FIELD DEVICES – ANALYTICAL Product Specifications

invensus Foxboro®

PSS 6-1C3 A

DolpHin[®] Series Models PH10 and ORP10 Electrochemical Sensors and Accessories for pH and ORP Measurements



The Foxboro[®] brand DolpHin[®] 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.

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.

Invensys engineers have developed a unique proprietary electrode glass formulation which makes 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
- 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.

FEATURE HIGHLIGHTS

- 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.

TRANSMITTER/ANALYZER COMPATIBILITY

DolpHin sensors are fully compatible with Foxboro Models 870ITPH and 876PH Intelligent Transmitters and Model 875PH Intelligent Analyzers.

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

- Broken glass electrode
- Coating of sensing surface
- Aging (slope degradation)
- Liquid leakage into sensor body
- Preamp failure
- ATC, temperature element failure.

The coating and aging diagnostics are useful in scheduling preventive maintenance. And 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 Ω temperature elements only, and Model 870PH is compatible with preamplifier and 100 Ω RTDs only.

SENSOR BODY

The sensor is offered in a PVDF⁽¹⁾ 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 probe 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.

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

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.

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, and it 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









AUTOMATIC TEMPERATURE COMPENSATION

ATC, utilizing a resistance temperature detector (RTD), is a built-in feature in all DolpHin Sensors. Either 2- or 3-wire, 100 or 1000 Ω platinum RTDs, or a Balco 2-wire, 3 k Ω RTD may be selected. These RTDs are available with an enhanced response speed. Refer to "MODEL CODE SELECTION GUIDE".

INTERNAL PREAMPLIFIER

The sensor is 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. With the internal preamplifier, the 15.2 m (50 ft) transmission distance can be extended to 152 m (500 ft) as shown in the "PHYSICAL SPECIFICATIONS" and "MODEL CODE SELECTION GUIDE" sections.

PRECISION DOUBLE JUNCTION REFERENCE ELECTRODE

The external, process wetted reference junction is ceramic material with ultra fine 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 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 quick cable connector allows 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 19.

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

OPERATING, STORAGE, AND TRANSPORTATION CONDITIONS



Figure 5. Typical Sensor Mounting Configurations

OPERATING, STORAGE, AND TRANSPORTATION CONDITIONS

Influence	Reference Operating Conditions	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

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.

		With Internal Preamp	
Measuring Electrode Type	Without Internal Preamp	Ball Valve or Submersion Installation	In-Line Installation (a)
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)
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)
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)
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)
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)

Table 1. Process Temperature Ratings

(a) For in-line installations of a DolpHin sensor with internal preamp, the upper body must be in ambient temperatures of 54°C (130°F) or less.

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	< 0.05 pH in NaNO ₃ 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

 \pm [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 (ATC)

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 by 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 19).

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:

- 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.
- 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.
- Variopin quick connector integral to sensor housing end.

Standard cable is PVC jacketed. High temperature cable is cross-linked, irradiated, polyethylene (xple). Variopin quick connector meets 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. The connector has a nickel plating and Viton O-ring.

When a preamplifier internal to the sensor is used, the transmitter or analyzer can be up to 500 ft (152 m) away from the sensor. If no sensor internal preamplifier is used, the distance is limited to 50 ft (15.2 m). See Figure 6 and Figure 7 for typical cable, extension cable, and patch cord configurations.



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 (see back page).

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

Testing Laboratory, Types of Protection, and Area Classification	Application Conditions	Electrical Safety Design Code
ATEX Intrinsically safe; II GD 1 EEx ia IIC; Zone 0.	Temperature Class T4 to T6.	CS-E/AAA
ATEX Type N (Limited Energy); II GD 3 EEx nL IIC; Zone 2.	Temperature Class T4 to T6.	CS-E/ANN
CSA 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.	CS-E/CAA
CSA 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.	CS-E/CNN
FM 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.	CS-E/FAA
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.	When installed per MI 611-206; Temperature Class T4 Ta=85°C; NEMA Type 4X.	CS-E/FNN
IECEx intrinsically safe; II GD 1 EEx ia IIC; Zone 0.	Temperature Class T4 Ta=-20°C to 85°C.	CS-E/DAA
IECEx Type N (Limited Energy); Ex nL IIC; Zone 2.	Temperature Class T4 Ta=-20°C to 85°C.	CS-E/DNN

Model
PH10
-1 -2 -3 -4
N P
1 2 3 4 5
A B Q
-E -C -2 -3 -4 -5 -1H -2H -3H -5H -5H -5H -5H -5H -5H -5H -5H -5H -5

MODEL CODE - DOLPHIN PH SENSOR

(a) High Temperature cable not available with Preamplifier Code P.

(b) Selection of Preamp (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. See Table 2.

(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.

Description	Model
DolpHin ORP Sensor	ORP10
ORP Electrode Type Platinum Gold	-1 -2
Preamplifier None Internal Preamplifier (a) (b)	N P
$eq:spectral_$	1 2 3 4 5
Sensor Termination 10 ft (3.05 m) Integral Cable Terminated with Crimped-on Straight Pin Lugs 10 ft (3.05 m) Integral Cable Terminated with Variopin Quick Connector (b) (c) Variopin Quick Connector Integral to Sensor (b) (c)	A B Q
Optional Selections EPDM (d) O-Rings (e) Chemraz (f) O-Rings (e) Integral Std. Temp Sensor Cable, 20 ft (6.1 m) overall length (g) Integral Std. Temp Sensor Cable, 30 ft (9.1 m) overall length (g) Integral Std. Temp Sensor Cable, 40 ft (12.2 m) overall length (g) Integral Std. Temp Sensor Cable, 50 ft (15.2 m) overall length (g) Integral High Temp Sensor Cable, 10 ft (3.05 m) overall length (a) (g) Integral High Temp Sensor Cable, 20 ft (6.1 m) overall length (a) (g) Integral High Temp Sensor Cable, 30 ft (9.1 m) overall length (a) (g) Integral High Temp Sensor Cable, 30 ft (12.2 m) overall length (a) (g) Integral High Temp Sensor Cable, 50 ft (15.2 m) overall length (a) (g) Integral High Temp Sensor Cable, 50 ft (12.2 m) overall length (a) (g) Integral High Temp Sensor Cable, 50 ft (15.2 m) overall length (a) (g) Integral High Temp Sensor Cable, 50 ft (15.2 m) overall length (a) (g) Integral High Temp Sensor Cable, 50 ft (15.2 m) overall length (a) (g)	-E -C -2 -3 -4 -5 -1H -2H -3H -4H -5H
Example: ORP10-1P4A-C5	

MODEL CODE - DOLPHIN ORP SENSOR

(a) High Temperature cable not available with Preamplifier Code P.

(b) Selection of Preamp (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. See Table 2.

(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 pubber).

(e) Standard O-ring material is Viton.

(f) Chemraz is a perfluoroelastomer.

(g) Cable options applicable to Sensor Termination Codes A and B only.

Table 2. Allowable Configurations with Sensor Selection Codes P, 2, 4, B, and Q

Preamplifier Code P	Temperature Compensation Codes 2 or 4	Sensor Termination Codes B or Q
YES	YES	NO
YES	NO	YES
NO	YES	YES

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

MODEL CODE - BVA SERIES BALL VALVE INSERTION ASSEMBLY

(a) Legacy model ball valve assemblies and insertion tubes (ordered by part number) are also available. Contact Invensys for details.

(b) Chemraz is a perfluoroelastomer.

(c) EPDM is ethylene-propylene terpolymer, also known as EPR (ethylene-propylene pubber).

(d) For versions without ball valve and nipple, select option -A (Insertion Assembly Only). When option -A is selected, add approximately 6 inches (152 mm) for 316 ss, or 7 inches (178 mm) for titanium, to the insertion depth dimensions shown in "Insertion Depth" above.

(e) Prior approval required; contact Invensys.

(f) Not available with Optional Selection -A (Insertion Assembly Only).

MODEL CODE SELECTION GUIDE

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 $121^{\circ}C/250^{\circ}F$. Fast and accurate pH response suitable for severe temperature and harsh chemical applications. Low sodium ion error. Suitable for applications down to 50 μ S/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 8.

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 9.

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 10.

Figure 8. PH10-1 Electrode, Domed Bulb with Protective Guard



Figure 9. PH10-2 Electrode, Domed Bulb without Protective Guard



Figure 10. 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 11.



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.

Preamplifier Selection N

This option allows for no integral preamplifier in the sensor. Select N in applications where the entire sensor body 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. The temperature limit of the preamp is 85°C (185°F) and it resides inside the upper portion of the sensor.

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.

Preamplifier Selection P

This selection provides an integral preamplifier located in the upper body of the DolpHin sensor. The preamp is highly recommended when any one of the glass pH electrodes is selected. The preamp provides unity gain and conversion to low impedance of the high impedance mV signal of the glass pH electrode. The preamp 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 preamp is required when the distance from the sensor to the transmitter exceeds 15.2 m (50 ft).

The preamp should not be selected when the upper half of the sensor body is submerged in process solutions above 85°C (185°F). The preamp, 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 Preamplifier Selection P, either Temperature Compensation Code 2 or 4, or Sensor Termination Code B or Q, is available; but not both. See Table 2.

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

Temperature Compensation Selections

DolpHin pH and ORP sensors include a precision temperature measuring element. Foxboro brand analyzers and transmitters use this temperature measurement to provide automatic temperature compensation 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.

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/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. See Table 2.

Temp. Comp. Selection 3: 2-Wire 100 Ω 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 is required along with 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 ultra fast temperature response. Refer to Figures 4 and 12.

> Figure 12. Platinum RTD Housing – Enhanced Response Speed



Temp. Comp. Selection 4: 3-Wire 1000 Ω 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 application 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 a preamplifier and a Variopin quick connector are both selected in the same sensor Model Code. See Table 2.

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.

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 2 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.

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 2 for availability of this selection when a preamplifier or a 3wire RTD temperature compensation element is also selected. See Figure 13. Also see Figure 7 for cable configurations.

Figure 13. Variopin Quick Connector Integral to Sensor

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 Preamp Selection P must be made. See Figures 6 and 7.

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).

Installations such as ball valve insertion assembly, or submersion mounting, 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.

ACCESSORIES

Universal Bushing Kit

The universal bushing kit is comprised of a bushing, a lockscrew, an o-ring, a back-up ring, a split ring, and instructions. It provides the following features:

- Allows sensor insertion and removal without causing cable "wind-up".
- Allows adjustment of submersion depth at either 2.1 or 3.1 in (53 or 79 mm) with the flat electrode, or either 2.5 or 3.5 in (63 or 89 mm) 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 3 and Figures 14 through 17.

Material	Assembly Part No.	Thread	
316 ss	BS810XC	1 NPT	
316 ss	BS810XD	R 1 1/2	
PVDF	BS810XB	1 NPT	
PVDF	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)		

Table 3. Universal Bushing Kits (a)

(a) With standard Viton O-rings. Contact Invensys for other O-ring materials.

Figure 14. Universal Bushing and Sensor Showing Split Ring, O-ring, and Back-up Ring Installed on Sensor in Position for 2.1 inch Insertion Depth



Figure 15. Universal Bushing Shown with Flat Glass Sensor Installed in Position for 2.1 inch Insertion Depth



Figure 16. Universal Bushing Shown with Flat Glass Sensor Installed in Position for 3.1 inch Insertion Depth



Figure 17. 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⁽²⁾ bushings are internal NPT and external pipe socket-weld connections. See Figure 18. The bushing identification in Figure 18 corresponds to the last two characters in the bushing part numbers listed in Table 4.



Figure 18. Typical Bushing Configurations

Table 4. Bushings

Bushing	Part Number using:		
Size (a)	316 ss (NPT)	PVDF (NPT)	CPVC (Slip)
3/4 x 1 3/4 x 1 1/4 3/4 x 1 1/2	BS810HA BS810HF BS810HG	BS810HC - BS810GZ	BS810KL BS810KM BS810KN
1 x 1 1 x 1 1/4 1 x 1 1/2	BS810HJ X0177CF X0177CE	BS810HK - BS810HH	BS810HM BS810HN 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 usersupplied 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 5 and Figure 19. Refer to the "Tee Kits" section that follows for tee/bushing assembly configurations.



Table 5. Tees

	Part Number using:		
Tee Size	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 6 and Figure 20.





Table 6. Tee Kits

	Assembl	ed Kit Part N	lo. Using:	
Assembled Size (a)	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	e-Temperatu	re Rating	
316 ss	1.4 MPag at	121°C (200 p	osig 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 0.4 MPag at	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, bushing lockscrew, lubricant, and installation instructions. 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 bushing lockscrew. 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 21 and Figure 7.

Table 7. 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 21. 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 22. Flanged end connection assemblies are comprised of a flange welded to a universal bushing, lockscrew, Viton oring, 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 22 and Table 8.

Table 8. Flanged Mounting Kits

Flanged Mounting Kits				
Flange Rating	Size	Holes	Part No.	
ANSI	2 in	4	BS810ZN	
Class 150	2-1/2 in	4	BS810ZP	
(316 ss)	4 in	8	BS810ZQ	
DIN PN 10	DN 50	4	BS810ZR	
(316 ss)	DN 100	8	BS810ZS	
Flange Material	Pressure-Temperature Rating			
316 ss	1.4 MPag a	t 121°C (20	0 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 23 and Table 9.



Flange End Connection Assembly				
Rating	Size	Holes	Part No.	
	2 in	4	BS808MP	
Class 150	2-1/2 in	4	BS809LZ	
	4 in	4 4 8 4 4 8	BS808MA	
	DN 50	4	BS808MB	
	DN 100	8	BS809LW	
Flange Material	Pressure-Temperature Rating			
316 ss	1.4 MPag a	t 121°C (2	00 psig at 250°F)	

Figure 23. 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 24 and Table 10.

Table 10. 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-Temperatu	re 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 24. 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 25 and Table 11.

Table 11. Universal Flow Chamber Kit

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



Figure 25. Universal Flow Chamber Kit

Ball Valve Insertion Assembly

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 up 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 probe 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 insertion assemblies are <u>not</u> compatible with Sensor Termination Code B. However, Sensor Termination Codes A and Q <u>are</u> compatible.

Refer to Table 12 for a list of available options, and Table 13 for temperature-pressure ratings. Also see Figure 26.

Refer to the "MODEL CODE - BVA SERIES BALL VALVE INSERTION ASSEMBLY" on page 14 for model code numbers, or contact Invensys to order legacy model ball valve assemblies and insertion tubes by part number.

Insertion Depth and Model Code (b)	Process Wetted Material	O-Ring Material	Miscellaneous Options
0 to 20.3 cm (0 to 8") BVA-PHA08	316 ss	Chemraz	Insertion Tube Assembly Only
0 to 40.6 cm (0 to 16") BVA-PHA16	Titanium	EPDM	
0 to 61.0 cm (0 to 24") BVA-PHA24		Kalrez	ANSI 150# Flange (1 1/2" to 4")
0 to 81.3 cm (0 to 32") BVA-PHA32		Perfluoroelastomer (FFKM)	
0 to XX per Sales Order (c) BVA-PHAXX		Viton	Safety Guard



(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 Invensys for details.

Table 13. Temperature-Pressure Ratings of BVA Series Ball Valve Insertion Assembly (a)

Process T	Temperature	Maximum Working Pressure		Maximum W		
		With 316 ss Material		With Titaniur	n Material	
°C	°F	MPa	psi	MPa	psi	
-29 to +66	-20 to +150	1.59	230	1.90	275	
93	200	1.35	195	1.72	250	
121	250	1.28	185	1.65	240	
149	300	1.21	175	1.59	230	

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



Figure 26. 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. They can be used with 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 dusttight and weatherproof rating of IP65 as defined by IEC 60529, and provide the NEMA ratings listed in Table 14. Refer to Table 14 and Figure 27.

Table 14. 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/ORP10N	NO	4X
BS807BZ	PH10/ORP10P	YES	4

(a) Extension cables can be provided. See Tables 16 through 19.



Figure 27. Junction Boxes and Part Numbers Shown with Covers Removed

Remote Preamplifier

Certain installations require a sensor without an integral preamplifier, 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, dustproof, and corrosion resistant protection. See Table 15 and Figure 28.

Table 15. Remote Preamplifier Part Number and
Application

Remote Preamplifier Part No.	Remote Preamplifier Used with Sensors Listed Below (a)	Enclosure Rating
BS811MB	PH10/OBP10N.,	NFMA 4X

(a) Extension cables can be provided. See Tables 16 through 19.





Extension Cable and Patch Cord Assemblies

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. Variopin quick connector or Invensys-specified junction box is recommended for connection of extension cable to sensor or sensor cable, especially for 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 brand transmitters and analyzers. See Figure 29.





PATCH CORDS have a Variopin connector on one end and pin lugs on the other. The Variopin connector is rated IP66/IP68, and has nickel plating and Viton Orings. 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). Refer to "MODEL CODE SELECTION GUIDE" for further Variopin connector information. See Figure 30.



Figure 30. Patch Cord with Variopin Quick Connector and Straight Pin Lugs

To select the proper cable, first determine if the sensor will have an integral preamplifier. The sensor Model Code contains an N for no preamp or a P for preamp. Refer to the "MODEL CODE SELECTION GUIDE" for advice regarding the preamplifier. Then select the cable termination, length and temperature rating required for the installation.

Extension cables for sensors without preamp are available as standard cable with PVC jacket, 80°C 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, also 7 conductors (coax plus 5). Sensors without preamps are restricted to 50 feet or less separation between sensor and transmitter/analyzer. Therefore, extension cables in this group are available in lengths up to 50 feet. Longer distances require the use of a preamp.

Extension cables for sensors with preamps are available as standard cable with PVC jacket, 80°C rating, 9 conductors. Preamps and preamp cable are not available for temperatures above 80°C. Extension cable for both the pin lug termination and Variopin types are available up to 500 feet maximum and are ordered by the foot.

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 31.





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

Table 16. Patch Cords - for Use with Sensors without Preamplifier (Model Code N)

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

Table 17. Extension Cables - for Use with Sensors without Preamplifier (Model Code N)

Table 18.	Extension Cables -	for Use with	Sensors with	Integral Pream	plifier (Model C	ode P)
				mograinicam		

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

Table 19. Raw Cable, Unterminated, Maximum Continuous Length, 1000 ft (a)

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

(a) Available in continuous lengths to 1000 feet in 1 foot increments.

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 litres (16 fluid ounces) of distilled water to convert to a buffer solution. Refer to Table 20 for part numbers for Buffer Solutions and Salt Packets.

Table 20. Buffer Solutions and Salt Packets

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



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 Assembly Code Material		Dimension A (Insertion Depth) (b)	Dimension B (Overall Length) (c)	
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 (d)	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 (d)	Add approx. 57.2 cm (22.5 inches) to XX	

(a) 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.

(b) When optional selection "A" is specified in the model code, no ball valve or nipple is included. Add approximately 6 inches (152 mm) for 316 ss, or 7 inches (178 mm) for titanium, to the insertion depth dimensions shown for Dimension A.

(c) Dimension B measured at the fully retracted position (not shown).

(d) Custom insertion depth "XX" available in 20.3 cm (8 inch) increments. Contact Invensys for details.

NOTES

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 M&I PRODUCTS

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