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In this manual a **mA** sign appears if it concerns the pH202G(S)-E/C/U/N

## PREFACE

### **WARNING**

#### **Electric discharge**

The EXA analyzer contains devices that can be damaged by electrostatic discharge. When servicing this equipment, please observe proper procedures to prevent such damage. Replacement components should be shipped in conductive packaging. Repair work should be done at grounded workstations using grounded soldering irons and wrist straps to avoid electrostatic discharge.

#### **Installation and wiring**

The EXA analyzer should only be used with equipment that meets the relevant IEC, American or Canadian standards. Yokogawa accepts no responsibility for the misuse of this unit.

### **CAUTION**

The Instrument is packed carefully with shock absorbing materials, nevertheless, the instrument may be damaged or broken if subjected to strong shock, such as if the instrument is dropped. Handle with care.

Although the instrument has a weatherproof construction, the transmitter can be harmed if it becomes submerged in water or becomes excessively wet.

Do not use an abrasive or solvent in cleaning the instrument.

#### **Notice**

Contents of this manual are subject to change without notice. Yokogawa is not responsible for damage to the instrument, poor performance of the instrument or losses resulting from such, if the problems are caused by:

- Improper operation by the user.
- Use of the instrument in improper applications
- Use of the instrument in an improper environment or improper utility program
- Repair or modification of the related instrument by an engineer not authorized by Yokogawa.

#### **Warranty and service**

Yokogawa products and parts are guaranteed free from defects in workmanship and material under normal use and service for a period of (typically) 12 months from the date of shipment from the manufacturer. Individual sales organizations can deviate from the typical warranty period, and the conditions of sale relating to the original purchase order should be consulted. Damage caused by wear and tear, inadequate maintenance, corrosion, or by the effects of chemical processes are excluded from this warranty coverage.

In the event of warranty claim, the defective goods should be sent (freight paid) to the service department of the relevant sales organization for repair or replacement (at Yokogawa discretion). The following information must be included in the letter accompanying the returned goods:

- Part number, model code and serial number
- Original purchase order and date
- Length of time in service and a description of the process
- Description of the fault, and the circumstances of failure
- Process/environmental conditions that may be related to the installation failure of the device
- A statement whether warranty or non-warranty service is requested
- Complete shipping and billing instructions for return of material, plus the name and phone number of a contact person who can be reached for further information.

Returned goods that have been in contact with process fluids must be decontaminated/disinfected before shipment. Goods should carry a certificate to this effect, for the health and safety of our employees. Material safety data sheets should also be included for all components of the processes to which the equipment has been exposed.

## 1. INTRODUCTION AND GENERAL DESCRIPTION

The Yokogawa EXA 202 is a 2-wire transmitter designed for industrial process monitoring, measurement and control applications. This user's manual contains the information needed to install, set up, operate and maintain the unit correctly. This manual also includes a basic troubleshooting guide to answer typical user questions.

Yokogawa can not be responsible for the performance of the EXA analyzer if these instructions are not followed.

### 1-1. Instrument check

Upon delivery, unpack the instrument carefully and inspect it to ensure that it was not damaged during shipment. If damage is found, retain the original packing materials (including the outer box) and then immediately notify the carrier and the relevant Yokogawa sales office.

Make sure the model number on the textplate affixed to the side of the instrument agrees with your order. Examples of nameplates are shown.



Figure 1-1. Nameplate

**NOTE:** The nameplate will also contain the serial number and any relevant certification marks. Be sure to apply correct power to the unit. The first two characters of the serial number refers to the year and month of manufacturing

Check that all the parts are present, including mounting hardware, as specified in the option codes at the end of the model number. For a description of the model codes, refer to Chapter 2 of this manual under General Specifications.

<b>Y = Year</b>	<b>M = Month</b>		
2000	M	January	1
2001	N	February	2
2002	P	March	3
2003	R	April	4
.....	..	.....	..
2008	W	September	9
2009	X	October	O
2010	A	November	N
2011	B	December	D

Basic Parts List: Transmitter PH202  
 User's Manual (See model code for language)  
 Optional mounting hardware when specified (See model code)

**NOTE:** mounting screws and special grommet are packed in the terminal compartment, together with a second link for impedance selection.

**1-2. Application**

The EXA converter is intended to be used for continuous on-line measurement in industrial installations. The unit combines simple operation and microprocessor-based performance with advanced self-diagnostics and enhanced communications capability to meet the most advanced requirements. The measurement can be used as part of an automated process control system. It can also be used to indicate dangerous limits of a process, to monitor product quality, or to function as a simple controller for a dosing/neutralization system.

Yokogawa designed the EXA analyzer to withstand harsh environments. The converter may be installed either indoors or outside because the IP65 (NEMA4X) housing and cabling glands ensure the unit is adequately protected. The flexible polycarbonate window on the front door of the EXA allows pushbutton access to the keypad, thus preserving the water and dust protection of the unit even during routine maintenance operations.

A variety of EXA hardware is optionally available to allow wall, pipe, or panel mounting. Selecting a proper installation site will permit ease of operation. Sensors should normally be mounted close to the converter in order to ensure easy calibration and peak performance. If the unit must be mounted remotely from the sensors, WF10 extension cable can be used up to a maximum of 50 metres (150 feet) with a BA10 junction box. Except installations with dual high impedance sensors, where the maximum cable length is 20 metres using integral cable only (no junction box).

The EXA is delivered with a general purpose default setting for programmable items. (Default settings are listed in Chapter 5 and again in Chapter 10). While this initial configuration allows easy start-up, the configuration should be adjusted to suit each particular application. An example of an adjustable item is the type of temperature sensor used. The EXA can be adjusted for any one of eight different types of temperature sensors.

To record such configuration adjustments, write changes in the space provided in Chapter 10 of this manual. Because the EXA is suitable for use as a monitor, a controller or an alarm instrument, program configuration possibilities are numerous.

Details provided in this user's manual are sufficient to operate the EXA with all Yokogawa sensor systems and a wide range of third-party commercially available probes. For best results, read this manual in conjunction with the corresponding sensor user's manual.

Yokogawa designed and built the EXA to meet the CE regulatory standards. The unit meets or exceeds stringent requirements of EN 55082-2, EN55022 Class A without compromise, to assure the user of continued accurate performance in even the most demanding industrial installations.

**2. PH202 SPECIFICATIONS**

**2-1. General**

**A. Input specifications**

: Dual high impedance inputs (2 x 10<sup>13</sup>Ω) with provision for liquid earth connection. Suitable for inputs from glass or enamel pH & reference sensors and ORP metal electrodes.

**B. Input ranges**

- pH : -2 to 16 pH
- ORP : -1500 to 1500 mV
- rH : 0 to 55 rH
- Temperature : -30 °C - 140 °C (-20 - 300 °F)
- 8k55 sensor : -10 °C - 120 °C (10 - 250 °F)
- PTC10k : -20 °C - 140 °C (0 - 300 °F)

**C. Span**

- pH : min 1 max 20 pH
- ORP : min 100 max 3000 mV
- rH : min 2 max 55 rH

**mA D. Output signal** : 4-20 mA loop powered, isolated from input, maximum load 425 Ω at 24 V DC. With the possibility of 22 mA "FAIL" signal (burn up) and 3.9 mA (burn down).

**mA NOTE:** The transmitter contains a switched power supply. The transmitter requires a minimum Power voltage in order to work correctly, which is dependant on the load. Please refer to figures 2-1 and 2-2 for the correct power supply.

**E. Temperature compensation**

- Range : Automatic or manual compensation to Nernst equation. Process compensation by configurable coefficient. Compensation for total range of selected temperature sensors (see B) Adjustable ITP (Iso-thermal point of intersection).

**F. Calibration**

: Semi-automatic using pre-configured NIST buffer tables 4, 7 & 9, of with user defined buffer tables, with automatic stability check. Manual adjustment to grab sample. Slope and Asymmetry Potential setting. Zero point can be selected for calibration and display instead or As. Pot. (IEC746-2)

**mA G. Serial communication**

: Bi-directional HART® digital communication superimposed on the 4-20 mA signal.

**H. Logbook**

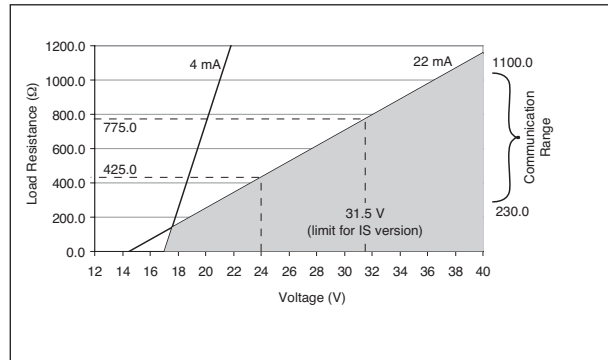
: Software record of important events and diagnostic data. Available through HART link, with key diagnostic information available in the display.

**I. Display**

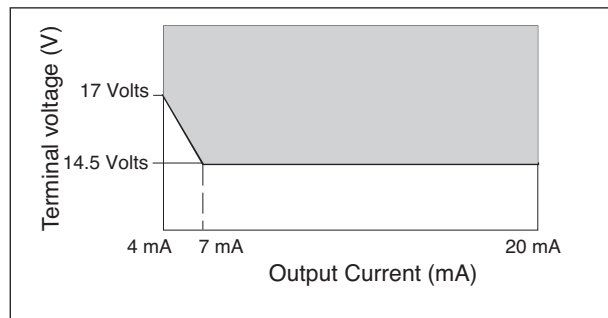
: Custom liquid crystal display, with a main display of 3<sup>1</sup>/<sub>2</sub> digits 12.5 mm high. Message display of 6 alphanumeric characters, 7 mm high. Warning flags and units (pH and mV).

**J. Power supply**

- : Nominal 24 volt DC loop powered system.
- PH202G : Up to 40 volts.
- PH202S : Up to 31.5 volts.



**Fig. 2-1. Supply voltage/ load diagram**



**Fig. 2-2. Minimum terminal voltage at the PH202**



**K. Input isolation** : 1000V DC

**2-2. Operating specifications**

**A. Performance : pH**

- Linearity :  $\leq 0.01 \text{ pH} \pm 0.02 \text{ mA}$
- Repeatability :  $< 0.01 \text{ pH} \pm 0.02 \text{ mA}$
- Accuracy :  $\leq 0.01 \text{ pH} \pm 0.02 \text{ mA}$

**Performance : ORP**

- Linearity :  $\leq 1 \text{ mV} \pm 0.02 \text{ mA}$
- Repeatability :  $< 1 \text{ mV} \pm 0.02 \text{ mA}$
- Accuracy :  $\leq 1 \text{ mV} \pm 0.02 \text{ mA}$

**Performance** : Temperature with Pt1000  $\Omega$ , 3 $\lambda$ U Balco, 5k/U, 35 U, 6k $\zeta$ U, PTC10k $\Omega$  & 8k55 $\Omega$

- Linearity :  $\leq 0.3 \text{ }^\circ\text{C} \pm 0.02 \text{ mA}$
- Repeatability :  $< 0.1 \text{ }^\circ\text{C} \pm 0.02 \text{ mA}$
- Accuracy :  $\leq 0.3 \text{ }^\circ\text{C} \pm 0.02 \text{ mA}$

**Performance : Temperature with Pt100  $\Omega$**

- Linearity :  $\leq 0.4 \text{ }^\circ\text{C} \pm 0.02 \text{ mA}$
- Repeatability :  $< 0.1 \text{ }^\circ\text{C} \pm 0.02 \text{ mA}$
- Accuracy :  $\leq 0.4 \text{ }^\circ\text{C} \pm 0.02 \text{ mA}$

**B. Ambient operating temperature**

: -10 to + 55  $^\circ\text{C}$  (10 to 131  $^\circ\text{F}$ )  
Excursions to -30 $^\circ\text{C}$  (-20  $^\circ\text{F}$ ) do not influence the current output function, and excursions to + 70 $^\circ\text{C}$  (160 $^\circ\text{F}$ ) are acceptable too.

**C. Storage temperature**

: -30 to +70  $^\circ\text{C}$  (-20 to 160  $^\circ\text{F}$ )

**D. Humidity**

: 10 to 90% RH

**mA** **E. HART specification**

- Min. cable diameter : 0.51 mm, 24 AWG
- Max. cable length : 1500 m
- Detailed information can be found at: [www.hartcomm.org](http://www.hartcomm.org)

**F. Housing**

: Cast aluminium case with chemically resistant coating, cover with flexible polycarbonate window. Case color is off-white and cover is moss green. Cable entry is via two 1/2" polyamide glands. Cable terminals are provided for up to 2.5 mm<sup>2</sup> finished wires. Weather resistant to IP65 and NEMA 4X standards. Pipe wall or panel mounting, using optional hardware.

**G. Shipping details** : Package size w x h x d  
290 x 225 x 170 mm.  
11.5 x 8.9 x 6.7 in.  
Packed weight approximately 2.5 kg (5lb).

**H. Data protection** : EEPROM for configuration and logbook, and lithium cell for clock.

**I. Watchdog timer** : Checks microprocessor

**J. Automatic safeguard** : Return to measuring mode when no keystroke is made for 10 min.

**K. Operation protection** : 3-digit programmable password.

**L. Sensor impedance checking** : Independent impedance check on measuring and reference sensor elements, with temperature compensation. Display of sensor impedance on message line of display. FAIL flag in event of "out of limits" impedance, and the possibility of 22 mA or 3.9 mA error signal.

**M. DD Specification** : The PH202 Device Description is available enabling communications with the Handheld communicator (HHC) and compatible devices. For more information contact your local Yokogawa sales offices.



**N. Regulatory compliance**

- EMC : meets council directive 89/336/EEC
- Emission : meets EN 55022 Class A
- Immunity : meets EN 61000-6-2

**O. Intrinsic safety**

- ATEX : EEx ib [ia] IIC T4 for Ta -10 to 55 °C  
EEx ib [ia] IIC T6 for Ta -10 to 40 °C  
KEMA 00ATEX1068 X



- CSA : Ex ia CL 1, DIV 1, GP C&D,  
T3C for Ta -10 to 55 °C  
Refer to Installation Drawing  
PH202S CSA



- FM : IS CL 1, DIV 1, GP ABCD  
T3B for Ta -10 to 55 °C  
T4 for Ta -10 to 40 °C  
HAZ LOC per Control Drawing  
FF1-PH202S-00

**P. Non-Incendive**

- FM : NI CL 1, DIV 2, GP ABCD  
T3B for Ta -10 to 55 °C  
T4 for Ta -10 to 40 °C  
HAZ LOC per Control Drawing  
FF1-PH202S-00



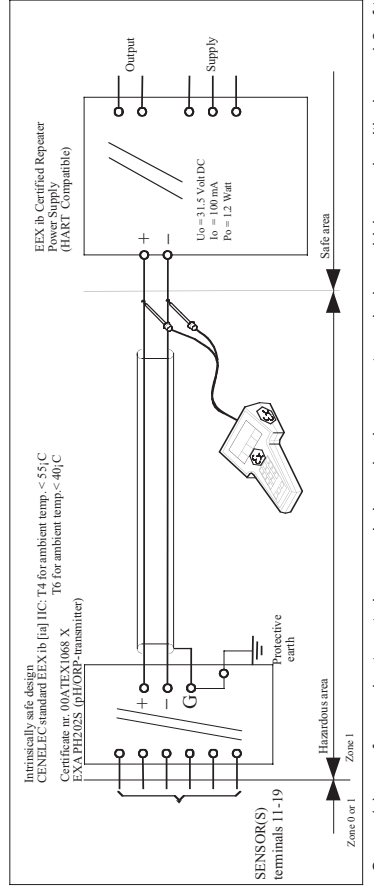
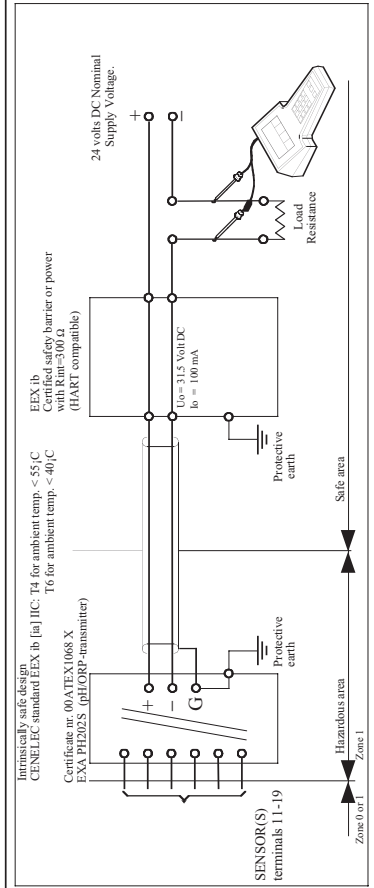
- ATEX : EEx nA [L] IIC T4 for Ta -10 to 55 °C  
EEx nA [L] IIC T6 for Ta -10 to 40 °C  
KEMA 00ATEX1115 X

**2-3. Model and suffix codes**

Mode•	Suffix Code	Option code	Description
PH202G			PH/ORP Transmitter, General Purpose version
Type	- E - C - U - F - P - E		Milli-amp (+HART) version, European style Milli-amp (+HART) version, Canadian style Milli-amp (+HART) version, North American style FOUNDATION ® Fieldbus version Profibus PA version Always E
Options		/H /U /SCT /Q	Hood for Sun Protection Pipe & Wall mounting hardware Stainless steel tagplate Calibration certificate

Mode•	Suffix Code	Option code	Description
PH202S			PH/ORP Transmitter, Intrinsic Safe version
Type	- E - C - U - F - P - N - B - D - E		Milli-amp (+HART) version, European style Milli-amp (+HART) version, Canadian style Milli-amp (+HART) version, North American style FOUNDATION ® Fieldbus version Profibus PA version Non-Incendive Milli-amp (+HART) version Non-Incendive FOUNDATION ® Fieldbus version Non-Incendive Profibus PA version Always E
Options		/H /U /SCT /Q	Hood for Sun Protection Pipe & Wall mounting hardware Stainless steel tagplate Calibration certificate

<p><b>Stamp Company :</b></p>	<p><b>Stamp Certification Institute :</b></p>
<p><b>Signature :</b></p>	<p><b>Remarks :</b> Model EXA PH202S</p>
<p><b>Title : Control Drawing PH202S Cenelec</b></p>	
<p><b>Number : FF1-PH202S-00</b></p>	<p><b>Page : 1 of 10</b></p>
<p><b>Revision : 5.4</b></p>	
<p><b>Date : 01/07/2004</b></p>	



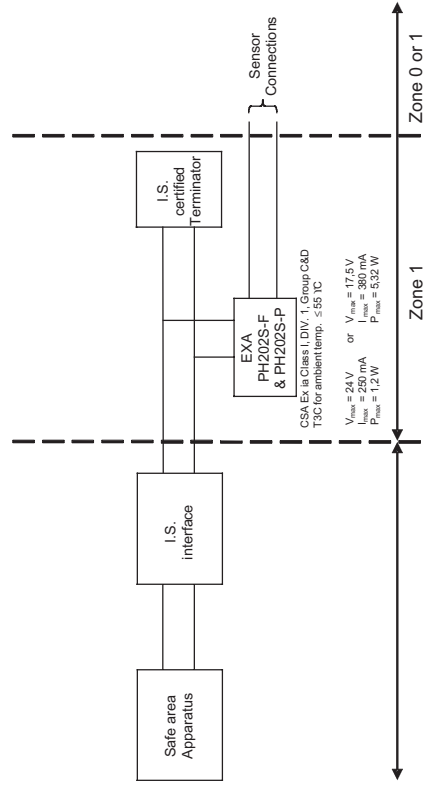
- Sensor(s) are of a passive type to be regarded as simple apparatus, devices which comply with clause 1.3 of the EN 50014.
- Electrical data of the EXAPH202S.
  - Supply and output circuit (terminals + and -):
    - Maximum input voltage U<sub>i</sub> = 31.5 V.
    - Maximum input current I<sub>i</sub> = 100 mA.
    - Maximum input power P<sub>i</sub> = 1.2 W.
  - Effective internal capacitance C<sub>i</sub> = 22 nF.
  - Effective internal inductance L<sub>i</sub> = 22 µH.
  - Sensor input circuit (terminals 11 through 19):
    - Maximum output voltage U<sub>o</sub> = 14.4 V.
    - Maximum output current I<sub>o</sub> = 32.3 mA.
    - Maximum allowed external capacitance C<sub>o</sub> = 600 nF.
    - Maximum allowed external inductance L<sub>o</sub> = 36 mH.
- Barriers and power supply specification must not exceed the maximum values as shown in the diagram above. These safety descriptions cover most of the commonly used industry standard barriers, isolators and power supplies.
- The Hand Held Communicator must be of a ATEX certified intrinsically safe type in case it is used on the intrinsically safe circuit in the hazardous area or of a ATEX certified non-incendive type in case it is used in the non-incendive circuit in the hazardous area.

<p><b>Stamp Company :</b></p>	<p><b>Stamp Certification Institute :</b></p>
<p><b>Signature :</b></p>	<p><b>Remarks :</b> Model EXA PH202S</p>
<div style="display: flex; justify-content: space-between;"> <div data-bbox="231 1265 646 2049"> <p>Safe area Apparatus</p> <p>I.S. interface</p> <p>EXA PH202S-F &amp; PH202S-P</p> <p>I.S. certified terminator</p> <p>Sensor Connections</p> <p>Safe area</p> <p>Zone 1</p> <p>Zone 0 or 1</p> <p>Hazardous area</p> <p>EE: 100 IIC T4 for ambient temp. ≤ 55 °C T6 for ambient temp. ≤ 40 °C</p> <p>Certificate no. 00ATEX1088 X</p> <p>U<sub>i</sub> = 24 V or U<sub>i</sub> = 17.5 V I<sub>i</sub> = 250 mA or I<sub>i</sub> = 380 mA P<sub>i</sub> = 1.2 W or P<sub>i</sub> = 5.32 W</p> </div> <div data-bbox="718 1321 1141 2049"> <p>&lt; Sensor(s) are of a passive type to be regarded as 'simple apparatus', devices which comply with clause 1.3 of the EN 50014.</p> <p>&lt; Electrical data of the EXA PH202S-F &amp; PH202S-P:</p> <ul style="list-style-type: none"> <li>- Supply and output circuit: <ul style="list-style-type: none"> <li>Maximum input voltage U<sub>i</sub>=24 V or</li> <li>Maximum input current I<sub>i</sub>=250 mA</li> <li>Maximum input power P<sub>i</sub>=1.2 W</li> </ul> </li> <li>Maximum input voltage U<sub>i</sub>=17.5 V</li> <li>Maximum input current I<sub>i</sub>=380 mA</li> <li>Maximum input power P<sub>i</sub>=5.32 W</li> </ul> <p>Effective internal capacitance C<sub>i</sub>=737 pF; Effective internal inductance L<sub>i</sub>=2.6 μH.</p> <ul style="list-style-type: none"> <li>- Sensor input circuit: <ul style="list-style-type: none"> <li>Maximum output voltage U<sub>o</sub>=14.4V; Maximum output current I<sub>o</sub>=32.3 mA</li> <li>Maximum allowed external capacitance C<sub>o</sub>=600 nF</li> <li>Maximum allowed external inductance L<sub>o</sub>=36 mH</li> </ul> </li> <li>&lt; Any I.S. interface may be used that meets the following requirements: <ul style="list-style-type: none"> <li>U<sub>o</sub> ≤ 24 V or U<sub>o</sub> ≤ 17.5 V</li> <li>I<sub>o</sub> ≤ 250 mA or I<sub>o</sub> ≤ 380mA</li> <li>P<sub>o</sub> ≤ 1.2 W or P<sub>o</sub> ≤ 5.32 W</li> </ul> </li> </ul> <p>Ca ? 737 pF + C<sub>ccable</sub>; La ? 2.6 μH + L<sub>ccable</sub></p> </div> </div>	
<p><b>Title : Control Drawing PH202S Cenelec</b></p>	
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<p><b>YOKOGAWA EUROPE B.V.</b></p>	
<p><b>Revision : 5.4</b></p>	
<p><b>Date : 01/07/2004</b></p>	

<p>Intrinsically safe design CSA Ex ia Class I, Div 1, Group C&amp;D, T4C for ambient temp. &lt;math&gt;\le 55^{\circ}\text{C}&lt;/math&gt; EXA PH202S (pH/ORP-transmitter)</p> <p>Suitable values are: <math>V_{\text{max}} = 31.5 \text{ V}_{\text{ohDC}}</math> <math>I_{\text{max}} = 100 \text{ mA}</math></p> <p>24 volts DC Nominal Supply Voltage.</p> <p>Load Resistance</p> <p>Protective earth</p> <p>Hazardous area Safe area</p>	<p>Intrinsically safe design CSA Ex ia Class I, Div 1, Group C&amp;D, T4C for ambient temp. &lt;math&gt;\le 55^{\circ}\text{C}&lt;/math&gt; EXA PH202S (pH/ORP-transmitter)</p> <p>Suitable values are: <math>V_{\text{max}} = 31.5 \text{ V}_{\text{ohDC}}</math> <math>I_{\text{max}} = 100 \text{ mA}</math> <math>P_{\text{max}} = 1.2 \text{ Watt}</math></p> <p>CSA certified Power Supply (HART compatible)</p> <p>Output</p> <p>Supply</p> <p>Protective earth</p> <p>Hazardous area Safe area</p>	<p><b>Stamp Company :</b></p>	<p><b>Signature :</b></p>	<p><b>Stamp Certification Institute :</b></p>	<p><b>Remarks :</b> Model EXA PH202S</p>	
<p><b>Title : Installation Drawing PH202S CSA</b></p>		<p><b>Number : FF1-PH202S-00</b></p>	<p><b>Page : 3 of 10</b></p>	<p><b>YOKOGAWA EUROPE B.V.</b></p>	<p><b>Revision : 5.4</b></p>	<p><b>Date : 01/07/2004</b></p>

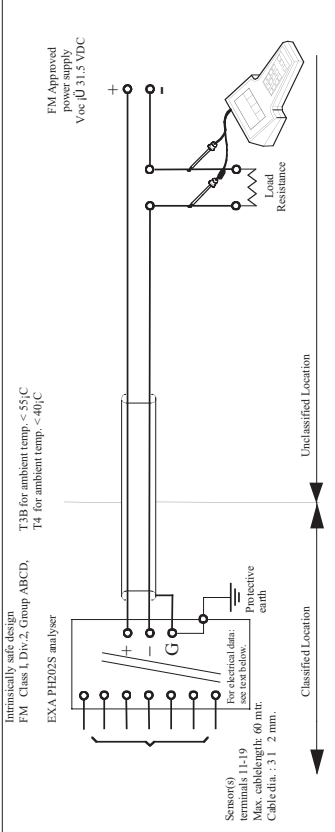
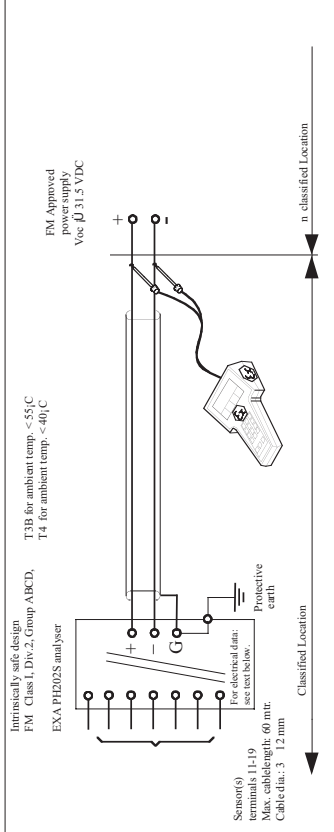
- Sensor(s) are thermocouples, RTD s, passive resistive switch devices, or are CSA entity approved and meet connection requirements.
- Electrical data of the EXA PH202S.
  - Supply and output circuit (terminals + and -):  
Maximum input voltage  $V_{\text{inmax}} = 31.5 \text{ V}$ .  
Maximum input current  $I_{\text{inmax}} = 100 \text{ mA}$ .  
Effective internal capacitance  $C_i = 22 \text{ nF}$ .  
Effective internal inductance  $L_i = 22 \mu\text{H}$ .
  - Sensor input circuit (terminals 11 through 19):  
Maximum output voltage  $V_{\text{oc}} = 14.4 \text{ V}$ .  
Maximum output current  $I_{\text{sc}} = 32.3 \text{ mA}$ .  
Maximum allowed external capacitance  $C_a = 600 \text{ nF}$ .  
Maximum allowed external inductance  $L_a = 36 \text{ mH}$ .
- Barriers and power supply should be CSA certified. The specifications must not exceed the maximum values as shown in the diagram above.
- Installation should be in accordance with Canadian Electrical Code, Part I or CEC, Part I.
- Maximum safe area voltage should not exceed  $250 \text{ V}_{\text{RMS}}$ .  
The Hand Held Communicator must be of a CSA certified intrinsically safe type in case it is used on the intrinsically safe circuit in the hazardous area.

<p><b>Stamp Company :</b></p>	<p><b>Stamp Certification Institute :</b></p>
<p><b>Signature :</b></p>	<p><b>Remarks :</b> Model EXA PH202S</p>
<p><b>Title : Installation Drawing PH202S CSA</b></p>	
<p><b>Number : FF-1-PH202S-00</b></p>	<p><b>Page : 4 of 10</b></p>
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<p><b>YOKOGAWA EUROPE B.V.</b></p>	



- < Sensor(s) are a thermocouple, RTD's, passive resistive switch devices, or is CSA entity approved and meet connection requirements.
- < Electrical data of the EXA PH202S-F & PH202S-P:
  - Supply and output circuit:
    - Maximum input voltage Vmax=24 V or Vmax=17.5 V
    - Maximum input current Imax=250 mA or Imax=380 mA
    - Maximum input power Pmax=1.2 W or Pmax=5.32 W
  - Effective internal capacitance Ci=737 pF; Effective internal inductance Li=2.6 µH.
  - Sensor input circuit:
    - Maximum output voltage Voc=14.4V; Maximum output current Isc=32.3 mA
    - Maximum allowed external capacitance Ca=600 nF
    - Maximum allowed external inductance La=36 mH
  - < Any CSA approved I.S. interface may be used that meets the following requirements:
    - Vmax ≤ 24 V or Vmax ≤ 17.5 V
    - Imax ≤ 250 mA or Imax ≤ 380mA
    - Pmax ≤ 1.2 W or Pmax ≤ 5.32 W
  - Ca ? 737 pF + Ccable; La ? 2.6 µH + Lcable
- Installation should be in accordance with Canadian Electrical Code, Part I or CEC, Part I.
- Maximum safe area voltage should not exceed 250 Vrms.

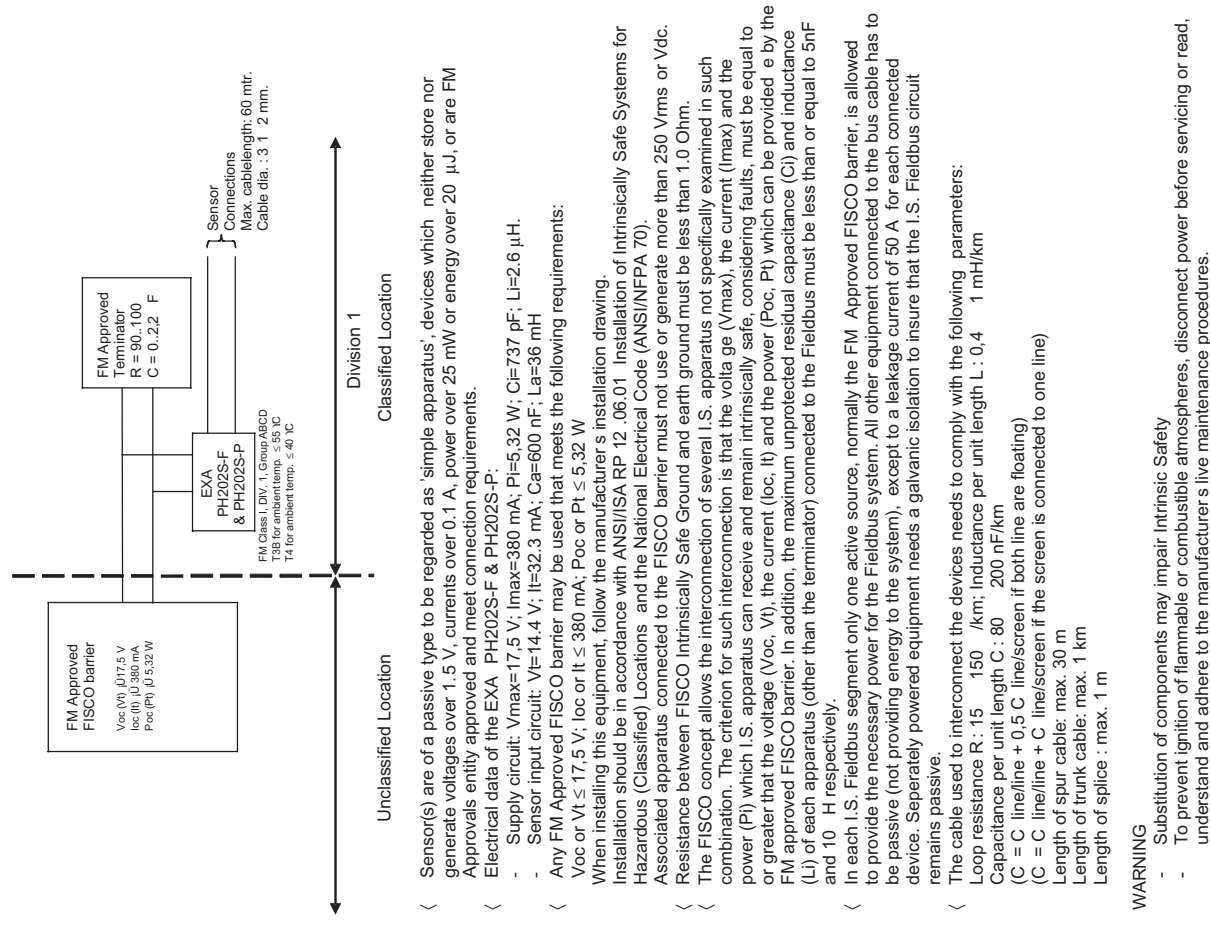
<p>Intrinsically safe design FM Class I, Div. 1, Group ABCD, EXA PH202S analyser</p> <p>T3B for ambient temp. &lt; 55°C T4 for ambient temp. &lt; 40°C</p> <p>24 volts DC Nominal Supply Voltage.</p> <p>Protective earth</p> <p>Load Resistance</p> <p>Sensors (11-19) Max. cable length: 60 mtr. Cable dia.: 3 - 12 mm.</p> <p>For electrical data: see text below.</p> <p>Classified Location</p> <p>Unclassified Location</p> <p>Figure 1</p>	<p><b>Stamp Company :</b></p> <p><b>Stamp Certification Institute :</b></p>	
<p>Intrinsically safe design FM Class I, Div. 1, Group ABCD, EXA PH202S analyser</p> <p>T3B for ambient temp. &lt; 55°C T4 for ambient temp. &lt; 40°C</p> <p>Output</p> <p>Supply</p> <p>Sensors (11-19) Max. cable length: 60 mtr. Cable dia.: 3 - 12 mm.</p> <p>For electrical data: see text below.</p> <p>Classified Location</p> <p>n. classified Location</p> <p>Figure 2</p>	<p><b>Signature :</b></p> <p><b>Remarks :</b> Model EXA PH202S</p> <p><b>No revision to drawing without prior FM Approval</b></p>	
<p><b>Electrical data of the EXA PH202S :</b></p> <ul style="list-style-type: none"> <li>- Supply circuit (terminals + and -): Maximum input voltage <math>V_{max} = 31.5</math> V. Maximum input current <math>I_{max} = 100</math> mA. Maximum input power <math>P = 1.2</math> W. Effective internal capacitance <math>C_i = 22</math> nF. Effective internal inductance <math>L_i = 22</math> μH.</li> <li>If Hand Held Terminal (HHT) is not connected to the power supply lines of the EXA PH202S (see figure 1): Any FM Approved barrier or power supply may be used that meets the following requirements: <math>V_{oc}</math> or <math>V_i \leq 31.5</math> V; <math>I_{sc}</math> or <math>I_i \leq 100</math> mA; <math>C_a \geq 22</math> nF + <math>C_{cable}</math>; <math>L_a \geq 22</math> μH + <math>L_{cable}</math></li> <li>If HHT is connected to the power supply lines of the EXA PH202S (see figure 2): The Hand Held Terminal must be FM Approved. Refer to the manufacturer's control drawing of the HHT and the barrier/power supply to determine the cable parameters. <math>(V_{oc}</math> or <math>V_i) + V_{HHT} \leq 31.5</math> V; <math>(I_{sc}</math> or <math>I_i) + I_{HHT} \leq 100</math> mA; <math>C_a \geq 22</math> nF + <math>C_{cable}</math> + <math>C_{HHT}</math>; <math>L_a \geq 22</math> μH + <math>L_{cable}</math> + <math>L_{HHT}</math></li> </ul> <p>When installing this equipment, follow the manufacturer's installation drawing. Installation should be in accordance with ANSI/ISA RP 12.06.01. Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations and the National Electrical Code (ANSI/NFPA 70). Control equipment connected to the barrier/power supply must not use or generate more than 250 Vrms or Vdc. Resistance between Intrinsically Safe Ground and earth ground must be less than 1.0 Ohm.</p>		<p><b>Title : FM Control Drawing PH202S (Intrinsic Safety)</b></p>
<p><b>WARNING</b></p> <ul style="list-style-type: none"> <li>- Substitution of components may impair Intrinsic Safety</li> <li>- To prevent ignition of flammable or combustible atmospheres, disconnect power before servicing or read, understand and adhere to the manufacturer's live maintenance procedures.</li> </ul> <p><b>Number : FF1-PH202S-00</b></p> <p><b>Page : 5 of 10</b></p> <p><b>Revision : 5.4</b></p> <p><b>Date : 01/07/2004</b></p> <p><b>YOKOGAWA EUROPE B.V.</b></p>		

 <p>Intrinsically safe design FM Class I, Div.2, Group ABCD, EXA PH202S analyser</p> <p>T3B for ambient temp. &lt; 55°C T4 for ambient temp. &lt; 40°C</p> <p>FM Approved power supply Voc: 31.5 VDC</p> <p>Load Resistance</p> <p>Sensor(s) terminals 11-19 Max. cable length: 60 mtr. Cable dia.: 3.1 - 2 mm.</p> <p>For electrical data, see text below.</p> <p>Protective earth</p> <p>Classified Location</p> <p>Unclassified Location</p>	<p><b>Stamp Company :</b></p> <p><b>Stamp Certification Institute :</b></p>
 <p>Intrinsically safe design FM Class I, Div.2, Group ABCD, EXA PH202S analyser</p> <p>T3B for ambient temp. &lt; 55°C T4 for ambient temp. &lt; 40°C</p> <p>FM Approved power supply Voc: 31.5 VDC</p> <p>Sensor(s) terminals 11-19 Max. cable length: 60 mtr. Cable dia.: 3 - 2 mm.</p> <p>For electrical data, see text below.</p> <p>Protective earth</p> <p>Classified Location</p> <p>n classified Location</p>	<p><b>Signature :</b></p> <p><b>Remarks :</b> Model EXA PH202S-N No revision to drawing without prior FM Approval</p>
<p><b>Title : FM Control Drawing PH202S-N (Non-incendive)</b></p>	
<p><b>Number : FF1-PH202S-00</b></p>	<p><b>Page : 6 of 10</b></p>
<p><b>YOKOGAWA EUROPE B.V.</b></p>	<p><b>Revision : 5.4</b></p>
<p><b>WARNING</b></p> <ul style="list-style-type: none"> <li>- Substitution of components may impair suitability for Division 2</li> <li>- Do not remove or replace while circuit is live unless area is known to be non-hazardous</li> <li>- Explosion Hazard — Do not disconnect equipment unless area is known to be non-hazardous</li> <li>- Do not reset circuit breaker unless power has been removed from the equipment or the area is known to be non-hazardous</li> </ul>	<p><b>Date : 01/07/2004</b></p>

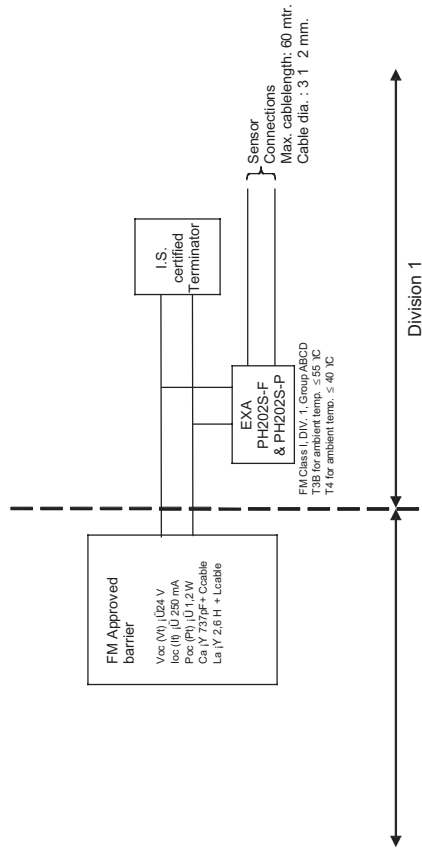
- **Electrical data of the EXA PH202S :**
  - Supply circuit (terminals + and -):  
Maximum input voltage  $V_{max} = 31.5$  V.  
Maximum input power  $P_i = 1.2$  W
  - Effective internal capacitance  $C_i = 22$  nF
  - Effective internal inductance  $L_i = 22$  H
- The Hand Held Terminal must be FM Approved in case it is used in the classified location.
- When installing this equipment, follow the manufacturers installation drawing. Installation shall be in accordance with Article 501.4(B) of the National Electrical Code (ANSI/NFPA 79).
- Nonincendive field wiring may be installed in accordance with Article 501.4(B)(3)
- Grounding shall be in accordance with Article 250 of the National Electrical code



<p><b>Stamp Company :</b></p>	<p><b>Stamp Certification Institute :</b></p>
<p><b>Signature :</b></p>	<p><b>Remarks :</b>  <b>Model EXA PH202S-F &amp; PH202S-P</b>  <b>No revision to drawing without prior FM Approval</b></p>
<p><b>Title : FM Control Drawing PH202S-F &amp; PH202S-P (Intrinsic safe Fisco concept)</b></p>	
<p><b>Number : FF1-PH202S-00</b></p>	<p><b>Page : 7 of 10</b></p>
<p><b>Revision : 5.4</b></p>	
<p><b>Date : 01/07/2004</b></p>	

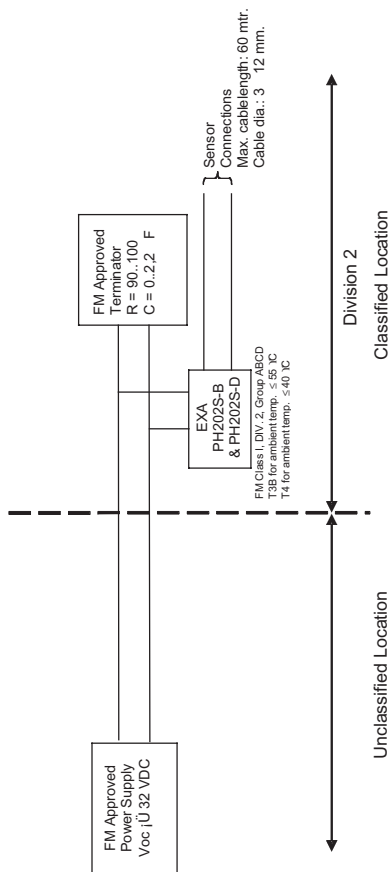


<p><b>Stamp Company :</b></p>	<p><b>Stamp Certification Institute :</b></p>
<p><b>Signature :</b></p>	<p><b>Remarks :</b>  <b>Model EXA PH202S-F &amp; PH202S-P</b>   <b>No revision to drawing without prior FM Approval</b></p>
<p><b>Title : FM Control Drawing PH202S-F &amp; PH202S-P (Intrinsic safe Entity concept)</b></p>	
<p><b>Number : FF1-PH202S-00</b></p>	<p><b>Page : 8 of 10</b></p>
<p><b>Revision : 5.4</b></p>	
<p><b>Date : 01/07/2004</b></p>	
<p><b>YOKOGAWA EUROPE B.V.</b></p>	



- < Sensor(s) are of a passive type to be regarded as 'simple apparatus', devices which neither store nor generate voltages over 1.5 V, currents over 0.1 A, power over 25 mW or energy over 20 µJ, or are FM Approvals entity approved and meet connection requirements.
  - < Electrical data of the EXA PH202S-F & PH202S-P:
    - Supply circuit:
      - Maximum input voltage Vmax=24 V
      - Maximum input current Imax=250 mA
      - Maximum input power Pi=1.2 W
      - Effective internal capacitance Ci=737 pF; Effective internal inductance Li=2.6 µH.
    - Sensor input circuit:
      - Maximum output voltage Vi=14.4 V; Maximum output current Ii= 32.3 mA
      - Maximum allowed external capacitance Ca=600 nF
      - Maximum allowed external inductance La= 36 mH
  - < Any FM Approved barrier may be used that meets the following requirements:
    - Voc or Vi ≤ 24 V
    - Ioc or Ii ≤ 250 mA
    - Poc or Pi ≤ 1.2 W
    - Ca ? 737 pF + Ccable; La ? 2.6 µH + Lcable
- When installing this equipment, follow the manufacturer's installation drawing. Installation should be in accordance with ANSI/ISA RP 12.06.01 Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations and the National Electrical Code (ANSI/NFPA 70).
- Associated apparatus connected to the barrier must not use or generate more than 250 Vrms or Vdc.
- < Resistance between Intrinsically Safe Ground and earth ground must be less than 1.0 Ohm.
- WARNING**
- Substitution of components may impair Intrinsic Safety
  - To prevent ignition of flammable or combustible atmospheres, disconnect power before servicing or read, understand and adhere to the manufacturer's live maintenance procedures.

<p><b>Stamp Company :</b></p>	<p><b>Stamp Certification Institute :</b></p>
<p><b>Signature :</b></p>	<p><b>Remarks :</b>  <b>Model EXA PH202S-B &amp; PH202S-D</b>   <b>No revision to drawing without prior FM Approval</b></p>
<p><b>Title : FM Control Drawing PH202S-B &amp; PH202S-D (Non-incendive Entity concept)</b></p> <p><b>Number : FF1-PH202S-00</b></p> <p><b>Page : 10 of 10</b></p> <p><b>Revision : 5.4</b></p> <p><b>Date : 01/07/2004</b></p>	
<p><b>YOKOGAWA EUROPE B.V.</b></p>	



< Sensor(s) are of a passive type to be regarded as 'simple apparatus', devices which neither store nor generate voltages over 1.5 V, currents over 0.1 A, power over 25 mW or energy over 20 μJ, or are FM Approvals entity approved and meet connection requirements.

< Electrical data of the EXA PH202S-B & PH202S-D:

- Supply circuit: Vmax=32 V; P=1.2 W; Ci= 737 pF; Li= 2.6 H
- Sensor input circuit: Vi=14.4 V; Ii=32.3 mA; Ca=600 nF; La=36 mH

When installing this equipment, follow the manufacturers installation drawing.  
 Installation shall be in accordance with Article 501.4(B) of the National Electrical Code (ANSI/NFPA 79).  
 Nonincendive field wiring may be installed in accordance with Article 501.4(B)(3)  
 < Grounding shall be in accordance with Article 250 of the National Electrical code.

- WARNING**
- Substitution of components may impair suitability for Division 2.
  - Do not remove or replace while circuit is live unless area is known to be non-hazardous
  - Explosion Hazard —Do not disconnect equipment unless area is known to be non-hazardous
  - Do not reset circuit breaker unless power has been removed from the equipment or the area is known to be non-hazardous



### 3. INSTALLATION AND WIRING

#### 3-1. Installation and dimensions

##### 3-1-1. Installation site

The EXA converter is weatherproof and can be installed inside or outside. It should, however, be installed as close as possible to the sensor to avoid long cable runs between sensor and converter. In any case, the cable length should not exceed 50 meters (162 feet). Select an installation site where:

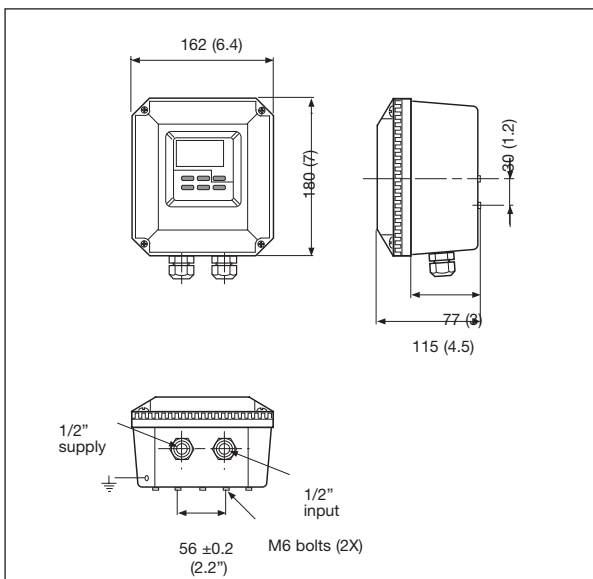
- Mechanical vibrations and shocks are negligible
- No relay/power switches are in the direct environment
- Access is possible to the cable glands (see figure 3-1)
- The transmitter is not mounted in direct sunlight or severe weather conditions
- Maintenance procedures are possible (avoiding corrosive environments)

The ambient temperature and humidity of the installation environment must be within the limits of the instrument specifications. (See chapter 2).

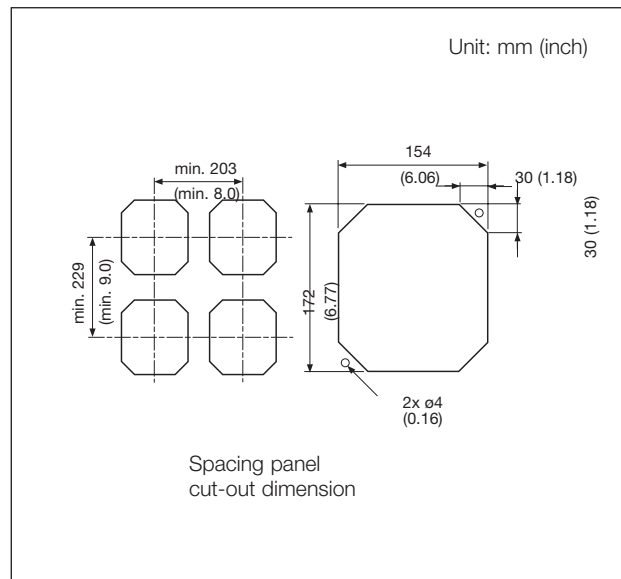
##### 3-1-2. Mounting methods

Refer to figures 3-2 and 3-3. Note that the EXA converter has universal mounting capabilities:

- Panel mounting using two (2) self-tapping screws
- Surface mounting on a plate (using bolts from the back)
- Wall mounting on a bracket (for example, on a solid wall)
- Pipe mounting using a bracket on a horizontal or vertical pipe (maximum pipe diameter 50 mm)



**Fig. 3-1. Housing dimensions and layout of glands**



**Fig. 3-2. Panel mounting diagram**

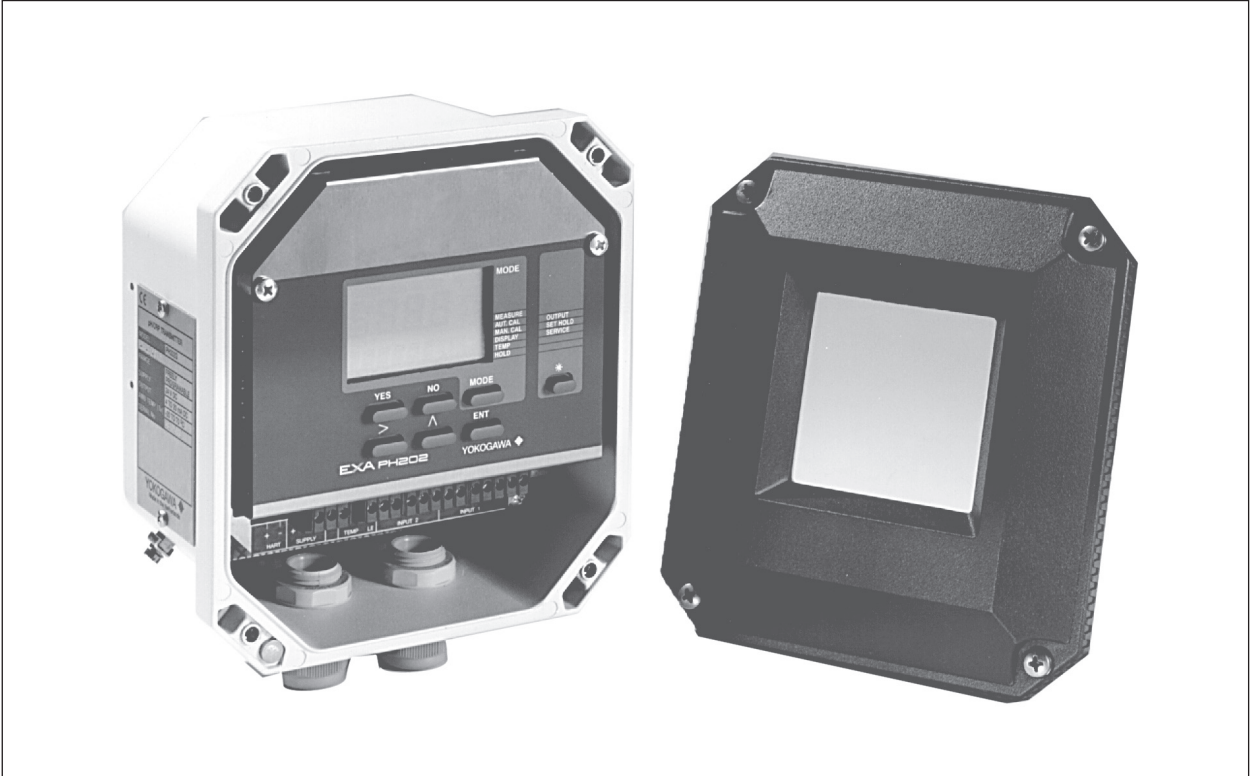
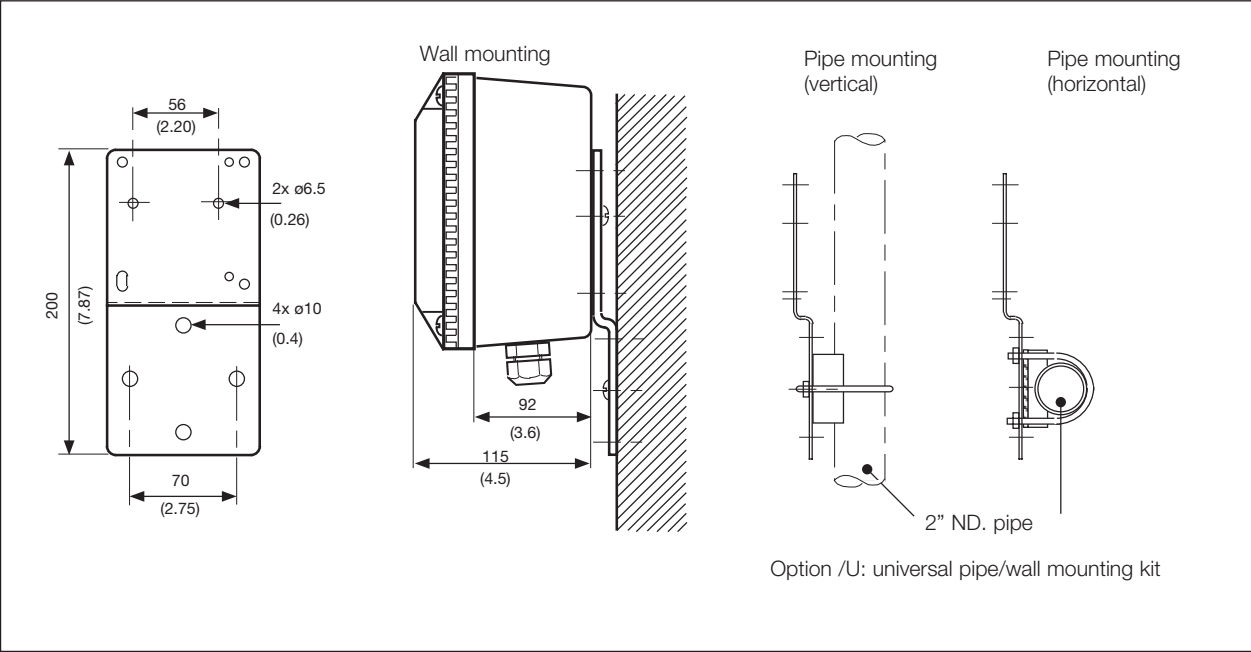


Figure 3-4. Internal view of EXA wiring compartment

### 3-2. Preparation

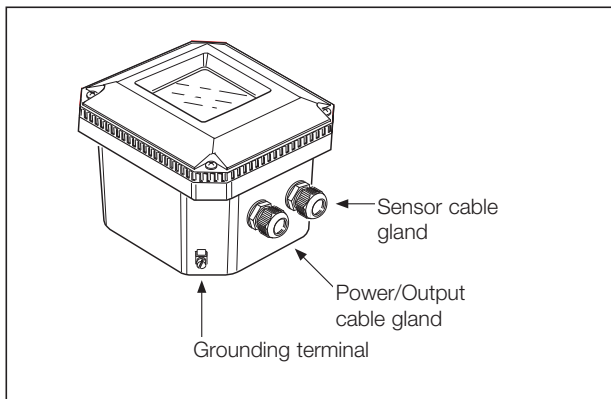
Refer to figure 3-4. The power/output connections and the sensor connections should be made in accordance with the diagram on page 3-6. The terminals are of a plug in style for ease of mounting.

To open the EXA 202 for wiring:

1. Loosen the four frontplate screws and remove the cover.
2. The terminal strip is now visible.
3. Connect the power supply. Use the gland on the left for this cable.
4. Connect the sensor input, using the gland on the right (see fig. 3-5). Switch on the power. Commission the instrument as required or use the default settings.
5. Replace the cover and secure frontplate with the four screws.
6. Connect the grounding terminals to protective earth.
7. The optional hose connection is used to guide the cables coming from an immersion fitting through a protective plastic tubing to the transmitter.

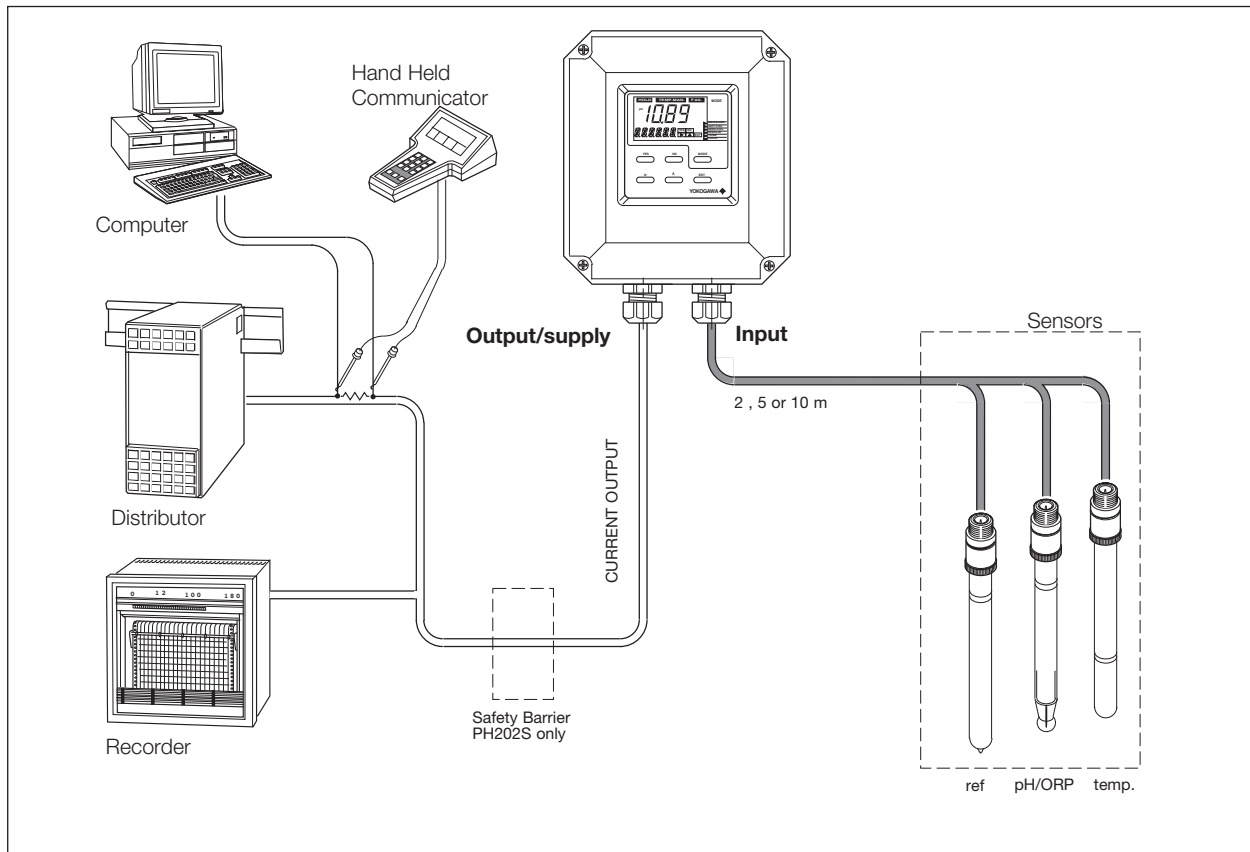
#### 3-2-1. Cables, terminals and glands

The PH202 is equipped with terminals suitable for the connection of finished cables in the size range: 0.13 to 2.5 mm (26 to 14 AWG). The glands will form a tight seal on cables with an outside diameter in the range of 7 to 12 mm (9/32 to 15/32 inches).



**Figure 3-5. Glands to be used for cabling**





**Figure 3-6. System configuration**

### 3-3. Wiring of sensors

#### 3-3-1. General precautions

Generally, transmission of signals from pH sensors is at a very low voltage and high impedance level. Thus a lot of care must be taken to avoid interference. Before connecting sensor cables to the transmitter make sure that next conditions are met:

- the sensor cables are not mounted in tracks together with high voltage and or power switching cables
- only standard coaxial electrode cables or extension cable are used
- the transmitter is mounted within the distance of the sensor cables (max. 10 m)
- the setup is kept flexible for easy insertion and retraction of the sensors in the fitting.

#### 3-3-2. Additional precautions for installations in hazardous areas

Make sure that the total of capacitances and inductances connected to the input terminals of the EXA PH202S do not exceed the limits given in the certificate.

This sets a limit to the cable and extensions used.

- The intrinsic safe version of the PH202S instrument can be mounted in Zone 1.
- The sensors can be installed in Zone 0 or Zone 1 if a safety barrier according to the limits given in the system certificate is used.
- Ensure that the total of capacitances and inductances connected to the terminals of the EXA PH202S do not exceed the limits given in the certificate of the safety barrier or distributor.
- The cable used should preferably have a BLUE colour or marking on the outside.
- Installation for (sensors in Zone 0 or 1):

Generally, the distributor with input/output isolation has no external earth connection. If there is an earth connection on the distributor and the external connection of the transmitter is connected to “protective” earth, the shield of the 2-wire cable may NOT be connected to “protective” earth at the distributor too.

### 3-3-3. Installation in: Hazardous Area-Non-Incendive

The EXA PH202S-N may be installed in a Category 3/ Zone 2/ Div.2 area without the use of safety barriers. Maximum permissible supply voltage 31.5V

### 3-3-4. Liquid earth

In all circumstances, the sensor side of the measuring loop must be grounded to the measuring liquid. The EXA PH202S uses advanced differential high impedance input circuits. This technique calls for a grounding to the liquid. In addition to that the sensor checking circuits also use the liquid earth for measurement of impedance of the sensors. All Yokogawa fittings have provisions for this connection. It is usually called liquid earth in all our manuals.

A separate connection should be made to the terminal numbered 14 in all cases to get a proper and stable measuring loop.

### 3-3-5. Access to terminal and cable entry

1. To access terminals remove the front cover of the EXA PH202S by releasing the 4 captive screws.
2. Thread the sensor cables into the connection space and connect the cables to the terminals as indicated in the wiring diagram. Make sure all connections are firm and do not touch each other.
3. Screw the gland securely and tighten it to keep out moisture. DO NOT use a wrench to tighten the nut.
4. The optional hose connection is used to guide the cables coming from an immersion fitting through a protective plastic tubing to the transmitter.

## 3-4. Wiring of power supply

### 3-4-1. General precautions

**WARNING** Do not activate the power supply yet. First make sure that the DC-power supply is according to the specifications given.

DO NOT USE ALTERNATING CURRENT OR MAINS POWER SUPPLY! !

The cable leading to the distributor (power supply) or safety barrier transports power to and output signal from the transmitter. Use a two conductor shielded cable with a size of at least 1.25 mm<sup>2</sup> and an outside diameter of 7 to 12 mm. The cable gland supplied with the instrument accepts these diameters. The maximum length of the cable is 2000 metre, or 1500 metres when using the communications. This ensures the minimum operating voltage for the instrument.

Grounding:

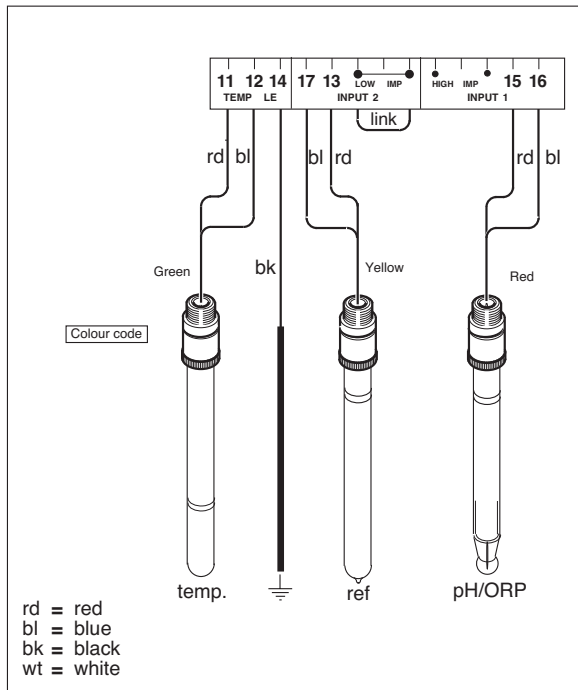
- If the transmitter is mounted on a grounded surface (e.g. a metal frame fixed in the soil) the shield of the 2-wire cable may NOT be connected to ground at the distributor.
- If the transmitter is mounted on a non-conducting surface (e.g. a brick wall) it is recommended to ground the shield of the 2-wire cable at the distributor end.

### 3-4-2. Connection of the power supply

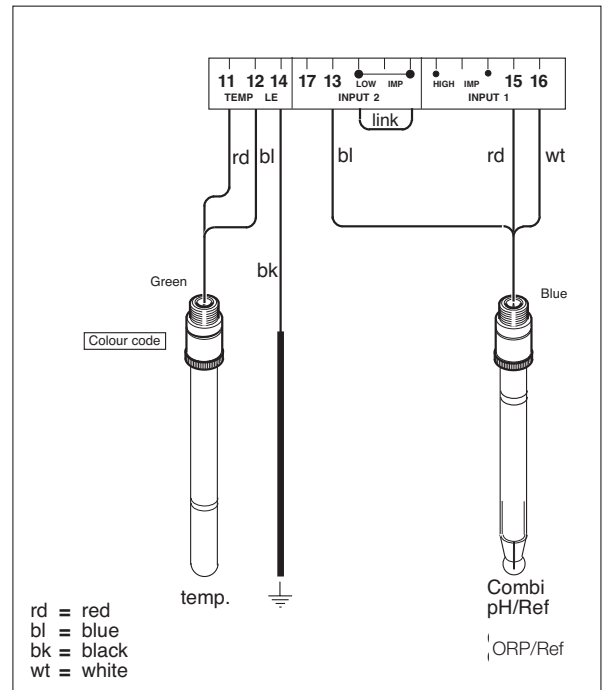
The terminal strip is accessed as was described in §3-2-1. Use the left-hand gland to insert the supply/output cable to the transmitter. Connect the supply to the terminals marked +, - and G as is indicated in figures 3-8 and 3-9.

### 3-4-3. Switching the instrument on

After all connections are made and checked, the power can be switched on from the distributor. Observe the correct activation of the instrument at the display. If for any reason the display does not indicate a value, consult the trouble shooting section.



SINGLE ELECTRODES



COMBINED ELECTRODES

Fig. 3-7. Connection diagrams

### 3-5. Wiring the sensor system

#### 3-5-1. Impedance measurement jumper settings

NOTE:

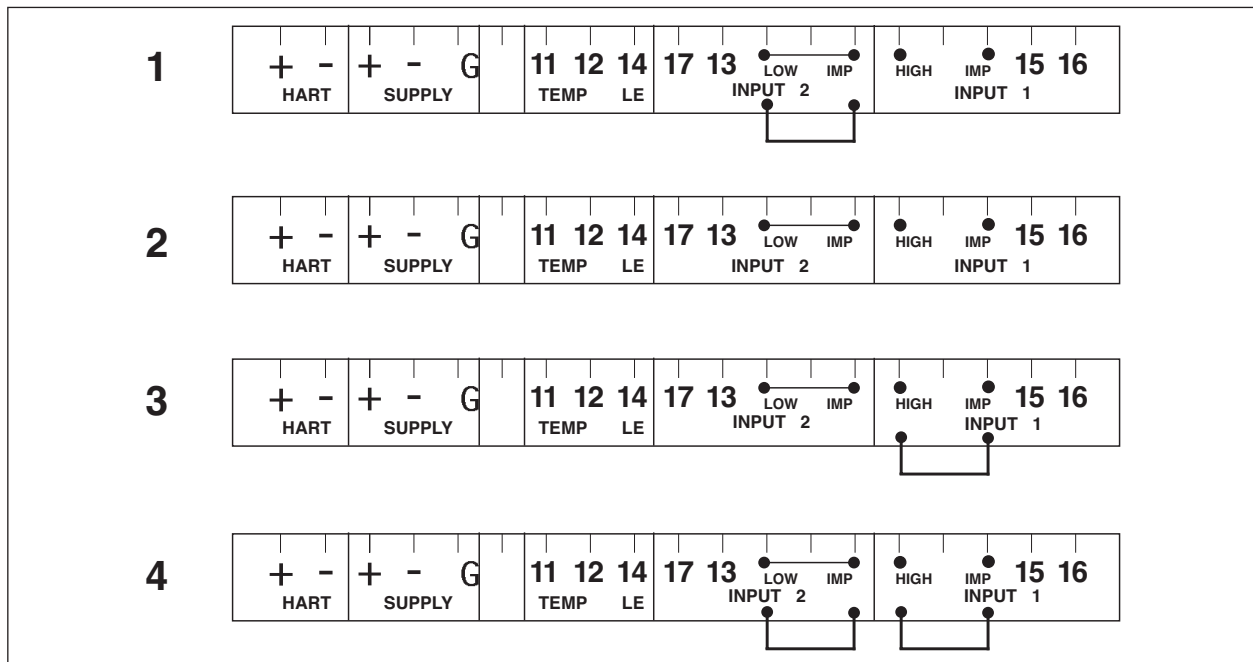
It is important to decide first which application and which settings are appropriate for the installation. This decision is best made before the jumpers are installed, because the cables will rest beside the jumpers in their installed positions.

**Table 3-1. Impedance measuring jumpers**

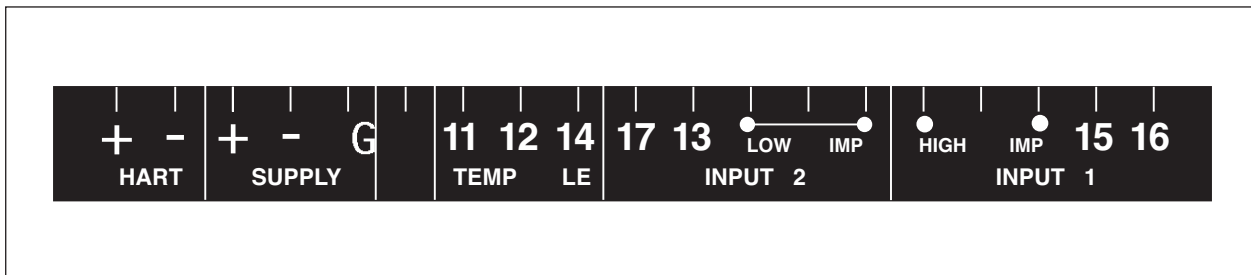
Figure no.	Jumper Settings Input #1	Jumper Settings Input #2	Application & Sensor Connections
1	High Impedance	Low Impedance	Normal pH sensors Glass sensor on Input #1 Reference sensor on Input #2
2	High Impedance	High Impedance	Special electrodes using 2 glass sensors (e.g. Pfaudler 18)
3	Low Impedance	High Impedance	ORP (pH compensated) and/or rH metal sensor on Input #1 pH glass (as reference) on Input #2
4	Low Impedance	Low Impedance	ORP (Redox measurement) metal sensor on Input #1 Normal reference on Input #2

For convenience insulated jumper links are provided. Ordinary wire links can also be used, and are just as effective.

The following four jumper figure illustrations (figure 3-8) show the jumper positions related to the figure numbers in the above table.



**Fig. 3-8. Jumper positions**



**Figure 3-9. Terminal identification labels**

### 3-6. Sensor wiring

Refer to figure 3-10, which includes drawings that outline sensor wiring.

The EXA analyzers can be used with a wide range of commercially available sensor types, both from Yokogawa and other manufacturers. The sensor systems from Yokogawa fall into two categories; the ones that use a fixed cable and the ones with separate cables.

To connect sensors with fixed cables, simply match the terminal numbers in the instrument with the identification numbers in the instrument on the cable ends.

The separate sensors and cables are not numbered, but instead use a color-coding system. The electrodes have a colored band incorporated in the label on the connection cap:

- **Red** for measuring electrodes (both pH and ORP)
- **Yellow** for reference electrodes
- **Blue** for combined sensors with both measuring and reference elements in the same body
- **Green** for temperature sensors

The recommended procedure is to color-code each end of the cables to match the sensors with the color strips provided with each cable. This provides a quick way to identify the ends of the cables belonging to a particular sensor when they are installed. (The procedure for fixing the identification labels is described in detail in the instruction sheet provided with the cable.)

**3-6-1. Connection cable**

There are two types of connection cable, one for single sensors and one for combined sensors. The former is a coaxial cable and has only two connections.

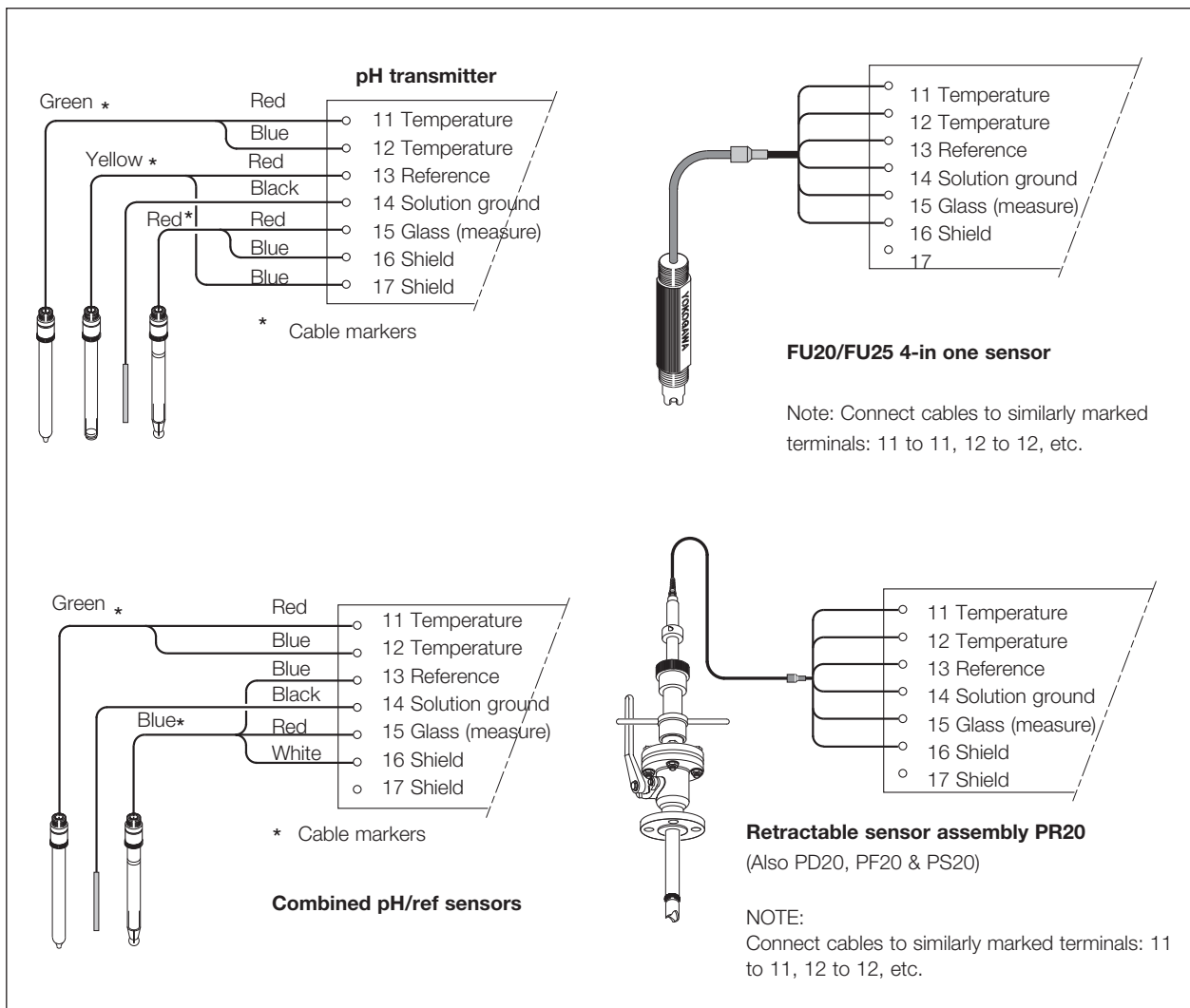
- Red to measuring element
- Blue to screen (shield)

The latter is a triaxial cable with three connections, (it has an extra white wire termination) these wires are connected:

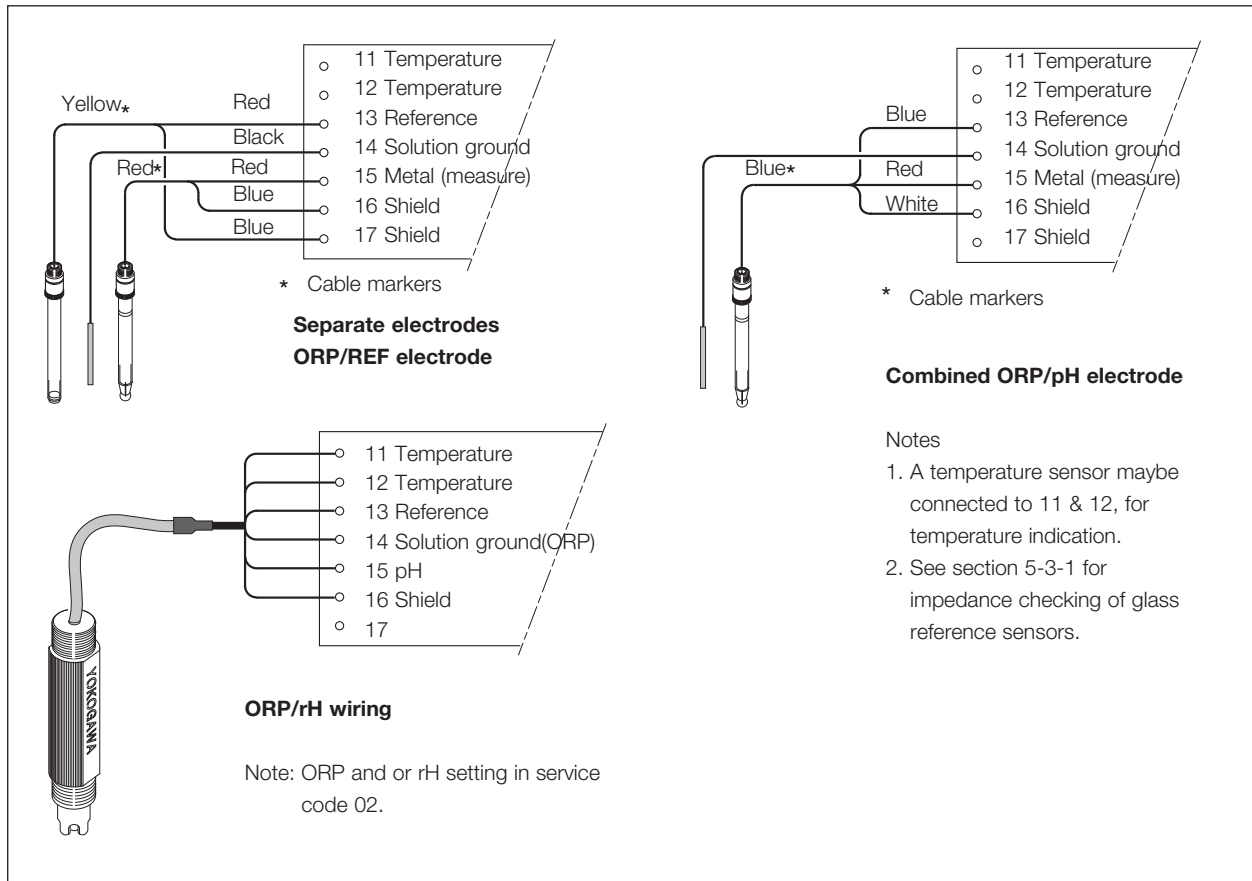
- Red to measuring element
- Blue to reference
- White to screen (shield)

To connect the other sensor systems, follow the general pattern of the terminal connections as listed below:

- 11 & 12 Temperature compensation resistor input
- 13 Input no. 2 (normally the reference element)
- 17 Screen (shield) for input no. 2
- 14 Liquid earth (solution ground) connection
- 15 Input no. 1 (normally the measuring element)
- 16 Screen (shield) for input no. 1



**Figure 3-10a. Sensor wiring**



**Figure 3-10b. Sensor wiring**

### 3-6-2. Sensor cable connection with special grommet

In order to seal multiple sensor cables into EXA, a special grommet is provided that is designed to accommodate one, two or three sensor cables (5 mm dia.) plus a liquid earth cable (2.5 mm dia.). In the pack with the grommet are blanking pieces to close any unused holes. When correctly assembled, the grommet maintains the IP65 (NEMA 4X) rating of the EXA PH202 housing.

Refer to figure 3-5 to assemble the grommet connections:

1. First remove the nut and standard rubber seal from the selected gland
2. Discard the seal. This will be replaced later by the special grommet
3. Thread the cables through the nut and the gland
4. Connect the cables to their designated terminals
5. Arrange the cables to avoid tangles and insert the grommet between the gland and the nut
6. The grommet is split to permit the cables to be mounted after connection. (This also ensures even length adjustment.)
7. Ensure that any unused holes are filled with the blanking pieces
8. Tighten the nut to form a firm seal. (Hand-tight is sufficient.)

#### NOTE:

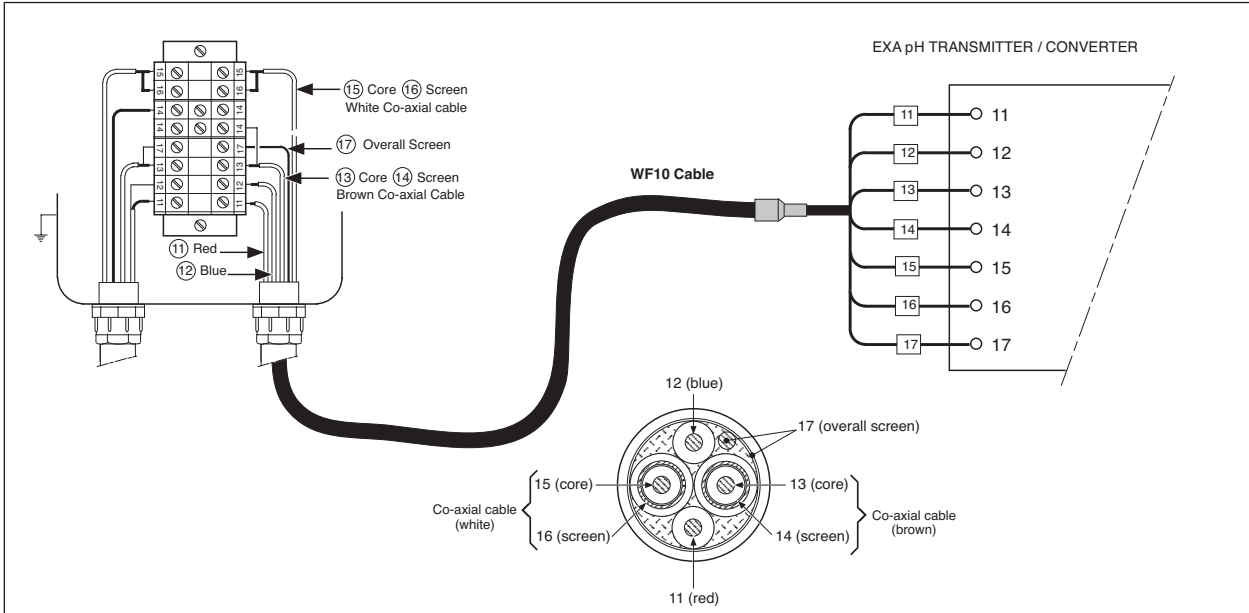
The special gland is intended to be used to seal the multiple cables from the Yokogawa flow fittings such as FF20 and FP20. The designated cables are WU20 sensor cables, which are approximately 5 mm (0.2 ") in diameter, and 82895002 liquid earth cables, which are approximately 2.5 mm (0.1 ") in diameter.

For sensor systems using a single cable, like the FU20 (FU25) and the PR20, PD20, PF20 and PS20, the standard gland will accommodate the cable adequately. Single cables between approximately 7 mm and 12 mm (0.28 " and 0.47 ") can be sealed properly with these glands.



**3-6-3. Sensor cable connections using junction box (BA10) and extension cable (WF10)**

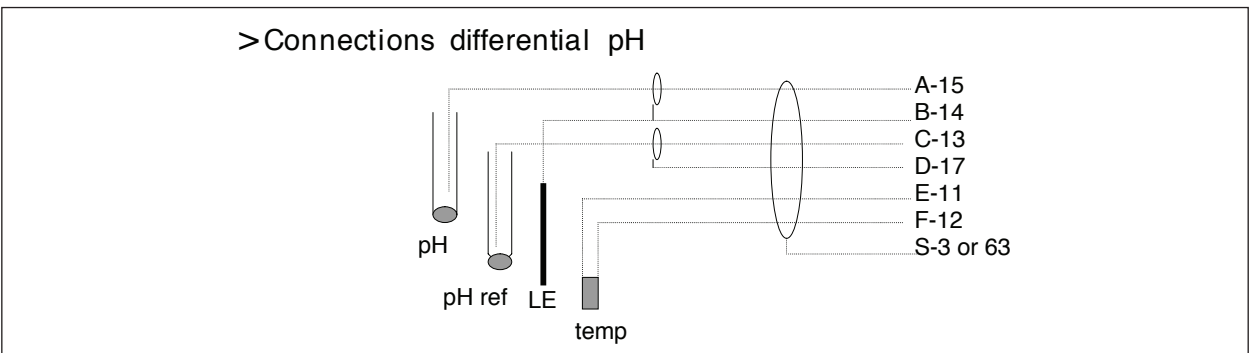
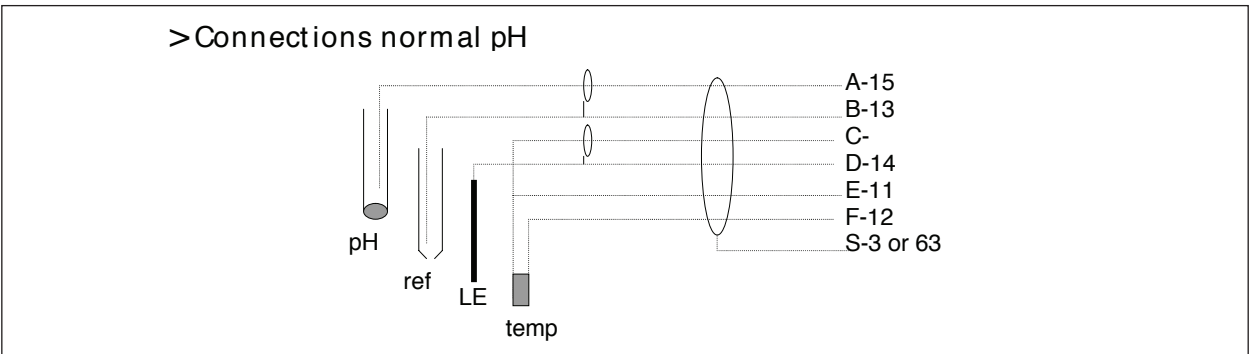
Where a convenient installation is not possible using the standard cables between sensors and converter, a junction box and extension cable may be used. The Yokogawa BA10 junction box and the WF10 extension cable should be used. These items are manufactured to a very high standard and are necessary to ensure that the specifications of the system are not compromised. The total cable length should not exceed 50 metres (e.g. 5 m fixed cable and 45 m extension cable). In the case of systems using dual high impedance sensors (e.g. Pfaudler 18), then the cable length is restricted to 20 metres (fixed cable only, no extension with WF10).



**Fig. 3-11. Connection of WF10 extension cable and BA10/BP10 junction box**

NOTE: See page 3-12 for termination for WF10 cable in combination with EXA pH.

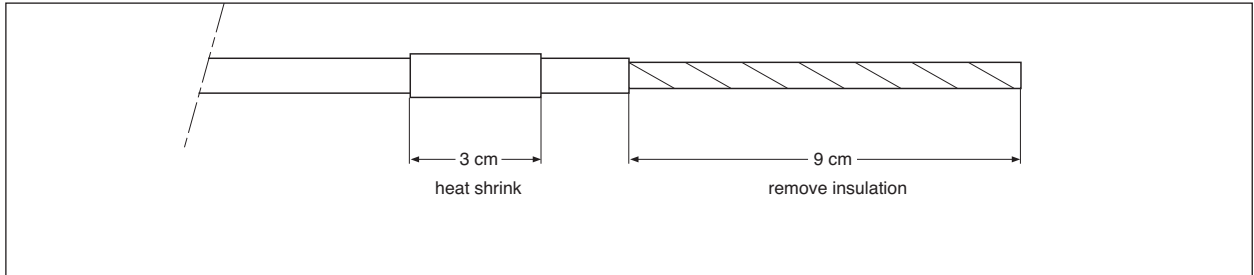
**3-6-4. Connection VP type sensor**



Extension cable may be purchased in bulk quantities, cut to length. Then it is necessary to terminate the cable as shown below.

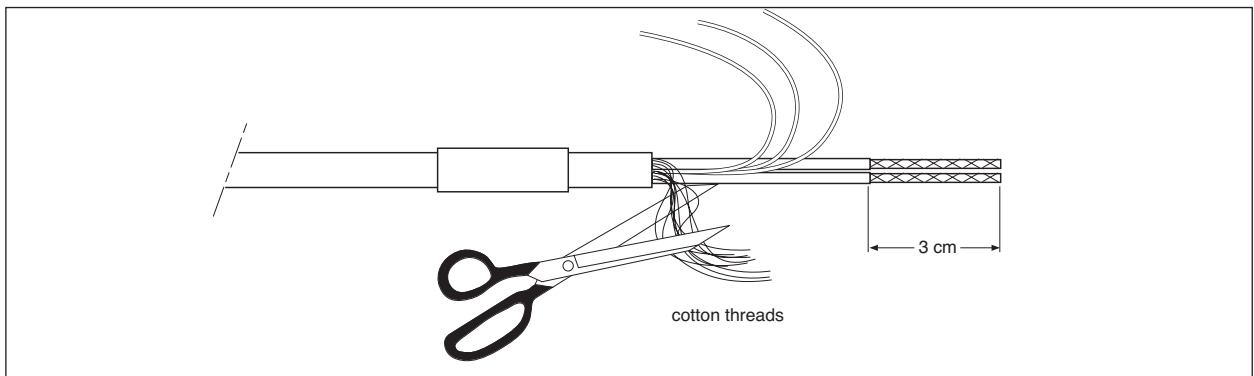
Termination procedure for WF10 cable.

1. Slide 3 cm of heat shrink tube (9 x 1.5) over the cable end to be terminated.
2. Strip 9 cm of the outer (black) insulating material, taking care not to cut or damage internal cores.



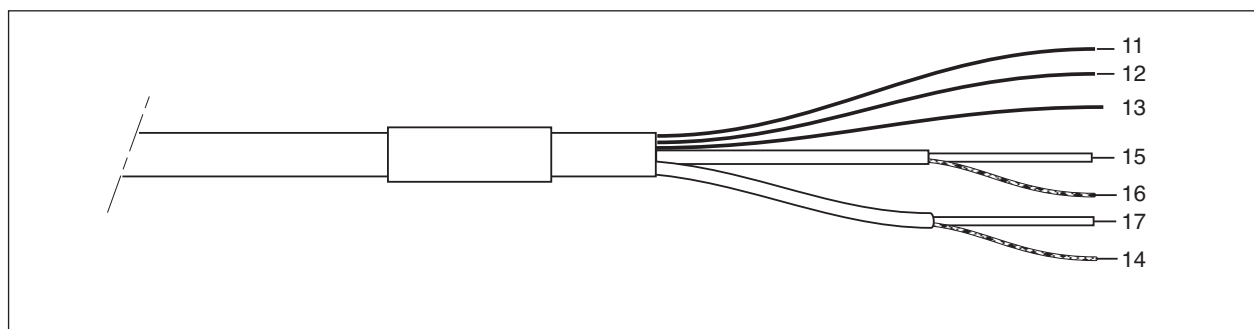
**Fig. 3-12a.**

3. Remove loose copper screening, and cut off the cotton packing threads as short as possible.
4. Strip insulation from the last 3 cm of the brown, and the white coaxial cores.



**Fig. 3-12b.**

5. Extract the coaxial cores from the braid, and trim off the black (low-noise) screening material as short as possible.
6. Insulate the overall screen and the 2 coaxial screens with suitable plastic tubing.
7. Strip and terminate all ends with suitable (crimp) terminals and identify with numbers as shown.



**Fig. 3-12c.**

8. Finally shrink the overall heat shrink tube into position.

## 4. OPERATION; DISPLAY FUNCTIONS AND SETTING

### 4-1. Operator interface

This section provides an overview of the operation of the EXA operator interface. The basic procedures for obtaining access to the three levels of operation are described briefly. For a step-by-step guide to data entry, refer to the relevant section of this user's manual. Figure 4-1 shows the EXA operator interface.

#### LEVEL 1: Maintenance

These functions are accessible by pushbutton through a flexible front cover window. The functions make up the normal day-to-day operations that an operator may be required to complete. Adjustment of the display and routine calibration are among the features accessible in this way. (See table 4-1).

#### LEVEL 2: Commissioning

A second menu is exposed when the EXA front cover is removed and the display board is revealed. Users gain access to this menu by pressing the button marked \* in the lower right of the display board. This menu is used to set such values as the output ranges and hold features. It also gives access to the service menu. (See table 4-1).

#### LEVEL 3: Service

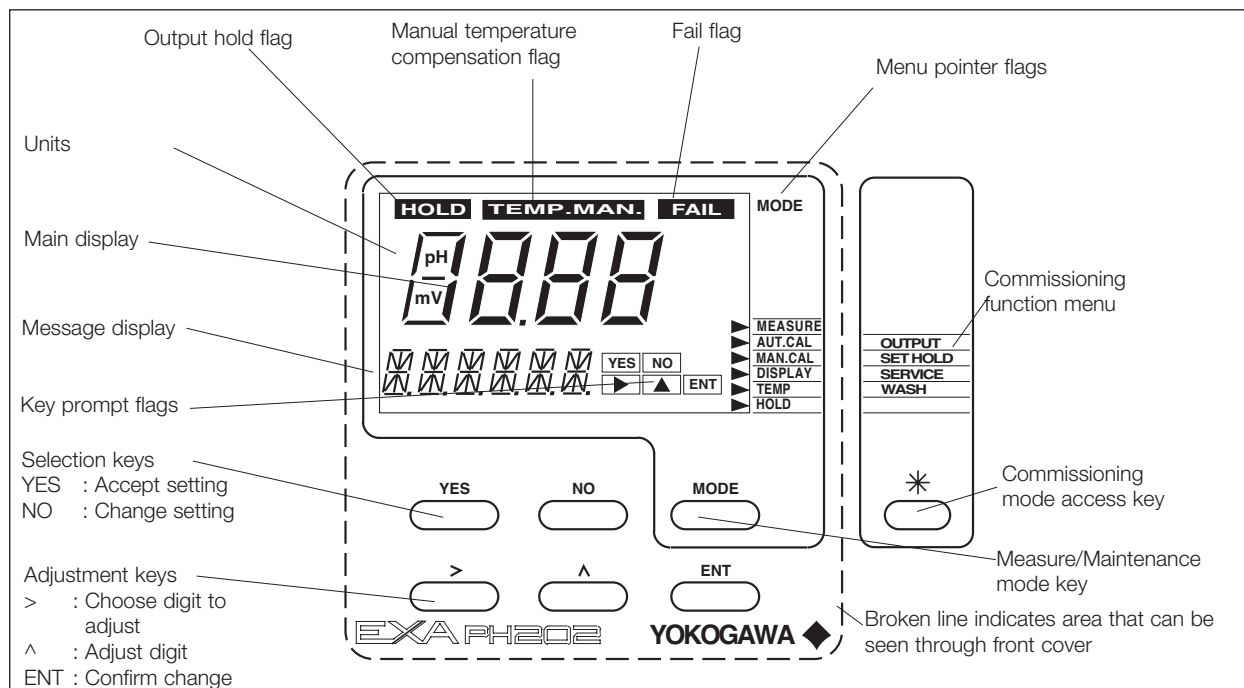
For more advanced configuration selections, press the button marked \* , then press "NO" repeatedly until you reach SERVICE. Now push the "YES" button. Selecting and entering "Service Code" numbers in the commissioning menu provide access to the more advanced functions. An explanation of the Service Codes is listed in chapter 5 and an overview table is shown in chapter 10.

**Table 4-1. Operations overview**

	<b>Routine</b>	<b>Function</b>	<b>Chapter</b>
<b>Maintenance</b>	AUT CA•	Calibration with programmed buffer solutions	6
	MAN CAL	Calibration with other buffer solutions	6
	SAMPLE	Grab sample calibration	6
	DISPLAY	Read auxiliary data or set message display	4
	MAN.IMP	Manual start of impedance check	5
	TEMP	Select automatic or manual compensation	5
	HOLD	Switch hold on/off (when activated)	5
<b>Commissioning</b>	RANGE	Adjust the output range	5
	SET HOLD	Activate the hold function	5
<b>Service</b> (Access to coded entries from the commissioning level)	SERVICE	Fine tune the specialized functions of the converter	5

**NOTE:**

All three levels may be separately protected by a password. See Service Code 52 in chapter 5 Service Code table for details on setting passwords.



**Figure 4-1. PH202 operator interface**

**4-2. Explanation of operating keys**

**MODE key** This key toggles between the measuring and maintenance modes. Press once to obtain access to the maintenance function menu.

- AUTO CAL
- MAN CAL
- DISPLAY
- SETPOINT
- WASH
- MAN.IMP
- TEMPERATURE
- HOLD

Press again to return to the measuring mode (press twice when hold is activated)

**YES/NO keys** These are used to select choices from the menu.  
 YES is used to accept a menu selection.  
 NO is used to reject a selection, or to move ahead to the next option.

**DATA ENTRY keys (▶ ▲ ENT)**

- ▶ is used as a “cursor” key. Each press on this key moves the cursor or flashing digit one place to the right. This is used to select the digit to be changed when entering numerical data.
- ▲ is used to change the value of a selected digit. Each press on this key increases the value by one unit. The value can not be decreased, so in order to obtain a lower value, increase past nine to zero, then increase to the required number.
- ENT When the required value has been set using the > & ^ keys, press ENT to confirm the data entry. Please note that the EXA does not register any change of data until the ENT key is pressed.

**\* key** This is the commissioning mode key. It is used to obtain access to the commissioning menu. This can only be done with the cover removed or opened. Once this button has been used to initiate the commissioning menu, follow the prompts and use the other keys as described above.

### 4-3. Setting passcodes

#### 4-3-1. Passcode protection

In Service Code 52, EXA users can set passcode protection for each one of the three operating levels, or for any one or two of the three levels. This procedure should be completed after the initial commissioning (setup) of the instrument. The passcodes should then be recorded safely for future reference.

When passcodes have been set, the following additional steps are introduced to the configuration and programming operations:

#### **Maintenance**

Press MODE key. The display shows 000 and \*PASS\*

Enter a 3-digit passcode as set in Service Code 52 to obtain access to the Maintenance Mode

**mA**

#### **Commissioning**

Press \* key. The display shows 000 and \*PASS\*

Enter a 3-digit passcode as set in Service Code 52 to obtain access to the Commissioning Mode.

#### **Service**

From the commissioning menu, select \*Service by pressing YES key. The display shows 000 and \*PASS\*

Enter a 3-digit passcode as set in Service Code 52 to obtain access to the Service Mode.

NOTE:

See Service Code 52 for the setting of passcodes.

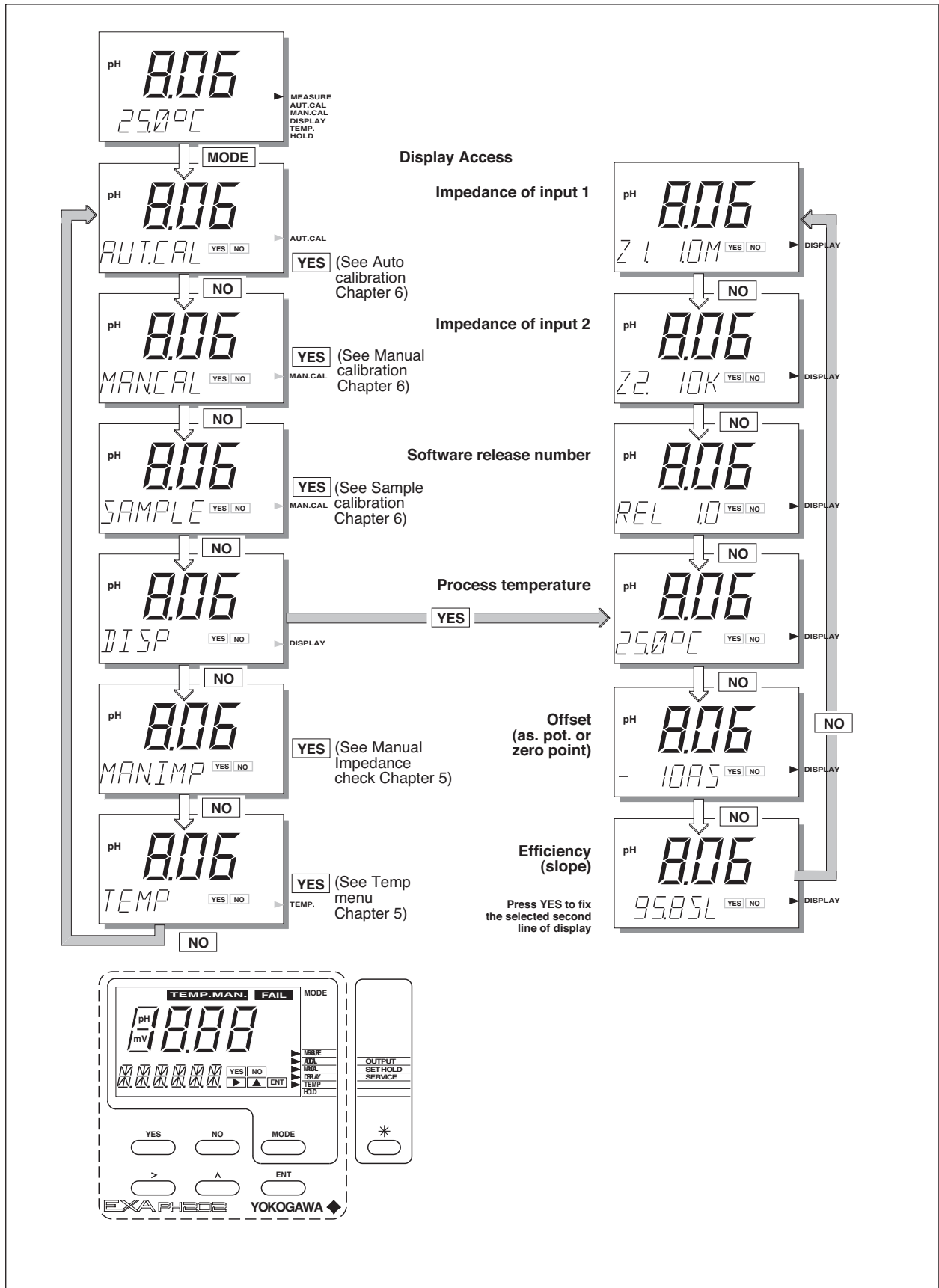
### 4-4. Display examples

The following pages show the sequence of button presses and screens displayed when working in some standard configurations.

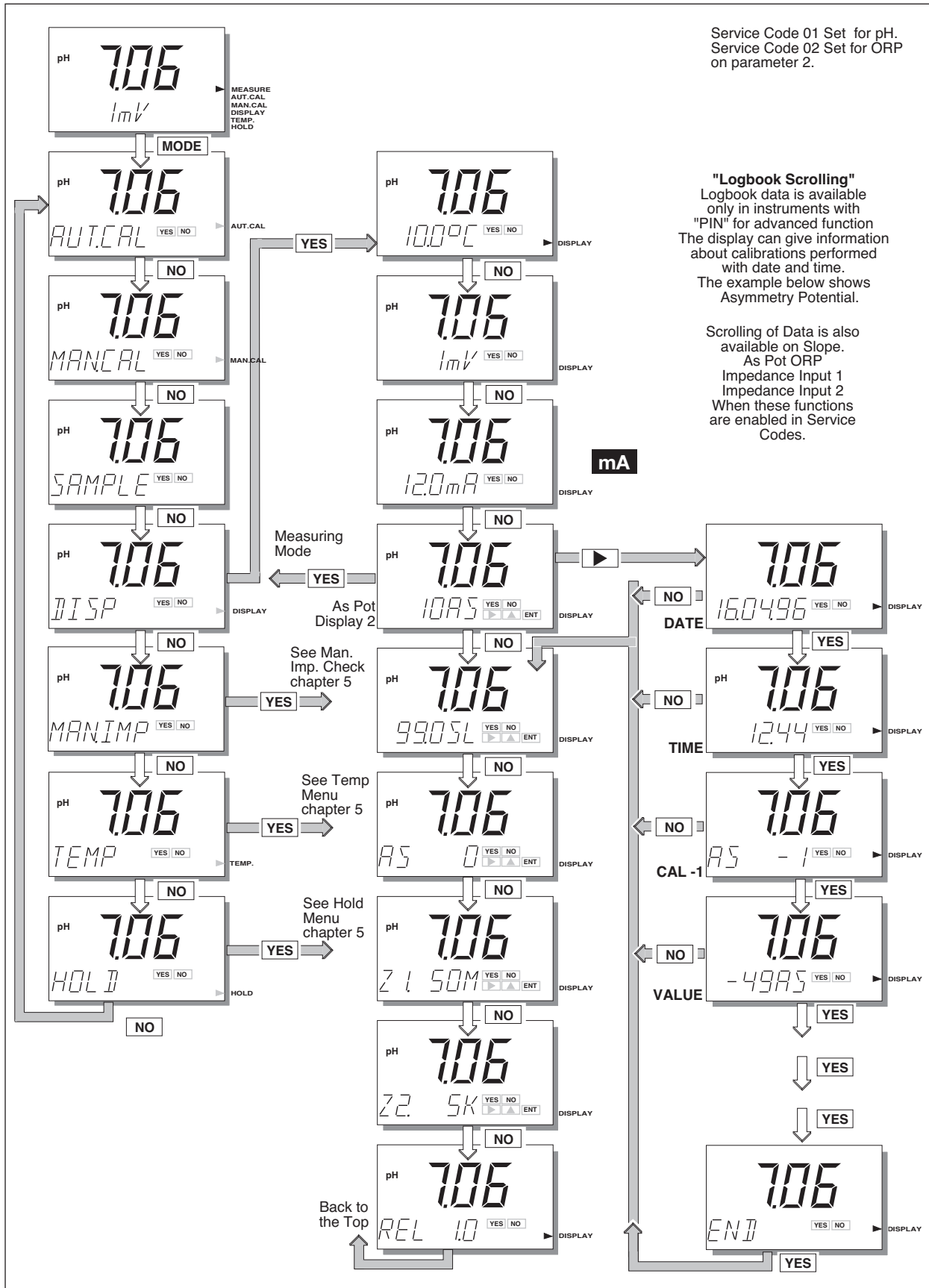
More or less options will be made available by the configuration of some service codes. For instance the impedance measurement screens do not appear when impedance checking is switched off in service codes 03 and 04.

### 4-5. Display functions

#### 4-5-1. Display functions pH (default)

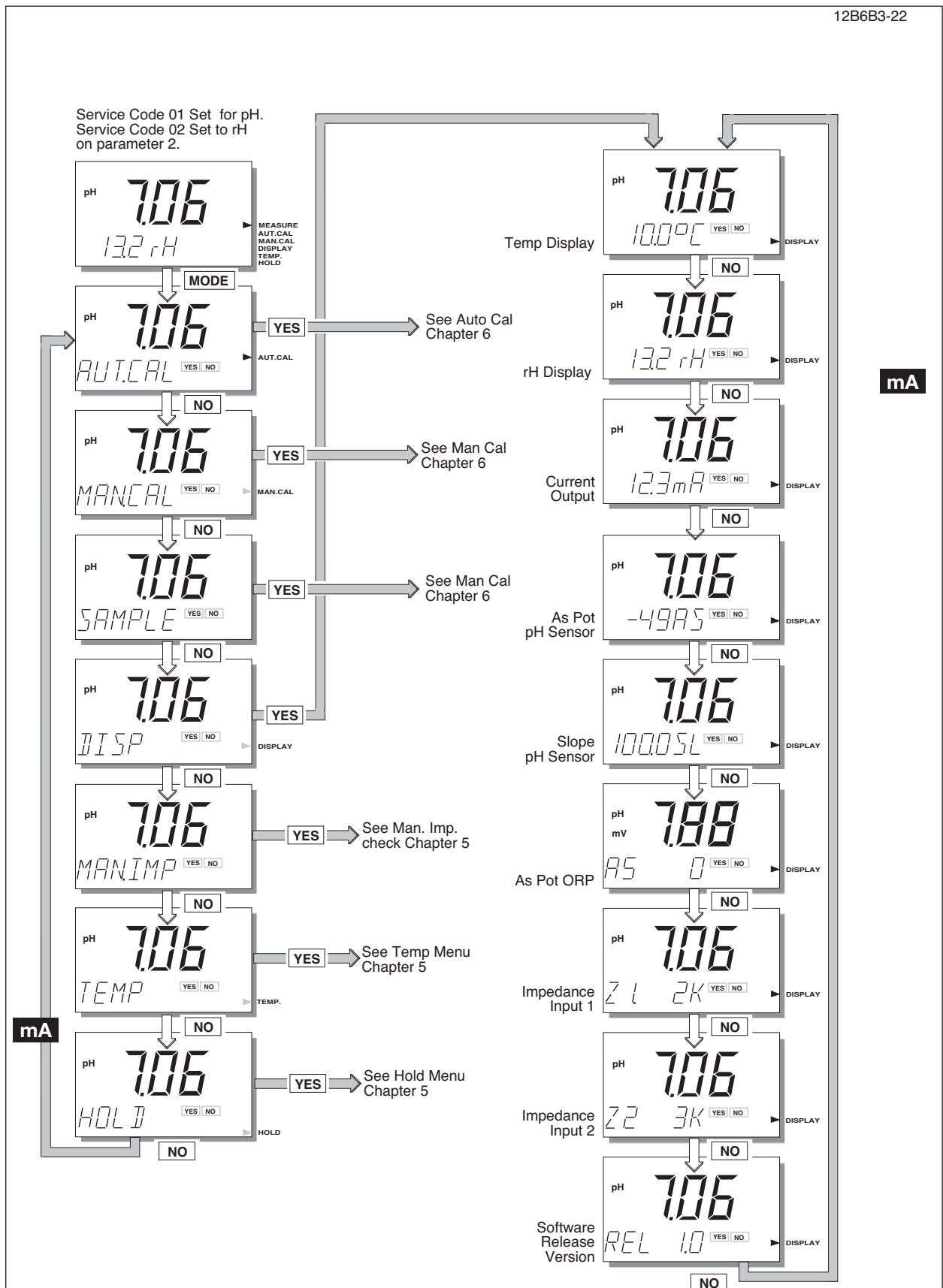


4-5-2. Display functions pH (ORP)





4-5-3. Display functions pH (rH)



## 5. PARAMETER SETTING

### 5-1. Maintenance mode

Standard operation of the EXA instrument involves use of the maintenance (or operating) mode to set up some of the parameters.

Access to the maintenance mode is available via the six keys that can be pressed through the flexible window in the instrument cover. Press the MODE-key once to enter this dialog mode.

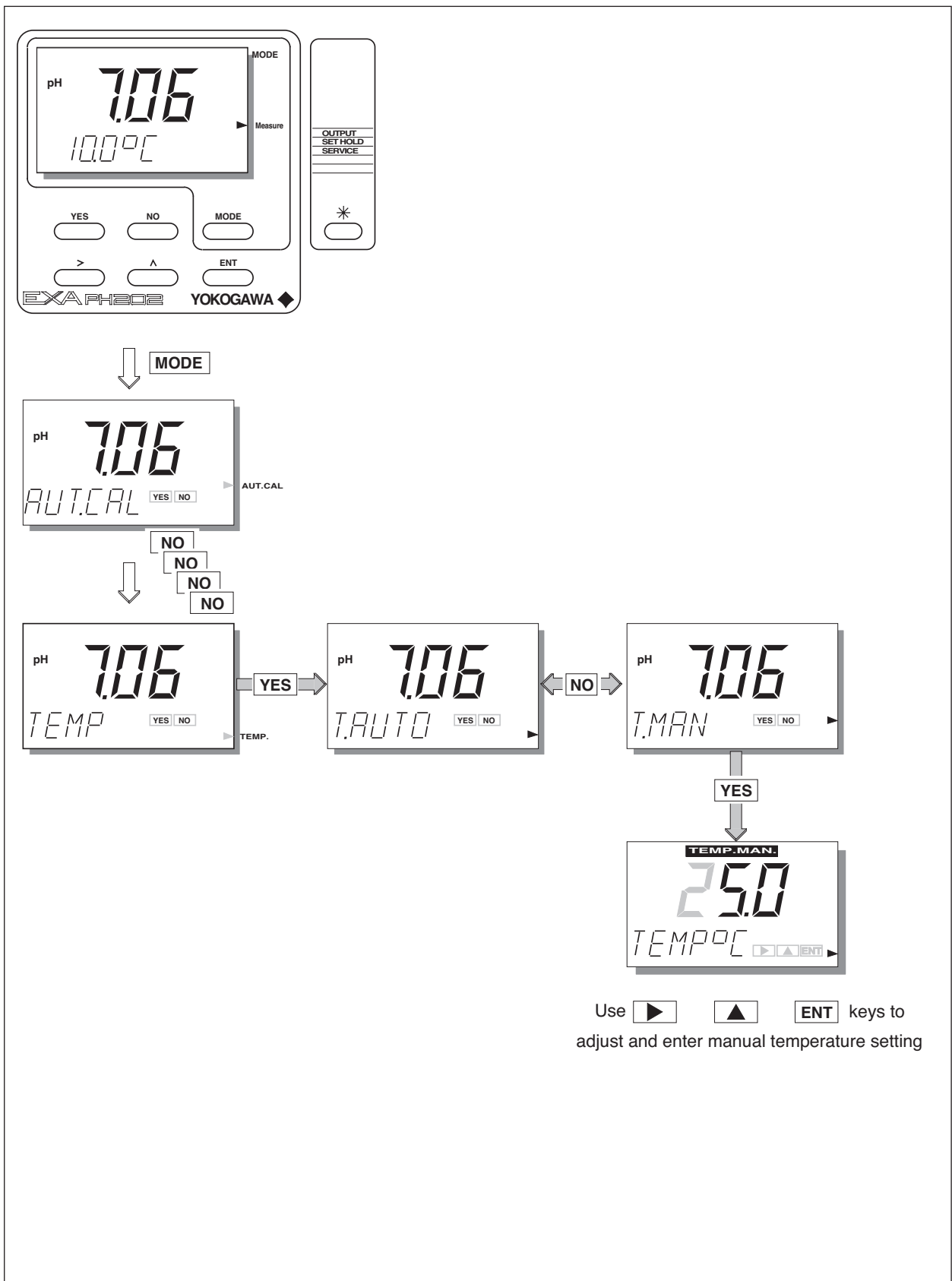
NOTE:

At this stage the user will be prompted for pass code where this has been previously set up in service code 52 in chapter 5.

Automatic calibration	See "calibration" section 6.
Manual calibration	See "calibration" section 6.
Sample calibration	See "calibration" section 6.
Display setting	See "operation" section 4.
Manual impedance check	See "parameter setting" §5-1-4 and §5-3-5 code 51.
Temperature	Set automatic or manual compensation and adjust manual reading (when pH is set in section 5 service code 01). See adjustment procedure in §5-1-1. Set automatic reading (when ORP is set in Section 5, service code 01). See adjustment procedure §5-1-2.
<b>mA</b> Hold	Manually switch on/off HOLD (when enabled in commissioning menu section). See adjustment procedure in §5-1-3.

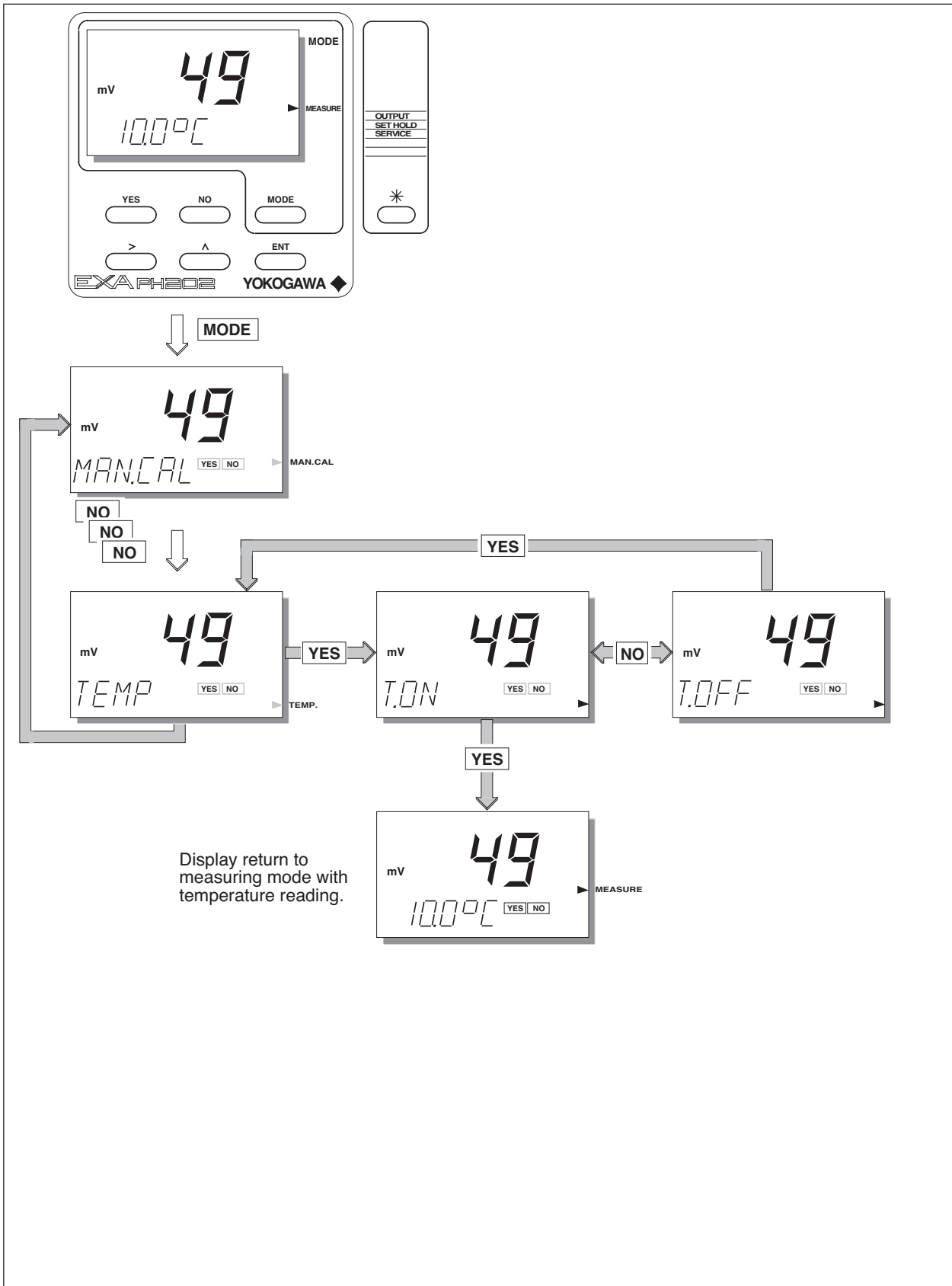
### 5-1-1. Manual temperature selection and adjustment

pH selected in service code 01.

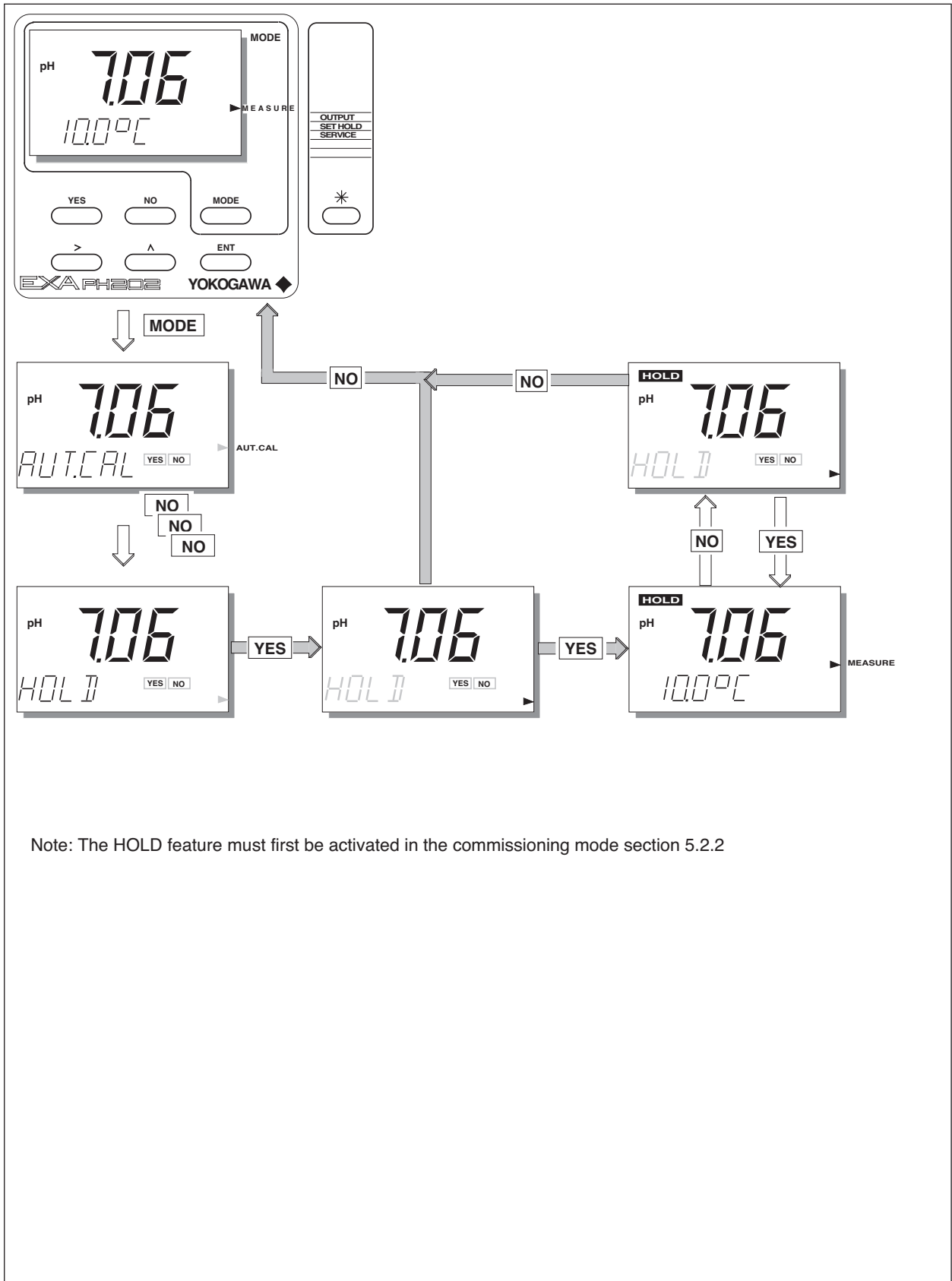


**5-1-2. Process temperature measuring in ORP mode**

ORP selected in service code 01.

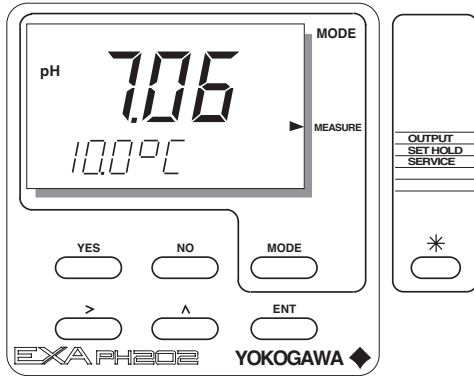


**mA** 5-1-3. Manual activation of HOLD

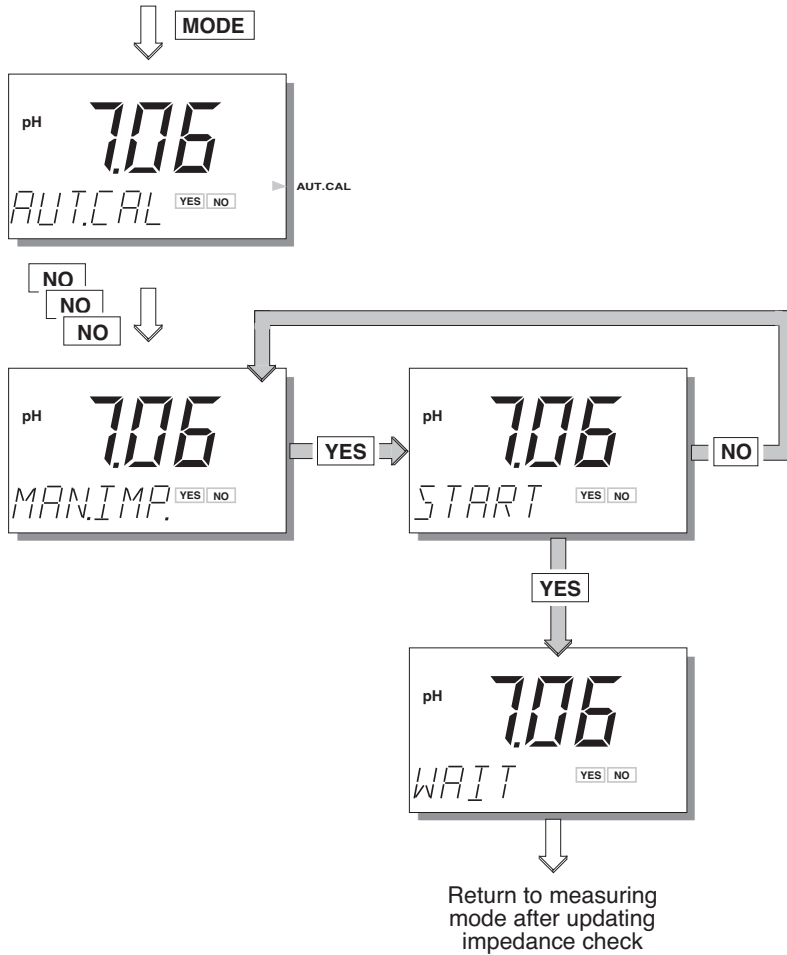


Note: The HOLD feature must first be activated in the commissioning mode section 5.2.2

**5-1-4. Manual impedance check**



Note: The manual impedance start is available when the sensor impedance measurement is enabled in Service Code 3 and 4. This enables the impedance data to be updated immediately after a maintenance event (e.g. replacing an electrode).



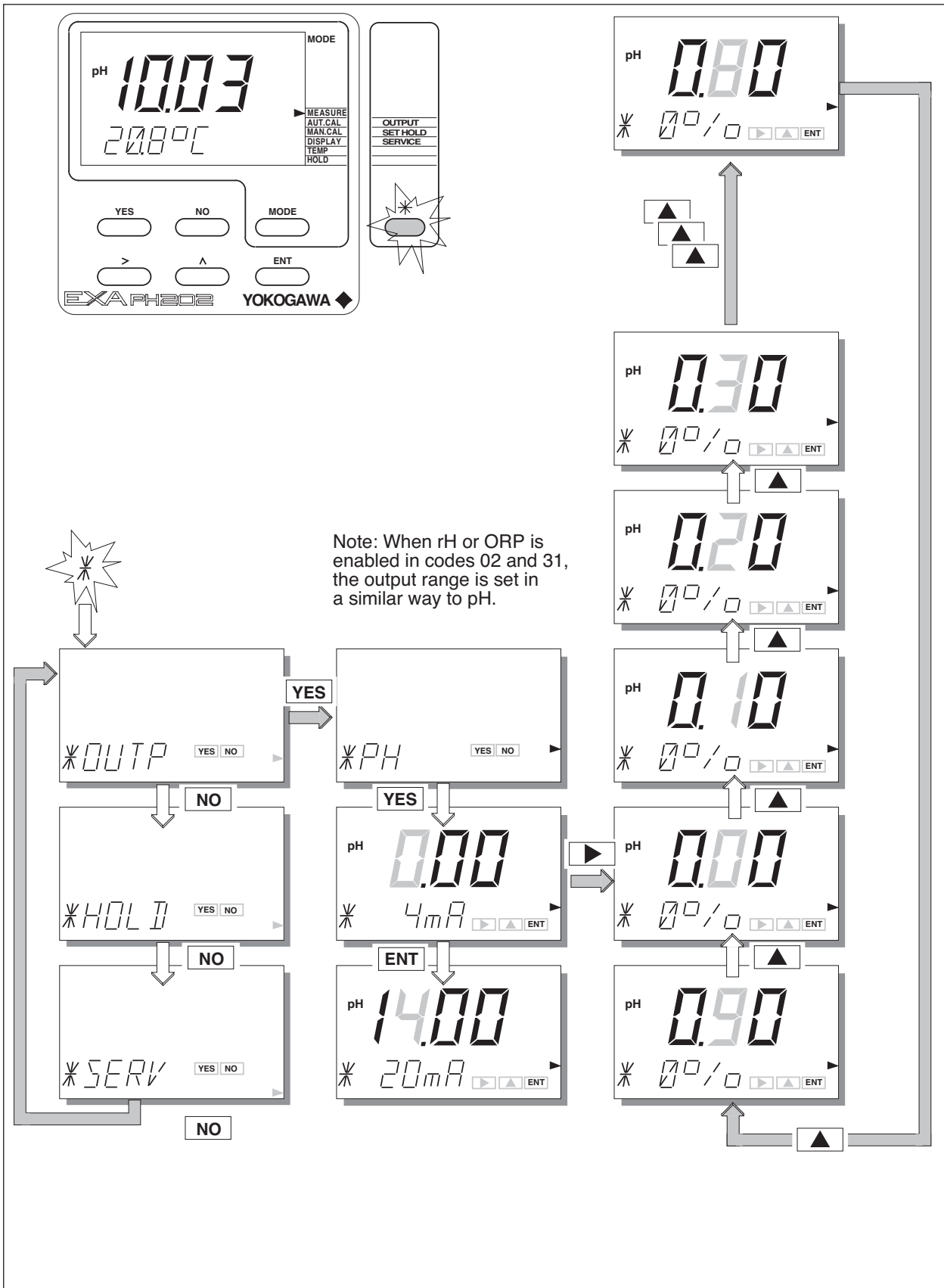
## 5-2. Commissioning mode

In order to obtain peak performance from the EXA, you must set it up for each custom application.

<b>mA</b> Output range	mA output is set as default to 0 - 14 pH.  For enhanced resolution in more stable measuring processes, it may be desirable to select 5 - 10 pH range, for example. Service codes 31 and 35 can be used to choose output function on mA output.
<b>mA</b> Hold	The EXA transmitter has the ability to “hold” the output during maintenance periods. This parameter should be set up to hold the last measured value, or a fixed value to suit the process.
Service	This selection provides access to the service menu.

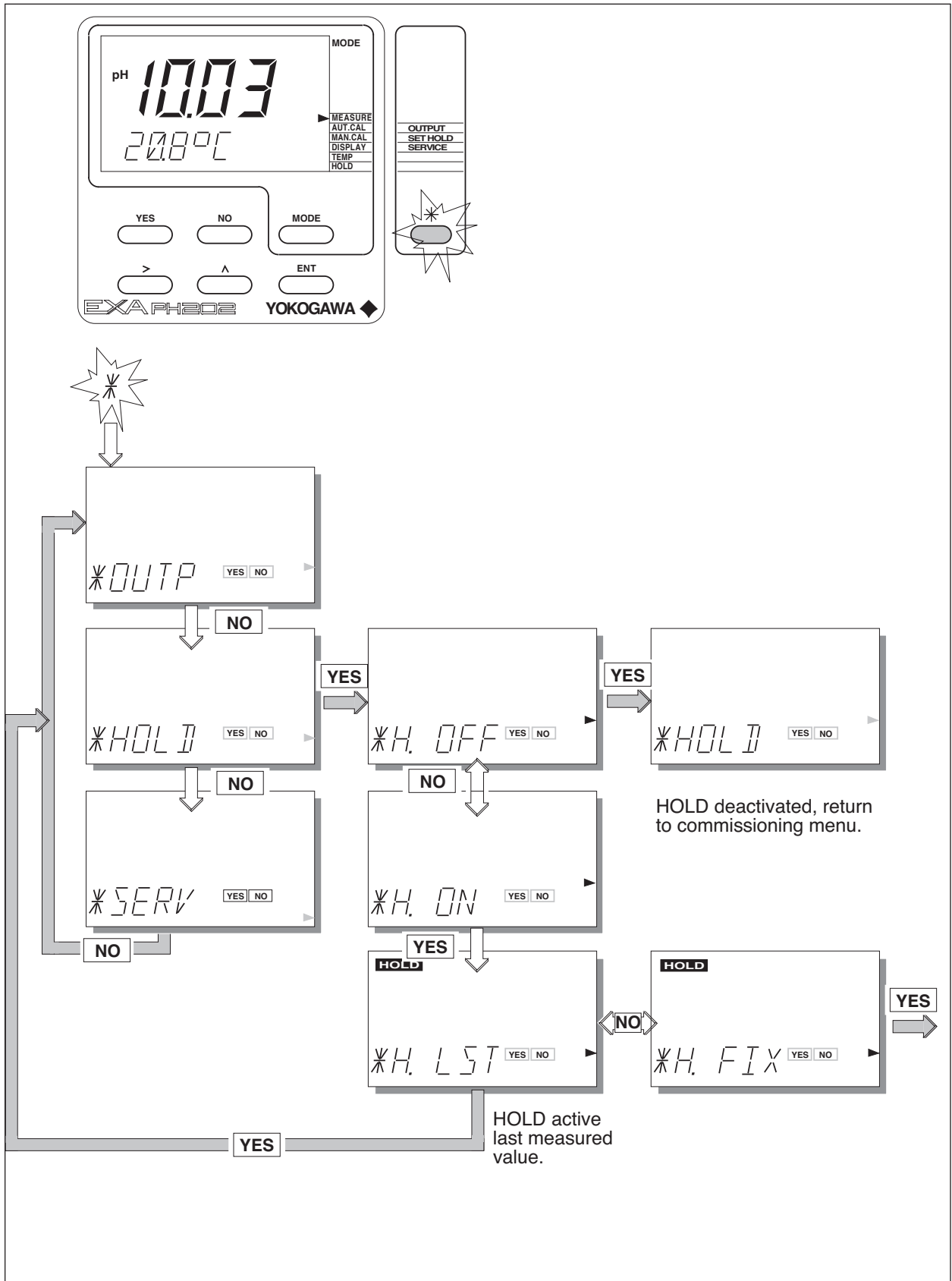
What follows are pictorial descriptions of typical frontplate pushbutton sequences for each parameter setting function. By following the simple YES/NO prompts and arrow keys, users can navigate through the process of setting range, hold and service functions.

**mA** 5-2-1. Output range

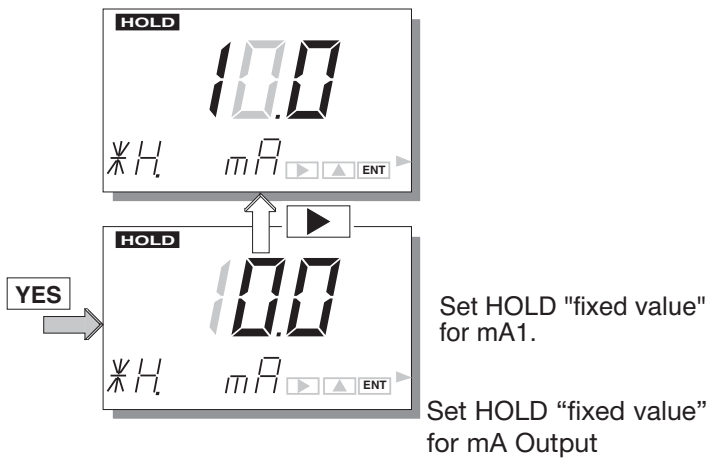
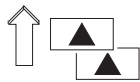
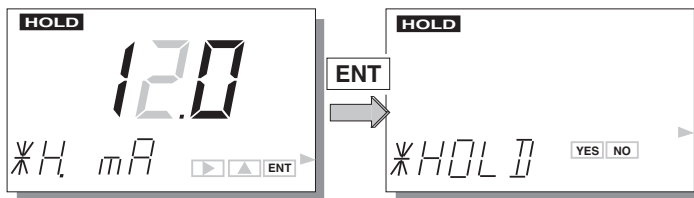




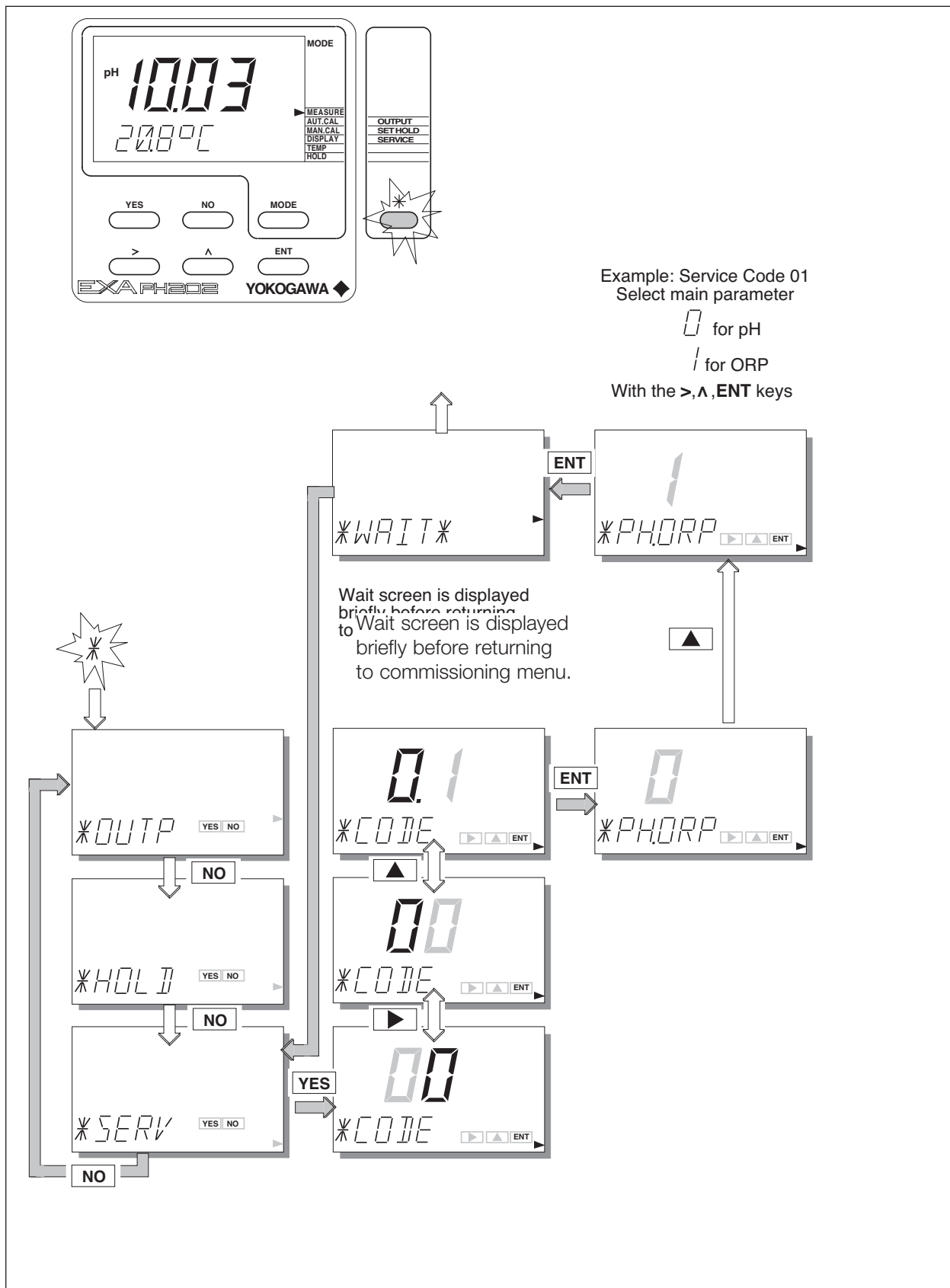
**mA** 5-2-2. Hold



HOLD value set,  
return to commissioning  
menu.



5-2-3. Service



**5-3-1. Parameter specific functions**

Code 1	pH/ORP	<p>Choose the main measuring parameter. The option of the ORP input is used with an inert metal electrode as measuring sensor which gives a reading directly in millivolts. This signal can then be interpreted to give information about the oxidation state of the process solution, and derived information like the absence of a compound (like Cyanide for example which is destroyed in oxidizing solutions).</p>
Code 2	PRM.2	<p>Enable the use of a second measuring parameter simultaneously with pH (the main parameter).          With the correct sensor (e.g FU20), ORP measurement is possible as parameter 2          With the same sensor, rH measurement is possible as parameter 2, this is calculated from pH and ORP and is a value which gives the oxidizing power of the solution while compensating for the effect of pH.          This function is particularly useful for applications where both the pH and oxidation-reduction potential of the process need to be known. The availability of both measurements in a single system is convenient.          Note that in both cases a suitable sensor combination is needed to make this possible. The Yokogawa FU20 (4-in-1) sensor can be used for this purpose, or a combination of individual sensors. Contact your local Yokogawa sales office for advice regarding applications and sensor selection.</p>
Code 3 & 4	Z1.CHK & Z2.CHK	<p>The EXA PH202 has an impedance check capable of monitoring the impedance of all sorts of sensor systems. In order to “fine tune” this diagnostic tool it is necessary to set it up to match the sensors used. The default settings give a good setup for a conventional system comprising pH glass sensor and a reference electrode, either as individual electrodes or as a combination style sensor. The impedance limits will need to be adjusted to get the best from systems using heavy duty, or fast response electrodes.          The impedance measuring system has a very wide span requirement. As it can measure in <math>k\Omega</math> and also in <math>G\Omega</math> (<math>10^9</math>) there are hardware switches to set high range (<math>1M\Omega</math> to <math>2 G\Omega</math>) or low range (<math>1k\Omega</math> to <math>1M\Omega</math>) measuring. As a default the system is set to measure high impedances on input 1 (the one normally used for the pH glass sensor input) and low impedances on input 2 (the one normally used for the reference input). Examples of where these settings need to be changed from the default, are Pfaudler enamel sensors which need two high impedance settings, and Platinum sensors with a standard reference, which need two low impedance settings.          The temperature compensation of the impedance measurement is for conventional pH glass sensors. When other sensors are used, switch this feature off.</p>
Code 5	CAL.CK	<p>The calibration checking feature, when enabled, gives security against entering wrong calibration data. For example when aged sensors are due for replacement, the EXA flags an error message and prevents a calibration being completed where the subsequent measurement can only exhibit errors and drift. Limits are set for the maximum permissible Asymmetry potential, and Slope.</p>

Code	Display	Function	Function detail•	X	Y	Z	Default values	
<b>Parameter specific functions</b>								
01	*PH.ORP	Select main parameter	pH ORP	0 1				
02	*PRM.2	Enable 2nd parameter	Off ORP rH	0 1 2			0	Off
03	*Z1.CHK	Impedance check 1	Low High Temp comp off Temp comp on Imp check off Imp check on	0 1	0 1		1.1.1	High On On
	*Z.L.xΩ	Low impedance limit x = None, K, M or G	Press NO to step through choice of units, press YES to select units, then use the >, ^ ENT keys to set the value			0 1		1 MΩ
	*Z.H.xΩ	High impedance limit	Press NO to step through choice of units, press YES to select units, then use the >, ^ ENT keys to set the value					1 GΩ
04	*Z2.CHK		Low High Temp comp off Temp comp on Imp check off Imp check on	0 1	0 1	0 1	0.0.1	Low Off On
	*Z.L.xΩ	Low impedance limit x = None, K, M or G	Press NO to step through choice of units, press YES to select units, then use the >, ^ ENT keys to set the value					100 Ω
	*Z.H.xΩ	High impedance limit	Press NO to step through choice of units, press YES to select units, then use the >, ^ ENT keys to set the value					200 kΩ
05	*CAL.CK	Calibration check	Asymmetry check off Asymmetry check on Slope check off Slope check on	0 1	0 1		1.1	On On
06-09			Not used					

### 5-3-2. Temperature compensation and measuring functions.

Code 10	T.SENS	Selection of the temperature compensation sensor. The default selection is the Pt1000 Ohm sensor, which gives excellent precision with the two wire connections used. The other options give the flexibility to use a very wide range of other pH sensors.
Code 11	T.UNIT	Celsius or Fahrenheit temperature scales can be selected to suit user preference.
Code 12	T.ADJ	With the process temperature sensor at a stable known temperature, the temperature reading is adjusted in the main display to correspond. The calibration is a zero adjustment to allow for the cable resistance, which will obviously vary with length. The normal method is to immerse the sensor in a vessel with water in it, measure the temperature with an accurate thermometer, and adjust the reading for agreement.
Code 13	T.COMP	Process compensation automatically allows for changes in the pH or ORP of the process with temperature. The characteristic of each process will be different, and the user should determine if this feature is to be activated, and what compensation figure to choose.

The compensation is given in pH per 10 °C or mV per 10 °C.

Example: For pure water with an alkali dose, (e.g. boiler feed water) a coefficient of approx. 0.35pH can be expected. However, applications vary and a simple test will determine what if any coefficient is suitable for the process.

Code	Display	Function	Function detail•	X	Y	Z	Default values
<b>Temperature measuring and compensation functions</b>							
10	*T.SENS	Temperature sensor	Pt1000 Pt100 3kBalco 5k1 8k55 350 6k8 PTC10k	0 1 2 3 4 5 6 7			0 Pt1000
11	*T.UNIT	Display in °C or °F	°C °F	0 1			0 °C
12	*T.ADJ	Calibrate temperature	Adjust to allow for cable resistance				None
13	*T.COMP	Set temp comp	Compensation for process changes off Compensation for process changes on	0 1			0 Off
	*T.COEF	Adjust process TC	Set for TC in pH per 10 °C				-0.00 pH per 10 °C
14-19			Not used				

### 5-3-3. Calibration functions

- Code 20     $\Delta t$ .SEC &  $\Delta pH$     These functions are used to determine the stability level demanded by the EXA as acceptance criteria for the automatic calibration. The default settings give a good calibration for general purpose electrode systems with a fast response. Where heavy duty electrodes are used, or when low temperatures are concerned, these values should be adjusted.  
When adjusting these settings, the longer the time interval and the smaller the pH change, the more stable will be the reading. However, it is important to bear in mind that the time taken to reach stability is an exponential function, and too ambitious a setting will cause the instrument to wait for a very long time before accepting a calibration.
- Code 21    AS.LOW & AS.HI    Limit values for the drift of an electrode system before an error is signalled when a calibration is done. These default values should be adjusted to suit the application, this will be especially important with enamel or Antimony probes. In case in SC 27 the Asymmetry Potential is disabled and the Zero Point is used, SC 21 is used for entering the limits of the Zero Point.  
ZR.LOW & ZR.HI    Limit values for zeropoint, if enabled in Code 27.
- Code 22    SL.LOW & SL.HI    Limit values for acceptable slope (sensitivity) calibrations.
- Code 23    ITP, SLOPE & ASPOT    Values can be entered directly in this section. These data can be provided by the manufacturer of the probe, or by the users laboratory etc. They are determined independently of the measuring loop.  
NOTE: it is not necessary to enter this data in most cases as the EXA automatically does this while performing a calibration. The feature is used in the case of special electrode systems and where calibration in the process environment is not possible.
- Code 24, 25, & 26    Buffer tables    The following buffer calibration tables are programmed into the EXA. They are the primary buffer standards according to NIST (formerly NBS) and various other national standards. We strongly recommend the use of these buffer solutions as they give the best buffer capacity, reliability and accuracy when calibrating.

**Table 5-1.**

	pH 4	pH 7	pH 9		pH 4	pH 7	pH 9
<b>0 °C</b>	4.00	6.98	9.46	<b>45 °C</b>	4.05	6.83	9.04
<b>5 °C</b>	4.00	6.95	9.40	<b>50 °C</b>	4.06	6.83	9.01
<b>10 °C</b>	4.00	6.92	9.33	<b>55 °C</b>	4.08	6.83	8.99
<b>15 °C</b>	4.00	6.90	9.28	<b>60 °C</b>	4.09	6.84	8.96
<b>20 °C</b>	4.00	6.88	9.23	<b>65 °C</b>	4.11	6.84	8.94
<b>25 °C</b>	4.01	6.87	9.18	<b>70 °C</b>	4.13	6.85	8.92
<b>30 °C</b>	4.02	6.85	9.14	<b>75 °C</b>	4.15	6.85	8.90
<b>35 °C</b>	4.02	6.84	9.10	<b>80 °C</b>	4.16	6.86	8.89
<b>40 °C</b>	4.04	6.84	9.07				

These tables may be adjusted in the case that the user wishes to use other calibration solutions. The "name" of the buffer can be changed at the \*BUF.ID prompt. The other values can then be adjusted in sequence.

- Code 27    Zero Point    As an alternative to Asymmetry Potential, the Zero point can be used to define and calibrate the EXA pH unit.  
Note that this method conforms to the DIN standard for instruments No. IEC 746-2.



Code	Display	Function	Function detail*	X	Y	Z	Default values
<b>Calibration functions</b>							
20	*Δt.SEC *ΔPH	Stability check time Stability check pH					5 sec. 0.02 pH
21	*AS.LOW (As Pot) *AS.HI	As Pot low limit As Pot high limit					-120 mV 120 mV
21	*ZR.LOW (Zero) *ZR.HI	Zero Point low limit Zero Point high limit					5.00 pH 9.00 pH
22	*SL.LOW *SL.HI	Slope low limit Slope high limit					70 % 110 %
23	(pH) *ITP *SLOPE *ASP.1D  *ASP *ASPmV	Set ITP Set slope Set As Pot  Set As Pot Set As Pot ORP	Preset calibration data from manufacturer or from laboratory determinations. For the main parameter Press YES to confirm 0.1 mV resolution, then set value with >, ^, ENT keys. Press NO to change to *ASP. For the main parameter Press YES to confirm 1 mV resolution, then set value with >, ^, ENT keys. For parameter 2 (when activated in service code 02)				7.00 pH 100 % 0.0 mV
23	(ORP) *ASP.1D  *ASP	Set As Pot (ORP)  Set As Pot	For the main parameter Press YES to confirm 0.1 mV resolution, then set value with >, ^, ENT keys. Press NO to change to *ASP. For the main parameter Press YES to confirm 1 mV resolution, then set value with >, ^, ENT keys.				
24	*BUF.ID	Buffer table 4	Buffer tables to NIST (formerly NBS) (see section 10 for table details) User adjustable for special requirements				
25	*BUF.ID	Buffer table 7					
26	*BUF.ID	Buffer table 9					
27	*ZERO.P	Enable zero point in pH units	Disable zero point (enable As Pot) Enable zero point (disable As Pot)	0 1			0 Disabled
28-29			Not used				

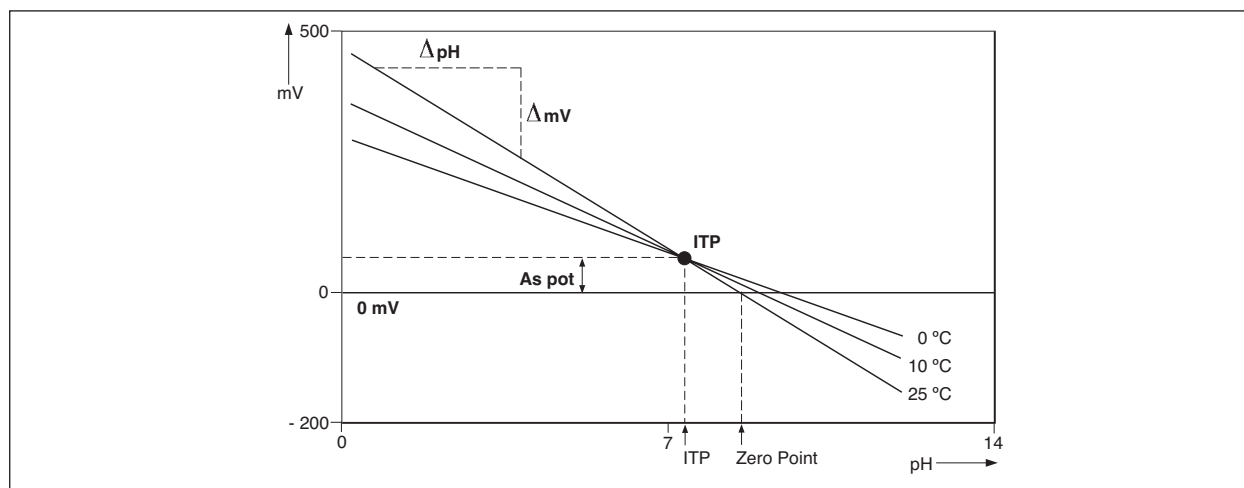


Fig. 5-1.

**mA 5-3-4. mA output functions**

Code 31 OUTF

When pH is set in code 1 as the main parameter, the output functions may be set as follows:-

pH

pH (table)

Parameter 2 (ORP or rH as set in code 02)

When ORP is set in code 1 as the main parameter, the output functions may be set to:

ORP

ORP (table)

Code 32 BURN

Diagnostic error messages can signal a problem by sending the output signals upscale or downscale (21 mA or 3.9 mA)\*. This is called upscale or downscale burnout, from the analogy with thermocouple failure signalling of a burned-out or open circuit sensor. The pulse burnout setting gives a 21 mA signal for the first 30 seconds of an alarm condition. After the "pulse" the signal returns to normal. This allows a latching alarm unit to record the error. In the case of the EXA the diagnostics are extensive and cover the whole range of possible sensor faults.

\* Only when the HART communication is disabled the downscale output signal is 3.6 mA. When HART communication is enabled the output signal is 3.9 mA.

Code 35 TABLE

The table function allows the configuration of an output curve by 21 steps (intervals of 5%).

The following example shows how the table may be configured to linearise the output with a mA curve.

**Table 5-2.**

	<b>4-20 mA</b>		<b>4-20 mA</b>
<b>0%</b>	4.0 mA	<b>50%</b>	12.0 mA
<b>5%</b>	4.8 mA	<b>55%</b>	12.8 mA
<b>10%</b>	5.6 mA	<b>60%</b>	13.6 mA
<b>15%</b>	6.4 mA	<b>65%</b>	14.4 mA
<b>20%</b>	7.2 mA	<b>70%</b>	15.2 mA
<b>25%</b>	8.0 mA	<b>75%</b>	16.0 mA
<b>30%</b>	8.8 mA	<b>80%</b>	16.8 mA
<b>35%</b>	9.6 mA	<b>85%</b>	17.6 mA
<b>40%</b>	10.4 mA	<b>90%</b>	18.4 mA
<b>45%</b>	11.2 mA	<b>95%</b>	19.2 mA
		<b>100%</b>	20.0 mA

<b>mA</b>	<b>Code</b>	<b>Display</b>	<b>Function</b>	<b>Function detail</b>	<b>X</b>	<b>Y</b>	<b>Z</b>	<b>Default values</b>	
<b>mA Outputs</b>									
	30			Not used					
	31	*OUTP.F	mA output functions Code 01 set for pH	pH pH (table) Parameter 2 (with suitable sensor(s), and when enabled in code 02)	0 1 2			0	
	32	*BURN	Burn function	No burnout Burnout downscale Burnout upscale Pulse burnout	0 1 2 3			0	No Burn.
	33, 34			Not used					
	35	*TABLE *0% *5% *10% ... ... *90% *100%	Output table for mA	Linearisation table for mA1 in 5% steps. The measured value is set in the main display using the >, ^, ENT keys, for each of the 5% interval steps. Where a value is not known, that value may be skipped, and a linear interpolation will take place.					
	36-39			Not used					

### 5-3-5. User interface

Code 50	*RET.	When Auto return is enabled, the converter reverts to the measuring mode from anywhere in the configuration menus, when no button is pressed during the set time interval of 10 minutes.
Code 51	*MODE	The manual impedance check (on demand) can be setup for operation in the maintenance mode. (Through the closed front cover).
Code 52	*PASS	Passcodes can be set on any or all of the access levels, to restrict access to the instrument configuration.
Code 53	*Err.4.1	<p>Error message configuration. Two different types of failure mode can be set.</p> <p>Hard fail gives a steady FAIL flag in the display, A Fail signal is transmitted on the outputs when enabled in code 32.</p> <p>Soft fail gives a flashing FAIL flag in the display. The call for maintenance is a good example of where a SOFT fail is useful. A warning that the regular maintenance is due, should not be used to shut down the whole measurement.</p>
Code 54		Not used
Code 55	*CALL.M	Call for maintenance is a trigger to signal that the system has been in service for longer than the set time without calibration. The user can set up to 250 days as a routine service interval.
Code 56	*DISP	The display resolution can be set to either 0.01pH or 0.1pH. Not applicable to the ORP (mV) display.

Code	Display	Function	Function detail	X	Y	Z	Default values	
<b>User interface</b>								
50	*RET	Auto return	Auto return to measuring mode Off Auto return to measuring mode On	0 1			1	On
51	*MODE	Mode setup	Manual impedance check Off Manual impedance check On	0 1			0	Off
52	*PASS	Passcode Note # = 0 - 9, where 0 = no passcode 1=111, 2=333, 3=777 4=888, 5=123, 6=957 7=331, 8=546, 9=847	Maintenance passcode Off Maintenance passcode On Commissioning passcode Off Commissioning passcode On Service passcode Off Service passcode On	0 #	0 #	0 #	0.0.0	Off Off Off
53	*Err.4.1 *Err.5.1 *Err.4.2 *Err.5.2 *Err.07 *Err.08 *Err.09 *Err.11 *Err.16	Error setting	Impedance low (input 1) Soft fai● Impedance low (input 1) Hard fai● Impedance high (input 1) Soft fai● Impedance high (input 1) Hard fai● Impedance low (input 2) Soft fai● Impedance low (input 2) Hard fai● Impedance high (input 2) Soft fai● Impedance high (input 2) Hard fai● Temperature too high Soft fai● Temperature too high Hard fai● Temperature too low Soft fai● Temperature too low Hard fai● pH out of range Soft fai● pH out of range Hard fai● Wash recovery check Soft fai● Wash recovery check Hard fai● Call for maintenance Soft fai● Call for maintenance Hard fai●	0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1			1 1 1 1 1 1 1 1 0 0 0 0	Hard Hard Hard Hard Hard Hard Hard Hard Soft Soft
54			Not used					
55	*CALL.M	Call for maintenance	Set time limit for calibration Off Set time limit for calibration On	0 1			0	Off
56	*DISP	Display resolution	Set pH decimal display 0.1 pH Set pH decimal display 0.01pH	0 1			1	0.01 pH
57-59			Not used					

### 5-3-6. Communication setup

<b>mA</b>	Code 60	*COMM.	The settings should be adjusted to suit the communicating device connected to the output. The communication can be set to HART or to PH201*B distributor (for Japanese market only)
		*ADDR.	For the Yokogawa PC202 software package, the default settings match the software as shipped.
<b>mA</b>	Code 61	*HOUR	The clock/calendar for the logbook is set for current date and time as reference.
		*MINUT	
		*SECND	
		*YEAR	
		*MONTH	
		*DAY	
	Code 62	*ERASE	Erase logbook function to clear the recorded data for a fresh start. This may be desirable when re-commissioning an instrument that has been out of service for a while.

### 5-3-7. General

	Code 70	*LOAD	The load defaults code allows the instrument to be returned to the default set up with a single operation. This can be useful when wanting to change from one application to another.
	Code 79	*CUST.D	Load customer defaults. This code allows the instrument to be returned to the factory default set, except that buffer tables (code 24,25,26) are unchanged.

### 5-3-8. Test and setup mode

	Code 80	*TEST	The test mode is used to confirm the instrument setup. It is based on the factory setup procedure and can be used to check the QIC (factory generated test certificate). To use this test feature it is necessary to have the detail provided only in the QIS (Quality Inspection Standard) or the Service manual.
--	---------	-------	--

NOTE: attempting to change data in service code, 80 and above without the proper instructions and equipment, can result in corruption of the instrument setup, and will impair the performance of the unit.

Code	Display	Function	Function detail*	X	Y	Z	Default values	
<b>Communication</b>								
<b>mA</b> 60	*COMM.	Communication	Set communication Off Set communication On write enable write protect Set communication PH201*B Without half time check With half time check	0 1  2	  0 1  0 1		1.0     00	On  write enable
<b>mA</b> 61	*ADDR. *HOUR *MINUT *SECND *YEAR *MONTH *DAY	Network address Clock setup	Set address 00 to 15 Adjust to current date and time using >, ^ and ENT keys					
62	*ERASE	Erase logbook	Press YES to clear logbook data					
63-69			Not used					

Code	Display	Function	Function detail*	X	Y	Z	Default values
<b>General</b>							
70	*LOAD	Load defaults	Reset configuration to default values				
71-78			Not used				
79	*CUST.D	Load Customer Defaults	Reset configuration to default values except buffer tables				

Code	Display	Function	Function detail*	X	Y	Z	Default values
<b>Test and setup mode</b>							
80	*TEST	Test and setup	Built in test functions as detailed in QIS and Service Manual				

**5-3-9. Notes for guidance in the use of service coded settings**



## 6. CALIBRATION

The EXA PH202 can be calibrated in three distinct ways.

### 6-1. Automatic calibration

This method uses internally programmed buffer tables, (from Service Codes 24, 25 and 26), to calculate the buffer value at the actual temperature during the calibration. In addition, the stability of the reading is automatically calculated, and when the reading has stabilized fully automatic adjustments of slope and asymmetry are made. This eliminates the question of how long the operator should allow prior to adjustment. A menu driven prompt system conducts the operator through the simple, foolproof routine.

Default settings for the buffer solutions are the standard NIST (formerly NBS) recognised solutions “4”, “7” and “9”. These are known as primary buffers. They have a much better buffer capacity than the “commercial” or adjusted buffers. Yokogawa strongly recommends the use of these buffers to provide the best pH calibration.

### 6-2. Manual calibration

In this method, the operator decides on the actual value to enter. Manual calibration is most often used for single-point adjustment of the asymmetry potential, by comparison method.

Manual calibration can also be used to perform a full 2-point calibration with solutions other than the NIST buffers that are listed in the calibration tables. In this case, the solutions are applied sequentially as in the AUT CAL method, but the user determines the adjustment of reading and stability.

#### NOTE:

During manual calibration the temperature coefficient is still active. This means that the readings are referred to 25 °C. This makes grab sample calibration easy and accurate. However, if the manual calibration technique is used for buffer calibration, the temperature coefficient must be set to zero in maintenance mode in the “TEMP” routine (see chapter 5).

### 6-3. Sample calibration

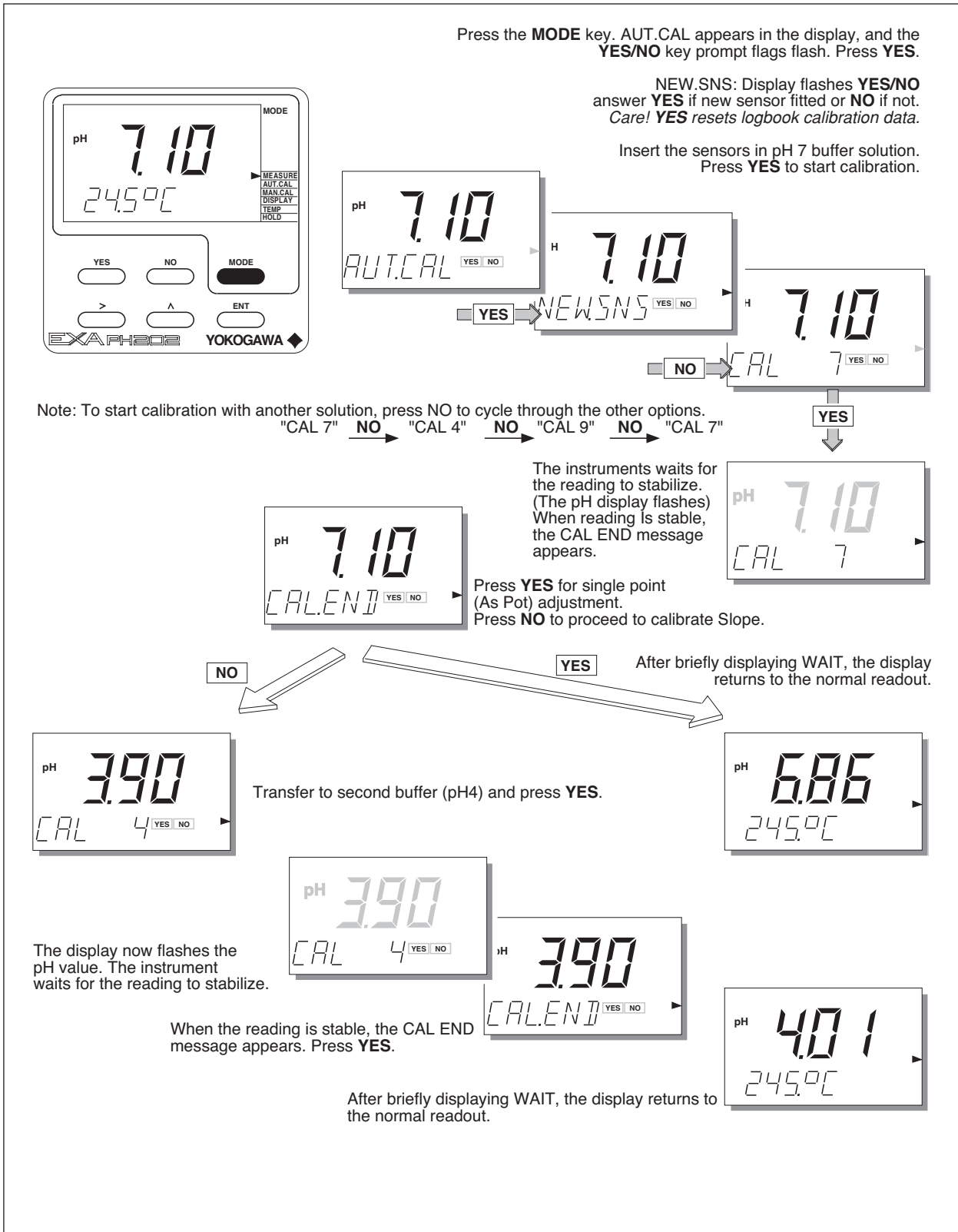
The operator activates the “SAMPLE” calibration routine, at the same time as taking a representative process sample. After determining the pH of this sample by independent methods, (in the lab for example) the reading can be adjusted. While the sample is being analyzed, EXA holds the sample data in memory, while continuing to control and read pH normally.

### 6-4. Data entry

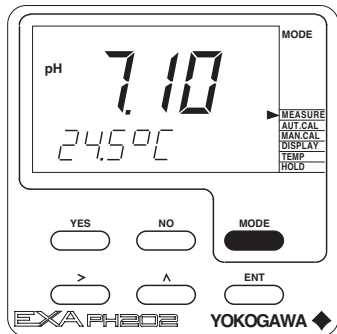
In special circumstances, users can directly enter the calibration data in the service code menu (see chapter 5). This is appropriate where the manufacturer provides calibration data for each probe (as with the Pfudler sensors) or where electrodes are laboratory calibrated for subsequent installation on the plant. Service Code 23 allows the values of ITP, asymmetry potential (or zero point) and slope to be entered.

6-5. Calibration procedures

6-5-1. Automatic calibration



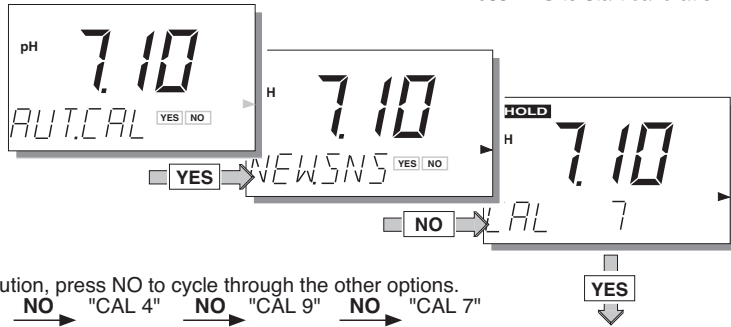
**mA 6-5-2. Automatic calibration with HOLD active**



Press the **MODE** key. **AUT.CAL** appears in the display, and the **YES/NO** key prompt flags flash. Press **YES**.

**NEW.SNS**: Display flashes **YES/NO** answer **YES** if new sensor fitted or **NO** if not. *Care! YES resets logbook calibration data.*

Insert the sensors in pH 7 buffer solution. Press **YES** to start calibration.



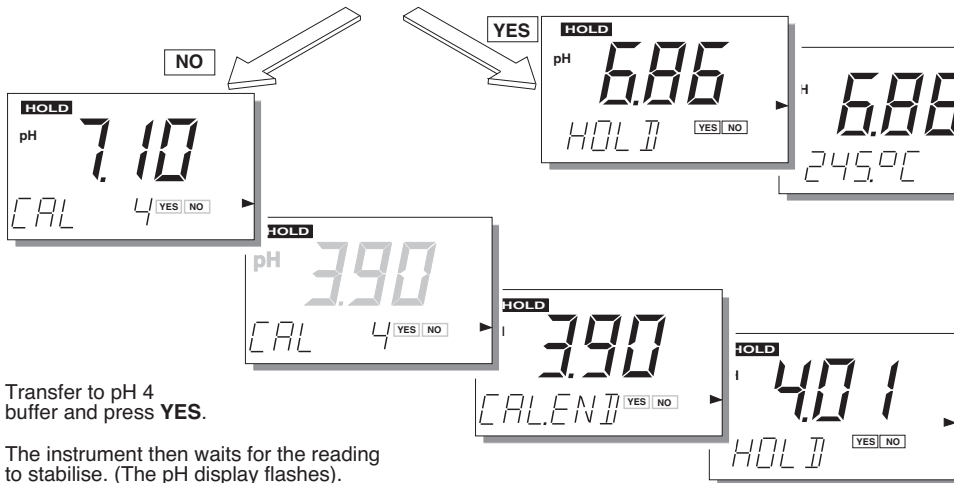
Note: To start calibration with another solution, press **NO** to cycle through the other options. "CAL 7" **NO** → "CAL 4" **NO** → "CAL 9" **NO** → "CAL 7"

The instrument waits for the reading to stabilise. (The pH display flashes) When reading is stable, the **CAL END** message appears.



Press **YES** for single point (As Pot) adjustment. Press **NO** to proceed to calibrate Slope.

The single-point calibration is now complete. put sensors back in the process and press **NO** to switch off **HOLD** and return to measuring mode.



Transfer to pH 4 buffer and press **YES**.

The instrument then waits for the reading to stabilise. (The pH display flashes).

When the reading is stable, the **CAL END** message appears. Press **YES**. **WAIT** flashes briefly then **HOLD**

The calibration is now complete. Put the sensors back in the process and press **NO** to turn off **HOLD** and return to the measuring mode.

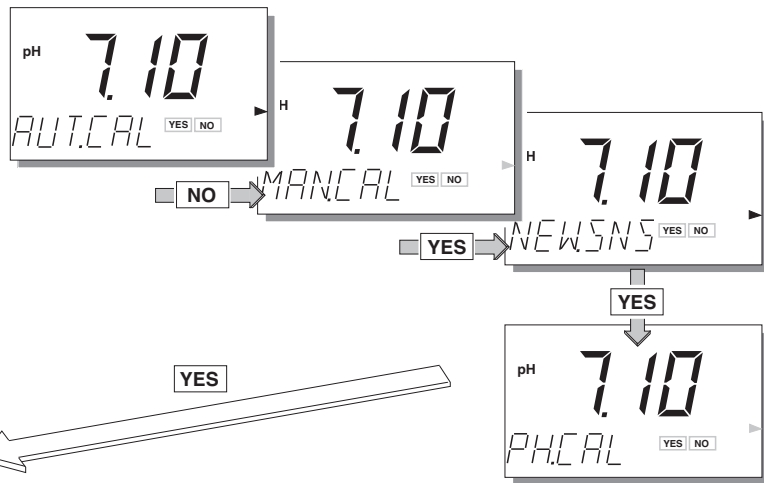
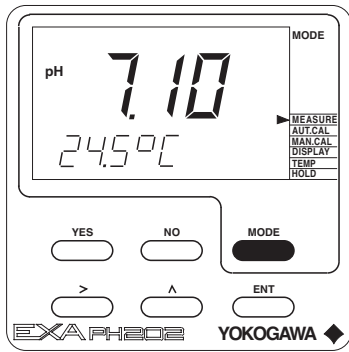


**6-5-3. Manual calibration (2nd parameter calibration)**

Press the **MODE** key. The legend **AUT.CAL** appears, and the YES/NO key prompt flags flash. Press **NO**.

The display **MAN.CAL** appears. Press **YES** to start calibration.

Press **YES** or **NO** at **NEW.SNS** prompt.

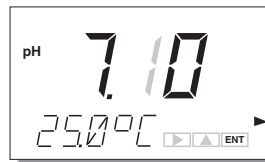


Put sensors in buffer solution. Press **YES**.



Set the value using the **>**, **^**, **ENT** key.

Select the flashing digit with the **>** key.



Increase its value by pressing the **^** key.

When the correct value is displayed, press **ENT** to enter the change.



**WAIT** is displayed briefly then EXA returns to measuring mode.

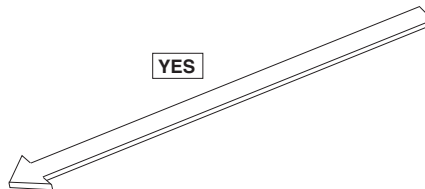
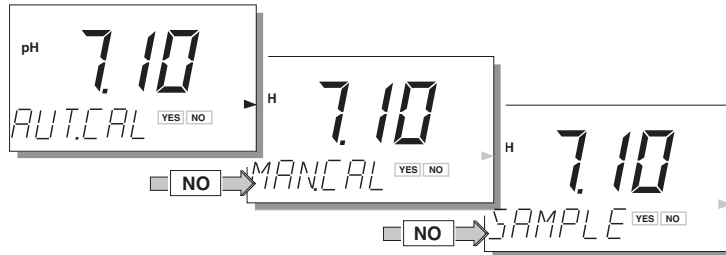
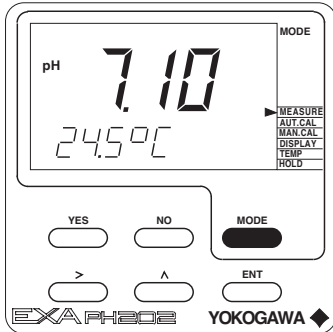
For 2 point (As Pot and Slope) Adjustment select second buffer solution and adjust as for pH7 buffer.



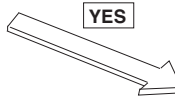
### 6-5-4. Sample calibration

Press the **MODE** key. The legend **AUT.CAL** appears, and the YES/NO key prompt flags flash. Press **NO**.

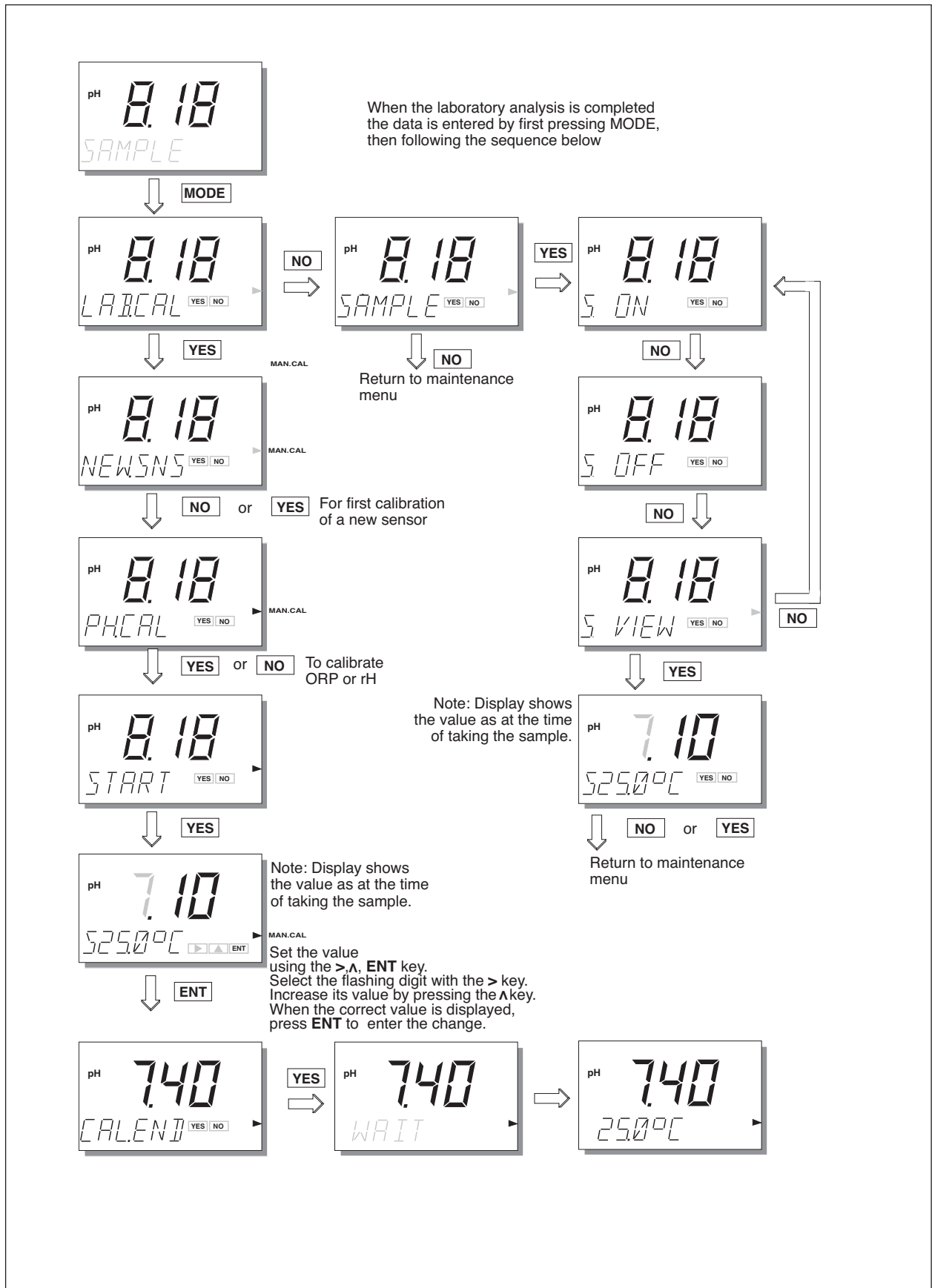
The display **MAN.CAL** appears. Press **NO**. **SAMPLE** appears. Press **YES** to start calibration.



Press **YES** at the same time as taking sample for analysis.



PH 202 now continues to measure/control, as before. **SAMPLe** flashes to indicate that data is stored waiting for input of analyzed value.







## 7. MAINTENANCE

### 7-1. Periodic maintenance for the EXA transmitter

The transmitter requires very little periodic maintenance. The housing is sealed to IP65 (NEMA 4X) standards, and remains closed in normal operation. Users are required only to make sure the front window is kept clean in order to permit a clear view of the display and allow proper operation of the pushbuttons. If the window becomes soiled, clean it using a soft damp cloth or soft tissue. To deal with more stubborn stains, a neutral detergent may be used.

**NOTE:**

Never use harsh chemicals or solvents. In the event that the window becomes heavily stained or scratched, refer to the parts list (Chapter 9) for replacement part numbers.

When you must open the front cover and/or glands, make sure that the seals are clean and correctly fitted when the unit is reassembled in order to maintain the housing's weatherproof integrity against water and water vapor. The pH measurement uses high impedance sensors and may otherwise be prone to problems caused by exposure of the circuitry to condensation.

The EXA analyzer contains a logbook feature which needs a clock to provide the timings. The EXA instrument contains a lithium cell (battery) to support the clock function when the power is switched off. This cell needs to be replaced at 5 yearly intervals (or when discharged). Contact your nearest Yokogawa service centre for spare parts and instructions.

### 7-2. Periodic maintenance for the sensor system

**NOTE:**

Maintenance advice listed here is intentionally general in nature. Sensor maintenance is highly application specific.

The sensor system must be kept clean to function well. This may require regular cleaning of the electrodes. (The effect of dirty electrodes will be to slow the system response and perhaps corrupt the measuring loop entirely). The frequency of cleaning and the method of cleaning will depend entirely on the process.

Where a refillable (flowing electrolyte) reference system is employed, make sure that the reservoir is kept topped up. The rate of electrolyte consumption will again be process dependent, so experience will show how often you must refill.

The periodic recalibration of the sensor system is necessary to ensure best accuracy. This takes into account the aging of the sensors, and the nonrecoverable changes that take place. These processes are slow, however. If frequent recalibration is needed, it is usually because the cleaning process is not effective, the calibration is not well executed or the pH readings are temperature dependent. Monthly calibrations should be sufficient for most applications.

If a film remains on the pH sensor after cleaning, or if the reference junction is partly plugged, then measuring errors can be interpreted as a need for recalibration. Because these changes are reversible with correct cleaning and/or proper selection or adjustment of the electrolyte flow through the junction, make sure that these items are correct before recalibrating the system.

**7-3. Calibration procedures are described in step-by-step detail in chapter 6. However, follow these guidelines.**

1. Before starting a calibration, make sure the electrode system is properly cleaned so that electrodes are fully functional. They must then be rinsed with clean water to avoid contamination of the calibration solution.
2. Always use fresh buffer solutions to avoid the possibility of introducing errors from contaminated or aged solutions. Buffers supplied as liquids have a limited shelf life, especially alkaline buffers which absorb CO<sub>2</sub> from the air.
3. Yokogawa strongly recommends NIST (primary) buffer standards in order to ensure the best accuracy and best buffer capacity is available. Commercially adjusted buffers (e.g. 7.00, 9.00 or 10.00pH) are a compromise as a standard, and are often supplied without the temperature dependency curve. Their stability will be much worse than for NIST solutions.

NOTE:

NIST (formerly NBS) buffers are available as consumable items from any Yokogawa sales office under the following part numbers:

6C232	4.01 pH at 25°C}	
6C237	6.87 pH at 25°C}	A box contains 5 packets of powder. Each makes a 200 ml solution.
6C236	9.18 pH at 25°C}	

## 8. TROUBLESHOOTING

The EXA is a microprocessor-based analyzer that performs continuous self-diagnostics to verify that it is working correctly. Error messages resulting from faults in the microprocessor systems itself are few. Incorrect programming by the user can be corrected according to the limits set in the following text.

In addition, the EXA also checks the electrodes to establish whether they are still functioning within specified limits. The transmitter checks the glass-electrode impedance for a low value to determine if it is broken or cracked, and for a high impedance to check for internal breakage or disconnection.

The reference system is prone to more faults than the glass electrode in general. The unit measures the impedance value and compares it to the programmed value in memory to determine acceptance during testing. A high impedance signals pollution or poisoning of the reference electrode diaphragm.

Also, the EXA checks the electrodes during calibration to determine if the reaction time is suitable for pH measurement. A specially timed check can be activated following each cleaning cycle. After calibration, the unit checks the calculated asymmetry potential and the slope to determine if they are still within limits specified by the software.

The slow shift of asymmetry potential could signal a poisoning of the reference electrode system by the process. The decrease of slope equals a decrease of sensitivity of the glass electrode or can show a coating buildup at the electrode.

The EXA makes a distinction among diagnostic findings. All errors are signaled by the FAIL flag in the display. Only faults in the measuring circuit can be set as HARD FAIL, with "Burn-up or Burn-down" signals on the mA output.

What follows is a brief outline of some of the EXA troubleshooting procedures, followed by a detailed table of error codes with possible causes and remedies.

### NOTE:

The diagnostic function of the EXA gives a variable time interval between impedance checks, up to 5 minutes. When trouble shooting, a manual impedance check can be initiated by following the procedure in section 5-1-6.

## **8-1. Diagnostics**

### **8-1-1. Off-line calibration checks**

The EXA transmitter incorporates a diagnostic check of the asymmetry potential after a calibration has been completed. This is a valid check for both manual and automatic calibration routines.

The actual value can be called up from the DISPLAY routine in the maintenance menu. A large value often indicates poisoning or pollution of the reference system used. If the asymmetry potential exceeds programmable limits, the EXA generates an error (E2).

The EXA also performs diagnostics to check for the slope of the pH electrode after automatic calibration is completed. The actual value of the slope can be called up on the DISPLAY routine in the maintenance menu (SL). This value is an indication of the age of the electrode. If the value stays within the limits of 70 to 110 percent of the theoretical value (59.16 mV/pH at 25°C), it is accepted. Otherwise, the unit generates an error (E3).

Activation or deactivation of the asymmetry diagnostic check and slope check is made from the Service Codes. See Chapter 5 or Chapter 10 (Appendix).

### **8-1-2. On-line impedance checks**

The EXA has a sophisticated impedance checking system. The sensors can be checked for their impedance over a very wide range, which makes the tool equally useful for glass, enamel, reference and metal (ORP) sensors. The measurement is temperature compensated for the characteristic of the pH glass sensor.

In order to measure accurately over such a wide range, it is necessary to split the range into two. This is done by a pair of jumper settings, high range and low range can be set on either input, making the system extremely flexible.

The following error message table gives a list of problems that are indicated when the high or low impedance limits are exceeded for a sensor. Such things as fouling, breakage and cable faults are readily detected. The non-immersion of the sensors in the process fluid is also signalled.

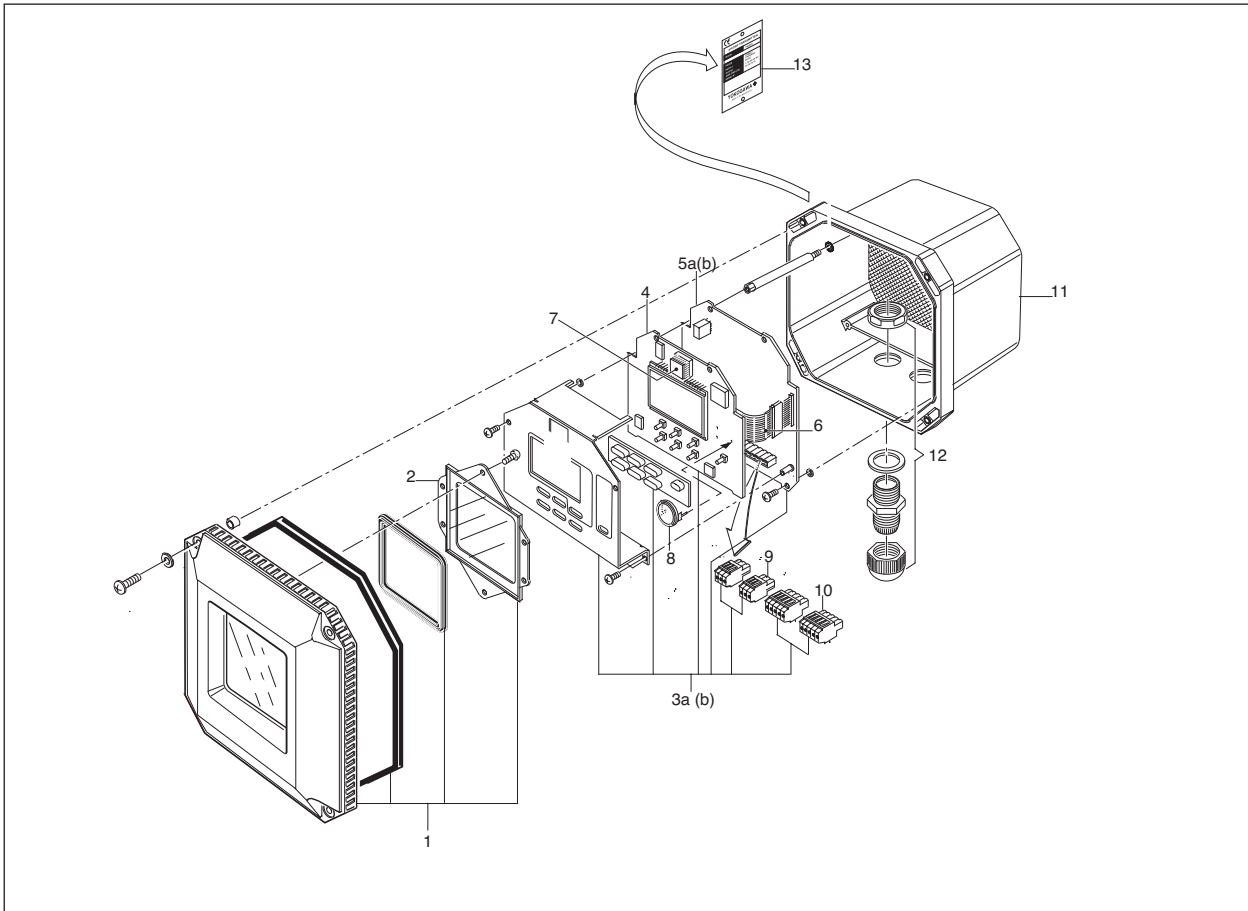
**Table 8-1. Error Codes**

Code	Error description	Possible cause	Suggested remedy
E0	Buffer solution temperature outside the programmed range	Buffer solution too hot or too cold	Adjust buffer temperature Check cabling
E1	Measurement failed to stabilize during the calibration	Sensors fouled Sensors too slow (aged sensor)	Clean sensors Replace sensors
E2	Asymmetry potential too high. (Limits set in service code 22.)	Sensors are aged or polluted Mistake in calibration	Check buffer solution Recalibrate at pH7 Replace sensor
E3	Slope (sensitivity) is outside limits. (Limits set in service code 23.)	Measuring sensor aged Poor insulation at the connector	Replace measuring sensor Replace or dry cables
E4.1	Impedance of input 1 too low. (Limits set in service code 03.)	Measuring sensor broken Damaged or damp connections	Replace measuring sensor Replace or dry cable
E4.2	Impedance of input 2 too low. (Limits set in service code 04.)	Reference sensor broken Damaged connections	Replace reference sensor Replace cables
E5.1	Impedance of input 1 too high. (Limits set in service code 03.)	Measuring sensor disconnected Sensors not immersed in process Liquid earth disconnected	Check connections Check process Check connections
E5.2	Impedance of input 2 too high. (Limits set in service code 04.)	Reference sensor fouled Liquid earth disconnected Insufficient electrolyte	Clean or replace sensor Check sensor immersion Check electrolyte reservoir
E7	Temperature sensor open > 140°C (or < -10°C for 8k55)	Process too hot or too cold Wrong temperature sensor setting Temperature sensor damaged	Check process Check sensor & setting Check connections
E8	Temperature sensor shortened < -30 °C (or > 120 °C for 8k55)	Process too cold or too hot Wrong temperature sensor used Temperature sensor damaged	Check process Check sensor & setting Check connections
E9	Measurement out of range (-2 to 16 pH)	Sensors disconnected Sensor wrongly connected Sensor(s) defective	Check cabling Check cabling Replace sensor(s)
E10	EEPROM write failure	Fault in electronics	Try again, if unsuccessful contact Yokogawa
<b>mA</b> E11	Wash recovery check error (if communication is set to pH201*B in code 60)	Measuring sensor aged Sensor still coated after washing Defective wash system	Replace measuring sensor Check cleaning system If needed adjust timings
E12	ORP / rH outside of preset limits	Sensors disconnected or wrongly connected	Check cabling
E14	No valid calibration data.	Data lost after switching from pH to ORP	Recalibrate
E15	Cable resistance to temperature sensor exceeds limit value.	Cable resistance too high Corroded contacts Wrong sensor programmed	Use Pt1000Ω Clean and reterminate Reprogram
E16	Call for maintenance interval time exceeded.	System not maintained in preset time period	Perform maintenance Reset interval
<b>mA</b> E17	Output span too small < 1pH	Incorrect configuration by user	Reprogram
E18	Table values make no sense		
E19	Programmed values outside acceptable limits	Incorrect configuration by user	Reprogram
E20	All programmed data lost	Fault in electronics Very severe interference	Contact Yokogawa
E21	Checksum error	Software problem	Contact Yokogawa
E23	Zeropoint outside limits	Sensors are aged or polluted Mistake in calibration	Check buffer solution Recalibrate at pH7 Replace sensor

## 9. SPARE PARTS

**Table 9-1. Itemized parts list**

Item No.	Description	Part no.
1	Cover assembly including window, gasket and fixing screws	K1542JZ
2	Window	K1542JN
3a	Internal works assembly (general purpose)	K1544DA
3b	Internal works assembly (intrinsically safe)	K1544DD
4	Digital (display) board	K1544DH
5a	Analog (input) board (general purpose)	K1544PL
5b	Analog (input) board (intrinsically safe)	K1544PE
6	Ribbon cable	K1544PH
7	Eeprom + latest software pH202	K1544BK
8	Lithium cell (battery)	K1543AJ
9	Terminals (block of 3)	K1544PF
10	Terminals (block of 5)	K1544PG
11	Housing	K1542JL
12	Gland set (one gland including seal and backing nut)	K1500AU
13	HART® modem for communications to PC	K1544WM
<b>Options</b>		
/U	Pipe and wall mounting hardware	K1542KW
/H	Hood for sun protection	K1542KG
/SCT	Stainless steel tag plate	K1544ST



**Fig. 9-1. Exploded view**

## 10. APPENDIX

## 10-1. User setting table

FUNCTION		SETTING DEFAULTS		USER SETTINGS		
<b>Parameter specific functions</b>						
01	*PH.ORM	0	pH			
02	*PRM2	0	Off			
03	*Z1.CHK	1.1.1	High range, TC on check on,			
04	*Z2.CHK	0.0.1	Low range, TC off check off no TC			
05	*CAL.CK	1.1	AP on, Slope on			
<b>Temperature functions</b>						
10	*T.SENS	0	Pt1000			
11	*T.UNIT	0	°C			
12	*T.ADJ		None			
13	*T.COMP	0	Off			
	*T.COEF	-0.00	pH/10°C			
<b>Calibration functions</b>						
20	*Δt.SEC	5	Sec			
	*ΔpH	0.02	pH			
21	*AP.LOW	-120	mV			
	*AP.HI	120	mV			
22	*SL.LOW	70	%			
	*SL.HI	110	%			
23	*ITP	7.00	pH			
	*SLOPE	100.0	%			
	*ASP.1D	0.0	mV			
	*ASP.mV		mV			
24	*BUF.ID	4	NIST 4			
25	*BUF.ID	7	NIST 7			
26	*BUF.ID	9	NIST 9			
27	*ZERO.P	0	disabled			
<b>mA outputs</b>						
31	*OUTP.F	0	pH (ORP)			
32	*BURN	0	off			
35	*TABLE	21 pt table	see code 31			

mA  
mA  
mA

FUNCTION		SETTING DEFAULTS		USER SETTINGS		
<b>User interface</b>						
50	*RET	1	on			
51	*MODE	0	off			
52	*PASS	0.0.0	all off			
53	*Err.4.1	1	hard fail			
	*Err.5.1	1	hard fail			
	*Err.4.2	1	hard fail			
	*Err.5.2	1	hard fail			
	*Err.07	1	hard fail			
	*Err.08	1	hard fail			
	*Err.09	1	hard fail			
	*Err.11	0	soft fail			
	*Err.16	0	soft fail			
55	*CALL.M	0	250 days			
56	*DISP	1	0.01 pH			
<b>Communication</b>						
mA mA	60	*COMM.	0.1	off/write prot.		
		*ADDR.	00	00		
	61	*HOUR				
	62	*ERASE				
<b>General</b>						
	70	*LOAD				
	79	*CUST.D				
<b>Test and setup mode</b>						
	80	*TEST				



## 10-2. Configuration checklist for PH202G

	Standard Configuration	Options	Reference for change
<b>Measured Variable(s)</b>			
primary inputs	pH, ORP and Temp		
pH range	0-14 pH	any span within -2-16 pH	"output"
pH range linearized	disabled	21 point table	codes 31& 35
ORP range	-500 to 500 mV	spans up to 3000 mV between -1500 to 1500mV	"output"
Temperature range	-30-140°C		
Temperature unit	Celsius	Fahrenheit	code 11
<b>mA mA mA mA</b> <b>mA Outputs</b>			
analog output	4- 20 mA for pH	pH/ORP/(parameter 2)	code 01, 02, 31
output linearization	disabled	pH/ORP	codes 35
<b>Communication</b>			
digital interface	disabled	HART	60
communication software	externa•	HHC or PC202	contact factory
variables on display	pH/ORP and temp	pH/ORP, parameter 2, mA output SL, AP, Z1, Z2 etc.	"display"
burn out	disabled	burn low (3.9)/ high (22) on mA output	code 32
password protection	disabled	for maint/ comm./ serv leve•	code 52
autoreturn	return to measure in 10 min.	enable or disable	code 50
add. functions in MAINT	disabled	Impedance check start	code 51
<b>Diagnostics</b>			
impedance checking	active	enable or disable	code 03 & 04
check on calibration data	active	enable or disable	code 05
check on stability	0.02 pH per 5 s	choose stability leve•	code 20
display calibration log.	enabled with logbook	diagnostics setup	codes 03, 04 & 05
<b>Compatibility</b>			
pH or ORP	glass sensor/metal electrode	pH or ORP	code 01
temperature sensor	Pt 1000Ω	Pt1000; Pt100, etc	code 10
other sensors	enamel sensors (Pfaudler)	ITP & impedance check setup	codes 23, 03 & 04
2nd parameter	disabled	pH & ORP/ pH &rH	code 02
manual temp. comp.	disabled	disable or enable	"temp"
<b>Special Features</b>			
buffer table configuration	NIST standard	fully configurable	codes 24, 25 & 26
temperature calibration	none	adjustment +/- 20 °C	code 12
zero point calibration	disabled	disable or enable	code 27
call for maintenance		set time interval 1 - 250 days	code 55
HOLD during maintenance		hold last or hold fix	"hold"
process temp. compensation	disabled	set temperature coefficient	code 13
logbook	disabled	2 x 50 events	code 61, 62

### 10-3. Setup for sensor compatibility

#### 10-3-1. General

The inputs of the EXA transmitter are freely programmable for ease of installation. Standard glass pH electrodes, Ag/AgCl reference electrodes and Pt100 and Pt1000 temperature sensors need no special programming. The EXA indicates a fault with a signal in the display field if there is a mismatch of sensors in the connection.

#### 10-3-2. Selection of measurement and reference electrode

The EXA PH202 is preprogrammed to accept industry standard glass electrodes and reference electrodes. The unit initiates checks for asymmetry and slope during calibration. The on-line impedance checking function has been upgraded in this most recent EXA release.

The EXA is universally compatible with all types of electrodes, such as enamel and antimony. In such systems, however, the specific isothermal point of intersection (ITP), slope (pH/mV) and asymmetry potential can be set for the type of electrode.

#### 10-3-3. Selecting a temperature sensor

The EXA PH202 reaches its highest accuracy when used with the Pt1000 temperature sensor. This element offers a 10-fold increase in resistance dependence over the Pt100 sensor. Choice of temperature sensor is made in the Service Codes found in Chapter 5 of this manual.

- **ITP**

Most Yokogawa sensor systems use an Iso-thermal point (ITP) of pH7 and a zero point at pH7. This is the default condition for which the transmitter is set. It is only necessary to consider this adjustment when installing a system with a different ITP. Antimony systems and Pfaudler probes are good examples of systems with different ITP values. Service code 23 is used. This also permits the setting of calibration data for precalibrated sensors.

- **Temperature sensor**

The Pt 100 U RTD sensor is now becoming the most commonly used for temperature compensation. The transmitter accepts inputs from several different temperature sensors to suit most sensor systems. Service code 10-19 are used to set the temperature parameters and the process temperature coefficient.

- **Temperature calibration**

For best accuracy, the temperature sensor should be calibrated to compensate for connection cable errors. See Service code 12.

- **pH Calibration**

Traditionally, users select buffer solutions to suit the chosen output range. This is merely a continuation of the days of analog instruments that used indicators driven by the mA output. With digital technology, it is better to choose good buffer solutions and make an effective calibration than to use commercial (adjusted) buffers which may have round number values, but are less effective buffers with lower buffer capacity. It is for this reason that Yokogawa recommends that the NIST 4, 7 and 9 standard buffers be used to calibrate solutions. The temperature responses of these are pre-programmed into Service codes 24, 25, and 26 in the EXA PH202. Where other buffers are used with the semi-automatic calibration function, their temperature response should be programmed into the relevant code.

#### 10-4. Setup for other functions

##### **mA** • **Current outputs**

Transmission signals for the measured parameters and FAIL signals can be set up in service codes 30 to 39.

##### • **Diagnostic Checks**

Impedance checks, response time and stability checks are all included in the PH202. In order to get the best performance from each of these features, the converter should be fine tuned according to experience in the installation, and for the particular sensors selected. Service codes 3, 4, 5 & 20 all contribute to the diagnostics. Please note that the default settings provide an excellent starting point and provide most valuable information about the performance of the electrode system.

##### **mA** • **Communications**

The proprietary HART (FSK) communication link allows remote configuration and data retrieval through the PC202 communication package. This is an excellent tool for the maintenance engineer, quality engineer or plant manager. Service codes 60-69 are used to set up the communications.

##### • **Logbook**

In combination with the communications link, a "logbook" is available to keep an electronic record of events such as error messages, calibrations and programmed data changes. By reference to this log, users can easily evaluate diagnostic information to determine predictive maintenance schedules. For example, by monitoring the deterioration in the slope of the pH sensor, it can be changed before a failure (or process shutdown) occurs.

### 10-5. Set up for Pfaudler Type 18 sensor

The PH202 is intended to measure with all sorts of pH sensors, including the Pfaudler Type 18 sensor. The Pfaudler design of dual membrane system uses two enamels of differing sensitivity. The first a pH sensitive membrane, and the second one that responds to Na<sup>+</sup> and K<sup>+</sup> and acts as a reference.

The analyzer has dual high impedance inputs which measure perfectly even with very high impedance sensors. However, the impedance measuring system (diagnostics) needs to be set up for best performance.

#### 10-5-1. General set up

1. Set impedance measuring hardware. This is done by the use of links on the terminals adjacent to the input terminals. For the Pfaudler system, this means that the terminals should have the links disconnected in order to set for HIGH/HIGH impedance measuring.
2. Set the impedance check in software. Use codes 03 & 04 to enable the measurement and set for high impedance and configure appropriate limits.

Code 03 set to 1.0.1	low limit	1 Megaohm
	high limit	1 Gigaohm
Code 04 set to 1.0.1	lowlimit	1 Megaohm
	high limit	1 Gigaohm

3. Set the temperature compensation sensor as 100 Ohm Platinum RTD with service code 10.

Code 10 set to 1	100 Ohms Pt.
------------------	--------------

The system will now respond properly to the Pfaudler type 18 sensor, and the other functions of the EXA analyzer will need to be set in the normal way to suit the use to which the loop is being put. Output ranges, control functions and alarms should all be set as described elsewhere in this manual.

#### 10-5-2. Calibration set up

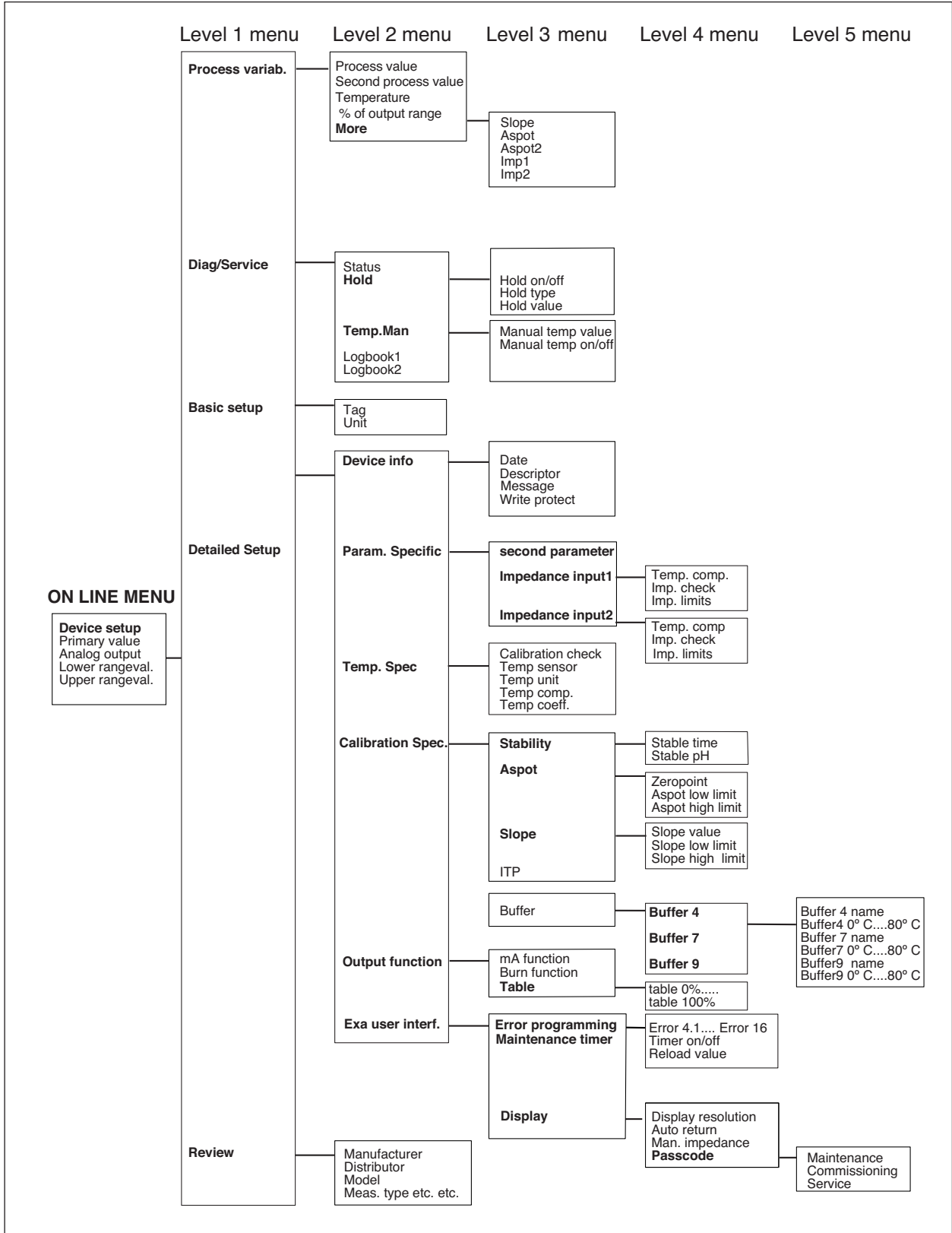
4. The alternative Zero point (calibration and display) according to IEC 746-2 may be enabled in service code 27, and set in the MAN.CAL routine. A value of 10.5 pH is a good starting point for the Pfaudler 18 sensor.
5. Where lab test data are available for the sensor, service code 23 can be used to set values for ITP & Slope (and As pot for parameter 2 when enabled).

(This method can be useful for the type 18 sensor, as it is not usual to perform regular calibrations on this system as with normal sensors. This is because the system may well respond differently, to ordinary buffers, than with the process solutions. The procedure is to determine the temperature response (ITP) and the sensitivity (Slope) of the sensor, and enter these values in code 23.)

Because this is a rather complex procedure, it is recommended instead to use the default settings of ITP = 7.00, and Slope = 100 %, and make a single point (MAN.CAL) calibration in the process at the working temperature, and at the normal operating (control setpoint) pH. This ensures that the desired control point will be measured accurately, even if there may be small deviations when there is a big deviation from the setpoint. This of course has no effect on the accuracy of a control loop. The special construction of the Pfaudler sensor ensures that there is practically no drift in the calibration. All that is necessary is to keep the sensor membranes clean. This is best done by cleaning with low pressure steam, which restores the original condition of the sensor, including the original calibration values.

**mA 10-6. Device Description (DD) menu structure**

The Device Description (DD) is available from Yokogawa or the HART foundation. An example is shown below of the ON LINE menu structure. This manual makes no attempt to explain the operation of the Hand Held Communicator (HHC). For detailed operating instructions, refer to the HHC user's manual and the on-line help structure.



## **10-7. Field Change Order**

Software changes of the PH202

### **10-7-1. Changes made by software release 1.1**

- The hardware and software of the PH202 has been modified in order to make the instrument suitable for 8 temperature sensors.
- Software version 1.0 supports only the PCB suitable for 5 temp sensors.
- Software version 1.1 is prepared to handle both versions of transmitters (the 5 and 8 temperature sensor PCB's). The new release will recognize (auto detection) which version is used.

### **10-7-2. Changes made by software release 1.2**

- In order to operate the PH202 in combination with the model 275 Hand-Held Communicator (HHC) from Fisher-Rosemount it is necessary that :
  - the software of the PH202 is updated.
  - the Model 275 is upgraded with the PH202-Device Description (DD).
- In case the instrument is programmed as pH device with second parameter rH-measurement enabled (Service code 02), the instrument returned with an inverted rH value. This calculation is now corrected in this software release.
- When MODE keypress during non-successful calibration (E0, E1, E2 ,E3), the error will be cleared instead of leaving the (soft) error active.
- In case a Sample is taken, the sample can be viewed. In this Sample view menu, the 2nd process value was the actual measured value instead of the wanted sample value. In this release, the sample value is shown correctly.

### **10-7-3. Changes made by software release 1.3**

- Sample calibration did not work correctly in case the Temperature Coefficient (T.C.) is other than zero. - The change in pH due to this T.C. was incorrectly interpreted as a direct aspot change.
- In case the passcode check was enabled, and an incorrect passcode was entered, this caused to stop functioning of the display and keyboard.
- Writing of instrument setting went wrong. Communication related update for handheld and PC202 operation. For PC202 operation with the PH202, this software version is necessary.
- In case manual temperature was enabled, any temperature error (E7, E8) was still displayed. the temperature errors should be cleared automatically in the case of a manual temperature value.

### **10-7-4. Changes made by software release 1.4**

- A problem with Automatic Test Equipment during manufacturing was solved.

### **10-7-5. Changes made by software release 1.5**

- The rH calculation was incorrect. There was a sign-error in the calculation formula. Also a 304mV offset voltage has been added in the calculation to make it right for a modern sensor. The rH calculation is correct now for a pH-sensor with a buffer solution of pH 7 and an Ag/AgCl/KCl reference system . The old calculation was based on a sensor with a buffer solution of pH 1 (with HCl reference system).

### **10-7-6. Changes made by software release 1.6**

- Sensor check is switched OFF now during the start of CAL to prevent an unclear situation for the customer.
- Temperature errors were not switched OFF during MANTEMP.
- During INIT sometimes characters were missing in the messageline.
- During QIS the ORP measurement stops at 1220 mV. This has been changed so ORP can be measured up to 1500 mV. Also temperatures below -10 °C were not shown correctly.

**10-7-7. Changes made by software release 1.7**

- Default \* T.COEFF changed from 0.00 to -0.00.
- Error 5.1 occurs (instead of 4.1) if no sensor is connected.
- E12 can only occur if second process is ORP or rH.

**10-7-8. Changes made by software release 1.8**

- Communications with PH201\* B possible.
- Three new temperature sensors (DKK 350, 6K8 and NTC10K).
- Periodically unused errors are reset.
- Service 79 added for loading defaults excepts pH buffer tables.
- No longer PIN needed for communication and "logbook scrolling".

**10-7-9. Changes made by software release 1.9**

- Enabling user to set Zero point limits in service code 21.
- mA table handling improved.
- Interpolation mA table improved.
- Communication with PH201\* B improved (WASH).
- High impedance limit raised to  $2G\Omega$  (as described in IM).

**10-7-10. Changes made by software release 2.0**

- E20 is cleared after the programmed data was recovered.

**10-7-11 Changes made by software release 3.0**

- The maximum ORP span is set to 3000mV (was 2000mV)  
Communication is default set to enabled / write enabled

**10-7-12 Changes made by software release 3.3**

- The NTC10k $\Omega$  was replaced by the PTC10k $\Omega$ .

**10-7-13 Changes made by software release 3.4**

- Updated internal tester identification range.

**10-7-14 Changes made by software release 3.5**

- Fixed rare HART communication failure.

**10-7-15 Changes made by software release 3.6**

- Solve problem with E4.1 / E5.1 impedance errors after loading all parameters from DCS
- Burn low value set to 3.6 mA, only selectable if HART-Communication is disabled
- Prevent incidental reset of the unit while loading default settings
- Prevent incidental communication problems with MH-02 PC-HART modem

**10-7-15 Changes made by software release 3.7**

- Implementation of Burn low in combination with HART changed.

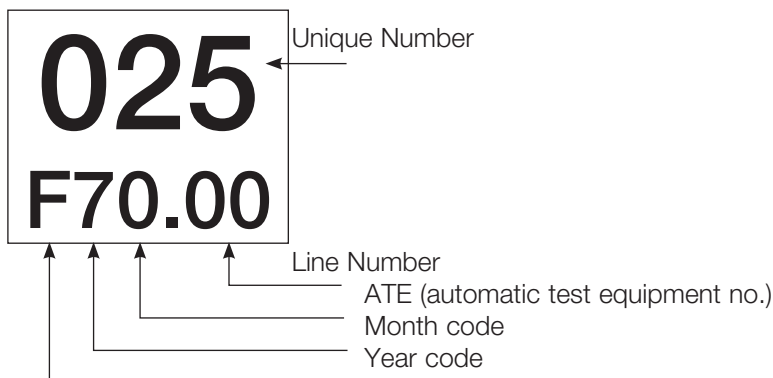
## 11. Test Certificate

# Test Certificate

**EXA Series**  
**Model PH202**  
**Transmitter for pH / ORP**

### 1. Introduction

This inspection procedure applies to the model PH202 converter. There is a serial number, unique to the instrument, which is stored in non-volatile memory. Each time the converter is powered up, the serial number is shown in the display. An example is shown below, for details see the Users manual:



### 2. General Inspection

Final testing begins with a visual inspection of the unit to ensure that all the relevant parts are present and correctly fitted.

### 3. Safety Test

The (-) minus and the external ground terminal of the housing are connected to a Voltage generator (100 VDC). The measured impedance value should be over 9.5 MΩ.

Terminal 12 and the external ground terminal of the housing are connected to a Voltage generator (500 VAC RMS) for 1 minute. The leakage current should remain below 8 mA.

#### 4.1 Accuracy Testing

Our automated testing facility checks the accuracy of the dual high inputs of the instrument using a calibrated variable resistor (decade resistor box) to simulate sensor mV's.

#### 4.2 Accuracy Testing of all supported temperature elements

Our automated testing facility checks the input accuracy of the instrument using a calibrated variable resistor (decade resistor box) to simulate the resistance of all temperature elements.



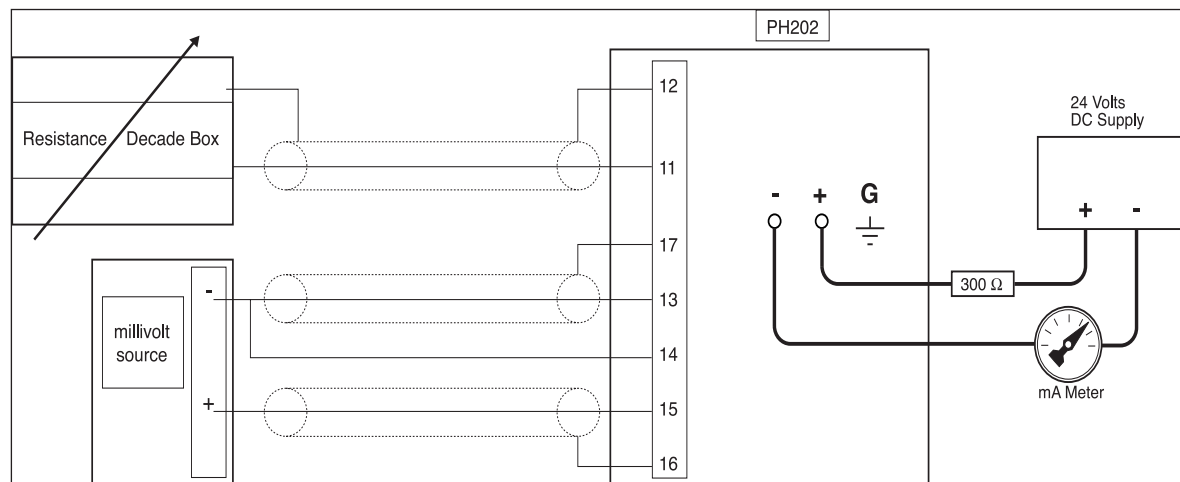
### 4.3 Overall accuracy test

This test can be performed by the end-user to check the overall accuracy of the instrument. The data specified on the Test certificate are results of the overall accuracy test performed during production and can be reproduced by performing similar tests with the following test equipment:

1. A variable resistor box 1 (resistor decade box) to simulate the temperate element. All tests are performed simulating 25°C (77 °F).
1. A fixed resistor of 300 Ω to simulate the mA-output load.
2. A millivolt source ranging from -1500 to +1500 mV with an accuracy of 0.1%.
2. A stabilised voltage supply unit : nominal 24 Volt DC
3. A current meter for DC currents up to 25 mA, resolution 1uA, accuracy 0.1%
3. A multimeter capable of measuring megohm ranges to check insulation impedance.
4. Screened cable to connect the input signals.
5. Single core flexible cable for liquid earth connection.

Connect the PH202 as shown in Figure 1. Set box 1 to simulate 25 °C (1097,3 U for Pt1000)

Before starting the actual test, the PH202 and peripheral testing equipment has to be connected to the power supply for at least 5 minutes, to assure the instrument is warmed up properly.



**Figure 1. Connection diagram for the overall accuracy test**

The tolerances specified relate to the performance of the PH202 with calibrated test equipment under controlled test conditions (humidity, ambient temperature). Note that these accuracy's are only reproducible when performed with similar test equipment under similar test conditions. Under other conditions, the accuracy and linearity of the test equipment will be different. The display may show values, which differ as much as 1% from those measured under controlled conditions.

### 4.4 Accuracy test mA output circuit

Our automated testing facility checks the output accuracy of the instrument with simulated mA-output values.

# Test Certificate

EXA Series  
Model PH202  
pH / ORP Transmitter

<b>1. Instrument Description</b>							
Model : PH202S-E-D/U/Q/SCT				Serial No : P5013018			
Order : 100000322002				Release Version : 3.1			
<b>2. General Inspector</b> OK							
<b>3.1 Insulation Test</b> OK				<b>3.2 Communication Test</b> OK			
<b>4.1 Accuracy Test (mV Display)</b>							
Input mV	Display mV	Tolerance mV	Reading mV				
1500	1500	± 1	1500				
750	750	± 1	750				
0	0	± 1	0				
-750	-750	± 1	-751				
-1500	-1500	± 1	-1501				
<b>4.2.1 Accuracy Test (Temp. Display with Pt100 RTD)</b>				<b>4.2.2 Accuracy Test (Temp. Display with Pt1000 RTD)</b>			
Resistance Ω	Temp. °C	Tolerance °C	Reading °C	Resistance Ω	Temp. °C	Tolerance °C	Reading °C
92.2	-20	± 0.4	-19.9	921.6	-20	± 0.3	-19.9
109.7	25	± 0.4	25.0	1097.3	25	± 0.3	25.0
129.0	75	± 0.4	74.9	1290.0	75	± 0.3	75.0
149.8	130	± 0.4	129.9	1498.2	130	± 0.3	130.0
<b>4.2.3 Accuracy Test (Temp. Display with 3K Balco)</b>				<b>4.2.4 Accuracy Test (Temp. Display with 5K1)</b>			
Resistance Ω	Temp. °C	Tolerance °C	Reading °C	Resistance Ω	Temp. °C	Tolerance °C	Reading °C
2406	-20	± 0.3	-20.0	4273.8	-20	± 0.3	-20.0
3000	25	± 0.3	25.0	5100.0	25	± 0.3	25.0
3660	75	± 0.3	75.0	6018	75	± 0.3	75.0
4386	130	± 0.3	130.0	7027.8	130	± 0.3	130.0
<b>4.2.5 Accuracy Test (Temp. Display with 8K55)</b>				<b>4.2.6 Accuracy Test (Temp. Display with 350)</b>			
Resistance Ω	Temp. °C	Tolerance °C	Reading °C	Resistance Ω	Temp. °C	Tolerance °C	Reading °C
47000	-10	± 0.3	-10.0	297.2	-20	± 0.3	-20.0
8550	25	± 0.3	25.0	350.0	25	± 0.3	25.0
1263	75	± 0.3	75.0	408.6	75	± 0.3	75.0
343	120	± 0.3	119.9	473.1	130	± 0.3	130.0
<b>4.2.7 Accuracy Test (Temp. Display with 6K8)</b>				<b>4.2.8 Accuracy Test (Temp. Display with 10K PTC)</b>			
Resistance Ω	Temp. °C	Tolerance °C	Reading °C	Resistance Ω	Temp. °C	Tolerance °C	Reading °C
5698.4	-20	± 0.3	-20.0	8462.0	-20	± 0.3	-10.0
6800.0	25	± 0.3	25.0	10000.0	25	± 0.3	25.0
8024.6	75	± 0.3	75.0	11680.0	75	± 0.3	74.9
9370.4	130	± 0.3	130.0	13525.0	130	± 0.3	120.0
<b>4.3 Overall Accuracy Test (Pt1000 RTD @ T = 25± 0.3°C)</b>							
Input mV	Display pH	Tolerance pH	Reading pH	Nominal mA	Tolerance mA	Reading mA	
414.1	0.00	± 0.01	0.00	4.00	± 0.06	4.00	
177.5	4.00	± 0.01	4.00	8.57	± 0.06	8.56	
0.0	7.00	± 0.01	7.00	12.00	± 0.06	12.00	
-177.5	10.00	± 0.01	10.00	15.43	± 0.06	15.42	
-414.1	14.00	± 0.01	14.00	20.00	± 0.06	20.00	
<b>5. Accuracy Test mA output circuit</b>				Date	Ambient Temp	Rel. Humidity	
Simulated Output mA	Tolerance mA	Actual Output mA		23-05-02	°C	%RH	
4.0	± 0.02	4.00					
8.0	± 0.02	8.00					
12.0	± 0.02	12.00					
16.0	± 0.02	16.00					
20.0	± 0.02	20.00					



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**GLOSSARY****pH**  $(-\log [H^+])$ 

This is a logarithmic function of the Hydrogen ion activity (concentration). This provides a quick indication of the acidic or alkaline behavior of a dilute solution. Normally measured on a scale of 0-14 pH where low numerical values are acidic (0 is approximately 1 Normal acid) and high numbers are alkaline (14 is approximately 1 Normal NaOH). The neutral point is pH 7.

Defined by Nernst in the following equation:  $E = E_o + RT/nF \times \ln [H^+]$

E = measured potential  
 R = gas constant  
 T = absolute temperature  
 n = valence  
 F = Faraday number  
 Ln = Napierian logarithm  
 $[H^+]$  = activity of the Hydrogen ion  
 Eo = Reference potential

**ORP**

Oxidation reduction potential is a measure of oxidizing power of a solution. The greater the millivolt value with a negative polarity, the greater the oxidizing power. Reducing power is indicated by positive values of mV.

**rH**

This is a composite value that indicates the oxidizing power of a solution compensating for the influence of the acid or alkaline components. The scale is 0-55 rH, where oxidizing solutions provide the highest readings.

**Asymmetry potential**

This is the difference between the isothermal point of intersection and the zero point.

**Slope**

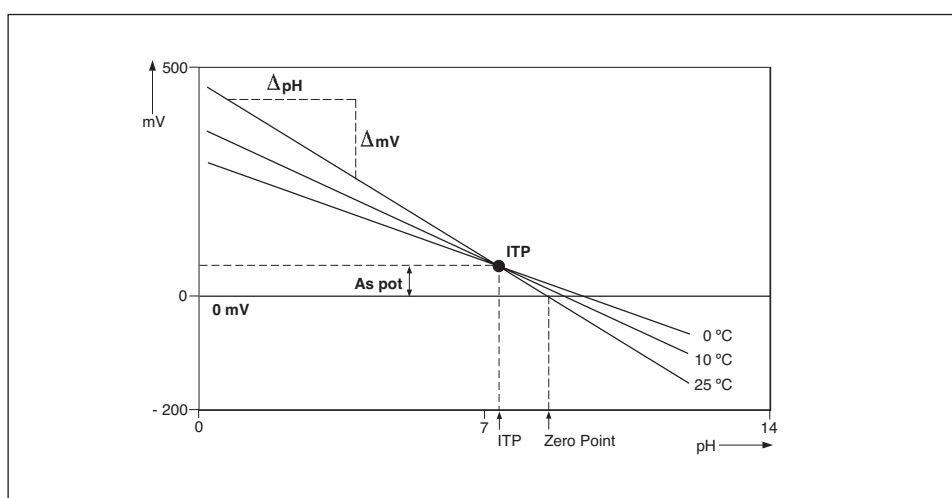
This is the sensitivity of the pH electrode (mV/pH) usually expressed as a % of the theoretical value (Nernst).

**ITP**

This is the isothermal point of intersection. This is the value in pH at which the temperature response of the system is at a null point. In other words, the point of intersection of the temperature lines on a graph of millivolts vs pH. This point is critical to the correct operation of the temperature compensation circuitry.

**Zero point**

This is the value of pH at which the electrode combination yields 0 mV as an output.



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