

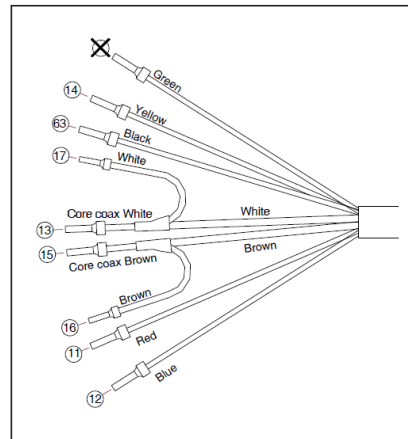
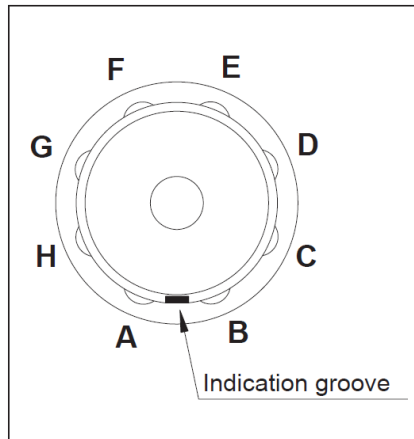
# TECHNICAL NOTE

PH202\*/PH450G/FLXA2\* Quick Start Guide for the Cation Differential pH/ORP Sensors (SC24V AND FU20-FTS)

## Proper Wiring

The SC24V AND FU20-FTS and FU20-FTS has an integral Variopin connector and must be used in conjunction with the WU10 dual coax cable (i.e. WU10-V-D-\*\*). Because of the SC24V AND FU20-FTS differential design, it can only be used with an analyzer capable of accepting *dual high impedance* inputs (i.e. Yokogawa PH202\*/FLXA21/PH402G/PH450G where **NO** jumpers should be installed on "input 2").

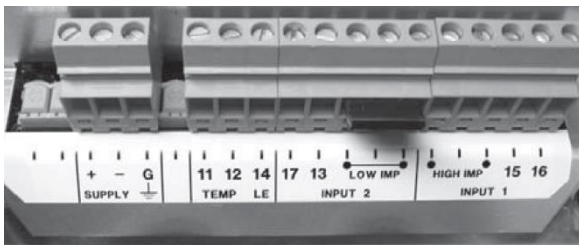
Variopin #	WU10 wire color	pH analyzer terminal #	Signal description
A	Brown	15	Core coax pH
B	Brown	16	Shield coax pH
C	White	13	Core coax pNa
D	White	17	Shield coax pNa
E	Red	11	Temperature
F	Blue	12	Temperature
G	Yellow	14	Liquid earth
H	Black	63	WU10 overall shield
	Green		Not used



## Initial Installation

The SC24V AND FU20-FTS differential pH/ORP sensor is dual high impedance and requires a transmitter that allows for a dual high impedance configuration. Traditional reference system is low impedance. This means for Yokogawa transmitters the Jumper that is normally installed at input 2 should be removed and the electronics may need reprogram. Please see the steps and placement of jumpers for the corresponding analyzer being used below.

### 1.) PH202\*



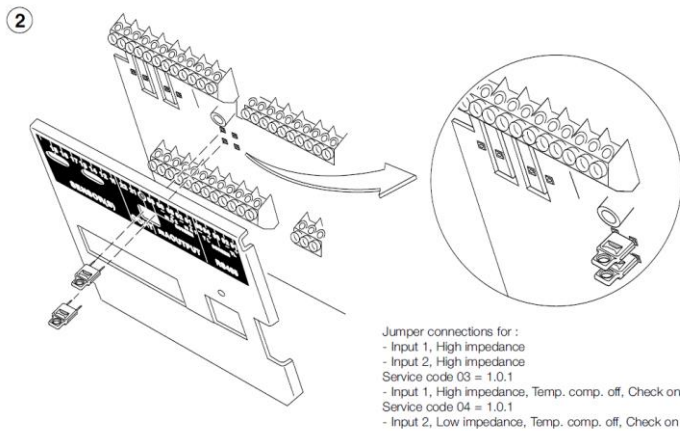
# TECHNICAL NOTE

PH202\*/PH450G/FLXA2\* Quick Start Guide for the Cation Differential pH/ORP Sensors (SC24V AND FU20-FTS)

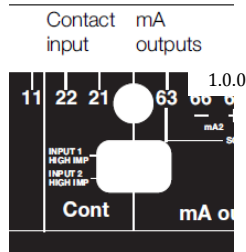
No Jumpers should be installed in input 1 or input 2. Service Code 04 should be changed to 1.0.0

Because the process salt concentration compared to the sodium buffers salt concentration being greater than 120 mV offset the ASY setting should be changed by setting **Service code 05 to 0.1.**

## 2.) PH402G

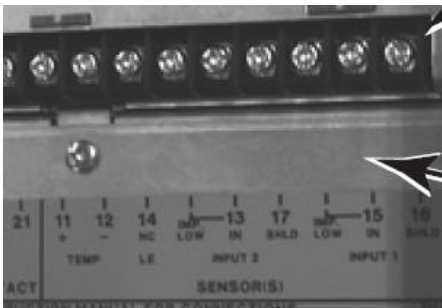


Jumpers should be installed as the photo shows above and Service codes 03 and 04 need to be modified as the photo shows above. Close up view of jumper location:



Because the process salt concentration compared to the sodium buffers salt concentration being greater than 120 mV offset the ASY setting should be changed by setting **Service code 05 to 0.1.**

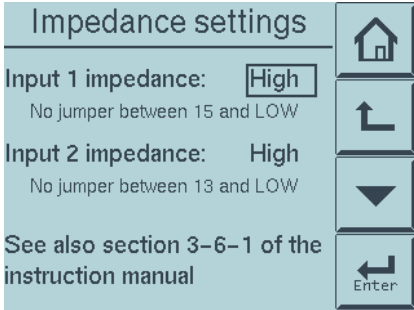
## 4.) PH450G




# TECHNICAL NOTE

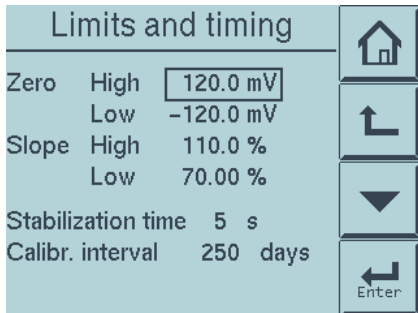
PH202\*/PH450G/FLXA2\* Quick Start Guide for the Cation Differential pH/ORP Sensors (SC24V AND FU20-FTS)

No jumpers should be installed in input 1 or input 2. Within the electronics the impedance 2 needs to be programmed for high impedance. Select the Wrench → Commissioning → Measurement Setup → Impedance settings, and set Input 1 and Input two to both read high.

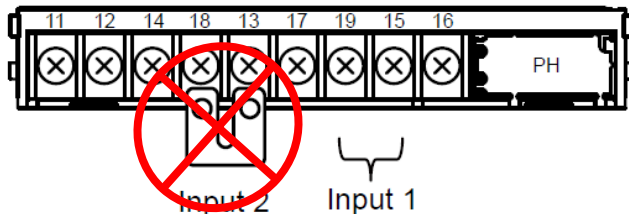


Select the return key, , one time to return to the Measurement Setup Screen.

Due to the process salt concentration compared to the sodium buffers salt concentration being greater than 120 mV offset the the ASY range needs to be either expanded or the check needs to be disabled. If we do not change or inactivate the alarm the process calibration will not be accept and an out of range error message will be given. Under the Measurement Setup → Calibration Settings → Limits and timing change the Zero high and low limits to +/- 250 mV. This should be a large enough range, that the manual process calibration will not be rejected.



FLXA2\*

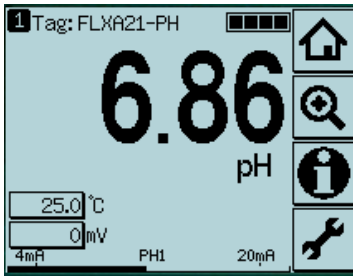


Glass sensor on Input 1.  
Reference sensor on Input 2.

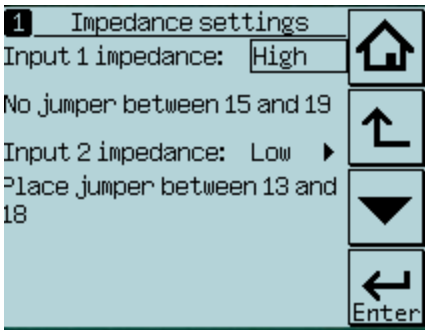
No jumpers should be installed in input 1 or input 2. Within the electronics the impedance 2 needs to be programmed for high impedance.


# TECHNICAL NOTE

PH202\*/PH450G/FLXA2\* Quick Start Guide for the Cation Differential pH/ORP Sensors  
(SC24V AND FU20-FTS)

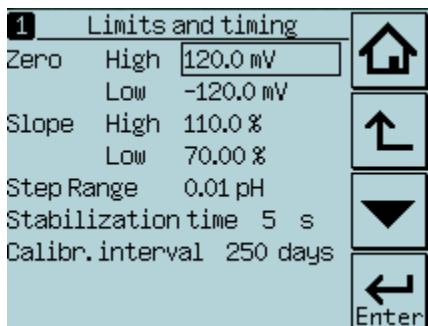


Once on the Main display, shown above, Select the Wrench → Commissioning → Measurement Setup → Impedance settings, and set Input 1 and Input two to both read high.



Select the return key, , one time to return to the Measurement Setup Screen.

Due to the process salt concentration compared to the sodium buffers salt concentration being greater than 120 mV offset the the ASY range needs to be either expanded or the check needs to be disabled. If we do not change or inactivate the alarm the process calibration will not be accept and an out of range error message will be given. Under the Measurement Setup → Calibration Settings → pH settings → limits and timing. Change the Zero high and low limits to +/- 250 mV. This should be a large enough range, that the manual process calibration will not be rejected.



# TECHNICAL NOTE

PH202\*/PH450G/FLXA2\* Quick Start Guide for the Cation Differential pH/ORP Sensors (SC24V AND FU20-FTS)

## Initial Calibration

Every SC24V AND FU20-FTS includes a Quality Inspection Certificate is in the packing box. Each certificate has, under the Functional Test section, the Zero point pH 7, which is the ASY, value and the calculated slope pH 7- pH 4 value that will be used during start-up. See the following image:

Quality Inspection Certificate		Model SC24V Combined 12mm 4-in-1 differential pH sensor	
<b>1. Sensor description</b>			
Model:	SC24V-ALN26-120	Serial number:	N1D900954
Order:	500091699		
<b>2. General characteristics</b>			
Measuring range	2 - 14 pH	Temperature element	PT1000
pH response time 90% (pH4-pH7)	< 15 sec	LE element	Platinum
Pressure operating range	0 - 10 Bar	Reference electrolyte	Salt sensitive glass
Temperature operating range	10°C - 120°C	Reference system	Ag/AgCl
Response time temperature 90%	< 90 sec	Wetted parts	Glass, Platinum
Glass membrane	pH / pNa		
Glass impedance nominal	750 / 750 MOhm		
<b>3. Functional test</b>			
	Specification	Measured	
Zero point pH7	0 ± 15 mV	-9.9	mV
Slope value pH4	zero point + pH4	158.2	mV
Calculated slope (pH7-pH4)	92 - 100 %	95.7	%
Temperature resistance @ 25 °C	1092 to 1102 Ohm	1093	Ohm
LE resistance	< 1 Ohm	0.34	Ohm
<b>4. Mechanical inspection</b>			
Dimensions	According to DIN 19263:2007-05		
<b>5. Certification</b>			
This product meets the requirements of the ATEX directive 94/9/EC.			
Marking	II 1 G Ex ia IIC T3...T6 Ga		
Certifying body	DEKRA 0344		
EC-type examination certificate	DEKRA 11 ATEX 0014 X		
Manufacturer	YOKOGAWA NL-3825 HD 2		
IECEX-type examination certificate	Ex ia IIC T3...T6 Ga IECEX DEK 11.0064X		
<b>6. Approval</b>			
Date	23-9-2013		
Approved by:			

Quality Inspection Certificate		Model SC24V Combined 12mm 4-in-1 differential pH sensor		
<b>1. Introduction</b> This standard applies to model SC24V sensors.				
<b>2. Mechanical Inspection</b> The sensor is checked visually on general appearance and dimensions. Labeling is done according to the MS code.				
<b>3. Functional Testing</b>				
<b>3.1. Conditioning</b> Prior to the test the sensor must be stored in water for a minimum of 24 hours. If the sensor is stored in it's own wet pocket, then the sensor must be thoroughly rinsed prior to the test.				
<b>3.2. Equipment for testing</b>				
a. High impedance voltmeter for mV measurement (PH450G or equivalent)				
b. TeraOhmmeter: high impedance insulation tester with 100 V <sub>DC</sub> test voltage				
c. Multimeter to measure resistance (Yokogawa 7502 or equivalent)				
d. pH buffers of 1M ionic strength, e.g. pH 2.00 (K1520BG), pH 4.00 (K1520BH), pH 7.00 (K1520BJ) and pH 9.00 (K1520BK). Temperature dependency of these buffers is given in Table 1. Preferably a temperature adjustable water bath has to be used to keep temperature of buffer and sensor stable.				
Table 1: Temperature dependency of pH buffers of 1M ionic strength (All pH values are ± 0.02 pH)				
pH	2.00	4.00	7.00	9.00
Temp				
5°C	2.00	3.98	6.93	9.35
10°C	2.00	3.99	6.96	9.22
15°C	2.00	3.99	6.98	9.13
20°C	2.00	4.00	7.00	9.00
25°C	2.02	4.01	7.01	8.89
30°C	2.02	4.01	7.02	8.87
35°C	2.02	4.02	7.03	8.86
40°C	2.04	4.04	7.04	8.85
45°C	2.08	4.08	7.05	8.85
50°C	2.08	4.08	7.07	8.14
<b>3.3. Functional Inspection (with sensor and solutions stabilized in a water bath at 25 ± 0.5°C)</b> Connect the sensor to a PH450S with terminal numbers matching the numbers on the cable ends: Temperature sensor (11/12); Reference cell (13); Shield of Reference cell (17); Solution Ground/Liquid earth (14); pH cell (15); Shield of pH cell (16).				
Place the sensor in a water bath at 25 ± 0.5°C. Allow 1 - 2 minutes to stabilize.				
• Use a multimeter to measure the resistance between wire 14 and the metal surface of the liquid earth electrode. This value should be < 1 Ω.				
• Place the sensor in pH 7 buffer and read mV value. Allow 1 minute to stabilize. Record the value. This must be 0 mV ± 15 mV. This value is the Asymmetry Potential (Aspot).				
• Rinse the sensor in demineralized water, blot dry with tissue and place in 4 pH buffer. Allow 1 minute to stabilize. Read the mV value and calculate the Slope with the formula: (mV/@ pH) - mV/@ 7 pH) / 1.7745 The value is recorded and must be within 92-100%.				
Disconnected the sensor.				
• Use a multimeter to measure the resistance of the temperature sensor between the wires marked 11 and 12. The value must be 1097 ± 5 Ω. When using cable length > 10 m, the values are increased by 0.9 Ω/10m.				
• Measure the resistance between the Glass cell (wire 15) and liquid earth electrode (wire 14) with the TeraOhmmeter at 100 V <sub>DC</sub> . The value must be 400-1000 MΩ.				
• Measure the resistance between the Reference cell (wire 13) and liquid earth electrode (wire 14) with the TeraOhmmeter at 100 V <sub>DC</sub> . The value must be 400-1000 MΩ.				

YOKOGAWA ◆ Euroweg 2  
3825HD Amersfoort  
The Netherlands

QIC 12B6J7-02E-E  
4th Edition

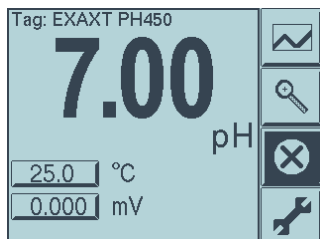
YOKOGAWA ◆ Euroweg 2  
3825HD Amersfoort  
The Netherlands

QIC 12B6J7-02E-E  
4th Edition

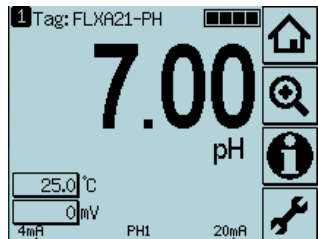
At the initial installation follow the steps below for the FLXA2\*, PH202\*, PH402G or PH450G analyzer programming the corresponding values for the ASY and slope values from the Quality Certificate into the electronics.

## FLXA21 and PH450G:

PH450G



FLXA2\*

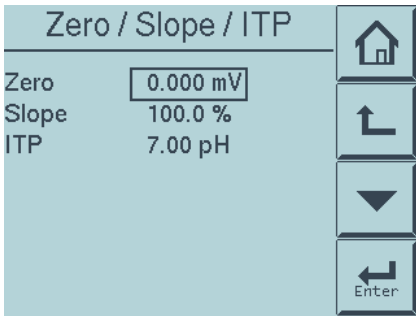


# TECHNICAL NOTE

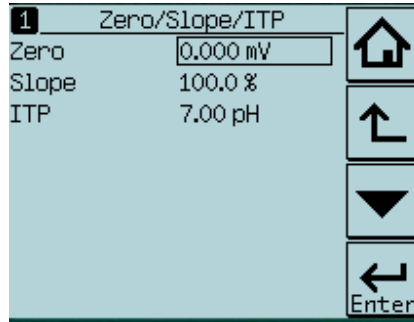
PH202\*/PH450G/FLXA2\* Quick Start Guide for the Cation Differential pH/ORP Sensors (SC24V AND FU20-FTS)

On the Main display, Select the following: Wrench → Commissioning → Measurement Setup → Calibration settings → pH settings → Zero/ Slope/ ITP

PH450G

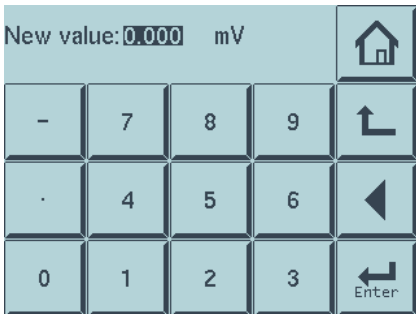


FLXA21

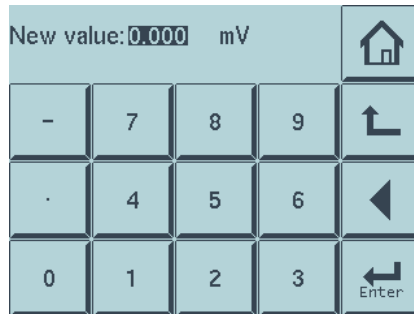


Once you are on the above screen, Select on the data points for the Zero and Slope so that a key board will appear.

PH450G



FLXA21







Using the information from section 3. *Function test* from the test certificate, program the Zero (Zero point pH7 shown on the certificate) and the Slope values in the analyzer to match what is shown on the certificate.

Glass impedance nominal		750 / 750 MOhm	
<b>3. Functional test</b>			
	Specification	Measured	
Zero point pH7	0 ± 15 mV	-9.9	mV
Slope value pH4	zero point + pH4	158.2	mV
Calculated slope (pH7-pH4)	92 - 100 %	95.7	%
Temperature resistance @ 25 °C	1092 to 1102 Ohm	1093	Ohm
LE resistance	< 1 Ohm	0.34	Ohm





## TECHNICAL NOTE


PH202\*/PH450G/FLXA2\* Quick Start Guide for the Cation Differential pH/ORP Sensors  
(SC24V AND FU20-FTS)

PH450G

Zero / Slope / ITP		
Zero	-9.900 mV	  
Slope	95.70 %	
ITP	7.00 pH	

FLXA21

1 Zero/Slope/ITP		
Zero	-9.900 mV	  
Slope	95.70 %	
ITP	7.00 pH	

Once this has been done press the Home icon  to return to measurement mode. You can use traditional pH7 and pH4 buffers as a **functional check only**. Place the SC24V AND FU20-FTS sensor in the 7 buffer, allow the sensor to stabilize, and then place it in the pH 4 buffer. If the sensor responds to the pH change then the sensor is operating properly.






One final step is required before the sensor can be placed online.

Now take a process grab sample and perform a one point manual sample calibration to correct for the background salts in the process.





**NOTE:** Remember if the salt concentration changes of the process media by 25%, then a pH change of 0.2 pH could be seen that is not a true pH change but a salt concentration. If this occurs then a one point manual process calibration should be done to offset the new salt concentration.

### (MANUAL PROCESS CALIBRATION)

PH450G

Calibration pH		
 Manual	zero/slope	  
◆ Automatic	zero/slope	
◆ Sample		
◆ Temperature calibration		
◆ Start manual wash cycle		

FLXA21

1 Calibration pH		
◆ Manual		  
◇ Automatic		
◇ Sample		

# TECHNICAL NOTE

PH202\*/PH450G/FLXA2\* Quick Start Guide for the Cation Differential pH/ORP Sensors (SC24V AND FU20-FTS)

pH manual

---

Solution 1

6.83 pH  
25.0 °C

Adjust now  
Quit without adjusting

1 pH Manual

---

zero/slope  
zero/slope/ITP(3point)  
zero/slope1, 2(3point)

pH manual

---

Solution 1

6.83 pH  
25.0 °C  
CHECKING STABILITY...

1 pH Manual

---

First buffer

6.83pH  
25.0 °C

Adjust now  
Quit without adjusting

pH manual

---

New value: 6.83 pH

-	7	8	9	Up
.	4	5	6	Left
0	1	2	3	Enter

1 pH Manual

---

First buffer

6.83pH  
25.0 °C  
CHECKING STABILITY...

pH manual

---

Completed (1 point)

6.83 pH  
25.0 °C

Go to solution 2  
Calibration complete

pH Manual

---

New value: 6.83\_ pH

-	7	8	9	Up
.	4	5	6	Left
0	1	2	3	Enter



# TECHNICAL NOTE

PH202\*/PH450G/FLXA2\* Quick Start Guide for the Cation Differential pH/ORP Sensors (SC24V AND FU20-FTS)

pH manual	
Completed (1 point)	
6.83 pH 25.0 °C	
Zero = -9.618 mV Slope = 95.70 %(unchanged)	
⏪ Accept Data ◆ Cancel calibration	Enter

1 pH Manual	
Completed(1 point)	
6.83pH 25.0 °C	
◇Go to second buffer ◆Calibration complete	

Calibration pH	
⏪ Manual zero/slope	
◆ Automatic zero/slope	
◆ Sample	
◆ Temperature calibration	Enter
◆ Start manual wash cycle	

1 pH Manual	
Completed(1 point)	
6.83pH 25.0 °C	
Zero = -9.625 mV Slope = 95.70 % (unchanged)	
◆ Accept Data ◇ Cancel calibration	Enter

1 pH Manual	
New sensor?	
"Yes" resets sensor wellness data.	
◆ Yes ◇ No	

Indicate **YES** for initial setup only,  
otherwise indicate **NO**

1 Calibration pH	
◆ Manual	
◇ Automatic	
◇ Sample	

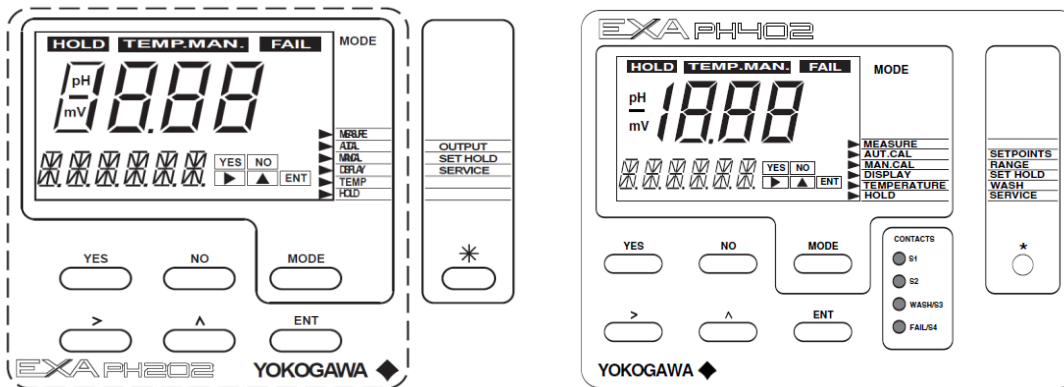
Once the Calibration is complete and the analyzer returns to the *Calibration pH* screen, press the Home icon to return to measurement mode and the sensor is now ready to be installed into the process

# TECHNICAL NOTE

PH202\*/PH450G/FLXA2\* Quick Start Guide for the Cation Differential pH/ORP Sensors (SC24V AND FU20-FTS)

## PH202\* and PH402G:

Remove the front cover of the PH202\* or the PH402G. Press the  key and press  until **\*SERV** is displayed. Press  to enter the Service menu.



Enter Service Code **23** by pressing  and  until the display shows **23**, press . **\*ITP** will appear, press . **\*Slope** will appear, using the information from section 3. *Function test* from the test certificate program the Slope value in the analyzer to match what is shown on the certificate by using the  and . Once the value is changed press . **\*ASP.1D** will appear press . **\*ASP** will appear press  to change the value. Again using the information from section 3. *Function test* from the test certificate program the ASP value (Zero point pH7 shown on the certificate) in the analyzer to match what is shown on the certificate by using the  and . Once the value is changed press .

Specification	Measured
Zero point pH7	-9.9 mV
Slope value pH4	158.2 mV
Calculated slope (pH7-pH4)	95.7 %
Temperature resistance @ 25 °C	1093 Ohm
LE resistance	0.34 Ohm

It should return you to the screen that shows **\*SERV**. Press  to enter the Service menu. From you here can press the  to return to the home screen.

## TECHNICAL NOTE

PH202\*/PH450G/FLXA2\* Quick Start Guide for the Cation Differential pH/ORP Sensors  
(SC24V AND FU20-FTS)

**\*NOTE:** Can be done but not necessary because of setting we previously did to Service Code 03 and 04 in the beginning.

Enter Service Code **03** by pressing  and , press . **\*Z1.CHK** will appear, using the  and  keys set the analyzer to 1.1.1 and press . **\*Z.L.xΩ** will appear, press . Using the  and  keys set the low impedance reading to **1 MOhm**, press  once complete. **\*Z.H.xΩ** will appear, press . Using the  and  keys set the low impedance reading to 1 MOhm. Press  once complete. Using the  and  keys set the low impedance reading to **1 GOhm**, press  once complete. It should return you to the screen that shows **\*SERV**. Press  to enter the Service menu. Enter Service Code **04** by pressing  and , press . **\*Z2.CHK** will appear, using the  and  keys set the analyzer to 1.1.1 and press . **\*Z.L.xΩ** will appear, press . Using the  and  keys set the low impedance reading to **1 MOhm**, press  once complete. **\*Z.H.xΩ** will appear, press . Using the  and  keys set the low impedance reading to 1 MOhm. Press  once complete. Using the  and  keys set the low impedance reading to **1 GOhm**, press  once complete.

You can use traditional pH7 and pH4 buffers as a **functional check only**. Place the SC24V AND FU20-FTS sensor in the 7 buffer, allow the sensor to stabilize, and then place it in the pH 4 buffer. If the sensor responds to the pH change then the sensor is operating properly.

One final step is required before the sensor can be placed online. Take a process grab sample and perform a one point manual sample calibration to correct for the background salts in the process.

### (MANUAL PROCESS CALIBRATION)

Press the  key and press  once until **\*MAN>CAL** is displayed. Press . **NEW.SENS** will appear, press  (for initial setup only, otherwise indicate **NO**). **PH.CAL** will appear, press . **START** will appear, press .

Using the  and  set the pH value of the sample to the predetermined known value and press .

**CAL.END** will appear, press . The analyzer will return to normal measuring mode and the sensor is now ready to be installed into the process.

### Proper Calibration

Differential sensors having both a standard pH glass and a cation reference like the SC24V AND FU20-FTS, need to be calibrated to correct both the **ZERO** and **SLOPE**. However, conventional pH buffers (N.I.S.T 4.00, 6.86 and 9.18) can NOT be

## TECHNICAL NOTE

PH202\*/PH450G/FLXA2\* Quick Start Guide for the Cation Differential pH/ORP Sensors  
(SC24V AND FU20-FTS)

used because they have low strength and different values from one another (0.005- 0.01 m). Therefore, when used for calibration a slope of > 105% will be received. In order to properly perform a 2-point calibration use buffers specifically designed for cation-based references which have the same sodium level for each pH value. Yokogawa offers such solutions. By using these solutions the differential sensor will react like a traditional pH sensor. These buffer solutions have an ionic strength of 1 mol/l NaCl so they will have a theoretical zero point of 0 mV at pH 7. The Isopotential point (ITP) of the sensor in these solutions is at 7 pH.

However because the process salt concentration will be different than the buffer concentrations a one point manual grab process sample calibration always has to be performed before the sensor is placed back online in the process. Follow the steps shown above for the appropriate analyzer's **Manual Process Calibration**. Then the ZERO point will be updated accordingly.

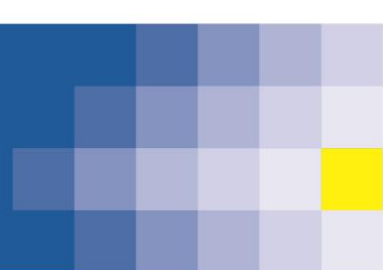
**\*NOTE:** For optimal performance the Isopotential point (ITP) should be updated as well. This ITP is set in the software and is typically  $(7+pNa)$ .

### APPENDIX II SC24V AND FU20-FTS being used for ORP Measurements... What to expect:

- When asked Europe how salt concentration would affect ORP values I was informed that when using the SC24V AND FU20-FTS as an pH and ORP sensor then the normal reference is the salt membrane. The reference would change same as for pH measurement. Thus, expected mV of ORP will decrease when concentration is decreasing in salt content.
- For ORP calibration you can use the premade Hamilton solutions because it was found in a test between the differential SC24V AND FU20-FTS reference system and the traditional reference sensor FU20 that both sensor were within the +/- 30mV tolerance for ORP readings. In the Hamilton 475 or 271 standard solution, the sensors match readings within the allowed 30 +/- mV in the solution. In the 271 solution the SC24V AND FU20-FTS read 284 and the FU20 read 270; and in the 475 solution the SC24V AND FU20-FTS read 466 and the FU20 read 470. However since the process has a mixture of salts and it is impossible to predict the voltage in mixtures of salts it is recommended that the best practice will be a grab sample calibration.

# TECHNICAL NOTE

PH202\*/PH450G/FLXA2\* Quick Start Guide for the Cation Differential pH/ORP Sensors  
(SC24V AND FU20-FTS)



	SC24V		FU20		
	Slope	mV	Slope	mV	
Calibration	95.11%	-7.86	95.96%	2.926	
Alarms	NONE		NONE		
Temperature	20.4°C		20.1°C		
	pH	mV	pH	mV	Difference in mV
Water Sample	5.32	357	4.54	517	160
<b>Without Quinhydrone</b>					
NIST 6.86 Buffer	5.61	307	6.68	468	161
NIST 4.01 Buffer	2.13	440	3.95	511	71
Na 7.0 Buffer	6.99	267	6.48	238	-29
Na 4.0 Buffer	3.92	300	4.34	231	-69
<b>With Quinhydrone</b>					
NIST 6.86 Buffer	5.56	160	6.77	85	-75
NIST 4.01 Buffer	2.21	352	4	254	-98
Na 7.0 Buffer	6.98	59	3.71	85	26
Na 4.0 Buffer	3.86	237	3.99	264	27
Hamilton 475 mV	1.07	466	1.14	470	4
Hamilton 271 mV	4.29	284	3.79	270	-14