User's Manual

FLXA202 / FLXA21 2-Wire Analyzer Operation of pH/ORP

IM 12A01A03-31EN

YOKOGAWA
Yokogawa Electric Corporation

IM 12A01A03-31EN
2nd Edition

Introduction

Thank you for purchasing the FLXA™202/FLXA™21 2-Wire Analyzer.

Please read the following respective documents before installing and using the FLXA202/FLXA21.

When the FLXA21 with the output of FOUNDATION Fieldbus or PROFIBUS PA Communication is used, please refer to the User's Manual, IM 12A01A02-71E or IM 12A01A02-72E, too.

The related documents are as follows.

General Specifications

Contents	Document number	Note
FLXA202 2-wire Analyzer	GS 12A01A03-01EN	For FLXA202. Online manual
FLXA21 2-wire Analyzer	GS 12A01A02-01E	For FLXA21. Online manual
FLXA21 2-wire Analyzer FOUNDATION Fieldbus Communication	GS 12A01A02-71E	For FLXA21. Online manual
FLXA21 2-wire Analyzer PROFIBUS PA Communication	GS 12A01A02-72E	For FLXA21. Online manual

* the "E" or "EN" in the document number is the language code.

User's Manual

Contents	Document number	Note
FLXA202/FLXA21 2-wire Analyzer Start-up Manual	IM 12A01A02-12E	Attached to the product
FLXA202/FLXA21 2-wire Analyzer Safety Precautions	IM 12A01A02-20E	For intrinsic safety, nonincendive and Type n. Attached to the product
FLXA202/FLXA21 2-wire Analyzer Installation and Wiring	IM 12A01A03-01EN	Online manual
FLXA202/FLXA21 2-wire Analyzer Operation of pH/ORP	IM 12A01A03-31EN	For pH/ORP (-P1) selection Online manual (This manual)
FLXA202/FLXA21 2-wire Analyzer Operation of SC	IM 12A01A03-32EN	For Conductivity (SC) (-C1) selection Online manual
FLXA202/FLXA21 2-wire Analyzer Operation of ISC	IM 12A01A03-33EN	For Inductive conductivity (ISC) (-C5) selection Online manual
FLXA202/FLXA21 2-wire Analyzer Operation of DO	IM 12A01A03-34EN	For Dissolved oxygen (DO) (-D1) selection Online manual
FLXA202 2-wire Analyzer Operation of SENCOM SA-pH/ORP	IM 12A01A03-36EN	For pH/ORP of SENCOM SA (-S5) selection Online manual
FLXA202 2-wire Analyzer Operation of SENCOM SA-SC	IM 12A01A03-37EN	For Conductivity (SC) of SENCOM SA (-S5) selection Online manuall
FLXA21 2-wire Analyzer FOUNDATION Fieldbus Communication	IM 12A01A02-71E	For FLXA21, output "-F" Online manual
FLXA21 2-wire Analyzer PROFIBUS PA Communication	IM 12A01A02-72E	For FLXA21, output "-P" Online manual

* The "E" or "EN" in the document number is the language code.

Note: Please read the Safety Precautions (IM 12A01A02-20E) before using the product.
The Safety Precautions includes Control Drawings of intrinsic safety, nonincendive and Type n that describes specific condition for using FLXA202/FLXA21 in hazardous/classified location.

An exclusive User's Manual might be attached to the products whose suffix codes or option codes contain the code "Z" (made to customers' specifications). Please read it along with this manual.

Technical Information

Contents	Document number	Note
FLXA202 2-wire Analyzer Selection Guide for Intrinsic Safety type Associated Apparatus	TI 12A01A02-42EN	Online manual
FLXA202/FLXA21 2-Wire Analyzer HART Communication	TI 12A01A02-60E	Online manual

* The "E" or "EN" in the document number is the language code.

You can download the latest documents from our website. Scan QR code.

http://www.yokogawa.com/an/flxa202/download/

Read corresponding user's manual for details about sensors or other related products.

Notes on Handling User's Manuals

- Please hand over the user's manuals to your end users so that they can keep the user's manuals on hand for convenient reference.
- Please read the information thoroughly before using the product.
- The purpose of these user's manuals is not to warrant that the product is well suited to any particular purpose but rather to describe the functional details of the product.
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- If you have any questions, or you find mistakes or omissions in the user's manuals, please contact our sales representative or your local distributor.

Drawing Conventions

Some drawings may be partially emphasized, simplified, or omitted, for the convenience of description.

Some screen images depicted in the user's manual may have different display positions or character types (e.g., the upper / lower case). Also note that some of the images contained in this user's manual are display examples.

Composition of this User's Manual

The FLXA202/FLXA21 2-Wire Analyzer offers following measurements:
pH/ORP (oxidation-reduction potential), conductivity (SC), inductive conductivity (ISC), dissolved oxygen (DO), pH/ORP with SA11 SENCOM™ Smart Adapter, SC with SA11 SENCOM Smart Adapter.

This document explains pH/ORP measurement operation, configuration and calibration.
For other common insturuction such as installation, see the reference user's manual as shown in the next table.

Model	1st input code	Contents	Document number
FLXA202 FLXA21	All	Start-up Manual	IM 12A01A02-12E
FLXA202 FLXA21		Safety Precautions	IM 12A01A02-20E
FLXA202 FLXA21		Installation and Wiring	IM 12A01A03-01EN
FLXA202 FLXA21	-P1	Operation of pH/ORP	IM 12A01A03-31EN (This manual)

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FLXA202 / FLXA21
2-Wire Analyzer
Operation of pH/ORP

IM 12A01A03-31EN 2nd Edition

CONTENTS

1. OPERATION OF pH/ORP

This chapter describes the screen operations of pH/ORP, the object to be measured. Further details of screen operations can also be found in 1.2 Screen Operation in IM 12A01A03-01EN.

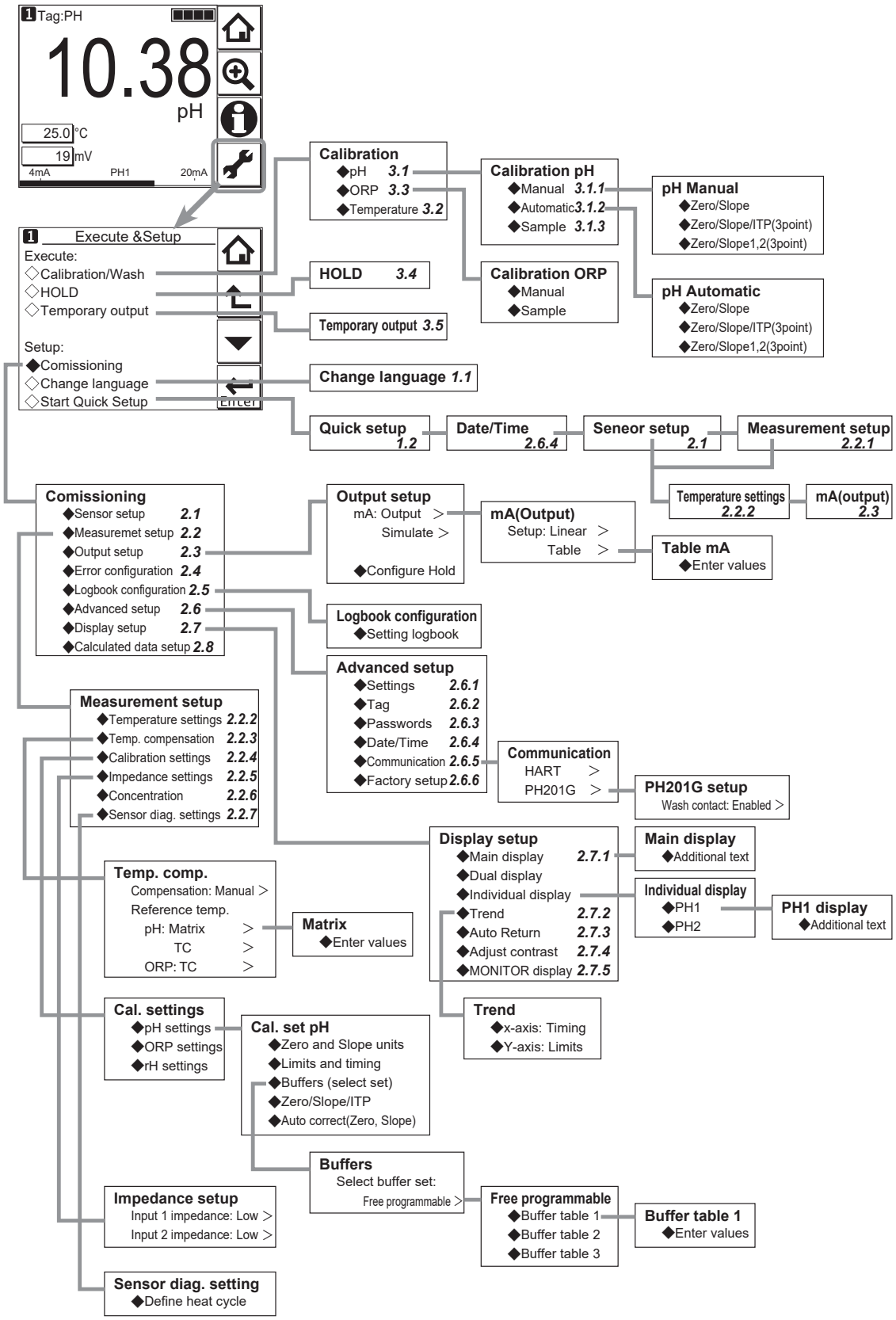


Figure 1.1 Menu structure of pH/ORP (the number after the item refers to the relevant section)

1.1 Change language

The screen is set to display English at factory shipment; if you wish to use the FLXA202/FLXA21 in another language, first select a language as described in 2.7 Operation in IM 12A01A03-01EN

1.2 Quick setup

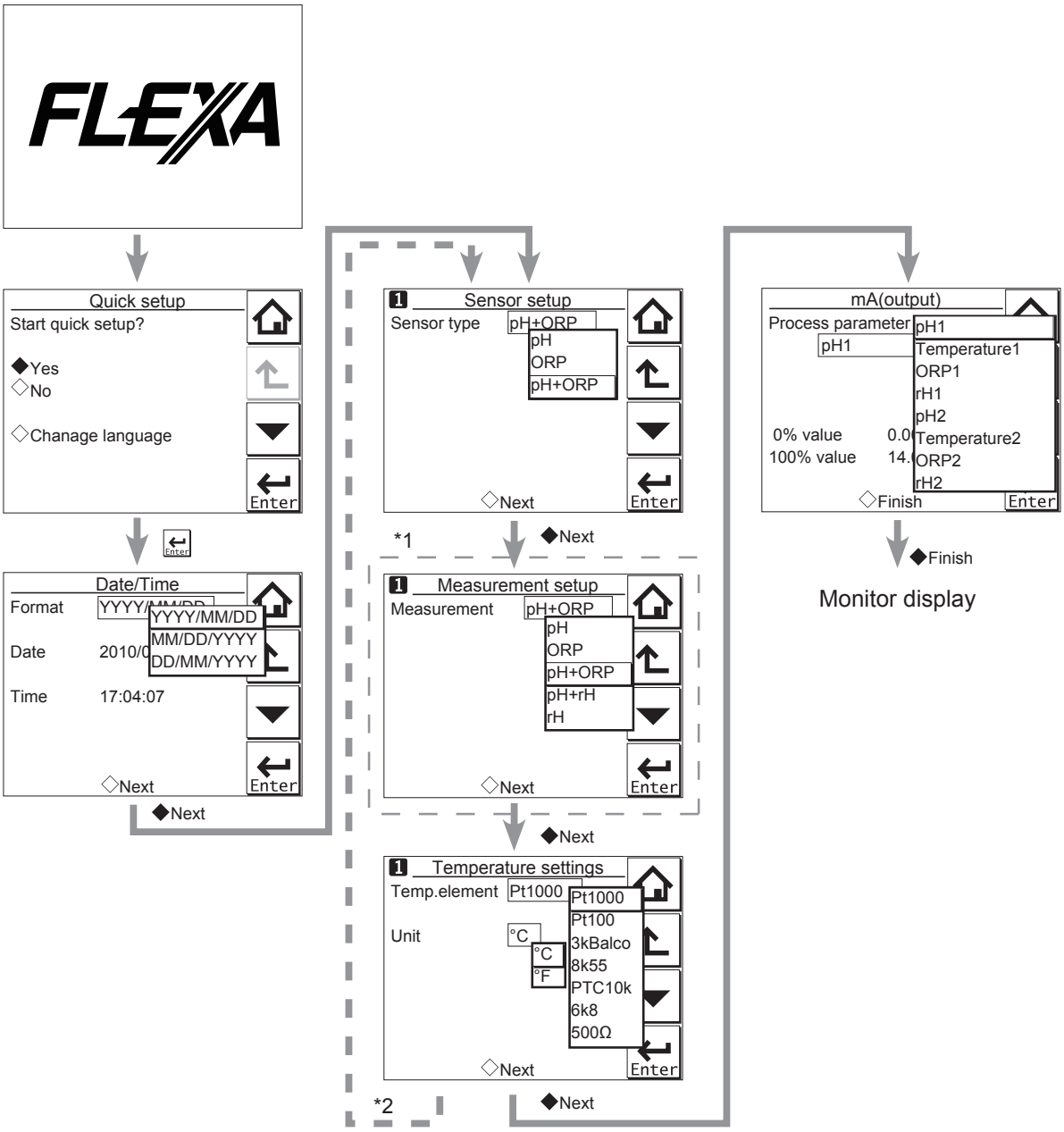
The Quick setup screen is used to set up the basic items you want to set up first, such as the date/time and sensor settings. The detailed settings are described in 2. COMMISSIONING OF pH/ORP.

You may leave the Quick setup now and return to it later; however, it is recommended to perform the quick setup first.

Each time the FLXA202/FLXA21 is started up, this screen is displayed. If it is not necessary to change the setup, press No or  .

NOTE

When no operation is performed for 10 minutes or 60 minutes (depending on the setting of “Auto Return”), the display except Trend display automatically changes to the Monitor display (or to the Main display or the Home display when the MONITOR display is disabled).



*1: The Measurement setup screen appears only when “pH + ORP” is selected on the Sensor setup screen.
*2: If two sensors are connected, the second sensor can also be set up.

Figure 1.2 Quick setup

Date/Time

The date display format can be selected from among the three types.

Enter the date or time of day by using the numerical keys.

For details, 2.6.4 Date/Time

Sensor setup

Select a suitable electrode from among the displayed electrode types and set it up.

For details, see 2.1 Sensor setup

Measurement setup

Select a suitable measurement parameter from among those displayed and set it up.

Measurement parameter setup can be made only when “pH + ORP” is selected on the Sensor setup screen.

For details, see 2.2.1 Measurement.

Temperature settings

Select a suitable temperature element from among those displayed and set it up.

Celsius (ºC) or Fahrenheit (ºF) temperature scale can be selected.

For details, see 2.2.2 Temperature settings

mA (output)

Select a suitable process parameter from among those displayed and set it up.

For example, the mA output of pH has been set to 0 – 14 pH at factory shipment. If the resolution needs to be improved, set a suitable value for the process.

For details, see 2.3 Output setup

1.3 Home display, Main display and Monitor display

Pressing  changes the screen to the Main display shown in Figure 1.3 (or the Home display shown in Figure 1.4).

If two sensors are connected, pressing  on the Main display changes the display to the Home display shown in Figure 1.4.

If only one sensor is connected,  is grayed out and disabled on the Main display.

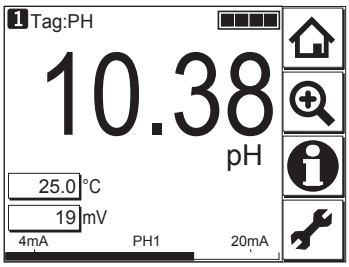


Figure 1.3 Example of main display

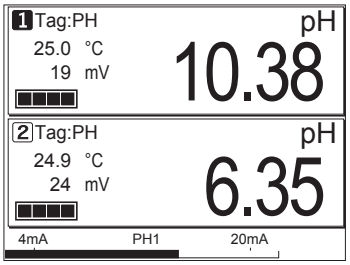


Figure 1.4 Example of home display

On the Home display, pressing [ ] of the 1st sensor (top) or 2nd sensor (bottom) causes the display of the selected sensor to appear on the Main display.

On the Main display, pressing [ ] of the 2nd or 3rd display item causes the 1st display item to be replaced by the selected item.

NOTE

Measured values to be displayed in the 1st to 3rd display items depend on the user definition (see 2.7.1 Main display (Dual display, Individual display) For example, on the default condition of pH measurement, the 1st display item is pH, the 2nd display item is temperature, and the 3rd display item is empty.

When the MONITOR display is enabled (see 2.7.5 MONITOR display), pressing the 1st display item on the home display or the main display changes the display to the Monitor display with the enlarged font of the measured value.

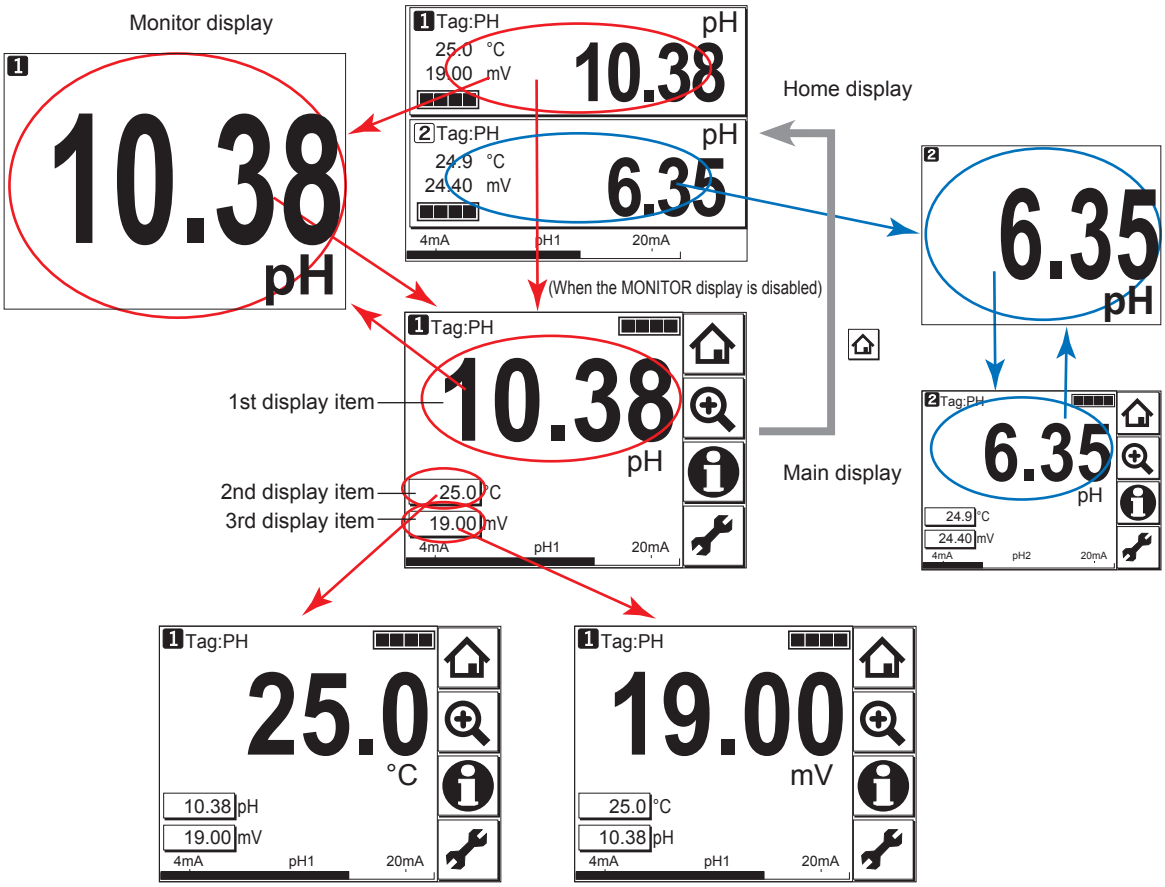
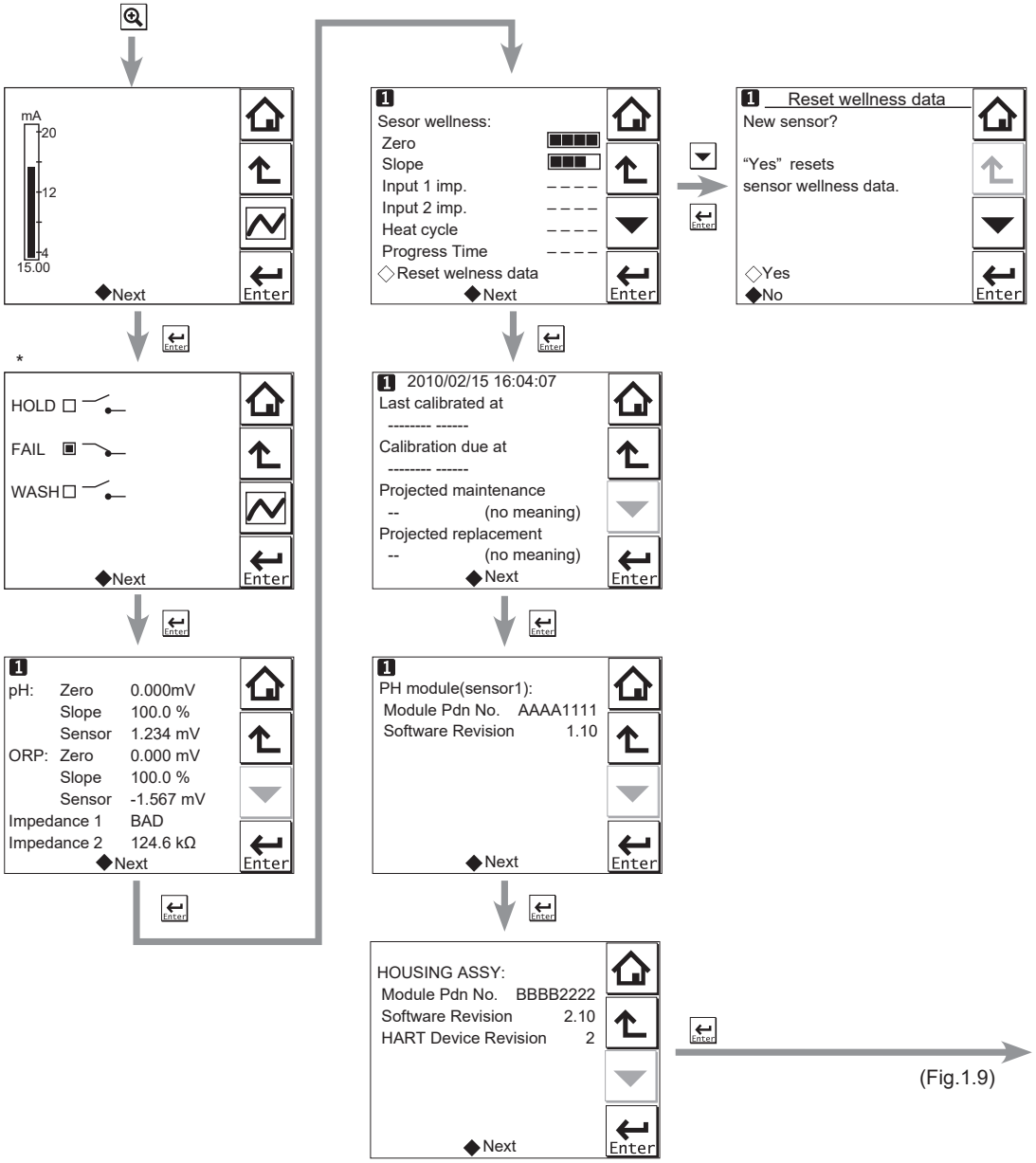


Figure 1.5 Change display

1.4 Zooming in on details

Pressing [ ] on the Main display allows you to check detailed instrument information (instrument information such as setup, sensor diagnosis, calibration, and module productions number) through a transition of screens as shown in Figure 1.6.

In case of trouble, when you contact your nearest Yokogawa service center, please inform us of the module and FLXA202/FLXA21 software revision displayed on the Detail screen and other display information as well as the module productions number indicated on the nameplate attached to the instrument.



*: This screen is displayed only if the PH201G distributor is used and "PH201G" is selected in communication setup.

Figure 1.6 Detail display

■ Current output mA

= current output in mA. The range and function of this mA output can be set in Commissioning → Output setup → mA.

For details, see 2.1 Sensor setup.

■ Contact status

This screen is displayed only if the PH201G distributor is used and "PH201G" is selected in communication setup.

PH (ORP)'s zero, slope, and sensor, and Impedance

Zero

= calibrated sensor offset in mV. Theoretically, the sensor reads 0 mV in a buffer solution of pH 7. The ZERO value indicates the condition of the sensor. The trend of ZERO drift of the sensor is used to predict the lifetime of the sensor.

ZERO can also be displayed in pH units and then it represents the pH value where the sensor output is 0 mV at 25ºC. Setting can be made in Commissioning → Measurement setup → Calibration settings → Zero and Slope units.

Setting of the zero value can be made in Commissioning → Measurement setup → Calibration settings → Zero/Slope/ITP. For details, see 2.2.4 Calibration settings

Slope

= calibrated efficiency of the sensor unit as a percentage of the theoretical slope of the sensor unit. The theoretical slope follows the NERNST equation and is 59.16 mV/pH (at 25ºC). The SLOPE can be calibrated only after a two-point calibration in buffer solutions with a different pH value. A low slope indicates that the sensor is not clean or is faulty.

The SLOPE can also be displayed as a mV/pH value at 25ºC if the user has defined this variable as mV/pH in Commissioning → Measurement setup → Calibration settings → Zero and Slope units.

Setting of the slope value can be made in Commissioning → Measurement setup → Calibration settings → Zero/Slope/ITP. For details, see 2.2.4 Calibration settings

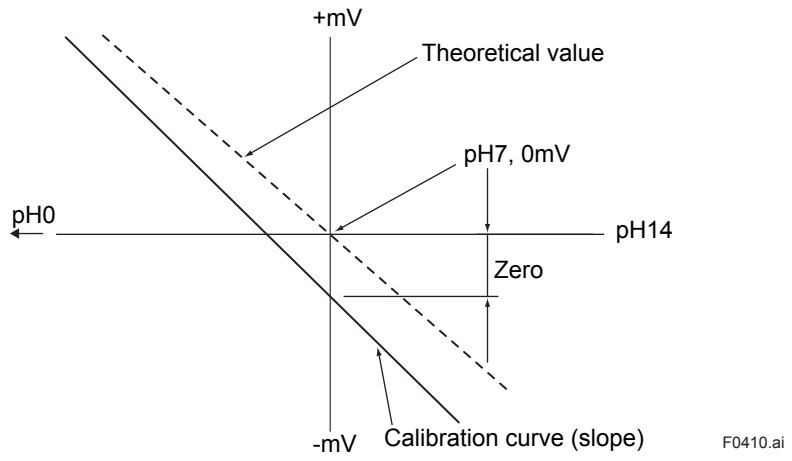


Figure 1.7 Zero/slope

Sensor

Represents the electromotive force of the sensor.

Impedance 1

For a PH sensor, "Impedance" shows electrical resistance of the glass membrane electrode. The FLXA202/FLXA21 checks the impedance to know damage of the electrode.

For an ORP sensor, "Impedance" shows electrical resistance of metal electrode.

The FLXA202/FLXA21 checks the impedance to know the surface condition of smudge and the snapping of sensor wires. In case of "Input Impedance setting" is "High" and the measured input-1 impedance value is higher than 100 kΩ, the display shows "MΩ RANGE". The measured input-1 impedance value is lower than 100 kΩ, display shows "BAD".

If both impedance measurements are disabled (Error setting: Off), the display shows “- - - - (bar)”. If either impedance measurement 1 or 2 is enabled, the display shows both the impedance values.

- **Impedance 2**

  Impedance shows the electrical resistance of the reference electrode liquid junction. The liquid junction forms the electrolytic contact between the reference electrode and the measuring electrode, so it must be kept clean and filled with conductive electrolyte. Otherwise the measurement will suffer from instability, drift and measuring errors. The electrical impedance is one of the most important.

  In case of “Input Impedance setting” is “High” and the measured input-2 impedance value is higher than 100 kΩ,the display shows “MΩ RANGE”. The measured input-2 impedance value is lower than 100 kΩ, display shows “BAD”.

  If both impedance measurements are disabled (Error setting: Off), the display shows “- - - - (bar)”. If either impedance measurement 1 or 2 is enabled, the display shows both the impedance values.

■ Sensor wellness

At the Sensor wellness window, the soundness of a module is displayed. A larger number of ■ in each gauge indicates that the parameter concerned is sound. A gauge is indicated for only those parameters whose sensor wellness setting is “enabled,” while a bar (----) is displayed if the sensor wellness setting is “disabled.”

Sensor wellness setup can be made in Commissioning → Measurement setup → Sensor diag. settings. For details, see 2.2.7 Sensor diagnostic settings

The “Reset wellness data” button can reset wellness data.

When a sensor or an electrode is exchanged or replaced, sensor wellness data should be reset.

NOTE

When a sensor is replaced, the replacement can be recorded manually into a logbook. (Refer to Figure 1.9.)

■ Last calibrated

= date on which the last sensor calibration was performed. The displayed value of the Zero is the result of this calibration. The displayed value of Slope was calibrated on this date only if the last calibration was a 2-point calibration.

■ Calibration due

= the date when the calibration must be done next according to the settings of the calibration interval. The calibration intervals are set in Commissioning → Measurement setup → Calibration settings → Limits and timing.

■ Projected maintenance

The projected maintenance function predicts the date when the sensor unit will need recalibrating for maintaining measurement accuracy. The function checks the input-2 impedance (reference impedance) every 24 hours.

The function predicts the date when the input-2 impedance will cross the upper or lower limits, and indicates the date and its status (the status is displayed in parentheses).

As shown in Figure 1.8, the date is predicted based on the intersection point of the upper or lower limits and the extrapolated line of the values obtained by the least squares method.

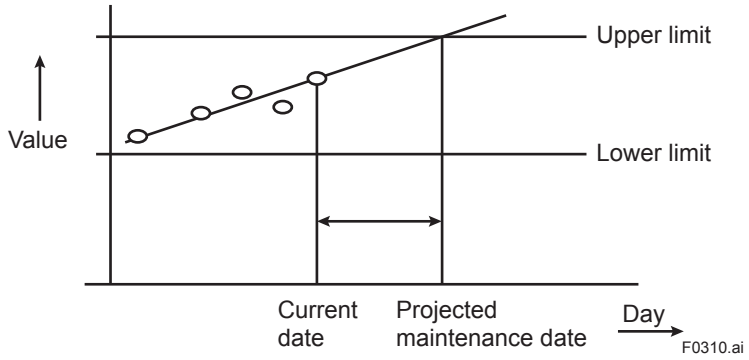


Figure 1.8

The status shows the certainty of the projected maintenance date in terms of the correlation coefficient R. Tables 1.1 and 1.2 show respective display patterns.

Table 1.1 Display pattern of the projected maintenance date

Projected date	- -	0-1 month	1-3 months	3-6 months	6-12 months	Over 1 year

- - : cannot be predictable due to insufficient data

Table 1.2 Display pattern of the status

Status	(- - - - -) (R < 0.50)	(Poor) (0.50 ≤ R < 0.70)	(Reasonable) (0.70 ≤ R < 0.85)	(Excellent) (0.85 ≤ R < 1.00)

Projected replacement

The projected replacement function predicts the date when the sensor will need replacing for maintaining the measurement accuracy, based on the pH zero and pH slope on each calibration, and reference impedance (input-2 impedance) after each calibration. The projected replacement date is predicted based on these parameters stored upon calibration, and displayed the same as that of projected maintenance. For details, see the description about the projected maintenance. Since three parameters (pH zero, pH slope, and input-2 impedance after calibration) are used for this projection, the nearest coming day is selected as the projected replacement date from the extrapolated line of the values obtained by the least squares method.

PH module (sensor)

With this screen, you can check the module productions number and software revision of the installed module.

HOUSING ASSY

With this screen, you can check the module productions number, software revision, and HART device revision of the housing assembly.

Read logbook

The FLXA202/FLXA21 has two types of logbook per sensor to store history information on events, such as changed settings and calibrations.

By selecting one of the logbooks that you wish to check, you can retrieve and check this information. Storage of history information on each event in a logbook or which logbook to use for storage can be set up on the Configure logbook screen. For details, see 2.5 Logbook configuration

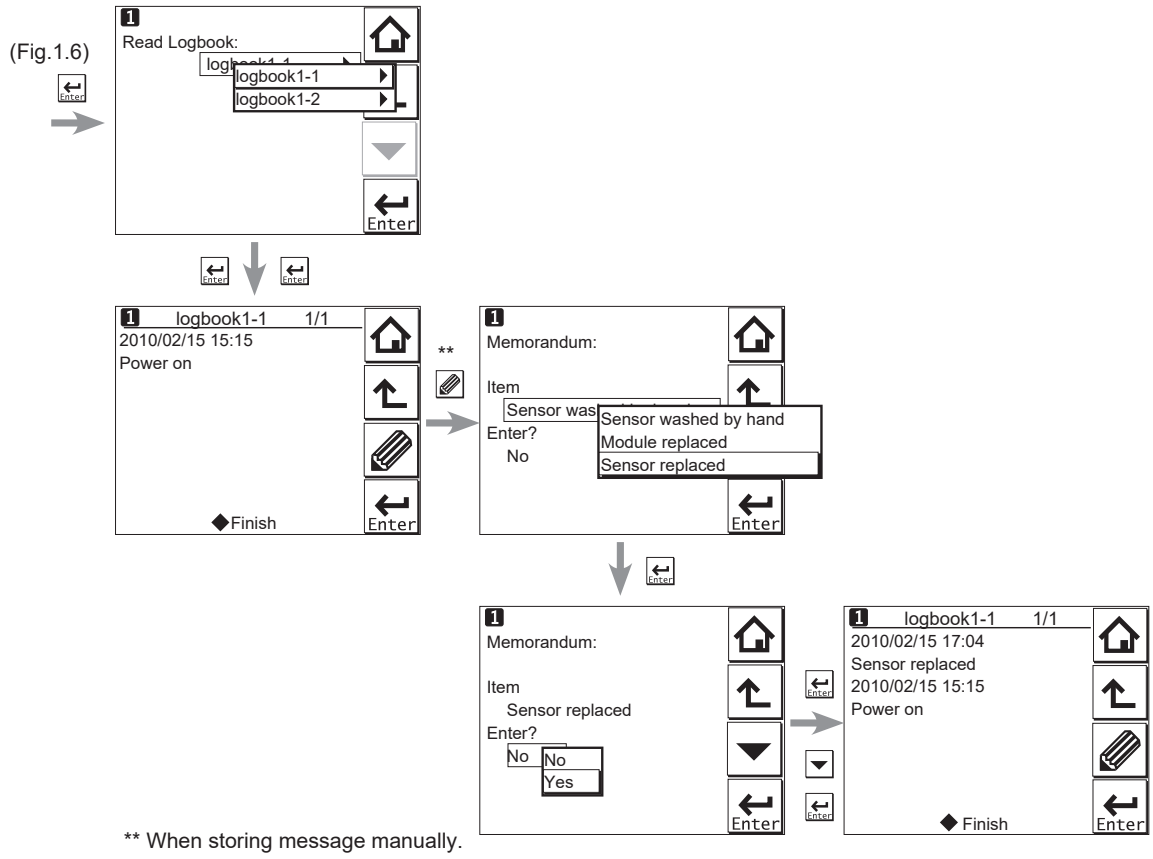
History information on events are automatically stored on the preset conditions.

In addition to this storing, following three messages can be manually stored in the logbook;

"Sensor washed by hand", "Module replaced", "Sensor replaced"

To store these messages, press  and select one of three messages from the Item on the Memorandum screen. Its event date/time will be the time when a message is selected and entered.

When a password for Commissioning is set on the passwords' setup, pressing  requires entering the password. (Refer to 2.6.3 Passwords.)



** When storing message manually.

Figure 1.9 Detail display (continued)

1.5 Trend graphics

Pressing  on the Zoom display changes the display to a graphical mode in which the average measured value is shown on a time scale. The "Live" value is also digitally displayed in a text box. The time scale (X-axis) and the primary value scale (Y-axis) are set in the "DISPLAY SETUP" menu (2.7.2 Trend).

The screen displays the trend of up to 41 averages of the measurement for each time interval. The FLXA202/FLXA21 samples the measurements every second. The trending graphic also shows the maximum and minimum measured values in that interval.

For example, if the time scale is set to 4 hours, then the trend is shown for 4 hours prior to the actual measurement. Each point on the trend line represents the average over 4×60×60/41 = 351 measurements (seconds).

NOTE

Updating the trend screen setup resets the current trend graph and starts a new one.

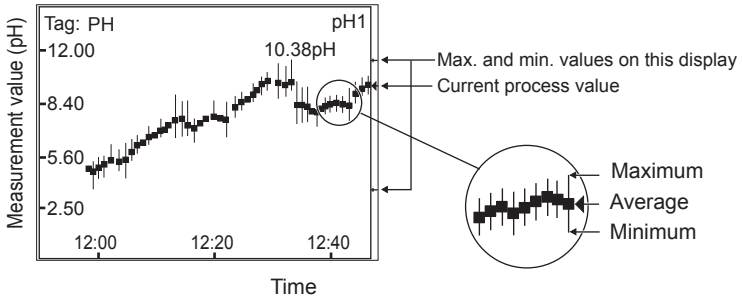


Figure 1.10 Trend screen

The 1st display item data on the Main display is shown as a graph. Touching any point on the display changes the display to the 2nd display item data (and to the 3rd display item data if set) and then returns to the Main display.

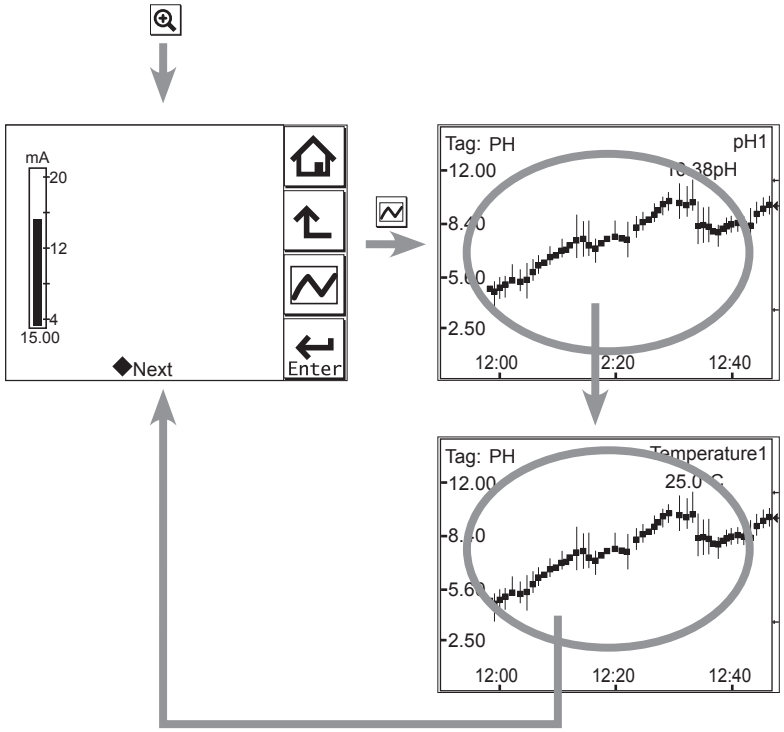


Figure 1.11 Trend graphics

1.6 Instrument status screen

In the field of the Main display, the (Warning) or (Fault) sign appears according to the instrument status. Upon pressing the displayed button, detailed information of the relevant status appears. See 1.2 Screen Operation in IM 12A01A03-01EN.

1.7 Calibration and Commissioning

Allows you to calibrate and configure the instrument. These operations can be protected with a password.

For details on the password, refer to 1.2 Screen Operation in IM 12A01A03-01EN

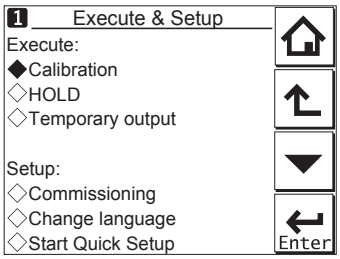


Figure 1.12 Execute & Setup

Pressing  changes the display to the Execute & Setup screen.

Browse through the menu items by pressing  until you find the desired menu and then press  to enter that menu. It is also possible to enter a desired menu by pressing the ◇ symbol beside the menu item.

For calibration (HOLD, Temporary output), read 3. CALIBRATION OF pH/ORP, and for commissioning, read 2. COMMISSIONING OF pH/ORP.

2. COMMISSIONING OF pH/ORP

This chapter describes how to check and change settings from the Commissioning screen.

When you move to the Commissioning screen, the output is held.

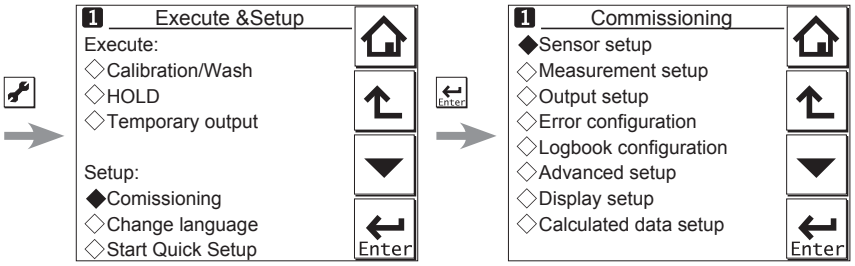


Figure 2.1 Example of the commissioning screen (for two modules)

Operations in Commissioning can be password-protected. If you set up a password, always take a note of it. For details on setting a password, see 2.6.3 Passwords

Figure 2.1 shows the commissioning procedure. Before changing any parameters, read the relevant sections in this document and understand how the change of parameters affects the performance of this instrument. If you set a wrong value, return it to the default setting or value and then set it again.

On the first startup, the parameters are all default values configured at the factory. Check the parameters in Table 2.1 and change any of them if necessary depending on the sensors to be connected and the purpose of use.

Set “Sensor type” first. Some measurement parameters and relevant options change accordingly. The underlined parameters in Table 2.1 are used for the quick setup.

You can download the default values and setting ranges from “User setting table of pH/ORP”at http://www.yokogawa.com/an/flxa202/download/

After confirming that the instrument operates normally with the parameters, print out the “User setting table of pH/ORP” and write down these parameters in the column of User Settings.

All user parameters can also be saved in the instrument.

Select Commissioning → Advanced setup → Settings → Save user settings (see 2.6.1 Settings).

Table 2.1 Menu Structure and Default Values in "Commissioning"

Parameter					Ref. sect.
Sensor setup	Sensor type				2.1 Sensor setup
Measurement setup	Measurement				2.2.1 Measurement
	Temperature setting	Temp. element			2.2.2 Temperature settings
	Temp. compensation	Compensation			2.2.3 Temperature compensation
		Reference temp.			
		Process Temp. Compensation			
	Calibration settings	pH settings	Zero and Slope units		2.2.4 Calibration settings
			Limits and timing		
			Buffers (select set)		
			Zero/Slope/ITP		
			Auto correct (Zero, Slope)		
		ORP settings rH settings	Limit and timing		
			Zero/Slope		
	Impedance settings				2.2.5 Impedance settings
	Concentration	Unit			2.2.6 Concentration
	Sensor diag. settings	Input 1 imp.:			2.2.7 Sensor diagnostic settings
		FINE			
		Input 2 imp.:			
		Process time			
		Heat cycle:			
		Define heat cycle			
Output setup	mA				2.3 Output setup
		Output	Process parameter		
			Setup		
			Linear	0 % value	
				100% value	
			Table		
			Burn		
			Damping time		
		Simulate	Simulation perc.		
	Configure Hold				
Error configuration					2.4 Error configuration
Logbook configuration					2.5 Logbook configuration
Advanced setup	Settings				2.6.1 Settings
	Tag				2.6.2 Tag
	Passwords				2.6.3 Passwords
	Date/Time				2.6.4 Date/Time
	Communication				2.6.5 Communication
		HART			
		PH201G			
	Factory setup				2.6 Advanced setup
Display setup	Main display (Dual display, Individual display)				2.7.1 Main display (Dual display, Individual display)
	Trend				2.7.2 Trend
	Auto Return				2.7.3 Auto Return
	Adjust contrast				2.7.4 Adjust contrast
	MONITOR display				2.7.5 MONITOR display
Calculated data setup	Function				2.8 Calculated data setup

NOTE

All the parameters for the quick setup (underlined ones in Table 2.1) are crucial for measurement. If you change any of them, other parameters may be initialized. For the parameters that may initialize other values, see Appendix 1.

2.1 Sensor setup

"Sensor type" setup is determined by the sensor to be connected to the instrument. Select one of the following three sensor types:

- pH: Only pH is measured. The glass electrode (input 1) is connected to terminal 15 and the reference electrode (input 2) is connected to terminal 13.
- ORP: Only Redox is measured. The metal electrode (input 1) is connected to terminal 15 and the reference electrode (or glass) (input 2) is connected to terminal 13.
- pH + ORP: Both pH and ORP are measured simultaneously. The glass electrode is connected to terminal 15, the reference electrode to terminal 13, and the metal electrode to terminal 14. This setup also allows rH to be measured.

For best results, connect a liquid earth to terminal 14. For details of the wiring connections, see 2.5.1. Wiring the pH/ORP sensor in IM 12A01A03-01EN. If there is no liquid earth, the sensor diagnostic function is disabled; set all of "Impedance 1 too high/low" and "Impedance 2 too high/low" in "Error configuration" to Off so that no related error is caused.

NOTE

The selection of "Sensor type" determines the menu structure throughout the instrument.

When pH + ORP is specified as the sensor type, the object under measurement will be displayed at the top of "Measurement setup."

If the sensor type is changed from pH to ORP, part of the relevant setup is reset, requiring reconfiguration.

When ORP is specified, and when an ORP sensor doesn't have any temperature element, set both of "Temperature too high/low" in "Error configuration" to Off so that no related error is caused. (Refer to 2.4 Error configuration.) Without temperature input, a temperature shown on the Main display or the Home display is the maximum or the minimum temperature of the temperature element's range set on the Temperature settings. Setting in "Display setup" can make temperature value on the display not to be displayed. (Refer to 2.7 Display setup.)

2.2 Measurement setup

This section describes how to set up various parameters relating to measurements.

Measurements are performed based on the measurement parameter setup.

For measurement setup, part of the menu structure of settable items changes depending on the "Sensor type" selected in 2.1 Sensor setup .

2.2.1 Measurement

If “pH” or “ORP” is selected in “Sensor type,” a measurement type does not need to be selected and it is not displayed.

If “pH + ORP” is selected in “Sensor type,” five measurement types can be selected for the “Measurement” item at the top of the Measurement setup screen. Select a suitable measurement type for the application.

Moreover, associated items are added to parameters in “Error configuration,” “Display setup,” etc.; check the setting condition of each item.

2.2.2 Temperature settings

Select the temperature element used for compensation from among Pt1000, Pt100, 3kBalco, 8k55, PTC10k, 6k8, and 500Ω. Select the same type as the temperature element that is actually connected.

Celsius (°C) or Fahrenheit (°F) temperature units are available. If the unit is changed, the following values are also recalculated automatically to the new unit:

- Manual temp.
- Reference temp.
- Temp. coefficient
- Temp. ranges in the matrix

2.2.3 Temperature compensation

ORP measurement involves no temperature input. No setting is required on the temperature compensation. Process temperature compensation is effective if “T.C. ORP mV/°C” in “Temp. Coef.” is set.

■ Temperature compensation

This compensation of pH value is performed on the Nernst equation.

Two methods can be used: Automatic and Manual. Select Automatic when a temperature element is used, or select Manual when a manually set temperature is used.

NOTE

When Manual is selected on the Temperature compensation, a process temperature should be set in the “Manual temp.” A temperature shown on the Main display or the Home display is this manually set temperature.

■ Reference temperature

Set a reference temperature to which the measured pH value must be compensated. Normally 25°C is used, so this temperature is chosen as the default value.

■ Process temperature compensation

Select a temperature compensation method. “None” does not perform the temperature compensation.

If “pH” is selected in “Sensor type,” choose process temperature compensation from among None, TC, Matrix, and NEN6411. If “ORP” is selected in “Sensor type,” choose it from among None and TC.

- **TC**

  This method uses the linear compensation function.

  It is possible to adjust the temperature coefficient (TC) factor directly. If the temperature coefficient factor of the sample liquid is known from laboratory experiments or has been previously determined, it can be entered here.

  This TC is a pH variation to 1 °C (ΔpH/ΔT). Adjust the value between -0.1 to 0.1 pH/ºC.

  In combination with the reference temperature setting, a linear compensation function is obtained, which is suitable for all kinds of chemical solutions.

- **Matrix**

  Matrix means a temperature compensation which uses the temperature compensation matrix. The temperature compensation matrix is a table of pH values at various temperatures corresponding to the pH values at the standard temperature. For details, see Appendix 1.

  When the temperature or the precompensated pH value is out of the range of the temperature compensation matrix, the temperature compensation error (warning) will be issued. This is not a device error.

  In this case, however, the temperature compensation is performed by extrapolation.

  NOTE

  To display the precompensated pH value, set the Process Temp. Compensation to “None”.

  Select Measurement setup → Temp. compensation → Process Temp. Compensation.

- **NEN6411**

  This algorithm takes into account the dissociation of water in strong acid and strong alkaline solutions. It is particularly useful for pH measurement of boiler feed water.

2.2.4 Calibration settings

The screen flow differs depending on the combination of objects to be measured.

Calibration settings for a pH converter involve slope (sensitivity), zero (aspot), and ITP (isothermal point). Figure 2.2 shows the pH value against the mV output of the sensor. The characteristic for pH measurement is an offset also known as aspot [mV] or zero [pH] and a Slope [%, mV/pH]. For an ideal sensor, the theoretical slope is 59.16 mV/pH at 25ºC. The slope can be entered in mV/pH or as a percentage of the theoretical slope (100% corresponds to 59.16 mV/pH). ITP represents a pH value where the output of the sensor does not change with temperature. Note that slope and zero are defined at 25ºC.

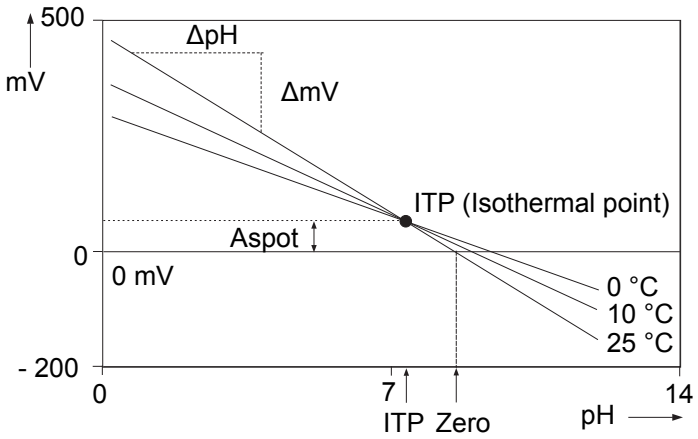


Figure 2.2 Calibration parameters

pH settings

Zero and Slope units

Zero is an alternative to Asymmetry Potential. The method of zero (aspot) unit conforms to the DIN standard for IEC 60746-2 instruments. Zero is defined in pH or mV.

The unit of Slope (sensitivity) is mV/pH or % (with the theoretical value as 100%).

Limits and timing

Zero High/Low

Set the high and low limits of Zero (aspot). During calibration, it is checked whether the new zero exceeds these high and low limits. Narrowing the band will prevent bad calibration procedures and calibration of bad sensors, which results in higher accuracy. The default values should be adjusted to suit the application and the “users” criterion.

Slope High/Low

Set the high and low limits of Slope (sensitivity). During calibration, it is checked whether the new slope exceeds these high and low limits. Narrowing the band will prevent bad calibration procedures and calibration of bad sensors, which results in higher accuracy. The default values should be adjusted to suit the application and the “users” criterion.

Step Range

Set the range over which the stability of a measured value is checked. If variations of a measured value over the stabilization time are within this set value, the measured value is judged to have stabilized.

Stabilization time

During calibration, the stability of the pH value is constantly monitored. When variations of the pH value are within a value set in Step Range over this stabilization time set here, the value is regarded as being stable. If the pH value does not stabilize within 10 minutes, calibration is aborted.

Calibr. interval

Set the interval in which a new calibration must take place. If the interval set here is exceeded, the instrument will be notified according to the setting in “Calib. time exceeded” in the error configuration.

Buffers (select set)

Calibration is made using standard calibration buffers. We recommend the NIST (JIS equivalent) standard buffers for highest accuracy, but the user is free to select DIN 19267, US, or a user-defined buffer. The standard buffers can be found in Appendix 1.

Three types of user-defined buffer tables can be defined. On the Free programmable screen, select a buffer table that you wish to set up. When a buffer table is selected on this screen, the Buffer table 1 to Buffer table 3 screens of the selected buffer table are displayed.

Clear table?

If you select “Yes” and press “Yes” when prompted to clear the table, the contents of the buffer table will be cleared, the display will return to the Buffer table screen automatically, and the “Table was cleared” message will be displayed. If you want to perform temperature compensation using the matrix after clearing the table, matrix values must be redefined.

Check values?

If you select “Yes,” a value check starts. When the check ends, the results will be displayed on the screen. When the results are normal, the “No error” message appears. In case of an error, error information is displayed.

Zero/Slope/ITP

You can enter Zero (aspot), Slope (sensitivity), and ITP values directly in the screen displayed. These data can be obtained from the manufacturer of the probe, by the users laboratory, etc.

NOTE

It is not necessary to enter this data. In most cases, as the FLXA202/FLXA21 automatically does this while performing calibration, the feature is used in the case of special electrode systems or where calibration in the process environment is not possible. See Chapter 3.

Auto correct (Zero, Slope)

This function calculates calibration coefficients from the transition of past calibration data (zero, slope) and compensates pH value using these calibration coefficients after the latest calibration. The default setting is “Disable.” To make the function effective, select “Enable.”

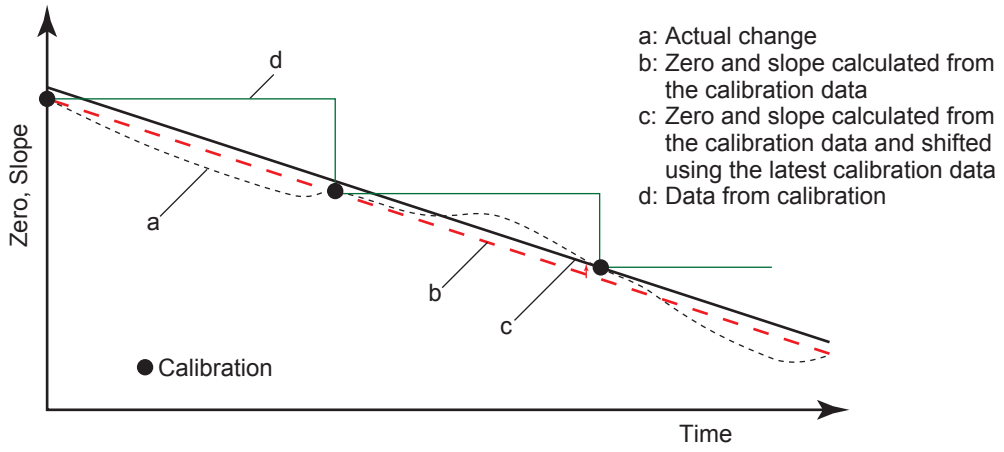


Figure 2.3 Auto correct

■ ORP settings

● Limits and timing

Zero High/Low

Zero (aspot) high and low limits. During calibration, it is checked whether the new zero exceeds these high and low limits. Narrowing the band will prevent bad calibration procedures and calibration of bad sensors, resulting in higher accuracy. The default values should be adjusted to suit the application and the “users” criterion.

Slope High/Low

Slope (sensitivity) high and low limits. During calibration, it is checked whether the new slope exceeds these high and low limits. Narrowing the band will prevent bad calibration procedures and calibration of bad sensors, resulting in higher accuracy. The default values should be adjusted to suit the application and the “users” criterion.

Step Range

Set the range over which the stability of a measured value is checked. If variations of a measured value over the stabilization time are within this setpoint, the measured value is judged to have stabilized.

Stabilization time

During calibration, the stability of the ORP value is constantly monitored. When variations of the ORP value are within a value set in Step Range over this stabilization time set here, the value is regarded as being stable. If the ORP value does not stabilize within 10 minutes, calibration is aborted.

Calibr. interval

Set the interval in which a new calibration must take place. If the interval set here is exceeded, the instrument will be notified according to the setting in “Calib. time exceeded” in the error configuration.

● Zero/Slope

You can enter zero and slope values directly.

2.2.5 Impedance settings

This screen is used to set the impedance relating to an input impedance check.

Input 1 impedance represents the “glass membrane impedance” of a pH sensor. In case of an ORP sensor, it represents “metal electrode impedance.” Input 2 impedance stands for “reference impedance.”

If you select “Input impedance: Low,” the display moves to the Input impedance screen, enabling you to set the high and low limits.

The FLXA202/FLXA21 has an impedance check, which is capable of monitoring the impedance of various sensor systems. In order to “fine tune” this diagnostic tool, it is necessary to set it up to match the sensors used.

The system can be set to measure the impedances of glass (input 1 impedance: high) and reference (input 2 impedance: low) electrodes. In applications that tend to leave deposits on the electrodes or to clog the reference sensor junction, the impedance check (set error configuration) on the reference sensor can be used to initiate an alarm, or to initiate the wash cleaning process, if one of the limits is exceeded. Sensors with a liquid earth use this liquid earth in impedance measurement. Sensors with a liquid earth that Yokogawa can provide include PH8EFP, PH8ERP, PH8EHP, OR8ERG, OR8EFG, etc. In pure water measurement using PH8EHP, the impedance of the solution to be measured is high; settings on the Error configuration screen should be set to Off so that the “Impedance 2 too high” error is not generated.

A sensor without a liquid earth cannot measure impedance. All settings on the Error configuration screen should be set to Off so that no “Impedance 1 too high” or “Impedance 2 too high” error is generated.

Sensors not equipped with a liquid earth that Yokogawa can provide include HA405, HA406, DPA406, DPA405, DPAS405, HF405, HA485, DPA485, etc.

This liquid earth refers to a metal pole built into a sensor or connected externally that contacts the solution to be measured and transmits the potential of this solution to the converter.

2.2.6 Concentration

Generally pH values are not converted into concentrations. Following linear conversion is not suitable for a lot of measurements.

The FLXA202/FLXA21 is capable of converting a measured pH value into concentration for display. Parameters required for concentration calculation can be arbitrarily set by the user. Those parameters are as follows:

Unit:	The default value is %. The unit can be selected from among mg/L, g/L, and ppm.
pH:	The default values are 0 and 14 pH (0 to 14). They are the pH zero and span required for conversion to concentration.
Concentration:	The default value are 0 and 100%. Concentration for each pH can be set.

Concentration can be assigned to the pH value zero and span individually.

2.2.7 Sensor diagnostic settings

This screen is used to set items relating to sensor diagnostics displayed on the screens invoked by pressing  .

Gauges are displayed for only parameters that have been enabled in “Sensor diag. settings.”

Parameters set to Disable are provided with a bar display.

The setting parameters include Input 1 imp., Input 2 imp., Progress time, and Heat cycle.

When input impedance is set “High” (section 2.2.5 Impedance settings), “FINE” value can be changed. When input impedance is set “Low”, its “High limit” and “Low limit” will be the limits for diagnostic.

It is also possible to set the “Bad limits” of the progress time and heat cycle and the “Heat cycle temp” and “Heat cycle time” of the heat cycle.

2.3 Output setup

The general procedure is to first define the function of the output, Output or Simulate. Then, set the process parameters associated with the output. On the Output, an output of measured value is selected. On the Simulate, a simulation value can be set.

And, the parameters for HOLD function can be set on this setting.

Output

The output signal is a current value specified by the following parameters.

Process parameter

The available process parameters depend on the selected “Sensor type” on the Sensor setup and the selected “Measurement” type on the Measurement setup.

The output of the selected process parameter is shown as a bar on the bottom of the Main display or the Home display. And its parameter symbol (for example, PH1 or Diff-pH) is shown above the bar, too. When a selected process parameter is displayed as a measurement value, the top left number or character is turned to be white number or character on black background (for example, 1 or R(1)). (Refer to 1.2 Screen operation in IM 12A01A03-01EN)

Process parameters can be selected from among:

pH1, Temperature 1, and ORP1:	1st module’s measured values
pH2, Temperature 2, and ORP2:	2nd module’s measured values
Calculated*1 and Redundant*2:	special output based on two inputs

*1: Refer to 2.8 Calculated data setup.

Calculated data and Redundant system are available when two modules are installed on the instrument. And, these functions are available when the “pH” (or the parameter including pH) or the “ORP” is selected on the “Sensor type” setting and the “Measurement” type setting. The parameter for the 1st module and the 2nd module should be the same. For wrong selection, an error is given.

When the process parameter is set at “Calculated” of “Redundant”, don’t change the “Sensor type” or the “Measurement” type. If it is changed, the process parameter will go back to the default.

<Redundant system>

On the Redundant system, when a sensor (Sensor 1) of the 1st module fails, the output is automatically switched to the output of the 2nd module.

After repairing the Sensor 1, manual reset of redundant system is necessary to return to the output of 1st module from the output of the 2nd module.

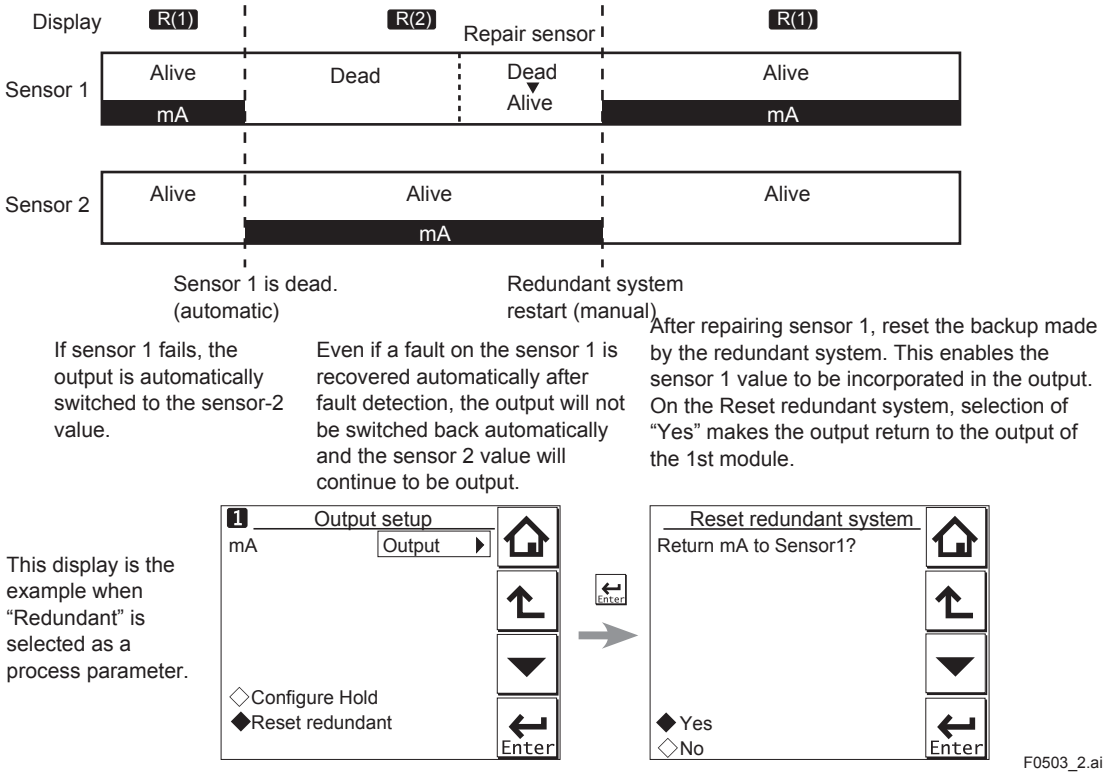


Figure 2.4 Redundant system

Setup

Select one of the output methods: Linear and Table.

Linear: Set the 0% and 100% values.

Table: This allows the configuration of an output curve by 21 points (5% intervals). (The 0% and 100% values must be entered.)

Burn

Select the designated output in case of a fault from among Off, Low, and High. See "2.4 Error configuration" to set the output.

Off: Output depends on the measured value.

Low: Output is fixed to 3.6 mA

High: Output is fixed to 22.0 mA.

Damping time

This is the time taken for a response to a step input change to reach 90% of the final value (attenuation time). Set this time in sec.

● Simulate

When this function is selected, an output of the instrument will be a fixed current value set in % of the output span. The output span range is -2.5% to 112.5% (3.6 mA to 22.0 mA).

When "Simulate" is selected, regardless of hold setting, the output is always simulated value.

Configure Hold

On the Configure Hold, settings are performed to hold of the mA output at a preset value. (Refer to 3.4 HOLD.) This is enabled only if “mA” is “Output.”

During the Commissioning or the Quick Setup, the mA output is automatically held. The preset value depends on a setting on the “Last or fixed”.

“Last”: The preset value is a value measured just before hold condition.

“Fixed”: The preset value is a value set in the “Fixed value mA”.

When the “Fixed” is selected, set a mA value in the “Fixed value mA”.

Selection on the “Hold during Calibration/Wash” decides to activate or deactivate the hold function automatically during calibration or wash.

“Enabled”: Activation of the automatic hold function

“Disabled”: No automatic hold function

Only when the “PH201G” is selected on the Communication, the message of “Hold during Calibration/Wash” is displayed. On other selections, the message of “Hold during Calibration” is displayed.

2.4 Error configuration

In Error configuration, configure the statuses of various error causes.

This allows the system to notify the user of the occurrence of an error according to the status categories in the Error configuration.

Select a status category from among Off, Warn. (Warning), and Fault.

“Fault” automatically performs burn-out. When Burn has been set to Off (2.3 Output setup), only the error message is displayed.

“Warn.” displays an error message.

When selecting PH201G in the communication setting, make sure that the “Fail contact” setting is appropriate.

The settable causes of errors are determined based on the settings of the Sensor setup and Measurement setup, and a status category is set to the causes displayed in the Errors 1/3 to 3/3 screens.

Table 2.2 Error configuration

Display item	Description	Default
pH too high	The pH value exceeds 16.00.	Warn.
pH too low	The pH value is lower than –2.00.	Warn.
Temperature too high	Measured process temperature is higher than the maximum limit.	Warn.
Temperature too low	Measured process temperature is lower than the minimum limit.	Warn.
ORP too high	The ORP value is higher than 1500 mV.	Off
ORP too low	The ORP value is lower than –1500 mV.	Off
rH too high	The rH value is higher than 100.	Off
rH too low	The rH value is lower than 0.	Off
Matrix config. error	The temperature compensation matrix is not set properly (see 2.2.3 Temperature compensation).	Fault
Calib. time exceeded	Calibration time exceeds the calibration interval (see 2.2.4 Calibration settings)	Off
Wash half-time error	The response to wash is abnormal.	Off
Impedance 1 too high	The sensor must be checked.	Off
Impedance 1 too low		
Impedance 2 too high		
Impedance 2 too low		

CAUTION

If canceling an error configuration could be risky, do not cancel it as a dangerous situation may result.

NOTE

The “Impedance 1 too high/too low” and “Impedance 2 too high/too low” error items are displayed in the Error configuration screen. In general, for a pH sensor, “Impedance 1” means “glass electrode,” and for an ORP sensor, it means “metal electrode.” “Impedance 2” represents the reference electrode in all cases. The “Impedance 1 too high/too low” and “Impedance 2 too high/too low” errors are applied to sensors with a liquid earth. Sensors with a liquid earth include PH8EFP, PH8ERP, PH8EHP, OR8ERG, OR8EFG, etc. For sensors not equipped with a liquid earth, these errors should all be set to Off; these sensors include HA405, HA406, DPA406, DPA405, DPAS405, HF405, HA485, DPA485, etc. Moreover, for measuring a solution with low conductivity such as when using a pH meter for pure water, set the “Impedance 2 too high” error to Off. Otherwise, no impedance can be detected.

NOTE

When ORP is specified as a sensor type in “Sensor setup”, and when an ORP sensor, such as OR8ERG and OR8EFG, doesn’t have any temperature element, set both of “Temperature too high/low” in “Error ” to Off so that no related error is caused. Due to the open input of temperature signal, a false error may happen as if temperature goes over a high limit or a low limit.

2.5 Logbook configuration

In “Logbook configuration,” the user configures information to be saved to a logbook or initializes the logbooks.

Logbooks are used to keep an electronic record of events such as error messages, calibrations, and programmed data changes. By referring to this log, users can, for instance, easily determine maintenance or replacement schedules.

In “Logbook configuration,” the user can select “Off,” “1-1,” or “1-2” for each item of interest to be logged. (For sensor 2, select “Off,” “2-1,” or “2-2.”) This can be done for items displayed on the Settings logbook 1/3 to 3/3 screens. Assigning 1-1 or 1-2 to each item allows information to be organized and logged in a logbook.

NOTE

Some events such as power-on are saved into the logbook “1-1” or “2-1”. This logbook may be full earlier. It is recommended that important information be saved into the logbook “1-2” or “2-2”.

For “Erase logbook”, a specified logbook “1-1” or “1-2” can be erased individually.

When the “Warn if logbook full” is set to “Yes”, a warning is given when the logbook come to near full (maximum 13 pages).

NOTE

When the logbook gets full, the oldest information is erased automatically.

2.6 Advanced setup

Advanced setup is used to set functions relating to matters other than measurements such as the selection of settings, tag setting, password setting for protecting calibration and commissioning operations, date setting, and communication setting.

("Factory setup" is for service engineers only; there is no item to be set by the user.)

2.6.1 Settings

In "Settings," select an item to be set as the default value from among "No action," "Load factory settings," "Save user settings," and "Load user settings."

When the default values are loaded, the instrument will be restarted. (In the case of "Save user settings," it will not be restarted.)

The following parameters are not included in the defaults:

- Tag
- The contents of all logbooks

NOTE

When the "Save user setting" is only selected, save of the user-set parameters will start at once.

To avoid wrong selection, operation in this Settings must be done by  , not by touching the menu message.

If you select "Load factory settings," the instrument will be set to the default settings at factory shipment.

When this item is selected, a screen prompting whether to restart is displayed. If this is no problem, press "Yes." Then the "Loading …" message appears and blinks and loading is started. When the factory settings have been loaded, the instrument will be restarted.

When "Save user settings" is selected, the current settings can be saved as the defaults. When this item is selected, the user settings will start to be saved immediately. After saving the parameters, press  or  to change the display because this save doesn't have restart function.

If "Load user settings" is selected, the settings saved as user settings can be set as the defaults.

When this item is selected, a screen prompting whether to restart is displayed. If this is no problem, press "Yes." Then the "Loading …" message appears and blinks and loading is started. When the user settings have been loaded, the instrument will be restarted.

2.6.2 Tag

A tag provides a symbolic reference to an instrument and is generally defined to be unique throughout the control system at one plant site. A tag can contain up to 12 alphanumeric characters. The default value is PH or FLXA21-PH. When two sensor modules are installed, each module can have their own tag numbers.

The tag is displayed at the top of the main and home displays.

2.6.3 Passwords

Calibration and commissioning operations can be separately protected by each password. To protect execute operations, enter a password in Execute's input field. To protect commissioning operations, enter a password in Commissioning's input field. By default, both input fields are empty. When a password input field is empty, operation is not password-protected. A password can contain up to 8 characters.

When you set a password, always take a note of it.

When a password is set, input of the password is necessary to enter the password-protected operation. After inputting the password, the display will change to an operator ID input display. When an operator ID is input, its operation is recorded into a logbook. The input of an operator ID is not necessary to enter the operation. An operator ID can contain up to 4 characters.

2.6.4 Date/Time

The Logbooks and trend graphs use the clock/calendar as a reference. The current date and time is set here. The time display format can be selected from among three types.

2.6.5 Communication

In "Communication," select the communication setting from among None, HART, and PH201G.

The burn down current value is 3.6 mA.

NOTE

To make the change of "Communication" valid, turn off the power supply once, and reboot.

In the case of "None," there is not the problem even if you do not change it as "HART" of default value.

■ HART

Select this menu when HART communication (HART 5) is made.

In the HART setup screen, specify the network address and set up parameters for SV, TV, and FV.

(PV is linked with the "process parameter" setting in "Output settings" and cannot be changed here.)

● Network address

For 1-to-1 communication, leave the default value [0] unchanged. For multi-drop where multiple HART devices are connected on a bus, set addresses in 1 to 15. In this case, the mA output will be fixed to 4 mA.

● PV

PV is a parameter selected for analog output; it cannot be changed here.

SV, TV, FV

The SV, TV, and FV parameters are items that the user must set up. Selectable items differ depending on the sensor type in “Sensor setup” and settings in “Measurement setup.”

If blank is selected for a parameter, items below that parameter must all be set to blank. If an item is blank, those below it cannot be set to a status other than blank.

For more information on HART communication, see the Technical Information (TI 12A01A02-60E).

PH201G

Select this menu if the PH201G distributor is connected to the instrument.
In the PH201G setup screen, make settings for “Hold contact,” “Fail contact,” and “Wash contact.”

Hold contact

Select Disabled or Enabled.

When this item is enabled, the output will be held according to the setting of “Hold type” on the Hold setup screen.

Fail contact

Select a status from among “Fail + Warn,” “Fail only,” and “Disabled.”

This setting depends on the error configuration. See 2.4 Error configuration.

“Fail” corresponds to “Fault.”

Wash contact

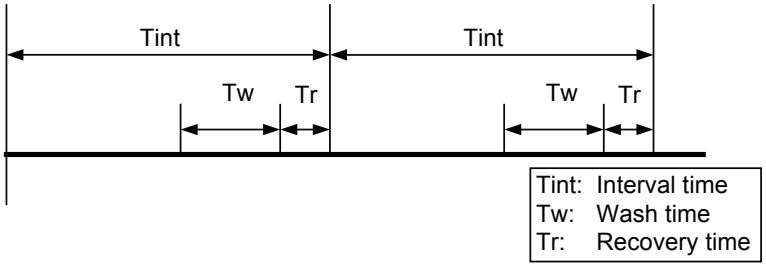
Select Disabled or Enabled.

When this item is enabled, items for a wash can be set on the Wash settings screen.

In the Wash settings screen, set the interval time, wash time, and recovery time and setup of various washes.

Interval time:	Set the wash interval in hours.
Wash time/measure time:	Set the wash time in minutes. In a continuous wash, wash time is replaced by measure time.
Recovery time:	Set the recovery time in minutes.
Manual wash:	Select “Disabled” or “Enabled.” When this item is enabled, a wash cycle can be activated manually. On the Calibration/Wash screen, press the “Start manual wash cycle” to perform a manual wash.
Imp2 wash:	Select “Disabled” or “Enabled.” When this item is enabled, a wash cycle can be started if the “Impedance 2 too high” error occurs with respect to the reference electrode.
Continuous wash:	Select “Disabled” or “Enabled.” A continuous wash cycle is started at the instant when this item is enabled. In a continuous wash, the “Measure time” and “Interval time” are reversed (see Figure 2.5).

When a continuous wash is disabled



When a continuous wash is enabled

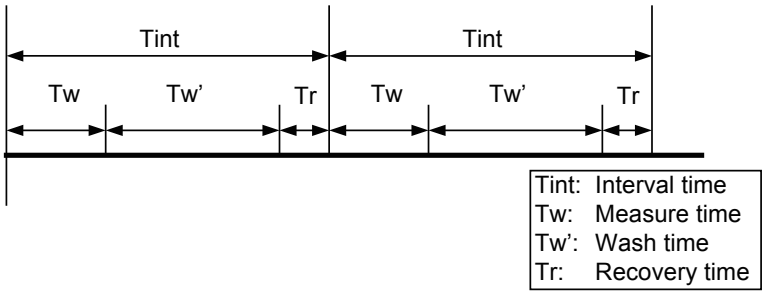


Figure 2.5

The instrument has a function for checking whether measurements are normally made after wash, allowing you to check a sensor response.

The wash recovery check is performed by making use of the time to recover half the wash-cycle pH change. The half the wash-cycle pH change recovery time replaces the relaxation time by the recovery time.

Whether to conduct the wash recovery check can be set on the Error settings 2/3 screen. Half the wash-cycle pH change refers to half the value (1/2ΔpH) of the difference (ΔpH) between the pH value during normal measurement of an example in Figure 2.6 and the pH value detected during wash. If the pH value during wash is greater than 1/2ΔpH when 1/3 tR has elapsed, the electrode is assumed to be good. If it is smaller than 1/2ΔpH, then the electrode is assumed to be bad.

However, for applications where the pH during wash shows almost the same value as the normal pH, the difference will be approximately zero. In such a case, disable the wash recovery check. An example of such applications is the monitoring of waste water pH. If you select water jet cleaning in such a case, the normal pH as well as the washing time pH will be around pH 7; the difference will be approximately zero, so the recovery time check will not work normally.

This function is available either for ORP measurement only.

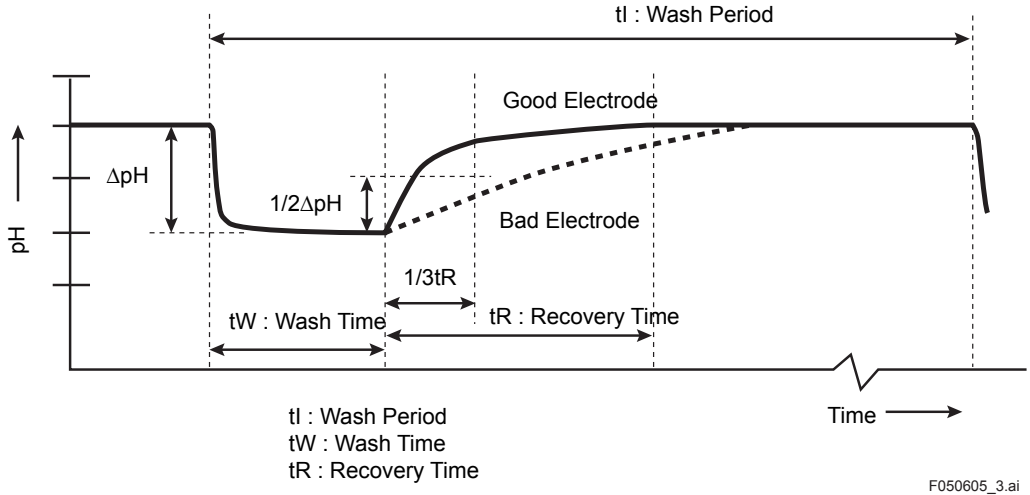


Figure 2.6

2.6.6 Factory setup

For “Factory setup,” there is no item to be set by the user.

NOTE

This menu is for service engineers only. This section is protected by a password. Attempting to change data in the factory adjustment menu without the proper instructions and equipment could result in corruption of the instrument setup and damage the performance of the unit.

2.7 Display setup

This screen is used to make various settings relating to screen display.

NOTE

Settable items differ depending on settings in “Sensor setup” and “Measurement setup.”

2.7.1 Main display (Dual display, Individual display)

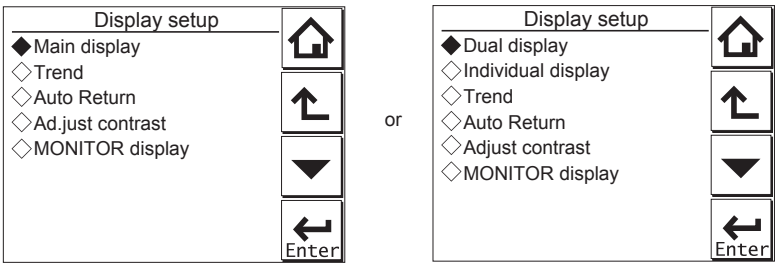


Figure 2.7 Display setup screens for a single module (left) and two modules (right)

- **Main display**

  When one module is installed on the instrument, only the Main display is available.

  Three measurement values can be set to display on the Main display as a primary value (1st line), a second value (2nd line) and a third value (3rd line) respectively.

  On the “Additional text”, a text of up to 12 alphanumeric characters can be assigned to each measurement value.

  Additional texts are displayed on the Main display, and are useful for identifying measurements. In some cases, not all 12 characters can be displayed due to the letters; check the texts displayed on the Main display after setting. If a part of the text is missing, adjust the number of characters.

- **Dual display**

  This screen is used to set items to be displayed in the top part (1st row) and bottom part (2nd row) of the Home display. These settings are available when two sensors are installed in the instrument.

  When the “Empty” is selected for the 2nd row, the Home display can not be displayed.

- **Individual display**

  When two modules are installed on the instrument, display items on the Main display for each module can be set on these settings.

  On the “PH1 display” or “PH2 display” screen, three measurement values can be set to display on each Main display as a primary value (1st line), a second value (2nd line) and a third value (3rd line) respectively.

  On the “Additional text”, a text of up to 12 alphanumeric characters can be assigned to each measurement value.

  Additional texts are displayed on the Main display, and are useful for identifying measurements. In some cases, not all 12 characters can be displayed due to the letters; check the texts displayed on the Main display after setting. If a part of the text is missing, adjust the number of characters.

2.7.2 Trend

This screen is used to make settings for the Trend Graph Screen.

Set the process parameters to be displayed for each trend. They can be set for the 1st to 3rd trends. When all three process parameters are set “Empty”, there is no trend display (no trend button).

- **X-axis: Timing**

  Select the X-axis timing’s time span on the trend graph display from a list.

- **Y-axis: Limits**

  Set the Y-axis high and low limits on the trend graph display on a Trend screen basis.

NOTE

Updating the trend display setup resets the current trend graph and starts a new one.

2.7.3 Auto Return

When no operation is performed for the time set in “Auto Return”, the display returns to the Monitor display (or to the Main display when the MONITOR display is disabled) and the analyzer returns to a normal measuring mode. (When the Trend display is selected, the Auto Return doesn’t work.)

Select the time from among Disable, 10 min, and 60 min. When the Auto Return function is not used, select “Disable.”

NOTE

A default is “10 min”. When maintenance like a calibration that may take much time is performed, “60 min” or “Disable” is recommended to be selected.

2.7.4 Adjust contrast

The LCD screen contrast can be adjusted.

Pressing the ▲▼ keys adjusts the contrast in 11 levels from +5 to –5 (including the default value of “0”).

2.7.5 MONITOR display

Select “Enable” so that the Monitor display becomes available. A default is “Enable”.

During Hold/Wash condition and a warning/fault condition, the Main display or the Home display is displayed to indicate the condition.

2.8 Calculated data setup

On this setup, parameters can be set for calculated data.

When two modules are installed on the instrument, the calculated data can be set for pH values or ORP values measured by two sensors.

Select “Differential” or “Average” on the Calculated data setup screen.

Differential:	A difference between measurement values measured by a sensor 1 and sensor 2 is an output as a calculated result.
(Diff)	(value of the sensor 1) – (value of the sensor 2)
Average:	The average of measurement values measured by a sensor 1 and sensor 2 is an output as a calculated result.
(Ave)	(value of the sensor 1 + value of the sensor 2) / 2

To display the calculated result, select “Calculated” on the Dual display screen (2.7.1 Main display (Dual display, Individual display). (The setting on the “Individual display” has no effect.)

While displaying a calculated data, measurement value of the sensor 1 or sensor 2 can be checked on the each sensor’s display with pressing Sensor 1 or Sensor 2 at the lower right on the Main display.

Pressing  returns the display to the original calculated data display.

A calculated data can be set as a process parameter on the “mA (Output)” setup screen (2.3 Output setup).

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3. CALIBRATION OF pH/ORP

Before pH measurement, calibrate the pH sensor with the standard solution.

Before ORP measurement, check the electrode as a part of regular maintenance.

NOTE

A default is “10 min” for “Auto Return”. When maintenance like a calibration that may take much time is performed, “60 min” or “Disable” is recommended to be selected. (Refer to 2.7.3 Auto Return)

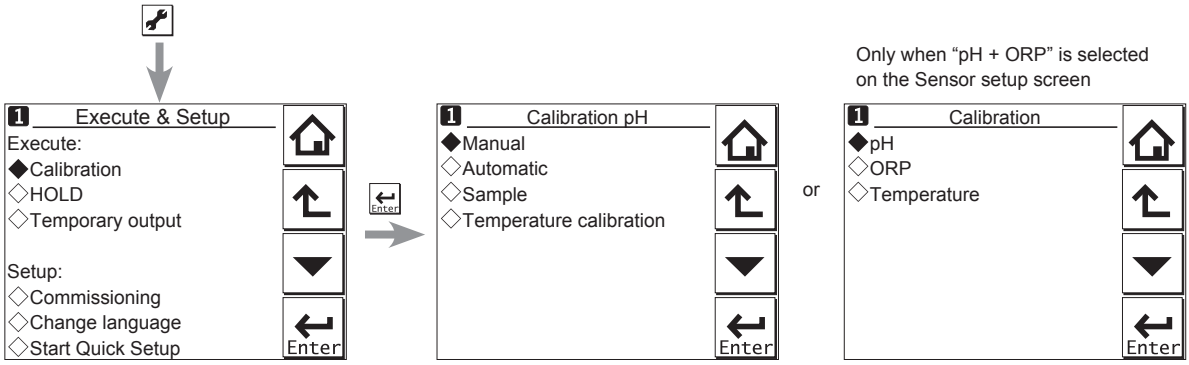

Figure 3.1 Calibration

The calibration items include pH, ORP, rH, and Temperature.

The item to be calibrated is determined according to the settings made in the Sensor setup and Measurement setup in Commissioning.

Press  to select Execute: Calibration, choose the item to be calibrated, configure the calibration settings, then perform calibration.

NOTE

Note the following when performing calibration with buffer solutions.

- Before starting a calibration, make sure the electrode system is properly cleaned and the electrodes are fully functional. They must then be rinsed with clean water to avoid contamination of the calibration solution(s).
- Always use fresh buffer solution to avoid the risk of introducing errors from contaminated or old solutions. Buffers supplied as liquids have a limited shelf life, especially alkaline buffers, which absorb CO_2 from the air.
- Yokogawa strongly recommends NIST/DIN 19266 buffer standards for the best accuracy and buffer capacity. Commercially adjusted buffers (e.g., pH 7.00, 9.00 or 10.00) are a compromise as a standard, and are often supplied without a temperature dependency curve. Their stability will never be as good as NIST (JIS equivalent) solutions.
- When the internal junction (Ag / AgCl) of the glass electrode is exposed to sunlight, the electromotive force changes due to the influence of ultraviolet rays. In this case, the pH value may be displayed higher than the actual pH value.
  When calibrating the pH sensor and measuring the process solution, keep the glass electrodes out of the sun.

Always ensure that the sensors are properly conditioned, clean and filled with the correct electrolyte solution (if appropriate) before starting a calibration. Refer to the sensor instructions for details.

3.1 pH calibration

There are the Manual, Automatic, and Sample modes of pH calibration.

3.1.1 Manual calibration

The unit is adjusted to match the value of the buffer standards or a process solution with a known pH value (buffer solution).

The user determines the pH value, temperature influence, and stability.

Select the calibration type from among [zero/slope], [zero/slope/ITP(3point)], and [zero/slope1,2 (3point)].

Calibration is performed stepwise; follow the prompts displayed on the screen.

A stability check is conducted at each measurement point. Proceed to the next step only after the reading has stabilized.

At calibration, we advise leaving the sensors for three to five minutes in the buffer solution before proceeding to the next step even when the reading has stabilized. This will give reliable and accurate calibration results.

NOTE

When a sensor or an electrode is exchanged or replaced, sensor wellness data should be reset.

When a sensor is replaced, the replacement can be recorded manually into a logbook. (Refer to the figure 3.9.)

- **zero/slope**

This calibration type is one-point or two-point calibration.

One-point calibration performs the zero adjustment only. Two-point calibration performs the zero and slope adjustments.

- **zero/slope/ITP(3point)**

This calibration type is ITP-type three-point calibration.

If ITP does not have pH 7, three-point calibration is performed to obtain the zero (asymmetry), slope (sensitivity), and ITP (isothermal point) for calibration.

Limitations

- Three different buffer solutions whose difference in pH value between buffer solutions is 1 pH or more should be used.

  (1st buffer < 2nd buffer < 3rd buffer or 1st buffer > 2nd buffer > 3rd buffer)
- The 2nd buffer solution should be pH 7 ± 2.
- The temperature difference between the 2nd and 3rd buffer solutions should be 5ºC or less. The temperatures of the 2nd and 3rd buffer solutions should be at least 20ºC higher or lower than the temperature of the 1st buffer solution.
- To calculate the pH value of the 3rd buffer solution (pH_{3cal}), insert the pH and temperature values of the 1st and 2nd buffer solutions and the temperature value of the 3rd buffer solution into the following equation.

$$pH_{3cal} = ITP - \frac{\left(\frac{t_3 - t_1}{t_2 - t_1}(273.15 + t_2)(ITP - pH_2) + (1 - \frac{t_3 - t_1}{t_2 - t_1}) \times (273.15 + t_1)(ITP - pH_1)\right)}{(273.15 + t_3)}$$

pH_n: pH value of n-th buffer solution

T_n: Temperature of n-th buffer solution (ºC)

ITP: ITP value displayed in calibration settings (see 2.2.4 Calibration settings) Assign 7.00 as the ITP value when a specific value is not available or for the first calibration of a sensor.

Do not use the 3rd solution whose pH value is within $pH_{3cal} \pm 1$.

- **zero/slope1,2(3point)**

This calibration type is the line-segment type three-point calibration.

If the relation between electromotive force and pH is not in proportion for a wide range, divide the relevant range into two sections and obtain the zero (asymmetry) and slope (sensitivity) in each section to perform calibration.

Limitations

- Three different buffer solutions whose difference in pH value between buffer solutions is 1 pH or more should be used.
  (1st buffer < 2nd buffer < 3rd buffer or 1st buffer > 2nd buffer > 3rd buffer)
- The temperature difference between the 1st and 2nd buffer solutions should be 20ºC or less.
- The temperature difference between the 2nd and 3rd buffer solutions should be 20ºC or less.

3.1.2 Automatic calibration

Calibration can easily be performed by following the calibration menus.

Pre-select the buffer solution to be used from among NIST/DIN 19266, DIN 19267, US, and User defined buffer in Commissioning → Measurement setup → Calibration settings → pH settings → Buffers (select set). See also Appendix table 1.

If you select User defined buffer, calibration is performed based on the conditions registered in buffer tables 1 to 3. Use of the proper buffer table allows the system to perform reliable calibration.

In the same way as manual pH calibration, select the calibration type from among [zero/slope], [zero/slope/ITP(3point)], and [zero/slope1,2(3point)].

Calibration is performed stepwise; follow the prompts displayed on the screen.

A stability check is conducted at each measurement point. Proceed to the next step only after the reading has stabilized.

NOTE

When a sensor or an electrode is exchanged or replaced, sensor wellness data should be reset.

When a sensor is replaced, the replacement can be recorded manually into a logbook.

zero/slope

Select the solution that works with the “buffer solution” selected in calibration settings and perform calibration by following the prompts on the screen.

zero/slope/ITP(3point)

Calibration is performed in the sequence of the sequence selection menu (Table 3.1) of the solution that works with the “buffer solution” selected in calibration settings. Perform calibration by following the prompts on the screen.

Limitations

- Three different buffer solutions whose difference in pH value between buffer solutions is 1 pH or more should be used.

  (1st buffer < 2nd buffer < 3rd buffer or 1st buffer > 2nd buffer > 3rd buffer)
- The 2nd buffer solution in the buffer table in the Free programmable screen should be pH 7 ± 2 (at 25ºC).
- Either of the following conditions should be met.

  - The temperature difference between the 1st and 2nd buffer solutions should be 5ºC or less. The temperature of the 1st and 2nd buffer solutions is at least 20ºC higher or lower than the temperature of the 3rd buffer solution.
  - The temperature difference between the 2nd and 3rd buffer solutions should be 5ºC or less. The temperature of the 2nd and 3rd buffer solutions is at least 20ºC higher or lower than the temperature of the 1st buffer solution.

zero/slope1,2(3point)

Calibration is performed in the sequence of the sequence selection menu (Table 3.1) of the solution that works with the “buffer solution” selected in calibration settings. Perform calibration by following the prompts on the screen.

Limitations

- Three different buffer solutions whose difference in pH value between buffer solutions is 1 pH or more should be used.

  (1st buffer < 2nd buffer < 3rd buffer or 1st buffer > 2nd buffer > 3rd buffer)
- The temperature difference between the 1st and 2nd buffer solutions should be 20ºC or less.
- The temperature difference between the 2nd and 3rd buffer solutions should be 20ºC or less.

Table 3.1 Selection of Buffer Solutions in Three-point Calibration

Buffer settings	Buffer sequence selection menus
NIST/DIN 19266	PH1.7→PH6.9→PH9.2
	PH4.0→PH6.9→PH9.2
	PH9.2→PH6.9→PH1.7
	PH9.2→PH6.9→PH4.0
DIN 19267	PH4.7→PH6.8→PH9.2
	PH9.2→PH6.8→PH4.7
US	PH4.0→PH7.0→PH10.0
	PH10.0→PH7.0→PH4.0
User defined buffer	table1→table2→table3
	able3→table2→table1

3.1.3 Sample calibration

A sample calibration is a single-point calibration for only the zero (asymmetric). It adjusts the recorded reading to a collected sample value. Press [Take Sample] to record a collected sample value in memory. Re-enter the Sample Cal. screen and press [Start calibration] to perform a sample calibration. This updates the recorded data.

NOTE

When a sensor or an electrode is exchanged or replaced, sensor wellness data should be reset.

When a sensor is replaced, the replacement can be recorded manually into a logbook.

3.2 Temperature calibration

For the most accurate measurements, it is important to have a precise temperature measurement. Measure the temperature with a high-precision thermometer and adjust the sensor reading accordingly. For best accuracy, this should be done as near to the normal operating temperature as possible.

3.3 ORP calibration (rH calibration)

The calibration modes for ORP or rH are “Manual” and “Sample”. No automatic calibration feature is available in an ORP or rH calibration.

Calibration is performed stepwise. Follow the prompts displayed on the screen.

A stability check is made at each measurement point. Proceed to the next step only after the reading has stabilized.

NOTE

When a sensor or an electrode is exchanged or replaced, sensor wellness data should be reset.

When a sensor is replaced, the replacement can be recorded manually into a logbook.

3.4 HOLD

The FLXA202/FLXA21 has a function to hold the mA output at a preset value (default: “Last”).

Use this menu to hold the output.

For the settings, see During commissioning or quick setup, the output is automatically held.

Setting “Hold during Calibration/Wash” to “Disabled” deactivates the hold function during calibration or washing.

Press  to select Execute: HOLD and then choose Manual Hold ON or Manual Hold OFF. This allows you to set up manual hold.

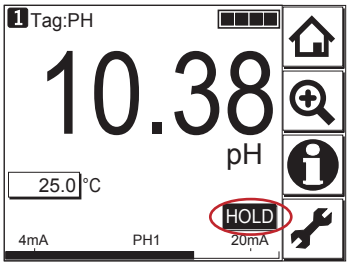

Figure 3.2 Example of the display with the manual hold enabled

To cancel manual hold, press the lit HOLD section on the Main display.

3.5 Temporary output

If measurement cannot be made due to replacement of one of the sensors, assignment of mA output can be temporarily changed from the currently setup sensor to the other sensor. This feature is enabled only when two sensors are connected and the process parameters including pH have been configured.

Press  to select Execute: Temporary output and then choose the process parameter to be assigned on the Temporary output screen.

When process parameter assignment has been modified, the 1 indication at the upper left of the screen changes to 1.

The feature is disabled the moment the screen returns to the Main display, and the setting (process parameter in mA output setting) returns to the original condition.

Appendix Reference material

Buffer tables

The following tables show the details of the buffer solutions selectable in Calibration settings of pH 2.2.4 Calibration settings (unit: pH).

Table 1 NIST (IEC 60746-2)/DIN 19266

	0°C	5°C	10°C	15°C	20°C	25°C	30°C	35°C	38°C	40°C	45°C	50°C	55°C	60°C	70°C	80°C	90°C	95°C
1.68 pH		1.668	1.670	1.672	1.675	1.679	1.683	1.688	1.691	1.694	1.700	1.707	1.715	1.723	1.743	1.766	1.792	1.806
4.01 pH	4.003	3.999	3.998	3.999	4.002	4.008	4.015	4.024	4.030	4.035	4.047	4.060	4.075	4.091	4.126	4.164	4.205	4.227
6.87 pH	6.984	6.951	6.923	6.900	6.881	6.865	6.853	6.844	6.840	6.838	6.834	6.833	6.834	6.836	6.845	6.859	6.877	6.886
9.18 pH	9.464	9.395	9.332	9.276	9.225	9.180	9.139	9.102	9.081	9.068	9.038	9.011	8.985	8.962	8.921	8.885	8.850	8.833

Table 2 DIN 19267 (German buffers) so called: technical buffer solutions

	0°C	10°C	20°C	25°C	30°C	40°C	50°C	60°C	70°C	80°C	90°C
4.65 pH DIN	4.670	4.660	4.650	4.650	4.650	4.660	4.680	4.700	4.720	4.750	4.790
6.79 pH DIN	6.890	6.840	6.800	6.790	6.780	6.760	6.760	6.760	6.760	6.780	6.800
9.23 pH DIN	9.480	9.370	9.270	9.230	9.180	9.090	9.000	8.920	8.880	8.850	8.820

Table 3 US technical buffers

	0°C	5°C	10°C	15°C	20°C	25°C	30°C	35°C	40°C	45°C	50°C	55°C	60°C
4.0 pH US	4.000	3.998	3.997	3.998	4.001	4.005	4.001	4.018	4.027	4.038	4.050	4.064	4.080
7.0 pH US	7.120	7.090	7.060	7.040	7.020	7.000	6.990	6.980	6.988	6.978	6.970	6.890	6.980
10.0 pH US	10.317	10.245	10.179	10.118	10.062	10.012	9.966	9.926	9.889	9.856	9.828	9.828	9.828

Table 4 FREE PROGRAMMABLE (Default settings based on rounded NIST values).

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

The freely programmable table is populated with a basic set of data to provide a start for the user configuration. This table is intended for the user to be able to choose his buffer solutions to suit his own preference. The data concerning the pH temperature characteristic will need to be obtained from the supplier of the buffers.

NOTE

Yokogawa recommend the use of NIST (primary buffer standards) rather than buffers which have been adjusted by the addition of acid or alkaline materials to the buffer composition. In this way the customer gets a recognized standard, as well as the best buffer capacity (the ability to resist pH change with contamination).

Matrix temperature compensation

Table 5 shows the defaults for the matrix temperature compensation selectable in Temperature compensation 2.2.3 Temperature compensation

Table 5 Defaults for the matrix temperature compensation (Reference temperature (Tref.): 25.0°C)

	Temp. range	Solution 1 (Min.)	Solution 2	Solution 3	Solution 4	Solution 5 (Max.)
Tref.	(25.0°C)	6.40 pH	7.00 pH	7.30 pH	7.60 pH	9.00 pH
Tmin. (T1)	5.0°C	6.42 pH	7.38 pH	7.94 pH	8.31 pH	9.74 pH
T2	25.0°C	6.40 pH	7.00 pH	7.30 pH	7.60 pH	9.00 pH
T3	45.0°C	6.34 pH	6.70 pH	6.86 pH	7.06 pH	8.40 pH
T4	65.0°C	6.23 pH	6.45 pH	6.54 pH	6.67 pH	7.91 pH
Tmax. (T5)	85.0°C	6.11 pH	6.25 pH	6.31 pH	6.40 pH	7.51 pH

User setting

Delete the matrix and then enter new values as shown in Table 6. Gray areas are mandatory. Other areas can be omitted.

Table 6 Example of user setting (Reference temperature (Tref.): 25.0°C)

	Temp. range	Solution 1 (Min.)	Solution 2	Solution 3	Solution 4	Solution 5 (Max.)
Tref.	(25.0°C)	6.40 pH	7.00 pH	7.30 pH	7.60 pH	9.00 pH
Tmin. (T1)	5.0°C	6.42 pH	7.38 pH	7.94 pH	8.31 pH	9.74 pH
T2	25.0°C	6.40 pH	7.00 pH	7.30 pH	7.60 pH	9.00 pH
T3	45.0°C	6.34 pH	6.70 pH	6.86 pH	7.06 pH	8.40 pH
T4	65.0°C	6.23 pH	6.45 pH	6.54 pH	6.67 pH	7.91 pH
Tmax. (T5)	85.0°C	6.11 pH	6.25 pH	6.31 pH	6.40 pH	7.51 pH

Note: The gray areas must be entered.

The reference temperature is set in the Temperature Compensation menu (default: 25.0°C).

Input temperatures for compensation in the Temp. ranges menu.

Input values from Solution 1 (low pH) to Solution 5 (high pH).

After entering all values, select “Check values?” to verify that there is no error. This function checks if the matrix is consistently incremental or decremental. If any error is found, its location is specified.

When there is no error, the matrix is compensated linearly and the blanks of the table (if any) are filled. If some areas are left empty without running “Check values?”, a 1st/2nd comp. matrix error will be issued.

Changing the settings

If any setting is accidentally changed, values to the right of the relevant arrow in Table 7 are all initialized.

Table 7 Parameters that initialize other values

Sensor type ->	Measurement ->	Output: Process parameter ->	Linear: 0% value, 100% value
			Table
			Communication: HART: PV
		Display setup: Individual display (Main display)	
		Trend Graph Screen ->	Y-axis (low, high)
		Communication: HART	
	Impedance settings		

Checking ORP sensor electrodes

The normal functionality of the ORP sensor electrode is determined by measuring the ORP value of the solution with a known ORP value, and by checking if the value is within the tolerable range.

To check the ORP sensor before regular operation, follow the procedure below.

The electrode is checked in measurement mode.

Solution for checking

Use solutions with a known ORP value, such as quinhydrone, ferrous, and other solutions.

Checking procedure

(1) Pour 50 to 100 ml of the solution into a clean 200-ml beaker.

(2) Remove the ORP sensor from the holder. Flush the measurement solution remaining on the sensor with water and wipe off the water. If the detecting part and liquid outlet of the sensor are stained, clean them with water.

(3) Immerse the tip of the ORP sensor into the solution. Read the ORP value after the reading becomes stable (usually 5 to 10 minutes).

Measure the solution temperature and check if the ORP value at the temperature is in the tolerable range.

Yokogawa's checking solution and tolerable range

Yokogawa offers the following reagents for checking. Use them as described below.

Quinhydrone (part number: K9024EC)

Ferrous (part number: K9024ED)

Quinhydrone solution

Put one bag of the reagent into a wide-mouthed jar (at least 250 ml) and pour deionized water into the jar to make a total solution volume of 250 ml. Cold deionized water may not dissolve the reagent completely and the reagent may partly float on the surface, but this does not cause any problem for measurement.

Ferrous solution

Put one bag of the reagent into a wide-mouthed jar (at least 250 mL) and pour 2 mol/l solution of sulfuric acid to make a total solution volume of 250 ml.

When using concentrated sulfuric acid, first pour approximately 150 ml of pure water into a wide-mouthed jar that contains the reagent. Add 14 ml of concentrated sulfuric acid while stirring the solution. Add more pure water to further dissolve the reagent and make a total solution volume of 250 ml.

CAUTION

Be careful to touch the concentrated sulfuric acid.

Figure 1 shows the ORP values of the checking solutions prepared with Yokogawa's reagents. If the measured ORP value is in the tolerable range, the electrode of the ORP sensor is working normally.

If the ORP value is out of the range, calibrate the sensor. If the ORP value is slightly out of range, verify whether the checking solution has been properly prepared.

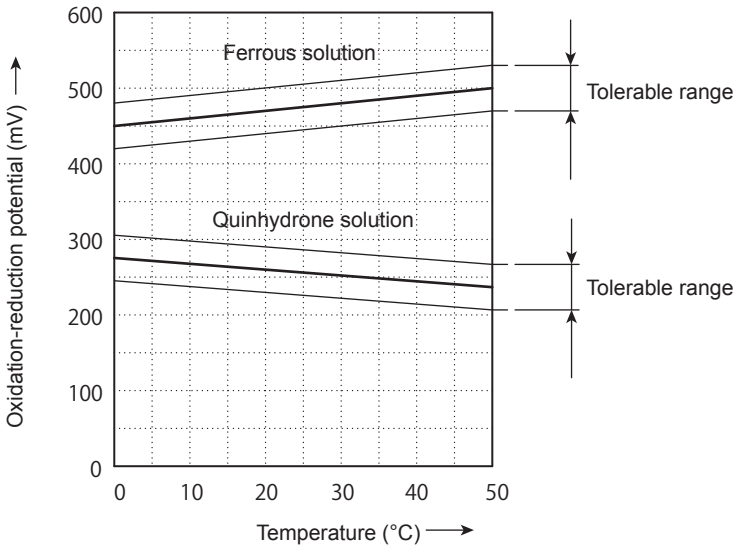

Figure 1 Oxidation-Reduction Potential given by Checking Solution (Reference electrode: 3.3 mol KCl - AgCl)

Revision Record

- Manual Title : FLXA202 / FLXA21 2-Wire Analyzer Operation of pH/ORP
- Manual No. : IM 12A01A03-31EN

Oct. 2021/2nd Edition
Added notes for calibration (page 3-1)
Jan. 2021/1st Edition
Newly published (Separate volume from IM 12A01A02-01E)

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