The Model PH18 Differential pH Sensor is unique and offers the possibility of maintenance-free operation for the correct application.

Construction of the enamel coated probe is based on a rigid steel rod. A blue base enamel is overlaid with two yellow bands of sensitive enamel. One pH sensitive enamel and the second a sodium ion enamel. They are combined with an integral temperature sensor, to form a probe that does not have any internal solutions.

The differential measuring principle combines the normal potential generated by the pH enamel with the potential from the sodium membrane. In suitable applications the level of sodium ions creates a stable reference voltage. Hence the measurement can be made without a conventional reference electrode, and drawbacks associated with a liquid junction.

The sensitive enamels are directly bonded to a metallic substrate, eliminates the need for conventional internal reference elements. This unique construction makes the PH18 independent of the drift typically caused by conventional reference elements as they age or become contaminated. When used in a system which is cleaned and/or sterilized with hot water or steam, the enamels produce a signal which has long term stability unrivalled by conventional systems.

APPLICATION
- Process where KCl is forbidden
- Process containing a low water content
- High process temperature and pressure
- Process with rapid pressure/temperature changes
- Fermentation processes
- Dairy product manufacture

FEATURES
- Sterilizable
- All enamel construction
- No reference fill solution or junction
- Easy installation and commissioning
- No routine maintenance
- Flexible installation options
- 140 °C, 15 bar (284 °F, 214 psi)

SYSTEM CONFIGURATION

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INTRODUCTION

The PH18 is not a conventional electrode. It relies on two dissimilar ion sensitive enamel membranes to generate the signal. The measuring element is like a pH electrode, and the reference like a sodium ion electrode.

Therefore the PH18 can only be used in combination with pH meters that feature:
1 Dual high impedance inputs
2 Adjustable setting for Isothermal Point
3 Adjustable temperature coefficient

The Yokogawa models PH202/FLXA21 and PH402/450 satisfy these requirements.

In both cases the membrane enamels are bonded directly to the metal substrate with no filling solution.

The response curves Fig. 1 (pH), Fig. 2 (reference) and Fig. 3 (application range) show the way in which the potential is generated at each element and combined in the output of the sensor.

Fig. 1 above pH11 the effect of sodium on the pH membrane starts to cause non-linearity (sodium error)
Fig. 2 below pH3 the high hydrogen ion content causes a change in the reference response
Fig. 3 a “linear” response to pH is obtained between 3 and 11 pH
Fig. 4 a plot of reference voltage against sodium content

The revolutionary measuring principle has some big advantages. The absence of filling solutions and reference junctions virtually eliminates the problems caused by aging and pollution of the reference sensor. Regular cleaning of the sensor virtually eliminates drift, and the sensor benefits from a very long working life. It is vital, however, to fit the sensor to the application correctly. The special nature of the reference element dictates that there must be a certain sodium level in the process. Fig. 4 shows a plot of reference voltage against sodium content. Because of the exponential nature of the response, it is plain that above about 0.5 N Na+ (30g NaCl/l) in the solution, the reference output tends towards a constant level. Of course when the sodium concentration remains constant in a process the reference voltage will also be constant at much lower levels of sodium.

It is because of the need to evaluate the chemistry of the process, that it is necessary to have an Application Data Sheet (page 7 of this GS) completed before approval for this sensor can be made.

The mechanical construction of the sensor also means that it may be used in processes involving both high temperatures and pressures. By eliminating the filling solutions, the sensor is truly robust and can even withstand severe thermal shocks that would ruin most systems.

The stainless steel mounting adapter forms the liquid earth (solution ground) connection needed to ensure best stability of measurement. EXA also uses this connection in the diagnostic circuit.

The PH18 is a differential pH sensor. It does not measure absolute pH except in limited applications. It does, however, measure a single control point accurately, repeatably and with minimum maintenance.
GENERAL SPECIFICATIONS

Model PH18 Differential pH Sensor
Temperature sensor: Pt1000 RTD
Wetted parts: pH sensor -pH sensitive enamel
Reference sensor - Na+ sensitive enamel
Liquid earth via SS adapter
Adapters (SS 316)
Max. measuring range: 3 to 11 pH (The actual range will be advised with reference to the completed application data sheet)
Temperature range: 0 to 140 ºC (284 ºF)
Pressure range: -1 to 15 Bar (214 psi)

NOTE:
The use of this sensor is highly application specific. Your local Yokogawa sales office will be pleased to advise on the suitability of your application, on receipt of the completed Application Data Sheet. Any and all information received by Yokogawa will be treated in the strictest confidence. To maintain traceability, the completed Application Data Sheet will form part of the contract of sale.
Yokogawa offers no function guarantee for applications where the attached data sheet (page 7) has not been satisfactorily completed. This does not affect the normal Yokogawa warranty covering defects in materials or workmanship.

MODEL AND SUFFIX CODE

<table>
<thead>
<tr>
<th>Model</th>
<th>Suffix Code</th>
<th>Option Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PH18</td>
<td>-SA</td>
<td>-E</td>
<td>Model PH18 Differential pH Sensor</td>
</tr>
<tr>
<td>Sensor mounting</td>
<td></td>
<td></td>
<td>Compatible with 25mm process connection</td>
</tr>
<tr>
<td>O-ring material</td>
<td>-E</td>
<td></td>
<td>Ethylene-propylene (EPDM)</td>
</tr>
<tr>
<td>Instruction manual</td>
<td>-E</td>
<td></td>
<td>English language</td>
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Note:
The sensor is supplied with cable connector. For first installation cable must be specified as well.

Note:
The material certificate 3.1.B is supplied with the sensor and the options

MODEL WU18 cable for model PH18 Differential pH Sensor
Max. temperature: 110 ºC (230 ºF)
Material: Thermoplastic Rubber (T.P.R.)
Color: Blue
Shipping details sensor and adapter
Package: wxhxd 350 x 220 x 110 mm
Weight: approx. 1.4 kg
Shipping details cable
Package: wxhxd 350 x 220 x 110 mm
Weight: 2 m. approx. 0.6 kg
5 m. approx. 0.9 kg
10 m. approx 1.4 kg

MODEL AND SUFFIX CODE

<table>
<thead>
<tr>
<th>Model</th>
<th>Suffix Code</th>
<th>Option Code</th>
<th>Description</th>
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<td></td>
<td>-03</td>
<td>03 meter connection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-05</td>
<td>05 meter connection cable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-10</td>
<td>10 meter connection cable</td>
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</table>

Fig. 5 Connection diagram WU18 for PH202/FLXA21 and PH402/PH450

Fig. 6. Corrosion curve of the Model PH18 Enamel
DIMENSIONS PH18-SA

Fig. 7. PH18-SA and the adapters

Fig. 8. External dimensions of the PH18-SA

Fig. 9. Options of the PH18-SA
PH18 INSTALLATION EXAMPLES

Example A. Straight weld-in adapter through a vessel wall.
Example B. 1" Screw-in adapter with existing pipe nipple through a vessel wall.
Example C. Angled weld-in adapter in large bore pipe.
Example D. Angled weld-in adapter mounted in a bend
Example E. Screw or weld-in adapter mounted in a large bore pipe.
Example F. Screw or weld-in adapter mounted on top of a large bore pipe.

Note 1: When measuring in plastic tanks or pipes, ensure that the adapter is wetted by the process. Avoid installations where an air pocket can be created (see fig 12 F). This isolates the adapter, and hence loses the liquid earth connection.

Note 2: Flow rate from the side of sensor (fig. 12 (C & D) ) should not exceed 2 metres/second in low viscosity fluids. In high viscosity fluids (>5cP) use only installation as shown in fig. 12 (D).

MODEL PH 18 ELEMENTS

The primary adapter is used to make a connection to the process used by the transmitter as the liquid earth (solution ground). This is needed for optimum stability of the measurement and is also used in the impedance checking circuit.

Fig. 14.
The primary adapter is used to make a connection to the process used by the transmitter as the liquid earth (solution ground). This is needed for optimum stability of the measurement and is also used in the impedance checking circuit.

Fig. 15.
Should be used to show process variations. The changes in pH and sodium content should be plotted against time for batch processes. Changes in temperature and pressure can also be plotted if appropriate. Where CIP is used, plot the cleaning cycle, and any sterilization stages. This leads to a clearer understanding of the process.
**Caution - Inappropriate handling can cause damage.**
Striking or scratching the sensor against hard surfaces such as steel, stone, glass or ceramic, may cause damage to the enamel. Such damage may not affect the sensor performance immediately, but after prolonged exposure to the process, flaking of the enamel may occur.

**Note - Enable impedance checks in the PH202/FLXA21 and PH420/PH450**
The sensor impedance checking can give early warning of damage to the enamel layers. If the transmitter signals an impedance failure of the PH18, the sensor should be removed from the process, as soon as possible (within 24 hours). The loss of significant amounts of enamel may thus be avoided.

**ACCESSORIES**
Spare parts for model PH18 differential pH sensor

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1263XY</td>
<td>O-ring set contains Qty 1 each of A, B, C&amp;D from figure 16</td>
<td></td>
</tr>
<tr>
<td>K1520EJ</td>
<td>Straight weld-in adapter</td>
<td>1</td>
</tr>
<tr>
<td>K1520EK</td>
<td>Angled weld-in adapter</td>
<td>1</td>
</tr>
<tr>
<td>M1289BA</td>
<td>Adapter 1&quot; NPT</td>
<td>1</td>
</tr>
<tr>
<td>237230</td>
<td>Blind plug and mounting out</td>
<td>1</td>
</tr>
</tbody>
</table>
SC24V or PH18 Application Data Sheet

Customer: ____________________________  
Tag No: ________________________________  
Address: ________________________________  
Contact: ________________________________  
Telephone: ________________________________  
Email: ________________________________  
Rep Name: ________________________________  

1. PROCESS DATA:

Sensor Selection:  
- PH18  
- SC24V

Application:  
- Chemical  
- Power  
- Pharmaceutical  
- Pulp & Paper  
- Other

Operation:  
- Batch  
- Control  
- Continuous  
- Monitor  
- Other

Type of Solution: ________________________________

2. PROCESS CONDITIONS:

Description: ________________________________

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min</th>
<th>Norm</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH Value</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conductivity Value</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sodium Concentration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature (°C/°F)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressure (psig)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flow Rate (ft/sec)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concentration of Solids:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type(s):</td>
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<td></td>
<td></td>
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<tr>
<td>Problems:</td>
<td></td>
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<tr>
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</tr>
<tr>
<td>Cleaning/Sterilization:</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Describe:</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. INSTALLATION DATA:

Mounting:  
- Insertion  
- Off Line  
- Flow Through  
- On Line Pipe  
- Retractable  
- On Line tank  
- Immersion  
- Sample Line  
- Other  
- Flanged

Wetted Materials:  
- 316SS  
- EPDM  
- Kynar  
- Kalrez

Distance to Converter: _______ ft

Instrument:  
- General Purpose  
- Intrinsic Safe

Power Supply:  
- 115 VAC  
- 24 VDC
ACCESSORIES

Spare parts for model PH18 differential pH sensor

- **Size of the O-Ring EPDM**
  - A = 17.12 x 2.62 K1500BR
  - B = 20.30 x 2.62 K1500BJ
  - C = 25.12 x 1.78 K1500BS
  - D = 17.12 x 2.62 K1500BR

**Fig. 16. Location of the O-rings**

SPARE PARTS

<table>
<thead>
<tr>
<th>Number Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>PH18-SA</td>
<td></td>
</tr>
<tr>
<td>Caution - Inappropriate handling can cause damage. Striking or scratching the sensor against hard surfaces such as steel, stone, glass or ceramic, may cause damage to the enamel. Such damage may not affect the sensor performance immediately, but after prolonged exposure to the process, flaking of the enamel may occur.</td>
<td></td>
</tr>
<tr>
<td>Note - Enable impedance checks in the PH202 or PH402. The sensor impedance checking can give early warning of damage to the enamel layers. If the transmitter signals an impedance failure of the PH18, the sensor should be removed from the process, as soon as possible (within 24 hours). The loss of significant amounts of enamel may thus be avoided.</td>
<td></td>
</tr>
<tr>
<td>K1500BJ Set O-rings 20.3 X 2.62 (EPDM)</td>
<td>unit 5</td>
</tr>
<tr>
<td>K1500BR Set O-rings 17.12 X 2.62 (EPDM)</td>
<td>unit 5</td>
</tr>
<tr>
<td>K1500BS Set O-rings 25.12 X 1.78 (EPDM)</td>
<td>unit 1</td>
</tr>
</tbody>
</table>

- **1tuNTB0051K**
- **K1522BR /SWR Straight weld-in adapter**
- **K1522EQ /SWA Angled weld-in adapter**
- **K1522ET /SBS Adapter ISO 7/1 - R1, JIS 1”**
- **K1522ES 1TPN “1 retpadA SNS/”**
- **K1522MV 1gulp dnilB 1ASB/”**