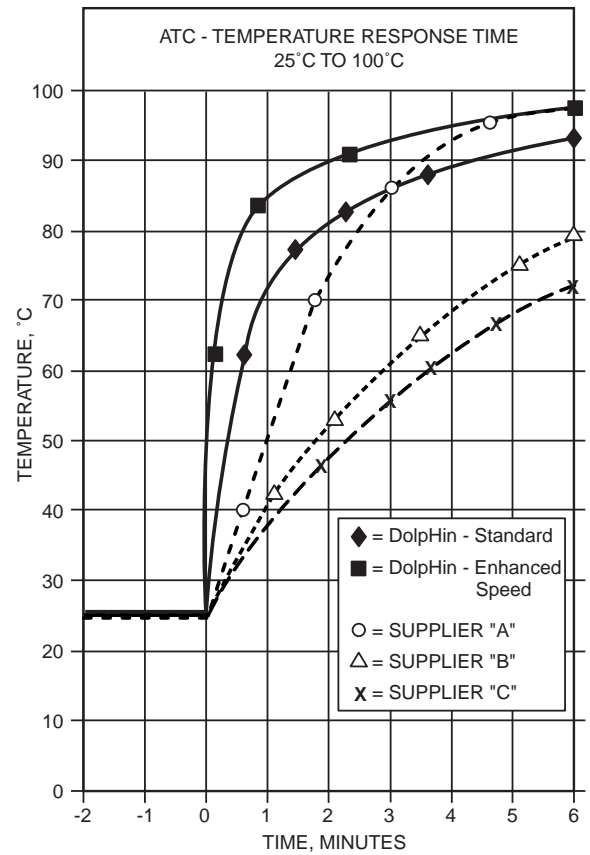


Figure 4. Temperature Response Time, 25° to 100°C



### **AUTOMATIC TEMPERATURE COMPENSATION**

ATC, utilizing a resistance temperature detector (RTD), is a built-in feature in all DolpHin Sensors. Analog sensors use either 2- or 3-wire, 100 or 1000  $\Omega$  platinum RTDs, or a Balco 2-wire, 3 k $\Omega$  RTD. Smart sensors (Dolphin PH10-\*S) use a 1000  $\Omega$  RTD. These RTDs are available with an enhanced response speed. Refer to "MODEL CODE SELECTION GUIDE".

### **PRECISION DOUBLE JUNCTION REFERENCE ELECTRODE**

The external, process wetted reference junction is ceramic material with ultrafine porosity and small surface area. This style junction provides minimum variability of junction potential which contributes to noise and drift problems typically seen in junctions with a large surface area.

Internal electrolyte is a high temperature gel that resists poisoning.

The reference electrode is a silver/silver chloride half cell. The reference electrode is encased in a Nafion ion barrier which allows charge transfer while minimizing poisoning of the electrode and preventing silver ion from migrating to the external junction and causing clogging.

### **EASE OF USE**

Experienced pH users know that sensor maintenance can be time consuming and costly. DolpHin Series sensors provide extended service life, thus reducing the number of maintenance calls. However, the sensor occasionally requires removal from process for calibration, possibly cleaning, and eventually replacement.

DolpHin features and accessories are set up to make sensor maintenance quick and easy. The Variopin or Smart quick cable connector allow the sensor to be easily disconnected from the cable.

The sensor may be mounted in many different ways. Typical mounting configurations are listed below and shown in Figure 5:

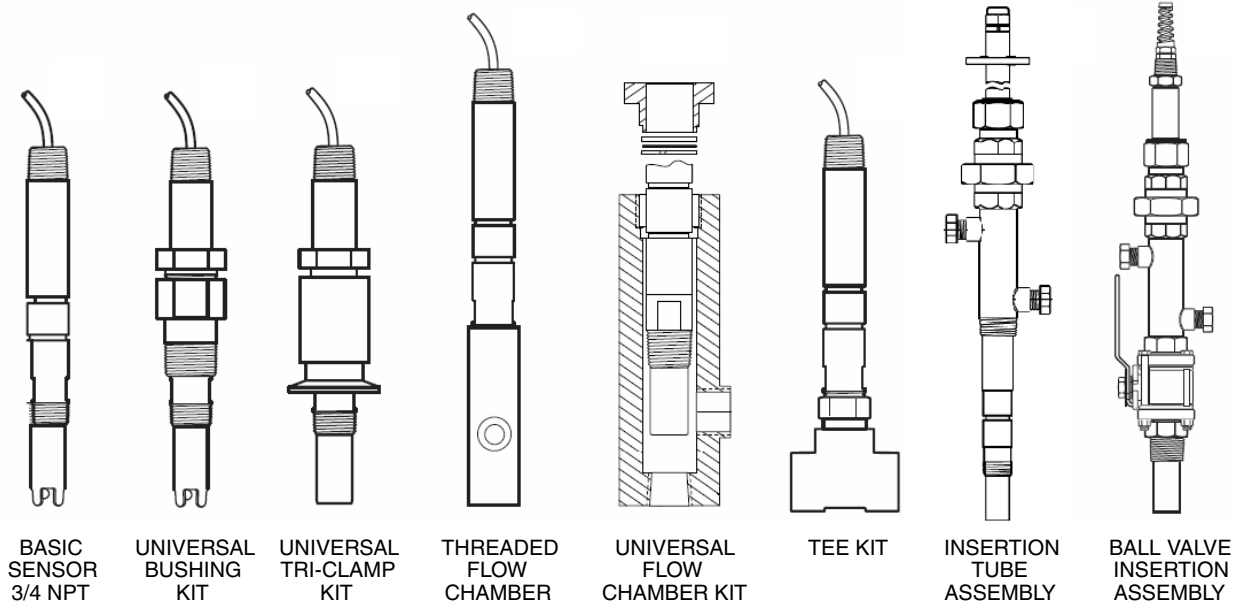
- ▶ In situ with 3/4 NPT Mounting
- ▶ With a Universal Bushing Assembly
- ▶ Universal Tri-Clamp Connection Assembly
- ▶ In Sample Line via a Flow Chamber
- ▶ In Sample Line via a Tee Kit and Bushings
- ▶ In line via a Variable Insertion Assembly
- ▶ In line via a Ball Valve Insertion Assembly with Purge Ports

#### **NOTE**

For more information on each of the mounting kits and assemblies, refer to "ACCESSORIES" on page 28.

The sensors' process connections are also backward compatible with most existing Foxboro brands and other sensors presently in the field.

Figure 5. Typical Sensor Mounting Configurations



**OPERATING, STORAGE, AND TRANSPORTATION CONDITIONS**

Influence	Reference Operating Conditions (a)	Normal Operating Condition Limits	Storage and Transportation Limits
Process Temp.	25 ±3°C (77 ±5°F)	See Table 1	-5 and +65°C (-23 and +149°F)
Process Press.	0 kPa gauge (0 psig)	0 and 700 kPag (0 and 100 psig)	Not Applicable
Mounting Position	Vertical with Electrode End Down	Vertical up to ±90° with Electrode End Down	Not Applicable

a. These operating conditions pertain to sensors with glass measuring electrode types.

**PROCESS PRESSURE AND TEMPERATURE SPECIFICATIONS**

The process temperature ratings of the sensor assembly are given in Table 1.

“In-line installation” means that only the sensing end, not the sensor body, is immersed in the solution.

“Submersion installation” is when the entire sensor assembly (sensing end and body) is completely submersed.

In addition to the normal operating pressure and temperature limits of the sensor as shown in this table, the DolpHin mounting accessories also have pressure and temperature limits. The specifications for the mounting accessories, shown in “ACCESSORIES” further in this document, may be greater or less than the sensor specifications. Always use the lesser of the two specification limits when designing the installation of a DolpHin sensor with accessories.

Table 1. Process Temperature Ratings

Measuring Electrode Type	Analog without Internal Pre-amplifier	Analog with Internal Pre-amplifier		Smart Digital (a)
		Ball Valve or Submersion Installation	In-Line Installation (b)	
Domed Glass - pH	0 to 121°C (32 to 250°F)	0 to 85°C (32 to 185°F)	0 to 121°C (32 to 250°F)	0 to 121°C (32 to 250°F)
Flat Glass - pH	0 to 85°C (32 to 185°F)	0 to 85°C (32 to 185°F)	0 to 85°C (32 to 185°F)	0 to 85°C (32 to 185°F)
Antimony - pH	0 to 121°C (32 to 250°F)	0 to 85°C (32 to 185°F)	0 to 121°C (32 to 250°F)	0 to 121°C (32 to 250°F)
Platinum - ORP	0 to 121°C (32 to 250°F)	0 to 85°C (32 to 185°F)	0 to 121°C (32 to 250°F)	Not applicable
Gold - ORP	0 to 121°C (32 to 250°F)	0 to 85°C (32 to 185°F)	0 to 121°C (32 to 250°F)	Not applicable

- a. For Smart sensors (PH10-\*S) in Intrinsically Safe or Non-Incendive hazardous locations, upper body must be in ambient temperature of 85°C (185°F) or lower.
- b. For Analog sensors with Pre-Amplifiers (PH10-\*P), upper body must be in ambient temperature of 54°C (130°F) or lower.



**PERFORMANCE SPECIFICATIONS**

*Under Reference Operating Conditions unless otherwise specified*

**pH Measurement**

Performance specifications are for the domed, high temperature glass electrode (pH electrode type PH10-1\*\*\*, and PH10-2\*\*\*). Other electrode choices include flat ruggedized glass pH, antimony pH, platinum ORP, and gold ORP. Selection of these electrodes is based on application considerations. Refer to “MODEL CODE SELECTION GUIDE”.

Parameter	Performance
EMF Efficiency	99.3% ±0.7%
Stability	±0.02 pH/24 hours
Electrometric Response (a)	<15 s, 4 to 10 pH
Sodium Ion Error	< 0.2 pH in 0.5M Na+ at pH 12.4

a. The interval of time between the initiation of the input step, and the time at which the output signal first attains 90% of its final steady state value.

**Accuracy - Temperature Measurement**

**100 Ω and 1000 Ω Platinum RTD**

± [0.30°C + (0.005)T]  
where T = measured temperature in °C.

**Temperature Measurements Speed of Response**

The interval of time between the initiation of the input step, and the final time at which the output signal first attains 80% of its final steady state value.

**100 Ω Platinum RTD**

< 2.5 min with Temperature Compensation  
Selection 1

< 1.0 min with Temperature Compensation  
Selection 3

**1000 Ω Platinum RTD**

< 2.5 min with Temperature Compensation  
Selection 2

< 1.0 min with Temperature Compensation  
Selection 4

**FUNCTIONAL SPECIFICATIONS**

**Measuring Electrode**

**pH Measurement**

Domed glass bulb, flat glass, or antimony

**ORP Measurement**

Platinum or Gold

**Reference Electrode**

The reference electrode is Ag/AgCl (silver/silver chloride) and is isolated from the internal salt-bridge by a Nafion ion barrier.

**Measurement Range**

**pH Measurement Range**

- ▶ Domed Glass: 0 to 14 pH
- ▶ Flat Glass: 2 to 12 pH
- ▶ Antimony: 1 to 11 pH

**ORP Measurement Range**

Platinum and Gold: +2000 to -2000 mV

**Electromagnetic Compatibility**

When properly installed per the applicable installation instructions with Foxboro Models 870ITPH Transmitters, 876PH Transmitters, 875PH Analyzers, applicable Models 873, or other compliant transmitters or analyzers, the DolpHin pH and ORP sensors comply with the Electromagnetic Compatibility Requirements of European EMC Directive 2004/108/EC by conforming to the following EN and IEC Standards: EN-61326-1, and IEC 61000-4-2 through 61000-4-6.

**Automatic Temperature Compensation**

Integral temperature element provides temperature measurement for pH compensation over the full rated temperature range of the pH sensor (0 to 121°C/32 to 250°F).

**Solution Temperature Measurement**

Solution temperature measurement is based on the RTD. The Resistance Temperature response is per DIN 43760, or IEC 751-1983, and is as follows:

Solution Temperature		Corresponding Resistance, in ohms (Ω), using the:		
°C	°F	100 Ω RTD	1000 Ω RTD	Balco RTD
0	32	100.00	1000.0	2663
10	50	103.90	1039.0	2798
20	68	107.79	1077.9	2933
25	77	109.73	1097.3	3000
30	86	111.67	1116.7	3067
40	104	115.54	1155.4	3202
50	122	119.40	1194.0	3337
60	140	123.24	1232.4	3472
70	158	127.07	1270.7	3607
80	176	130.89	1308.9	3742
90	194	134.70	1347.0	3877
100	212	138.50	1385.0	4013
110	230	142.28	1422.8	4148
120	248	146.06	1460.6	4283

## PHYSICAL SPECIFICATIONS

### Process Wetted Parts Materials

#### Body

Non-conductive Kynar, black, FDA compliant, mineral filled

#### Chemical Compatibility

Kynar, known as polyvinylidene fluoride or PVDF, is chemically resistant to virtually all acids, bases, and salts within the 0 to 14 pH range. It is also resistant to halogens, halogenated solvents, alcohols, and oxidants.

#### Measuring Electrode

- ▶ pH Measurement: Glass or Antimony
- ▶ ORP Measurement: Platinum or Gold

#### Reference Electrode

Ceramic junction

#### Solution Ground

Conductive Kynar (nonmetallic)

#### Seals

Viton is standard; EPDM (also known as EPR) and Chemraz are optionally available.

### Sensor Mounting

The upper housing of the sensor has 3/4 NPT external threads on both ends for use with widely accepted mounting accessories. The housing body also has wrench flats to facilitate sensor installation and removal. The sensor, with the appropriate accessories, is suitable for both in situ (submersible) and in-line installations. As indicated previously, the sensor can be mounted up to 90° from the vertical position, with the electrode end downward. Figure 5 shows typical sensor mounting configurations, and the "ACCESSORIES" section describes and specifies each accessory and its application.

### Cable Bend Radius

2 inch minimum recommended for cable part number P0170UU (see Table 3).

### Dimensions

- ▶ See "DIMENSIONS - NOMINAL" for sensor dimensions.
- ▶ See DP 611-182 for dimensions of the BVA Series ball valve insertion assemblies (ordered by model code).
- ▶ See DP 611-172 for dimensions of the legacy (ordered by part number) insertion tube and ball valve assemblies.
- ▶ See DP 611-173 for dimensions of sensor accessories.
- ▶ See DP 611-174 and DP 611-160 for dimensions of BS813XN and BS807BZ junction boxes, respectively.

### Sensor Connections and Cable Lengths

The sensor is offered with electrical terminations, as follows:

- ▶ For Analog sensors - Integral Sensor Cable 10 ft (3.05 m) long; terminated with crimped-on straight pin lugs. Optional cable lengths of 20, 30, 40, or 50 ft (6.1, 9.1, 12.2, or 15.2 m) are offered.
- ▶ For Analog sensors - Integral Sensor Cable 10 ft (3.05 m) long; terminated in a Variopin quick connector. Optional cable lengths of 20, 30, 40, or 50 ft (6.1, 9.1, 12.2, or 15.2 m) are offered.
- ▶ For all sensors: Variopin (PH10-\*N or PH10-\*P) or Smart (PH10-\*S) connector integral to the sensor housing. Optional cable lengths of 10, 20, 30, 40, or 50 ft (3.05, 6.1, 9.1, 12.2, or 15.2 m), and variable, are offered.

Standard cable is PVC jacketed. High temperature cable is cross-linked, irradiated, polyethylene (xple). Smart sensor cable is PFA-jacketed and suitable for all temperatures. Variopin and Smart quick connectors meet the ingress protection rating of IP66/68 per IEC 60529; the IP68 immersion rating is at a depth of 2 m (6.6 ft) for 48 hours. Analog sensor connectors are nickel plated with a Viton O-ring, and Smart sensor connectors are Ultem plastic with a fluorosilicon O-ring.

When a preamplifier internal to the Analog sensor is used, the transmitter or analyzer can be up to 500 ft (152 m) away from the sensor. If no internal preamplifier is used with an Analog sensor, the distance is limited to 50 ft (15.2 m). For Smart

sensors, the transmitter or analyzer can be up to 328 ft (100 m) away from the sensor. See Figure 6 and Figure 7 for typical cable, extension cable, and patch cord configurations.

Figure 6. Typical Cable Extension Configurations

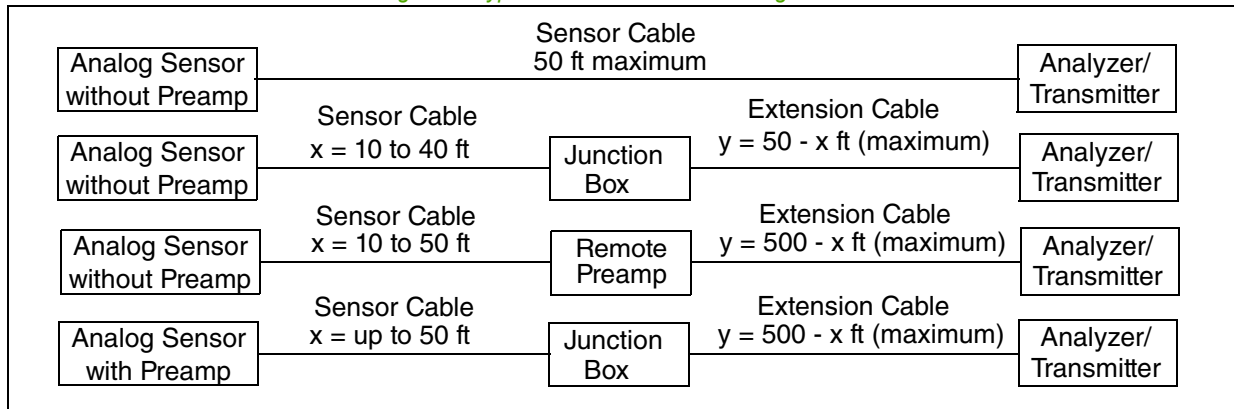
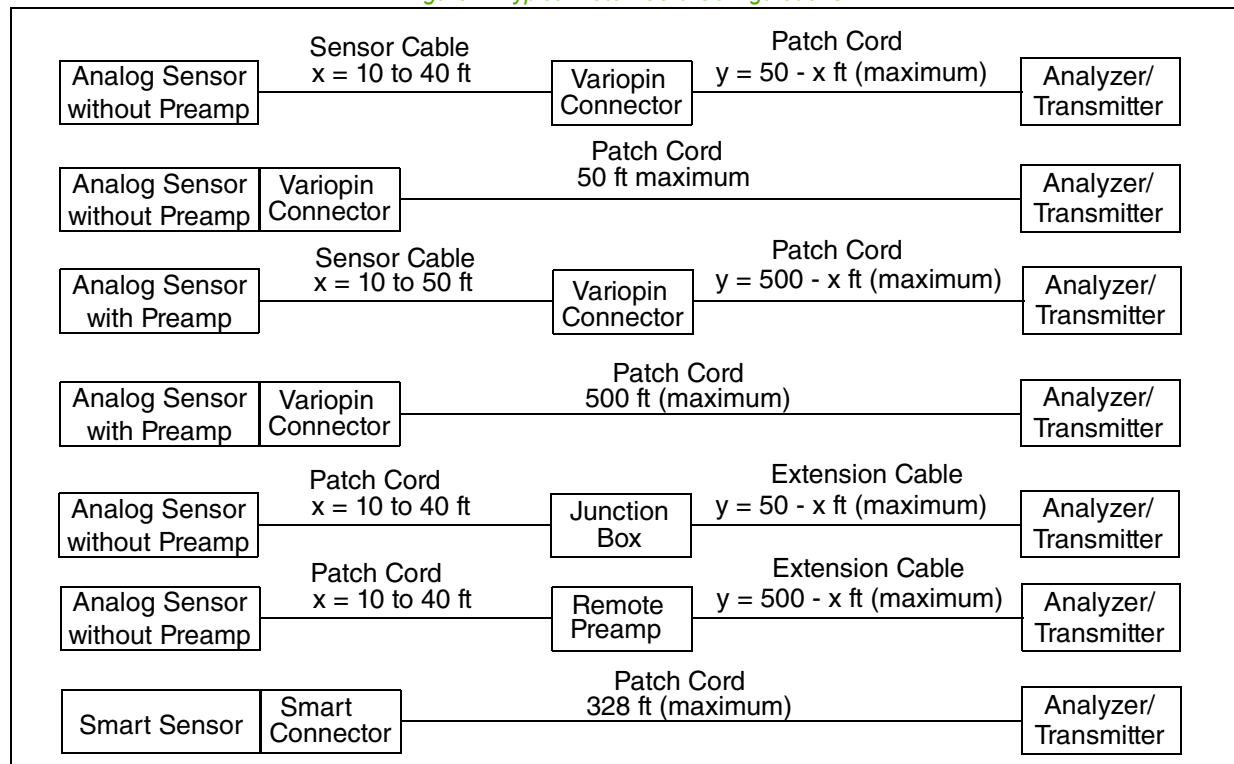


Figure 7. Typical Patch Cord Configurations



### Extension Cable and Patch Cord Assemblies for Analog Sensors

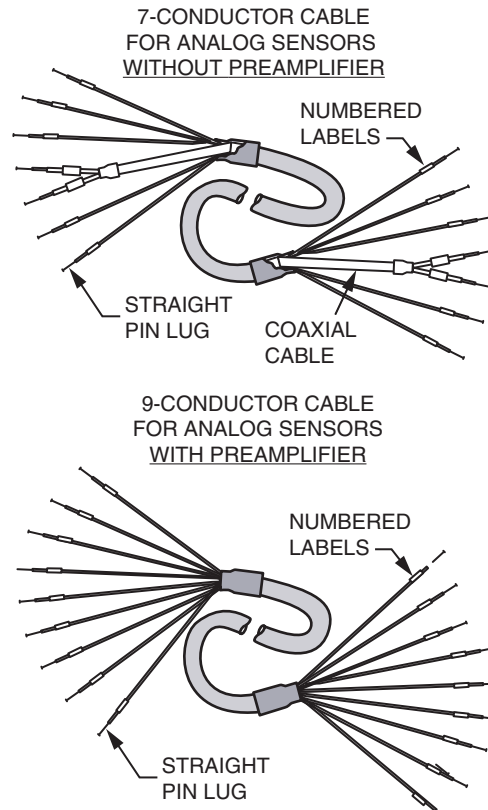
Extension cables and patch cords are offered for adding length to the connection between the DolpHin sensor and the transmitter/analyzer. Choices include standard cable, high temperature cable, terminated cable ordered to length, and raw cable unterminated. A Variopin quick connector or Foxboro specified junction box is recommended for connection of extension cable to sensor or sensor cable. This is especially important for Analog sensors without integral preamplifiers.

Extension cables for connection to transmitter/analyzer and junction box have crimped-on straight pin lugs on both ends. Because of the straight pins, this style cable termination is much easier to pull through conduit than spade or other style lug terminations. Pin lug leads are numbered for connection to corresponding terminal strip numbers in Foxboro transmitters and analyzers.

Extension cables for Analog sensors without preamplifier are available as standard cable with PVC jacket, 80°C (176°F) rating, 7 conductors (coax plus 5). They are also available in a high temperature version, with irradiated cross linked polyethylene jacket, rated to 125°C (257°F), also 7 conductors (coax plus 5). Sensors without preamplifiers are restricted to 50 feet (15.24 m) or less separation between sensor and transmitter/analyzer. Therefore, extension cables in this group are available in lengths up to 50 feet (15.24 m). Longer distances require the use of a preamplifier.

Extension cables for Analog sensors with preamplifiers are available as standard cable with PVC jacket, 80°C (176°F) rating, 9 conductors. Preamplifiers and preamplifier cable are not available for temperatures above 80°C (176°F). Extension cable for both the pin lug termination and Variopin types are available up to 500 feet (15.24 m) maximum and are ordered by the foot.

Figure 8. Extension Cable Assembly with Straight Pin Lugs (Analog Sensors)



**Table 2. Extension Cables - for Use with Analog Sensors without Pre-amplifier (Model Code N)**

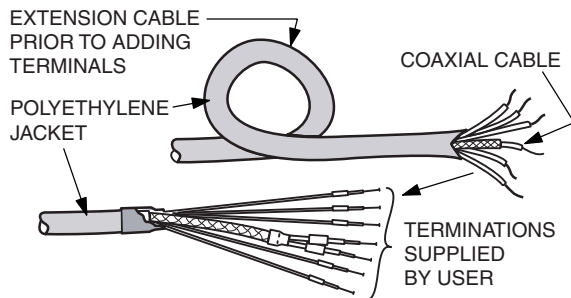
Part No.	Temperature Range	Cable Terminations	Length
BS811HE	Temperature to 80°C (176°F)	Pin Lugs to Pin Lugs	10 ft (3.04 m)
BS811HF	Temperature to 80°C (176°F)	Pin Lugs to Pin Lugs	20 ft (6.09 m)
BS811HG	Temperature to 80°C (176°F)	Pin Lugs to Pin Lugs	30 ft (9.15 m)
BS811HH	Temperature to 80°C (176°F)	Pin Lugs to Pin Lugs	40 ft (12.19 m)
BS811HJ	Temperature to 80°C (176°F)	Pin Lugs to Pin Lugs	50 ft (15.24 m)
BS810ZV	High Temp. to 125°C (257°F)	Pin Lugs to Pin Lugs	10 ft (3.04 m)
BS810ZW	High Temp. to 125°C (257°F)	Pin Lugs to Pin Lugs	20 ft (6.09 m)
BS810ZX	High Temp. to 125°C (257°F)	Pin Lugs to Pin Lugs	30 ft (9.15 m)
BS810ZY	High Temp. to 125°C (257°F)	Pin Lugs to Pin Lugs	40 ft (12.19 m)
BS810ZZ	High Temp. to 125°C (257°F)	Pin Lugs to Pin Lugs	50 ft (15.24 m)

**Table 3. Extension Cables - for Use with Analog Sensors with Integral Pre-amplifier (Model Code P)**

Part No.	Patch Length	Temperature Range	Cable Terminations
BS811JB	Patch Cord, per foot to 500 ft (152.4 m) max.	Temperature to 80°C (176°F)	Variopin to Pin Lugs
BS811HW	Extension Cable, per foot to 500 ft (152.4 m) max.	Temperature to 80°C (176°F)	Pin Lugs to Pin Lugs

Raw, unterminated cable is also available in continuous lengths up to 1000 feet. The installer must cut the cable to length and terminate the leads. Refer to Figure 9.

*Figure 9. Raw, Unterminated Cable 7-Conductor Extension Cable Shown*



**Table 4. Raw Cable, Unterminated, Maximum Continuous Length, 1000 ft (304.8 m) (a)**

Part No.	Description
P0170UU	For Non-Pre-amplifier Sensor; Temperature Range -20 to +80°C (-4 to +176°F)
P0170UA	For Non-Pre-amplifier Sensor; Temperature Range -40 to +125°C (-40 to +257°F)
P0170UV	For Pre-amplifier Sensor; Temperature Range -30 to +80°C (-22 to +176°F)

a. Available only with Analog sensors in continuous lengths to 1000 feet in 1 foot increments.

Patch cords for Analog sensors are rated at IP66/68, and have a Variopin connector on one end and pin lugs on the other. Patch cord connectors are nickel-plated with a Viton O-ring. This patch cord is selected for use with a sensor that has a mating Variopin quick connector located either directly on the sensor or on the end of the sensor cable (Model Code selection B or Q).

Figure 10. Patch Cord with Variopin Quick Connector and Straight Pin Lugs (Analog Sensors)

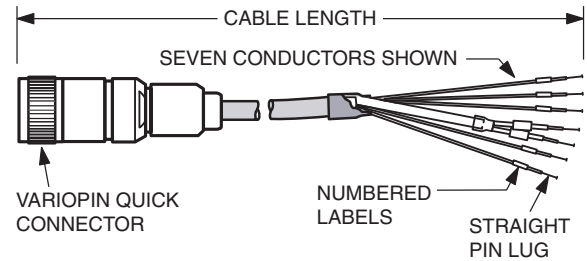


Table 5. Patch Cords - for Use with Analog Sensors without Preampfier (Model Code N)

Part No.	Temperature Range	Cable Terminations	Length
BS811GU	Temperature to 80°C (176°F)	Variopin to Pin Lugs	10 ft (3.04 m)
BS811GV	Temperature to 80°C (176°F)	Variopin to Pin Lugs	20 ft (6.09 m)
BS811GW	Temperature to 80°C (176°F)	Variopin to Pin Lugs	30 ft (9.15 m)
BS811GX	Temperature to 80°C (176°F)	Variopin to Pin Lugs	40 ft (12.19 m)
BS811GY	Temperature to 80°C (176°F)	Variopin to Pin Lugs	50 ft (15.24 m)
BS810QA	High Temp to 125°C (257°F)	Variopin to Pin Lugs	10 ft (3.04 m)
BS810QB	High Temp to 125°C (257°F)	Variopin to Pin Lugs	20 ft (6.09 m)
BS810QC	High Temp to 125°C (257°F)	Variopin to Pin Lugs	30 ft (9.15 m)
BS810QD	High Temp to 125°C (257°F)	Variopin to Pin Lugs	40 ft (12.19 m)
BS810QE	High Temp to 125°C (257°F)	Variopin to Pin Lugs	50 ft (15.24 m)

To select the proper cable for an Analog sensor, determine if the sensor will have an integral preamplifier. The sensor Model Code contains an N for no preamplifier or a P for preamplifier. Refer to the Model Code Selection Guide section for advice regarding the preamplifier. Then select the cable termination, length and temperature rating required for the installation.

### Patch Cord Assemblies for Smart Sensors

Patch cords available for use with Smart sensors have a Smart connector on one end and pin lugs on the other. This patch cord is also rated IP66/IP68, and is made of Ultem plastic with a fluorosilicon O-ring.

This patch cord is selected for use with a Smart sensor that has a Smart connector located directly on the sensor (Model Code selection S).

To select the proper patch cord for a Smart sensor, select the length required for the installation.

Figure 11. Patch Cord with Smart Connector and Straight Pin Lugs (Smart Sensors)

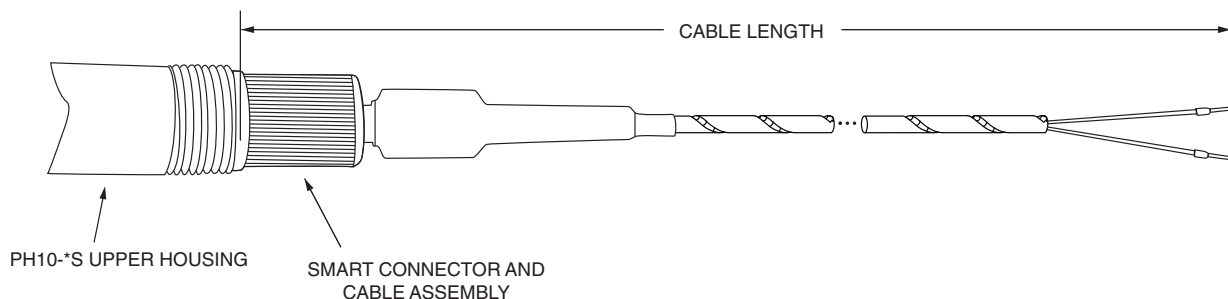


Table 6. Patch Cords - for Use with Smart Sensors (Model Code S)

Part No.	Temperature Range	Cable Terminations	Length
BS814KB	Temperature to 125°C (257°F)	Smart Connector to Pin Lugs	10 ft (3.04 m)
BS814KC	Temperature to 125°C (257°F)	Smart Connector to Pin Lugs	20 ft (6.09 m)
BS814KD	Temperature to 125°C (257°F)	Smart Connector to Pin Lugs	30 ft (9.15 m)
BS814KH	Temperature to 125°C (257°F)	Smart Connector to Pin Lugs	40 ft (12.19 m)
BS814KJ	Temperature to 125°C (257°F)	Smart Connector to Pin Lugs	50 ft (15.24 m)
BS814KK	Temperature to 125°C (257°F)	Smart Connector to Pin Lugs	Variable

Table 7. Foxboro Smart Sensor PC Interface Cable (a)

Part No.	Temperature Range	Cable Terminations	Length
BS814ME	Temperature to 85°C (185°F)	Smart Connector to PC Interface	5.5 ft (1.67 m)

a. Requires Foxboro Smart Sensor Device Type Manager (DTM) software See MI 611-205 for the PH10 for details.



## ELECTRICAL SAFETY SPECIFICATIONS

These sensors have been designed to meet the Electrical Safety descriptions listed below. For detailed information, or status of testing laboratory approval, or certifications, contact Invensys Systems, Inc. (see back page).

Specify Electrical Safety Design Code when ordering sensor for applications requiring certification.

Table 8. Electrical Safety Specifications for PH10 and ORP10 with Electronic Configurations N and P only.

Testing Laboratory, Types of Protection, and Area Classification	Application Conditions	Electrical Safety Design Code
<b>ATEX</b> Intrinsically safe; II GD 1 EEx ia IIC; Zone 0.	Temperature Class T4 to T6.	AA
<b>ATEX</b> Type N (Limited Energy); II GD 3 EEx nL IIC; Zone 2.	Temperature Class T4 to T6.	AN
<b>CSA</b> intrinsically safe for using in Class I, II, III Division 1, Groups A, B, C, D, E, F, and G.	Connect to certified 870ITPH Transmitter, per MI 611-206. Temperature Class T4 Ta=85°C; T5 Ta=40°C.	CA
<b>CSA</b> Non Incendive for Class I, II, III Division 2, Groups A, B, C, D, E, F, and G.	Connect to certified 870ITPH Transmitter, per MI 611-206. Temperature Class T4 Ta=85°C; T5 Ta=40°C.	CN
<b>FM</b> intrinsically safe (Entity) for using in Class I, II, III Division 1, Groups A, B, C, D, E, F, and G.	When installed per MI 611-206; Temperature Class T4 Ta=85°C; NEMA Type 4X.	FA
<b>FM</b> Non Incendive (NIFW) for using in Class I, Division 2, Groups A, B, C, and D; Class II, III, Division 2, Groups F and G.	When installed per MI 611-206; Temperature Class T4 Ta=85°C; NEMA Type 4X.	FN
<b>IECEx</b> intrinsically safe; II GD 1 EEx ia IIC; Zone 0.	Temperature Class T4 Ta = -20°C to 85°C.	DA
<b>IECEx</b> Type N (Limited Energy); Ex nL IIC; Zone 2.	Temperature Class T4 Ta = -20°C to 85°C.	DN

Table 9. Electrical Safety Specifications for PH10- \*S

Testing Laboratory, Types of Protection, and Area Classification	Application Conditions	Electrical Safety Design Code
ATEX Intrinsically safe; II 1 G Ex ia IIC Ga	Temperature Class T3 to T6.	AA
CSA intrinsically safe for using in Class I, II, III Division 1, Groups A, B, C, D, E, F, and G Zone 0, Ex ia IIC / AEx ia IIC	Temperature Class T3 to T4.	CA
CSA Non Incendive for Class I, II, III Division 2, Groups A, B, C, D, E, F, and G	Temperature Class T3 to T6.	CN
FM intrinsically safe (Entity) for using in Class I, II, III Division 1, Groups A, B, C, D, E, F, and G Zone AEx ia IIC / Ex ia IIC	Temperature Class T3 to T6.	FA
FM Non Incendive (NIFW) for using in Class I, Division 2, Groups A, B, C, and D; Class II, III, Division 2, Groups F and G	Temperature Class T3 to T6.	FN
IECEX intrinsically safe; Ex ia IIC Ga	Temperature Class T3 to T6.	DA
No certificates.	No certificates.	ZZ

MODEL CODE - DOLPHIN PH SENSOR

Description	Model
Dolphin pH Sensor	PH10
<b>pH Electrode Type</b>	
Domed, High Temperature, Glass Bulb with Protective Guard	-1
Domed, High Temperature, Glass Bulb without Protective Guard	-2
Flat Ruggedized Glass	-3
Antimony	-4
<b>Electronic Configuration</b>	
Analog without Preamplifier	N
Analog with Internal Preamplifier (a) (b)	P
Smart (c)	S
<b>Temperature Compensation (See Table 10)</b>	
2-Wire, 100 Ω Platinum RTD	1
3-Wire, 1000 Ω Platinum RTD (b) (c)	2
2-Wire, 100 Ω Platinum RTD, Enhanced Response Speed	3
3-Wire, 1000 Ω Platinum RTD, Enhanced Response Speed (b) (c)	4
2-Wire, 3 kΩ Balco RTD	5
<b>Sensor Termination</b>	
10 ft (3.05 m) Integral Cable Terminated with Crimped-on Straight Pin Lugs	A
10 ft (3.05 m) Integral Cable Terminated with Variopin Quick Connector (b) (d)	B
Variopin Quick Connector Integral to Sensor (b) (d)	Q
Smart Connector Integral to Sensor (c)	S
<b>Optional Selections</b>	
EPDM (e) O-rings (f)	-E
Chemraz (g) O-rings (f)	-C
Integral Std. Temp Sensor Cable, 20 ft (6.1 m) overall length (h)	-2
Integral Std. Temp Sensor Cable, 30 ft (9.1 m) overall length (h)	-3
Integral Std. Temp Sensor Cable, 40 ft (12.2 m) overall length (h)	-4
Integral Std. Temp Sensor Cable, 50 ft (15.2 m) overall length (h)	-5
Integral High Temp Sensor Cable, 10 ft (3.05 m) overall length (a) (h)	-1H
Integral High Temp Sensor Cable, 20 ft (6.1 m) overall length (a) (h)	-2H
Integral High Temp Sensor Cable, 30 ft (9.1 m) overall length (a) (h)	-3H
Integral High Temp Sensor Cable, 40 ft (12.2 m) overall length (a) (h)	-4H
Integral High Temp Sensor Cable, 50 ft (15.2 m) overall length (a) (h)	-5H
ATEX Ex ia	AA
ATEX Ex nL	AN
CSA Div 1	CA
CSA Div 2	CN
FM Div 1	FA
FM Div 2	FN
IECEX Ex ia	DA
IECEX Ex nL	DN
Instruction Manual	-M
Example: PH10-1N3B-E2HAA	

- a. High Temperature cable not available with Electronic Configuration Code P.
- b. Selection of Preamplifier (P) with 3-wire RTD (2 or 4) and with Variopin Quick Connector (B or Q) cannot be made at the same time. Any two are allowed together, but not all three.
- c. The PH10-\*S option utilizes a 1000-Ω RTD only, and has an integral connector requiring a mating patch cord.
- d. Requires mating patch cord with integral Variopin Quick Connector, if not customer supplied.
- e. EPDM is ethylene-propylene terpolymer, also known as EPR (ethylene-propylene rubber).
- f. Standard O-ring material is Viton.
- g. Chemraz is a perfluoroelastomer.
- h. Cable options applicable to Sensor Termination Codes A and B only.

MODEL CODE - DOLPHIN ORP SENSOR

Description	Model
Dolphin ORP Sensor	ORP10
<b>ORP Electrode Type</b>	
Platinum	-1
Gold	-2
<b>Electronic Configuration</b>	
Analog without Preamplifier	N
Analog with Internal Preamplifier (a) (b)	P
<b>Temperature Compensation (See Table 10)</b>	
2-Wire, 100 Ω Platinum RTD	1
3-Wire, 1000 Ω Platinum RTD (b)	2
2-Wire, 100 Ω Platinum RTD, Enhanced Response Speed	3
3-Wire, 1000 Ω Platinum RTD, Enhanced Response Speed (b)	4
2-Wire, 3 kΩ Balco RTD	5
<b>Sensor Termination</b>	
10 ft (3.05 m) Integral Cable Terminated with Crimped-on Straight Pin Lugs	A
10 ft (3.05 m) Integral Cable Terminated with Variopin Quick Connector (b) (c)	B
Variopin Quick Connector Integral to Sensor (b) (c)	Q
<b>Optional Selections</b>	
EPDM (d) O-rings (e)	-E
Chemraz (f) O-rings (e)	-C
Integral Std. Temp Sensor Cable, 20 ft (6.1 m) overall length (g)	-2
Integral Std. Temp Sensor Cable, 30 ft (9.1 m) overall length (g)	-3
Integral Std. Temp Sensor Cable, 40 ft (12.2 m) overall length (g)	-4
Integral Std. Temp Sensor Cable, 50 ft (15.2 m) overall length (g)	-5
Integral High Temp Sensor Cable, 10 ft (3.05 m) overall length (a) (g)	-1H
Integral High Temp Sensor Cable, 20 ft (6.1 m) overall length (a) (g)	-2H
Integral High Temp Sensor Cable, 30 ft (9.1 m) overall length (a) (g)	-3H
Integral High Temp Sensor Cable, 40 ft (12.2 m) overall length (a) (g)	-4H
Integral High Temp Sensor Cable, 50 ft (15.2 m) overall length (a) (g)	-5H
ATEX Ex ia	AA
ATEX Ex nL	AN
CSA Div 1	CA
CSA Div 2	CN
FM Div 1	FA
FM Div 2	FN
IECEX Ex ia	DA
IECEX Ex nL	DN
Instruction Manual	-M
Example: ORP10-1P4A-C5	

- a. High Temperature cable not available with Electronic Configuration Code P.
- b. Selection of Preamplifier (P) with 3-wire RTD (2 or 4) and with Variopin Quick Connector (B or Q) cannot be made at the same time. Any two are allowed together, but not all three.
- c. Requires mating patch cord with integral Variopin Quick Connector, if not customer supplied.
- d. EPDM is ethylene-propylene terpolymer, also known as EPR (ethylene-propylene rubber).
- e. Standard O-ring material is Viton.
- f. Chemraz is a perfluoroelastomer.
- g. Cable options applicable to Sensor Termination Codes A and B only.

**MODEL CODE - BVA SERIES BALL VALVE INSERTION ASSEMBLY**

<u>Description</u>	<u>Model</u>
Ball Valve Insertion Assembly	BVA
<b>Sensor Type</b> For use with DolpHin pH and ORP Sensors; 1 1/4 in NPT Full Port Valve (a)	-PHA
<b>Process Wetted Material</b> 316 stainless steel	1
Titanium	2
<b>O-ring Material</b> Chemraz (b)	C
EPDM (c)	E
Kalrez	K
Perfluoroelastomer (FFKM)	P
Viton	V
<b>Insertion Depth (Applies to Versions That Include a Ball Valve and a Nipple) (d)</b> 0 to 20.3 cm (0 to 8 inches)	08
0 to 40.6 cm (0 to 16 inches)	16
0 to 61.0 cm (0 to 24 inches)	24
0 to 81.3 cm (0 to 32 inches)	32
Custom length in 20.3 cm (8 inch) increments (e)	XX
<b>Optional Selections</b> Insertion Assembly Only (d) (f)	-A
Safety Guard (g)	-S
PVDF Ball Valve (f) (h)	-K
<b>Flanges</b> 1 1/2 inch ANSI 150# Flange	-C
2 inch ANSI 150# Flange	-D
3 inch ANSI 150# Flange	-F
4 inch ANSI 150# Flange	-H
Flat Face Flange (requires selection of a flange)	-J
Example: BVA-PHA1V08-FJ	

- a. Legacy model ball valve assemblies and insertion tubes (ordered by part number) are also available. Contact Global Customer Support for details.
- b. Chemraz is a perfluoroelastomer.
- c. EPDM is ethylene-propylene terpolymer, also known as EPR (ethylene-propylene rubber).
- d. For versions without ball valve and nipple, select option -A (Insertion Assembly Only). When option -A is selected, add approximately 152 mm (6 inches) for 316 ss, or 178 mm (7 inches) for titanium, to the insertion depth dimensions shown in "Insertion Depth" above.
- e. Prior approval required; contact Global Customer Support.
- f. Options -A and -K are mutually exclusive.
- g. Not available with Optional Selection -A (Insertion Assembly Only).
- h. PVDF ball valve option reduces the insertion depth by 4.14 cm (1.63 inches).

## MODEL CODE SELECTION GUIDE

### Electrode Types

This section includes electrode types for PH10 and ORP10.

#### PH10-1 Electrode – Domed Glass Bulb with Protective Guard

Unique pH glass formulation provides full 0 to 14 pH range and high temperature operation up to 121°C (250°F). Fast and accurate pH response suitable for severe temperature and harsh chemical applications. Low sodium ion error. Suitable for applications down to 50 µS/cm conductivity. For pure water applications, see Foxboro Model EP462A PH Sensor. Built-in PVDF guard protects bulb from breakage while in service and while handling during installation and maintenance. See Figure 12.

*Figure 12. PH10-1 Electrode, Domed Bulb with Protective Guard*



#### PH10-2 Electrode – Domed Glass Bulb without Protective Guard

This selection provides the same glass bulb and pH performance as Selection 1 above, but without the protective PVDF guard. This selection should be made when the application requires full pH range or high temperature operation and the process stream contains a high level of solid material that might otherwise

get caught on the protective guard. The user must exercise greater caution while handling this electrode type during installation and maintenance. See Figure 13.

*Figure 13. PH10-2 Electrode, Domed Bulb without Protective Guard*



#### PH10-3 Electrode – Flat Ruggedized Glass

Completely flat, smooth sensing surface. This glass electrode is designed for overall ruggedness and is especially well suited for applications with solids that coat or wear on the electrode. The smooth sensing surface tends to be self-cleaning by the action of the process flow. This design is also well suited to minimize breakage due to handling. This electrode selection is best suited for applications in the 2 to 12 pH range with temperatures less than 85°C (185°F). See Figure 14.

*Figure 14. PH10-3 Electrode, Flat Ruggedized Glass*



**PH10-4 Electrode – Antimony**

Metallic antimony electrode is available for applications containing hydrofluoric acid (HF). The pH range for an application is best when kept within the 1 to 10 pH range. Antimony should not be used in food and beverage, potable water, acid copper solutions, strong oxidizers/ reducers such as chromates, chlorine, hypochlorites, or sulfides.

**ORP10-1 Electrode – Platinum Electrode**

Platinum is the default selection for most ORP applications. Large surface area, high purity platinum provides full mV ORP range, and high temperature up to 121°C (250°F). See Figure 15. This electrode is not available for Smart version sensors.

*Figure 15. ORP10 Platinum Electrode*

**ORP10-2 Electrode – Gold Electrode**

The gold ORP electrode is similar in size, shape, and purity to the platinum ORP electrode. Gold provides an alternative electrode choice for those rare applications where platinum is not well suited; for example, cyanide reduction systems. This electrode is not available for Smart version sensors.

**Electronic Configuration Types**

This section includes configuration for PH10 and ORP10.

**Electronic Configuration N (Analog without Pre-amplifier)**

Select N in applications where the entire body of an analog sensor is exposed to process temperatures above 85°C (185°F), up to 121°C (250°F), such as submersion tank installation or hot tap/ball valve installations.

**NOTE**

It is recommended that the optional high temperature cable be specified in high temperature submersion applications.

Also select N when planning to use the DolpHin sensor with a non-Foxboro brand transmitter or analyzer. Power and wiring of the preamplifier is one area where sensor and transmitters may be incompatible when mixing equipment from different manufacturers.

**Electronic Configuration P (Analog with Pre-amplifier)**

This selection provides an integral preamplifier located in the upper body of the DolpHin sensor. The preamplifier is highly recommended when any one of the glass pH electrodes is selected. The preamplifier provides unity gain and conversion to low impedance of the high impedance mV signal of the glass pH electrode. The preamplifier provides signal integrity in electrically noisy environments, in installations where the sensor cable may be moving, and through sensor cable connections to an extension cable. A preamplifier is required when the distance from the sensor to the transmitter exceeds 15.2 m (50 ft).

The preamplifier should not be selected when the upper half of the sensor body is submerged in process solutions above 85°C (185°F). The preamplifier, however, may be selected (and is recommended) in all applications where the sensor is mounted such that only the sensing end or lower half of the sensor is exposed to process temperature; for example, in the universal bushing accessory.

## NOTES

With Electronic Configuration Selection P, either Temperature Compensation Code 2 or 4 or Sensor Termination Code B or Q is available but not both.

With Electronic Configuration Selection P, Optional selections -1H to -5H for high temperature cable are not available.

### Electronic Configuration Model Code Option S (Smart)

The PH10-\*S sensor with integral, digital electronics communicates digitally with a transmitter, and stores sensor ID, calibration parameters and diagnostic history in its non-volatile memory. This option utilizes a 1000  $\Omega$  RTD and is compatible only with the Model 876PH-S transmitter.

The operating temperature range for this selection is equivalent to the temperature range for the specified pH glass membrane, up to 125°C (80°F). The storage temperature for this selection ranges between -5 to 65°C (23 to 149 °F).

The 876PH-S transmitter is used for calibration and sensor configuration, the history of which is appended to existing history within the sensor.

All sensor-independent parameters in the 876PH-S transmitter can be configured without an attached sensor. When the transmitter detects that a sensor has been connected, it automatically uploads the most recent set of calibration and configuration data from the sensor. If a power cycle occurs, the 876PH-S transmitter uploads the most recent complete set of calibration and configuration data from a connected sensor.

The PH10-\*S sensor stores data such as date of manufacture, serial number, sales order number, model code, slope, asymmetry potential, aging and response time. The data on slope, asymmetry potential, aging, and response time are included in the status menu of 876PH-S transmitter.

Several parameters are stored in a sensor history log, along with Glass Resistance and Reference Resistance measured at last calibration and sensor and transmitter history data are stamped with real dates and times.

### Temperature Compensation Selections for PH10 and ORP10

DolpHin pH and ORP sensors include a precision temperature measuring element. Foxboro brand analyzers and transmitters use this temperature measurement to provide ATC of pH measurements. ORP measurements do not require compensation. The temperature measurement element is included in ORP10 Models for process temperature indication, and in PH10 Models for both process temperature indication and ATC.

DolpHin sensor design provides superior temperature compensation. The precision RTD is located in the tip of the sensor in close thermal contact with the pH electrode, the reference electrode, and the process liquid. Highly effective temperature compensation is achieved because the actual temperature of the electrodes is measured.

The Selection Guide that follows will facilitate the selection of one of the five ATC options based on specific sensor and instrument configurations. See Table 10.

- ▶ RTDs (resistance temperature detectors) are precision, platinum resistance elements conforming to DIN 43760 or IEC 751-1983 standards.
- ▶ Thermistors are less standardized and should be chosen to maintain compatibility with an installed transmitter or analyzer.
- ▶ 2-wire, 100  $\Omega$  RTDs are available for routine pH measurements when cable distances between the sensor and transmitter or analyzer are minimal or when the transmitter or analyzer does not support other selections. Many non-Foxboro brand and all Foxboro brand transmitters and analyzers accept this RTD. The Foxboro Model 873PH Analyzer requires the 100  $\Omega$  selection.



- ▶ 3-wire, 1000 Ω RTDs are recommended for highest accuracy and for loops with long cables or junction box connections. The 3rd wire provides compensation for errors due to cable length and junction box connections.
- ▶ Enhanced response time options should be selected when rapid changes in process pH are expected and when a slight protrusion (0.17 or 4.3 mm) for thermal coupling to the process at the sensor tip can be tolerated. The non-enhanced (non-protruding) options (1, 2, or 5) may be preferred when a flat glass membrane has been selected.

Table 10. Temperature Compensation Selections Guide

Selection	Description	Transmitter/Analyzer Compatibility	Valid Combinations of PH10 Electronic Configuration and Sensor Termination
1	2-wire, 100 Ω RTD	873PH 875PH 870ITPH	N and A N and B N and Q
3	2-wire, 100 Ω RTD, enhanced response time	876PH-T	P and A P and Q P and B
2	3-wire, 1000 Ω RTD	875PH 876PH-T 876PH-S 870ITPH	N and A N and B N and Q P and A S (a) and S (a)
4	3-wire, 1000 Ω RTD, enhanced response time		
5	Balco 3000 Ω Thermistor	875PH 876PH-T 870ITPH	N and A N and B N and Q P and A P and Q P and B

a. 876PH-S transmitter only.

**Temp. Comp. Selection 1: 2-Wire 100 Ω Platinum RTD**

This selection is the most widely applicable. Many non-Foxboro brand analyzers and all Foxboro brand analyzers and transmitters accept this RTD. Foxboro brand analyzers in the 873 family require this selection or Selection 3. The platinum 100 Ω, 2-wire RTD is suitable for most routine process applications.

**Temp. Comp. Selection 2: 3-Wire 1000 Ω Platinum RTD**

This selection should be made when high pH accuracy is required. A 3-wire RTD compensates for the error due to cable length and junction box connections, thus providing more accurate temperature compensation.

**NOTE**

This selection is not available when a preamplifier and a Variopin quick connector are both selected in the same sensor Model Code.

**Temp. Comp. Selection 3: 2-Wire 100  $\Omega$  Platinum RTD, Enhanced Response Speed**

Make this selection in critical pH applications or when process temperature changes rapidly and when using an 873PH Analyzer. Also make this selection when fast temperature response, Variopin quick connector, and preamplifier are all required.

This RTD housing protrudes slightly (0.17 in) from the sensing tip of DolpHin, providing greater thermal contact with the process. This selection is similar to Selection 1, but with ultrafast temperature response. Refer to Figures 4 and 16.

*Figure 16. Platinum RTD Housing – Enhanced Response Speed*



**Temp. Comp. Selection 4: 3-Wire 1000  $\Omega$  Platinum RTD, Enhanced Response Speed**

This selection provides the optimum accuracy and speed of response for temperature indication and pH temperature compensation. Make this selection for the most critical pH applications when using 870ITPH Transmitter, 876PH Transmitter, or 875PH Analyzer. This selection is similar to Temperature Compensation Selection 2 for RTD accuracy, and similar to Selection 3 for temperature speed of response.

Temperature Compensation Selection 4 may also be used for applications requiring the flat glass electrode, but consideration should be made for the slight protrusion of the RTD housing on the flat surface.

**NOTE**

This selection is not available when both a preamplifier and a Variopin quick connector are selected in the same Model Code.

**Sensor Termination Selections**

The following section describes sensor termination configurations for PH10 and ORP10.

**Sensor Termination Selection A: 3.05 m (10 ft) Integral Cable with Pin Lugs**

The sensor cable is an integral part of the sensor. This selection is best suited for installations such as submersion, hot tap ball valve insertion, or in-line with universal bushing mount. See Figure 6 for cable configurations. The cable is not available with Smart version sensors.

**Sensor Termination Selection B: 3.05 m (10 ft) Integral Cable with Variopin Quick Connector**

This selection is best suited for a submersion type installation where integral cable is desired and a long patch cord is also required. The Variopin quick connector meets the ingress protection rating of IP66/IP68 per IEC 60529; IP68 immersion is at a depth of 2 m (6.6 ft) for 48 hours. This cable with a Variopin connector requires a mating patch cable of appropriate length for the application. The mating patch cable does not need replacement when the sensor is replaced. Also, the transmitter or analyzer remains closed and does not need rewiring during sensor replacement. This selection is not suitable for use in hot tap or ball valve type insertion assembly installations. See Table 10 for availability of this selection when a preamplifier or a 3-wire RTD temperature compensation element is also selected. See Figure 7 for cable configurations. The cable is not available with Smart version sensors.

**Sensor Termination Selection Q: Variopin Quick Connector Integral to Sensor**

Similar to Selection B (with the same IP66/IP68 rating) but without cable integral to the sensor, this selection provides easy sensor replacement without running new cable and rewiring transmitter/analyzer. Prevents cable wind-up problem. Requires mating patch cable of appropriate length. Variopin quick connector cuts maintenance costs, reduces time required for sensor replacement. This selection is suitable for all sensor mounting styles, including DolpHin Series and BVA Series ball valve/insertion assemblies. See Table 10 for availability of this selection when a preamplifier or a 3-wire RTD temperature compensation element is also selected. See Figure 17. Also see Figure 7 for cable configurations. This selection is not available with Smart version sensors.

Figure 17. Variopin Quick Connector Integral to Sensor



**Sensor Termination Selection S: Smart Quick Connector Integral to Sensor**

Smart sensor has only one sensor termination option - the Smart integral connector with the Smart patch cord assembly shown in Figure 18.

Figure 18. Smart Quick Connector Integral to Sensor



**Optional Selections**

The following section describes optional selections for PH10 and ORP10.

**Optional Selections -E and -C**

Viton O-rings are standard. EPDM (-E) or Chemraz (-C) O-ring materials are available as options. O-rings are process wetted and should be selected based on chemical compatibility with process materials and temperatures.

**Optional Selections -2, -3, -4, -5: Extended Length Integral Cable**

Extended length integral cable is available in 3.05 m (10 ft) increments up to 15.2 m (50 ft) maximum. For applications that require the transmitter and sensor to be separated by greater than 15.2 m (50 ft), use of the standard length cable with junction box is recommended, and an extension cable up to a maximum of 152 m (500 ft) between sensor and transmitter. Also, for lengths greater than 15.2 m (50 ft), the Electronic Configuration Selection P must be made. See Figures 6 and 7. The cable is not available with Smart version sensors.

**Optional Selections -1H, -2H, -3H, -4H, -5H: High Temperature Sensor Cable**

High temperature cable is rated to 125°C (257°F). This cable is used in applications where the entire sensor body and some portion of the sensor cable are exposed to process temperatures above the standard cable specification of 80°C (176°F).

For installations such as ball valve insertion assembly or submersion, expose the cable to process temperature. In these cases, optional high temperature cables should be considered. It is appropriate for cost purposes to use high temperature cable from the sensor running out of the hot zone to a cooler area where a junction box or Variopin connection is made to a lower cost, standard temperature extension cable. This approach is especially cost effective if the application demands frequent sensor replacement. The standard Smart sensor cable is suitable for high temperature applications.

ACCESSORIES

Universal Bushing Kit

The universal bushing kit is comprised of a bushing, locking cap, O-ring, back-up ring, and split ring. It provides the following features:

- ▶ Allows sensor insertion and removal without causing cable “wind-up”
- ▶ Allows adjustment of submersion depth at either 53 or 79 mm (2.1 or 3.1 in) with the flat electrode, or either 63 or 89 mm (2.5 or 3.5 in) with the domed glass electrode.
- ▶ Provides a 1 NPT process connection, rather than the 3/4 NPT connection on the sensor body.

The bushing assembly is available in 316 ss or PVDF materials. See Table 11 and Figures 19 through 22.

Table 11. Universal Bushing Kits (a)

Material	Assembly Part No.	Thread
PVDF	BS810XB	1 NPT
316 ss	BS810XC	1 NPT
316 ss	BS810XD	R 1 1/2
316 ss	BS810XE	R 2
Material	Pressure-Temperature Rating	
316 ss	1.4 MPag at 121°C (200 psig at 250°F)	
PVDF	0.7 MPag at 90°C 0.35 (100 psig at 194°F)	
	0.35 MPag at 121°C (50 psig at 250°F)	

a. With standard Viton O-rings. Contact Global Customer Support for other O-ring materials.

Figure 19. Universal Bushing and Sensor Showing Split Ring, O-ring, and Back-up Ring Installed on Sensor in Position for 53 mm (2.1 in) Insertion Depth



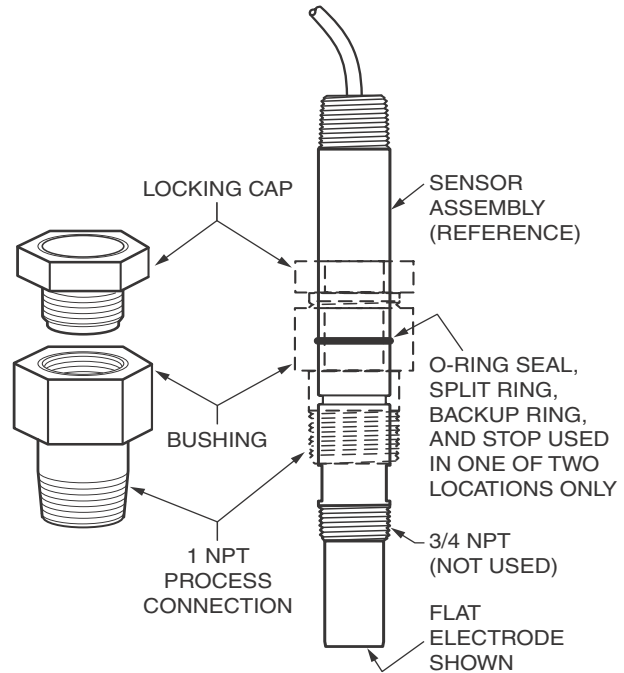
Figure 20. Universal Bushing Shown with Flat Glass Sensor Installed in Position for 53 mm (2.1 in) Insertion Depth



Figure 21. Universal Bushing Shown with Flat Glass Sensor Installed in Position for 79 mm (3.1 in) Insertion Depth



Figure 22. Universal Bushing Assembly



**Bushings**

Bushings may be used to mount sensors in a system using process piping larger than DN 20 or 3/4 inch. PVDF and 316 ss bushings are threaded on both ends, while the CPVC<sup>(2)</sup> bushings are internal NPT and external pipe socket-weld connections. See Figure 23. The bushing identification in Figure 23 corresponds to the last two characters in the bushing part numbers listed in Table 12.

Figure 23. Typical Bushing Configurations

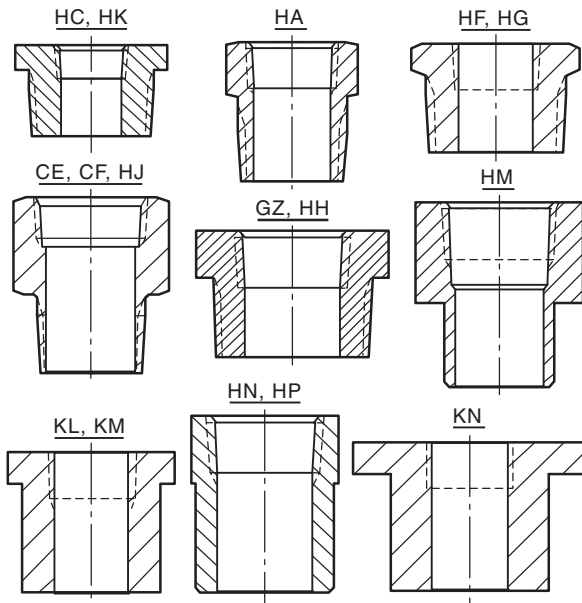


Table 12. Bushings

Bushing Size (a)	Part Number using:		
	316 ss (NPT)	PVDF (NPT)	CPVC (Slip)
3/4 x 1	BS810HA	BS810HC	BS810KL
3/4 x 1 1/4	BS810HF	–	BS810KM
3/4 x 1 1/2	BS810HG	BS810GZ	BS810KN
1 x 1	BS810HJ	BS810HK	BS810HM
1 x 1 1/4	X0177CF	–	BS810HN
1 x 1 1/2	X0177CE	BS810HH	BS810HP
Bushing Material	Pressure-Temperature Rating		
316 ss	1.4 MPag at 121°C (200 psig at 250°F)		
PVDF	0.7 MPag at 90°C (100 psig at 194°F) 0.35 MPag at 121°C (50 psig at 250°F)		
CPVC	0.7 MPag at 70°C (100 psig at 158°F) 0.4 MPag at 85°C (60 psig at 185°F)		

- a. Bushings with 3/4 NPT ID are used directly with DolpHin sensor.  
Bushings with 1 NPT ID are used with 1 inch Universal Bushings.  
1 x 1 bushings are used to lessen insertion depth.

2. CPVC = Chlorinated Polyvinyl Chloride.

### Tees

A tee is available for insertion in a pipeline with user-supplied bushings, as necessary. The tee is offered in three sizes and available in 316 ss, PVDF, or CPVC materials. PVDF and 316 ss tees are threaded on all three ends, while CPVC tees provide a slip fit on all three ends. See Table 13 and Figure 24. Refer to the “Tee Kits” section that follows for tee/bushing assembly configurations.

*Figure 24. Typical Tee Configuration*

TOP AND ENDS ARE EITHER ALL NPT  
OR ALL SLIP FIT DEPENDING ON  
MATERIAL USED.

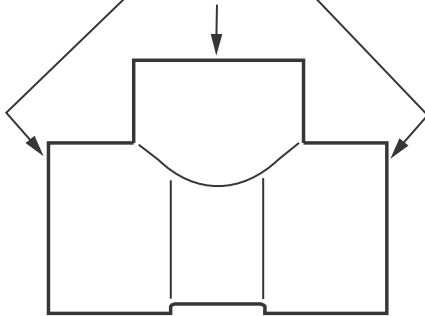


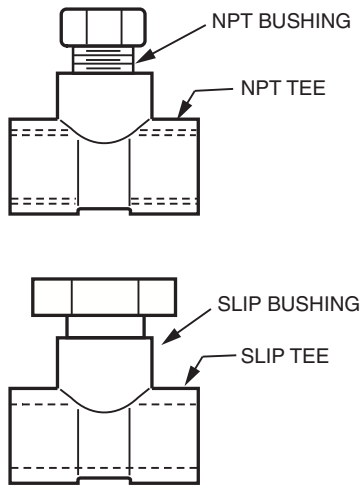
Table 13. Tees

Tee Size	Part Number using:		
	316 ss (NPT)	PVDF (NPT)	CPVC (Slip)
1	X0178JB	X0178HV	X0178HY
1 1/4	X0178HW	–	X0178HZ
1 1/2	X0173JY	X0178HX	X0178JA
Tee Material	Pressure-Temperature Rating		
316 ss	1.4 MPag at 121°C (200 psig at 250°F)		
PVDF	0.7 MPag at 90°C (100 psig at 194°F) 0.35 MPag at 121°C (50 psig at 250°F)		
CPVC	0.7 MPag at 70°C (100 psig at 158°F) 0.4 MPag at 85°C (60 psig at 185°F)		

**Tee Kits**

A tee kit consists of a tee and a bushing assembled together. The top of the assembly is for the sensor connections, while the two ends are for the pipeline connections. The assembled kits are available in 316 ss, PVDF, or CPVC. The 316 ss and PVDF kits have all NPT connections, while the CPVC kits have an internal NPT connection on top for the sensor, and slip fit connections on the pipeline ends. See Table 14 and Figure 25.

*Figure 25. Typical Tee Kit Configurations*



**Table 14. Tee Kits**

Assembled Size (a)	Assembled Kit Part No. Using:		
	316 ss (NPT)	PVDF (NPT)	CPVC (Slip)
3/4 x 1 x 1	BS810HS	BS810HV	BS810HU
3/4 x 1 1/4 x 1 1/4	BS810HW	–	BS810HZ
3/4 x 1 1/2 x 1 1/2	BS810JA	BS810JB	BS810JD
1 x 1 x 1	BS810JE	BS810JF	BS810JH
1 x 1 1/4 x 1 1/4	BS810JJ	–	BS810JM
1 x 1 1/2 x 1 1/2	BS810JN	BS810JP	BS810JR
Bushing Material	Pressure-Temperature Rating		
316 ss	1.4 MPag at 121°C (200 psig at 250°F)		
PVDF	0.7 MPag at 90°C (100 psig at 194°F) 0.35 MPag at 121°C (50 psig at 250°F)		
CPVC	0.7 MPag at 70°C (100 psig at 158°F) 0.4 MPag at 85°C (60 psig at 185°F)		

a. Tee kits with 3/4 NPT bushing are for direct connection of DolpHin series. Tee kits with 1 NPT bushing are for use with 1 NPT Universal Bushings.

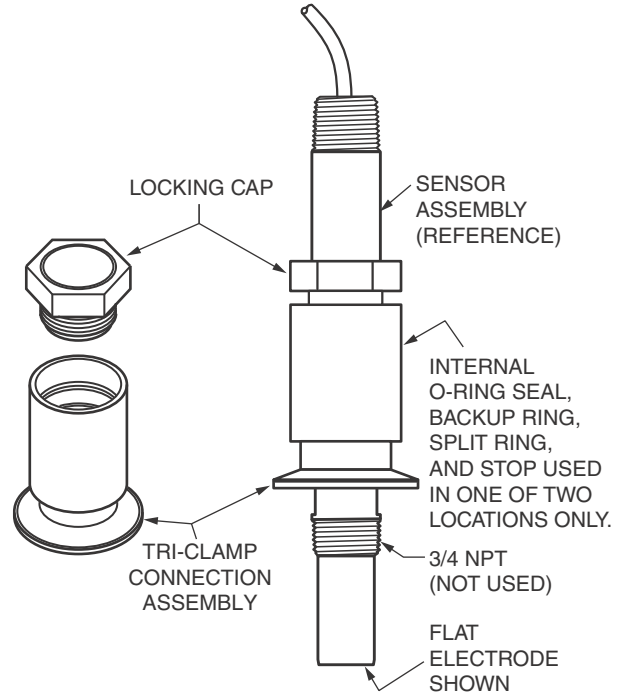
### Universal Tri-Clamp Mounting Kit

Tri-Clamp mounting kits are offered for users who require a quick-disconnect mounting arrangement. The mounting kit comprises a connection assembly, split ring, O-ring, backup ring, locking cap, and lubricant. The mating Tri-Clamp flange and clamp are provided by the user. The Tri-Clamp mounting kit replaces the universal bushing assembly described previously, and is similarly locked in place with a locking cap. Tri-clamp connections are available in standard 1.5 and 2 inch sizes, and are made from 316 ss with a 32 microinch finish, or better. See Figure 26 and Figure 15.

Table 15. Tri-Clamp Mounting Kits

Tri-Clamp Mounting Kits		
Material	Part No.	Size
316 ss	BS810ZU	1.5 in
316 ss	BS810ZT	2 in
Material	Pressure-Temperature Rating	
316 ss	1.4 MPag at 121°C (200 psig at 250°F)	

Figure 26. Universal Tri-Clamp Mounting Kit

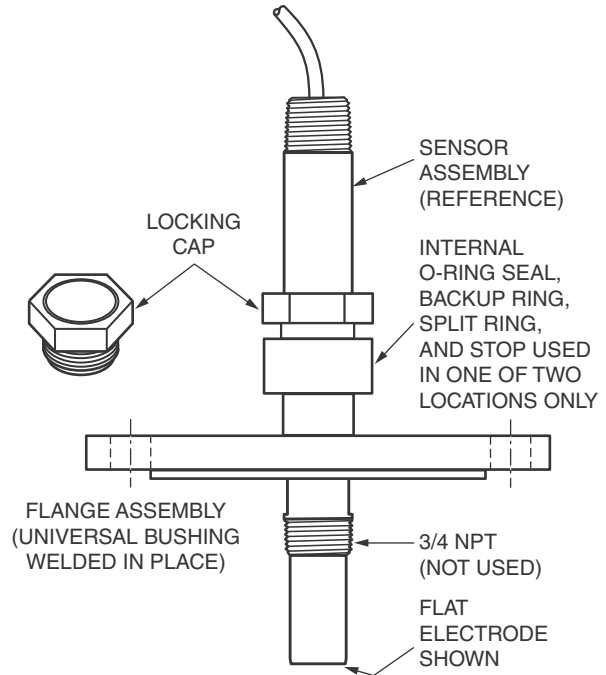




**Flanged Mounting Kits with Integral (Welded-in-Place) Universal Bushing Assembly**

Flanged Mounting Kits are offered for users who require a flange mounted sensor with an integral universal bushing assembly. The mating flange and flange gasket and bolts are provided by the user. The universal bushing assembly described previously is welded to the flange to form a flanged end connection assembly, as shown in Figure 27. Flanged end connection assemblies are comprised of a flange welded to a universal bushing, locking cap, Viton O-ring, back-up ring, and split ring. Flange Mounting Kits are made from 316 ss and available in ANSI Class 150, 2-, 2-1/2-, and 4-inch sizes; and PN 10, DN 50 and DN 100 sizes. See Figure 27 and Table 16.

*Figure 27. Flanged Connection Assembly with Welded-in-Place Universal Bushing Assembly*



**Table 16. Flanged Mounting Kits**

Flanged Mounting Kits			
Flange Rating	Size	Holes	Part No.
ANSI Class 150 (316 ss)	2 in	4	BS810ZN
	2-1/2 in	4	BS810ZP
	4 in	8	BS810ZQ
DIN PN 10 (316 ss)	DN 50	4	BS810ZR
	DN 100	8	BS810ZS
Flange Material	Pressure-Temperature Rating		
316 ss	1.4 MPag at 121°C (200 psig at 250°F)		

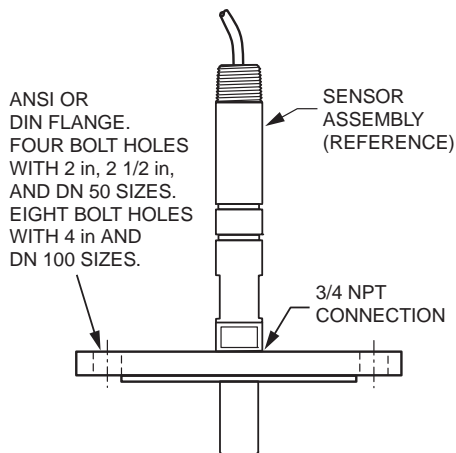
### Connection with Sensor Assembly Threaded Directly to Flange

A flanged end connection with 3/4 NPT is offered for threading sensor directly to flange. Mating flanges, gaskets, and bolts are provided by the user. The flange is made from 316 ss and available in ANSI Class 150, 2-, 2 1/2-, and 4-in sizes; and PN 10, DN 50, and DN 100 sizes. See Figure 28 and Table 17.

Table 17. ANSI and DIN Flanges

Flange End Connection Assembly			
Rating	Size	Holes	Part No.
ANSI Class 150	2 in	4	BS808MP
	2-1/2 in	4	BS809LZ
	4 in	8	BS808MA
DIN PN 10	DN 50	4	BS808MB
	DN 100	8	BS809LW
Flange Material	Pressure-Temperature Rating		
316 ss	1.4 MPag at 121°C (200 psig at 250°F)		

Figure 28. Flanged Connection with Sensor Assembly Threaded Directly to Flange



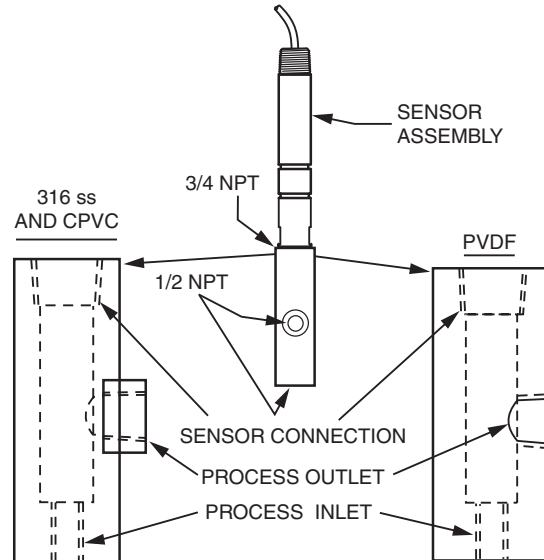
### Flow Chambers - Threaded

Flow chambers are a convenient way of mounting sensors in a system where a sample is provided by a small diameter sample line. The inlet and outlet ports of the chamber have 1/2 NPT. See Figure 29 and Table 18.

Table 18. Threaded Flow Chambers

Material	Part Number	Process Connection
316 ss	BS810SR	1/2 NPT
PVDF	BS810SS	1/2 NPT
CPVC	BS810SU	1/2 NPT
Material	Pressure-Temperature Rating	
316 ss	1.4 MPag at 121°C (200 psig at 250°F)	
PVDF	0.7 MPag at 90°C (100 psig at 194°F) 0.35 MPag at 121°C (50 psig at 250°F)	
CPVC	0.7 MPag at 70°C (100 psig at 158°F) 0.4 MPag at 85°C (60 psig at 185°F)	

Figure 29. Threaded Flow Chamber



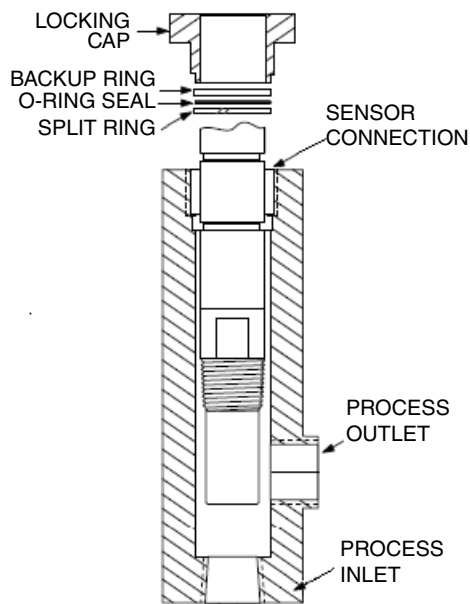
**Universal Flow Chamber Kit**

This 316 ss flow chamber includes the universal sensor mounting kit. Inlet and outlet ports are 1/2 NPT. See Figure 30 and Table 19.

**Table 19. Universal Flow Chamber Kit**

Material	Part Number	Process Connection
316 ss	BS810ND	1/2 NPT
Pressure-Temperature Rating		
1.4 MPag at 121°C (200 psig at 250°F)		

*Figure 30. Universal Flow Chamber Kit*



**Ball Valve Insertion Assembly (BVA)**

The BVA Series ball valve insertion assembly is used to install a DolpHin sensor into a hot tap/retractable type mounting. It permits the sensor to be inserted and removed from the process under rated pressure and temperature without draining the tank, shutting down a line, or using a bypass system.

The insertion assembly allows a continuously adjustable immersion depth to the full length of the insertion shaft, using a compression seal to hold the shaft at the desired depth. This allows the installer to place the sensing end of the DolpHin sensor at the optimum location for the application, and allows adjustment of the immersion depth in response to unexpected plumbing or hardware changes.

The BVA Series ball valve insertion assembly provides anti-blowout protection, and also provides purge ports on the retraction chamber as a safety feature. These ports allow the operator to purge away hot, pressurized or hazardous chemicals prior to opening the assembly and servicing the sensor. A sealing feature also prevents the process fluid from migrating out through the shaft, and possibly out the cable conduit to the transmitter.

The assembly includes ease-of-use features, such as the push/pull plate for easy movement of the insertion shaft. Accessing the sensor is easy, and assembly parts stay together even when removing the sensor, so parts do not get lost.

The BVA Series ball valve insertion assembly is one of the most effective, safe, and versatile means of installing and replacing DolpHin sensors.

**NOTE**

Ball valve assemblies are not compatible with Sensor Termination Code B. However, Sensor Termination Codes A, Q, and S are compatible.

Refer to Table 20 for available options, Table 21 for temperature-pressure ratings, and Figure 31.

Refer to "MODEL CODE - BVA SERIES BALL VALVE INSERTION ASSEMBLY" on page 21 for model code, or contact Global Customer Support to order legacy model ball valve assemblies and insertion tubes by part number.

Table 20. Options for BVA Series Ball Valve Insertion Assembly (a)

Insertion Depth and Model Code (b)	Process Wetted Material	O-Ring Material	Miscellaneous Options
0 to 20.3 cm (0 to 8") BVA-PHA**08	316 ss; Titanium	Chemraz; EPDM; Kalrez; Perfluoroelastomer (FFKM); Viton	Insertion Tube Assembly Only; PVDF Ball Valve; ANSI 150# Flange 1 1/2" to 4"; Safety Guard
0 to 40.6 cm (0 to 16") BVA-PHA**16			
0 to 61.0 cm (0 to 24") BVA-PHA**24			
0 to 81.3 cm (0 to 32") BVA-PHA**32			
0 to XX per Sales Order BVA-PHA**XX (c)			

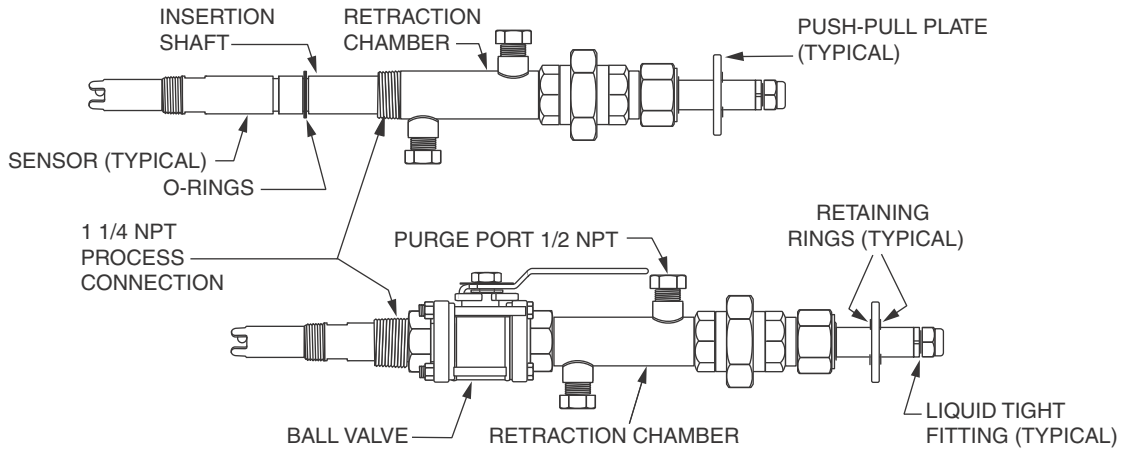
- a. Process connection is 1 1/4 NPT.
- b. Refer to DP 611-182 for additional dimensions. Refer to "MODEL CODE - BVA SERIES BALL VALVE INSERTION ASSEMBLY" for full model code.
- c. Custom insertion depth "XX" available in 20.3 cm (8-inch) increments. Contact Global Customer Support for details.

Table 21. Temperature and Pressure Ratings of BVA Series Ball Valve Insertion Assembly (a)

316 ss Ball Valve 316 ss Insertion Tube		Titanium Ball Valve Titanium Insertion Tube		PVDF Ball Valve 316 ss or Titanium Insertion Tube	
MPa at °C	psi at °F	MPa at °C	psi at °F	MPa at °C	psi at °F
1.59 MPa at -29 to 66°C	230 psi at -20 to 150°F	1.90 MPa at -29 to 66°C	275 psi at -20 to 150°F	1.00 MPa at -20 to 25°C	145 psi at -4 to 77°F
1.35 MPa at 93°C	195 psi at 200°F	1.72 MPa at 93°C	250 psi at 200°F	0.75 MPa at 50°C	109 psi at 122°F
1.28 MPa at 121°C	185 psi at 250°F	1.65 MPa at 121°C	240 psi at 250°F	0.37 MPa at 100°C	54 psi at 212°F
1.21 MPa at 149°C	175 psi at 300°F	1.59 MPa at 149°C	230 psi at 300°F	0.15 MPa at 140°C	22 psi at 284°F

- a. The ratings in this table may exceed the ratings of the sensor itself. Use the rating that is more restrictive.

Figure 31. BVA Series Ball Valve Insertion Assemblies



**Junction Boxes - Surface Mounted**

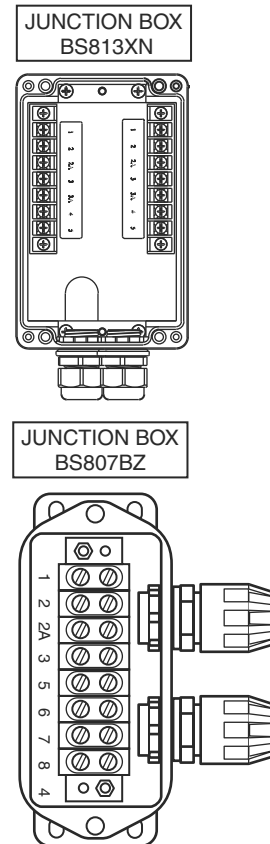
Two junction boxes are offered that provide the cabling interconnection between the sensor and transmitter or analyzer. These are not available for -S. They can be used with Analog sensors having or not having an integral preamplifier. (Junction boxes are simply interconnection devices and do not have preamplifiers. Refer to “Remote Preamplifier” section.) There is a generous amount of space within each junction box to accommodate the terminal blocks, and the sensor and transmitter/ analyzer cable assembly terminations. These junction boxes have the dust tight and weatherproof rating of IP65 as defined by IEC 60529, and provide the NEMA ratings listed in Table 22. Refer to Table 22 and Figure 32.

**Table 22. Junction Box Part Numbers**

Junction Box Part No.	Junction Box used with Sensors Listed Below (a)	Sensor has Integral Preamp.	Junction Box NEMA Rating
BS813XN	PH10/ORP10-*N**	NO	4X
BS807BZ	PH10/ORP10-*P**	YES	4

a. Extension cables are available. See Tables 2 through 3.

*Figure 32. Junction Boxes and Part Numbers Shown with Covers Removed*



### Remote Preamplifier

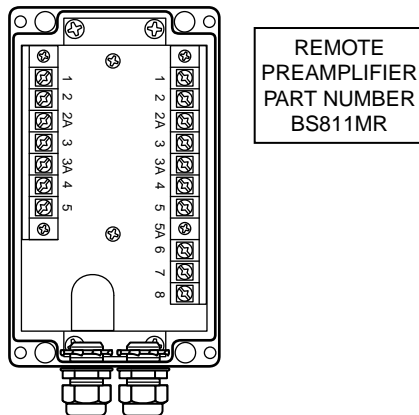
Certain installations require a sensor without an integral preamplifier (PH10-\*N models), but still must connect to a transmitter or analyzer with a cabling distance more than 15 m (50 ft) away. In this situation, a junction box with a remote preamplifier is provided that interconnects the sensor and transmitter/analyzer with a total cable length up to 150 m (500 ft) maximum. The junction box enclosure has a NEMA 4X rating that provides weatherproof, dust proof, and corrosion resistant protection. See Table 23 and Figure 33. This remote preamplifier is unnecessary with integral preamplifier or Smart models (PH10-\*P or PH10-\*S).

**Table 23. Remote Preamplifier Part Number and Application**

Remote Preamplifier Part No.	Remote Preamplifier Used with Sensors Listed Below (a)	Enclosure Rating
BS811MR	PH10/ORP10-*N**	NEMA 4X

a. Extension cables can be provided. See Tables 2 through 3.

*Figure 33. Junction Box with Remote Preamplifier*



### Buffers for use with DolpHin Model PH10 Sensors

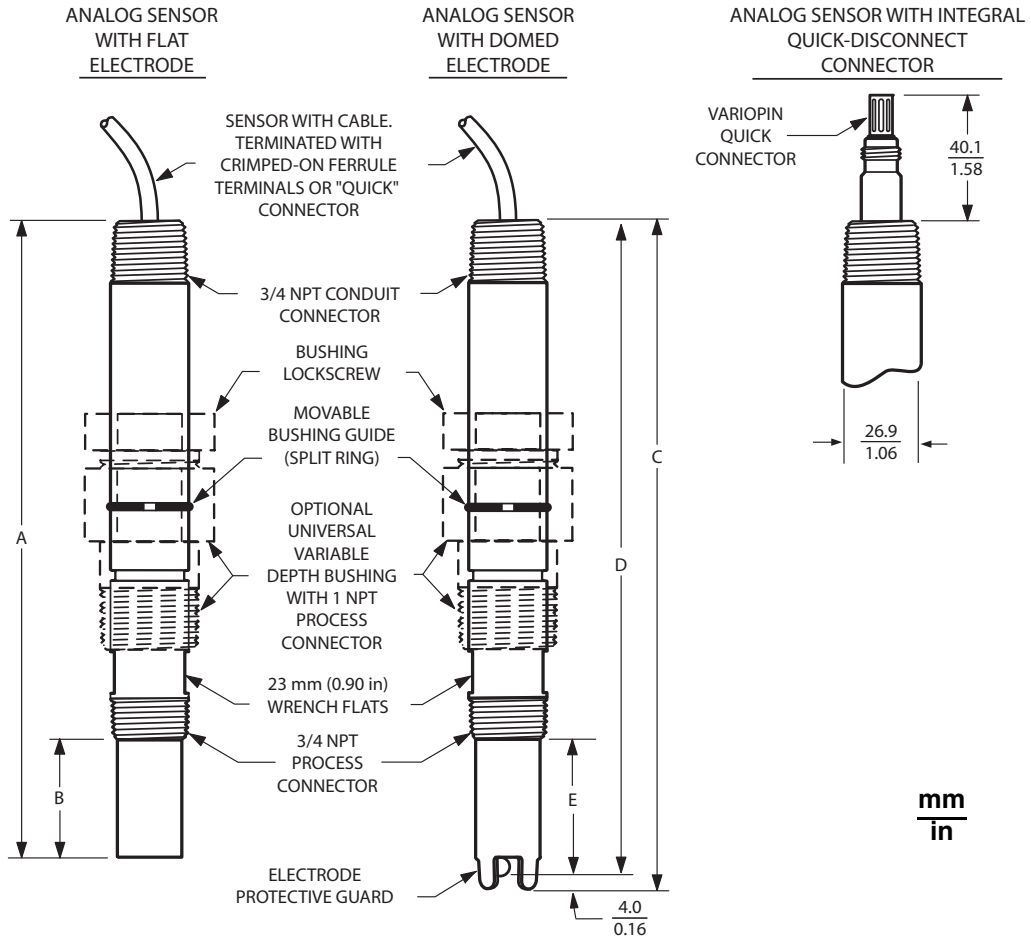
Buffers are available as a solution, or in a salt packet. When provided in a salt packet, the buffer is mixed with 0.47 liters (16 fluid ounces) of distilled water to convert to a buffer solution. Refer to Table 24 for part numbers for Buffer Solutions and Salt Packets.

**Table 24. Buffer Solutions and Salt Packets**

Type	Buffer Description	Part No.
Buffer Solution	4.00 pH, 0.47 L (16 fl oz)	Q0104KC
	7.00 pH, 0.47 L (16 fl oz)	Q0104KB
	10.00 pH, 0.47 L (16 fl oz)	Q0104KA
Salt Packet (a)	4.00 pH	1600100
	7.00 pH	1600101
	10.00 pH	1600102

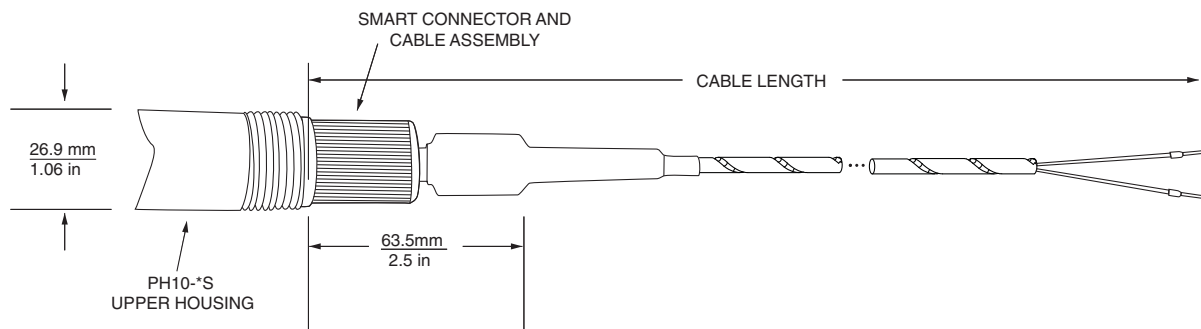
a. Mix buffer packet with 0.47 L (16 fl oz) of distilled water to convert to solution form.

DIMENSIONS - NOMINAL



Flat Electrodes - PH10-3, PH10-4, ORP10-1, and ORP10-2		
Electrode	Dimension A	Dimension B
PH10-3, -ORP10-1, ORP10-2	170 mm (6.7 in)	39.4 mm (1.55 in)
PH10-4	171.5 mm (6.75 in)	42.9 mm (1.69 in)

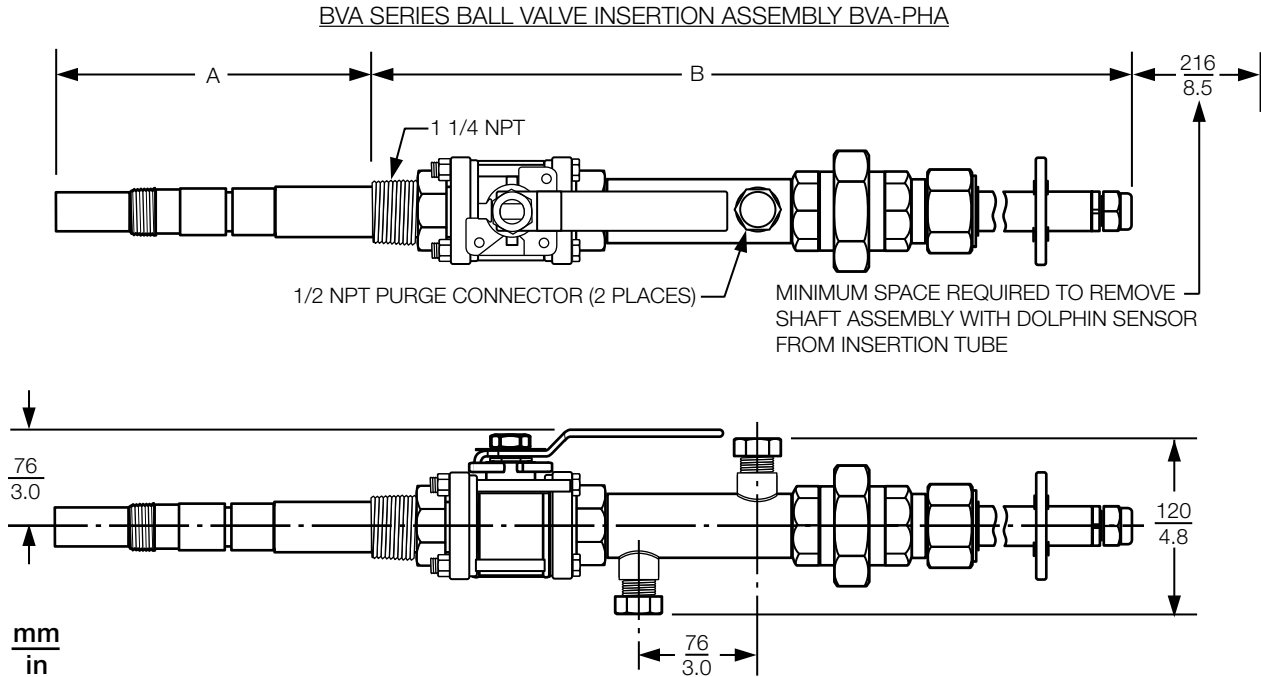
Domed Electrodes - PH10-1 and PH10-2			
Electrode	Dimension C	Dimension D	Dimension E
PH10-1	179.3 mm (7.06 in)	—	44.5 mm (1.75 in)
PH10-2	—	175.3 mm (6.90 in)	44.5 mm (1.75 in)



**NOTE**

Numerous accessories are offered with the DolpHiN sensors. For dimensional information, see DP 611-182 for BVA Series ball valve insertion assemblies, DP 611-172 for legacy ball valve and tube assemblies, and DP 611-173 for all other accessories.





Ball Valve Insertion Assembly Material, Insertion Depth, and Overall Length (a)			
Model Code	Assembly Material	Dimension A (Insertion Depth) (b) (c)	Dimension B (Overall Length) (d)
BVA-PHA1*08	316 ss	0 to 20.3 cm (0 to 8 inches)	74.9 cm (29.5 inches)
BVA-PHA1*16	316 ss	0 to 40.6 cm (0 to 16 inches)	95.3 cm (37.5 inches)
BVA-PHA1*24	316 ss	0 to 61.0 cm (0 to 24 inches)	115.6 cm (45.5 inches)
BVA-PHA1*32	316 ss	0 to 81.3 cm (0 to 32 inches)	135.9 cm (53.5 inches)
BVA-PHA1*XX	316 ss	0 to XX per sales order (e)	Add approx. 54.6 cm (21.5 inches) to XX
BVA-PHA2*08	Titanium	0 to 20.3 cm (0 to 8 inches)	77.5 cm (30.5 inches)
BVA-PHA2*16	Titanium	0 to 40.6 cm (0 to 16 inches)	97.8 cm (38.5 inches)
BVA-PHA2*24	Titanium	0 to 61.0 cm (0 to 24 inches)	118.1 cm (46.5 inches)
BVA-PHA2*32	Titanium	0 to 81.3 cm (0 to 32 inches)	138.4 cm (54.5 inches)
BVA-PHA2*XX	Titanium	0 to XX per sales order (e)	Add approx. 57.2 cm (22.5 inches) to XX

- Insertion depth and overall length are approximate. Actual dimensions depend on the extent of thread engagement in NPT connections. Addition of an optional flange does not affect the insertion depth and overall length. Refer to DP 611-182 for additional dimensions.
- When optional selection -A is specified in the model code, no ball valve or nipple is included. Add approximately 152 mm (6 inches) for 316 ss, or 178 mm (7 inches) for titanium, to the insertion depth dimensions shown for Dimension A.
- PVDF ball valve option reduces the insertion depth by 4.14 cm (1.63 inches).
- Overall length "B" dimension is at the fully retracted position (not shown).
- Custom insertion depth "XX" available in 20.3 cm (8 inch) increments. Contact Global Customer Support for details.

**NOTES**



### ORDERING INSTRUCTIONS

1. Model Number (see applicable "MODEL CODE" section).
2. Electrical Safety Design Code (see "ELECTRICAL SAFETY SPECIFICATIONS" section).
3. Accessories (see "ACCESSORIES" section).
4. User Tag Information.

### OTHER FOXBORO PRODUCTS

The Foxboro product lines offer a broad range of measurement and instrument products, including solutions for pressure, flow, analytical, temperature, positioning, controlling, and recording. For a list of these offerings, visit our web site at:

[www.fielddevices.foxboro.com](http://www.fielddevices.foxboro.com)