

**Model FLXA402
4-Wire Converter
Operation of pH/ORP**

IM 12A01F02-01EN

◆ Introduction

Thank you for purchasing the FLXA™ 402 4-Wire Converter.

This Instructor's Manual contains all essential information for the user to make full use of FLXA402.

Please read the following respective documents before installing and using the FLXA402.

The related documents are listed as follows.

General Specifications

Contents	Document number	Note
FLXA402 4-Wire Converter	GS 12A01F01-01EN	Online manual

"EN" in the document number is the language code.

User's Manual

Contents	Document number	Note
FLXA402 4-Wire Converter Start-up and Safety Precautions	IM 12A01F01-01EN	Attached to the product (printed manual)
FLXA402 4-Wire Converter Installation and Wiring	IM 12A01F01-02EN	Online manual
FLXA402 4-Wire Converter Operation of Converter	IM 12A01F01-03EN	Online manual
FLXA402 4-Wire Converter Operation of pH/ORP	IM 12A01F02-01EN	Online manual (This manual)
FLXA402 4-Wire Converter Operation of SC	IM 12A01F03-01EN	Online manual
FLXA402 4-Wire Converter Operation of ISC	IM 12A01F04-01EN	Online manual
FLXA402 4-Wire Converter Operation of DO	IM 12A01F05-01EN	Online manual

"EN" in the document number is the language code.

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
FLXA402 4-Wire Converter HART communication	TI 12A01F01-61EN	Online manual
FLXA402 4-Wire Converter Modbus communication	TI 12A01F01-62EN	Online manual

"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/flxa402/download/>



■ Notes on Handling User's Manuals

- Please provide the user's manuals to your end users so that they can keep the user's manuals 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.
- No part of the user's manuals may be transferred or reproduced without prior written consent from YOKOGAWA.
- YOKOGAWA reserves the right to make improvements in the user's manuals and product at any time, without notice or obligation.
- 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

FLXA402, a modular-designed converter, is a multi-parameter instrument offering a wide range of measurement choices; such as: pH/ORP (oxidation-reduction potential), Resistivity/Conductivity (SC), Inductive conductivity (ISC), Dissolved Oxygen (DO) – with the respective sensor module.

This user's manual contains general description and precautions of the instrument.

The table below shows user's manuals to read concerning the instrument's operation, configuration, or calibration, which vary depending on its installation, wiring, and specification of each instrument.

Contents	pH/ORP SENCOM™ SA	Contacting conductivity (SC) SENCOM SA	Inductive conductivity (ISC)	Dissolved oxygen (DO)
Introduction and general description	IM 12A01F01-02EN			
Wiring and installation	IM 12A01F01-02EN			
Converter operation (Setting, Calibration) Maintenance, Troubleshooting	IM 12A01F01-03EN (This manual)			
Sensor operation (Setting, Calibration)	IM 12A01F02-01EN	IM 12A01F03-01EN	IM 12A01F04-01EN	IM 12A01F05-01EN

■ Trademark Acknowledgments

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■ Terminology

sensor(s):	sensors, sensors with SA11, sensor module(s)
SENCOM SA	SA11, SENCOM Smart Adapter or “-S5” (SENCOM SA) of 1st or 2nd input
analog sensor (module)	selectable sensors when -P1/-C1/-C5/-D1 is specified for 1st or 2nd input, e.g. PH8E□P, PH4□, OR8E□G, SC4AJ, SC8SG, SC210G, ISC40GJ, ISC40SJ, DO30G.
multiple sensor connection	multiple sensor connection via BA11 junction box when “-S5” SENCOM SA is specified for 1st input
Optical DO Sensor, DO70G NE107:	”-D5” (Digital sensor”) for 1st input NAMUR NE107 see the section 4.7 in IM 12A01F01-03EN Operation of Converter
ID chip	Sensors with ID chip are selectable when “-S5” SENCOM SA is specified for 1st or 2nd input, such as PH8E□P... V, FU20-VS, SC4A...-VS, SC42-□V, SX42...-□V, SC4AJ...-VS, SC8SG...-VS
sensor connection number	e.g. 1-1. Note that this is NOT display name.

Model FLXA402

4-Wire Converter

Operation of pH/ORP

IM 12A01F02-01EN 4th Edition

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Revision Record.....i

1. Sensor Menu Outline

Main/Home screen >  "Sensor menu". > "Detail" / "Calibration" / "Setting"

The operation is secured by password. See the section 5.4 in [IM 12A01F01-03EN](#) Operation of Converter.

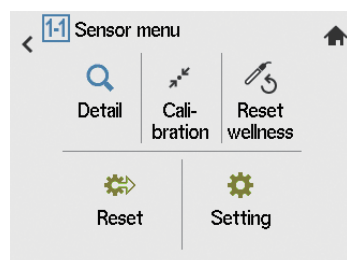


Figure 1.1 Sample image of "Sensor menu"

■ Sensor detail

On Sensor menu, tap  "Detail". Read 2.1.

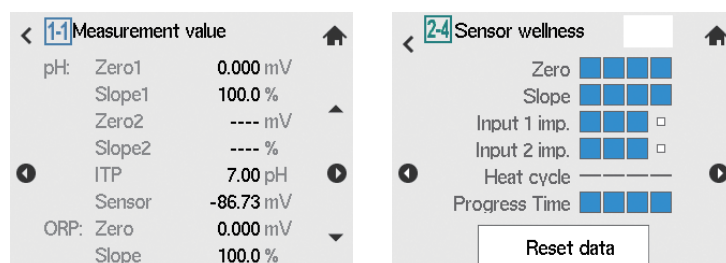


Figure 1.2 Sample image of "Detail"(Sensor menu>Detail)

■ Calibration

On Home/Main screen, tap . On Sensor menu, tap  for calibration of sensors.

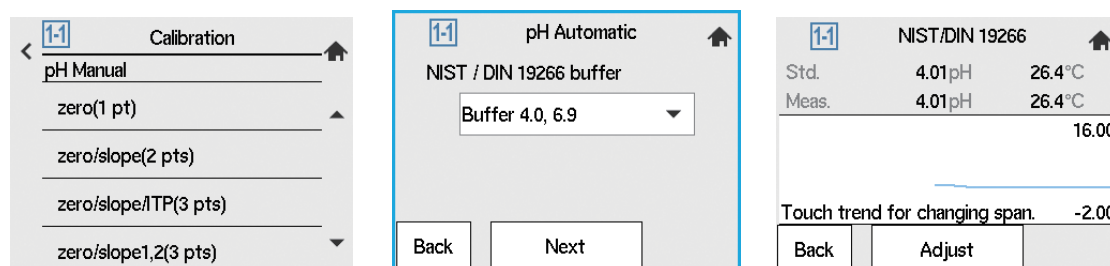


Figure 1.3 Sample images of pH Calibration

For further information read chapter 4.

■ Wellness reset

Go to Sensor menu> tap . Read 2.3.

■ Sensor reset

On Sensor menu, tap . Read 2.4.

■ **Configure sensor**

Converter menu or Sensor menu > ⚙️ “Setting”

Go to Converter menu to configure the setting of converter such as mA output, display setting.

Go to Sensor menu to configure the sensor setting such as calibration setting.

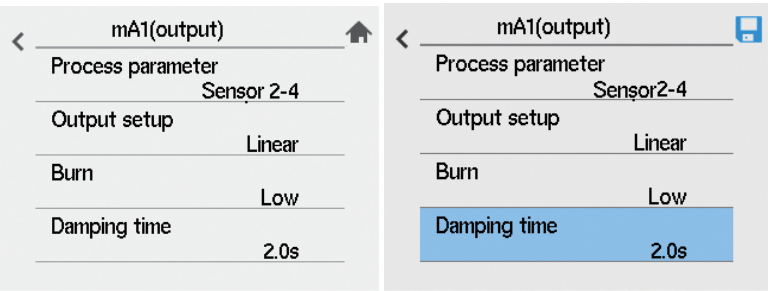


Figure 1.4 **Sensor configuration (parameter list)**

Select a parameter to change. The parameter becomes highlighted. To overwrite the data, tap .
Read Chapter3 about sensor configuration.

2 Sensor menu

Main screen  > Sensor menu

The following operation are available.

Detail (details on sensors)

Calibration (sensor calibration)

Setting (sensor setting)

etc.

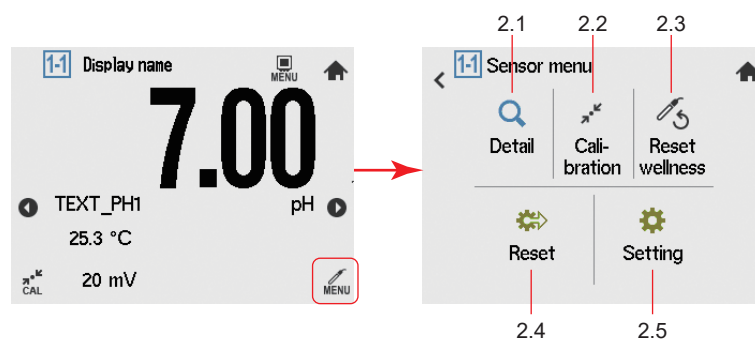
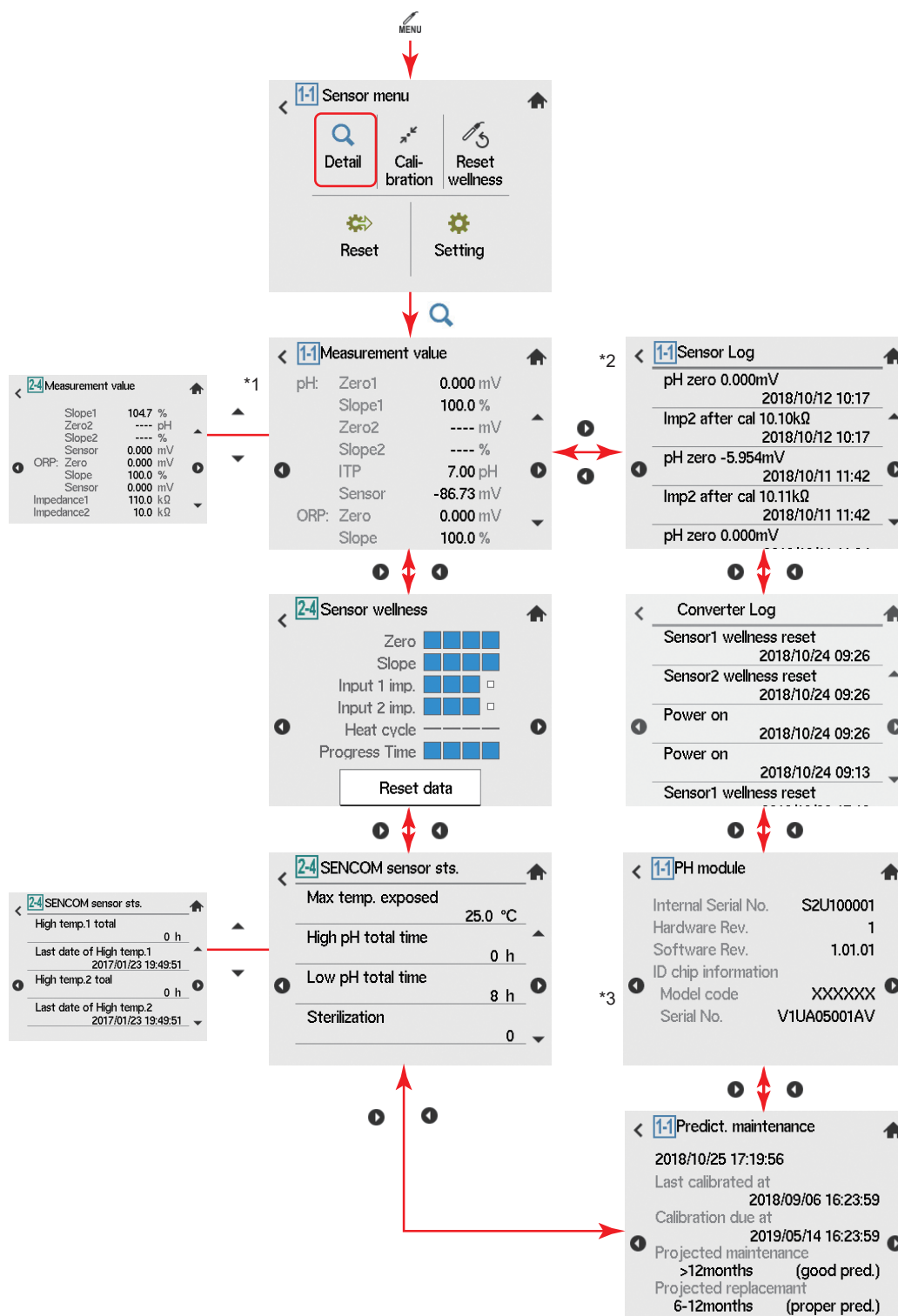


Figure 2.1 Sensor menu (sample)

2.1 Detail

Go to Sensor menu > “Detail” to check details (setup, sensor diagnosis, calibration, and module production number).

In case of trouble, when you contact Yokogawa service, please inform us of the module and FLXA402 software revision displayed on the Detail and module production number, revision number indicated on the nameplate attached to the instrument.



■ Measurement value

● pH/ORP_Zero(1/2)

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 25°C.

For setting directly go to Sensor menu> “Measure setting”> “Calibration setting”> “Zero/Slope/ITP”> “Zero”. Read 3.3.1 for the details.

When SENCOM SA is used:

Execute the proper procedure to reflect correct cal. info and ID CHIP info (Model code, Serial No.) of sensor when sensor or SA11+sensor (SA11 with sensor connected) is replaced. See “10.1 Installation of SA11” in SA11 Smart Adapter IM 12A06S01-00EN-P for more details.

● pH/ORP_Zero(1/2)

Calibrated efficiency of the sensor unit in percentage of theoretical slope of the sensor unit.

The theoretical slope follows the NERNST equation and is 59.16 mV/pH. 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 it indicates a bad sensor.

The SLOPE can also be displayed as mV/pH value at 25 °C

if the user has defined this variable as mV/pH in user setting.

For setting directly go to Sensor menu> “Measure setting”> “Calibration setting”> “Zero/Slope/ITP”> “Slope”. Read 3.3.1 for the details.

When SENCOM SA is used:

Execute the proper procedure to reflect correct cal. info and ID CHIP info (Model code, Serial No.) of sensor when sensor or SA11+sensor (SA11 with sensor connected) is replaced. See “10.1 Installation of SA11” in SA11 Smart Adapter IM 12A06S01-00EN-P for more details.

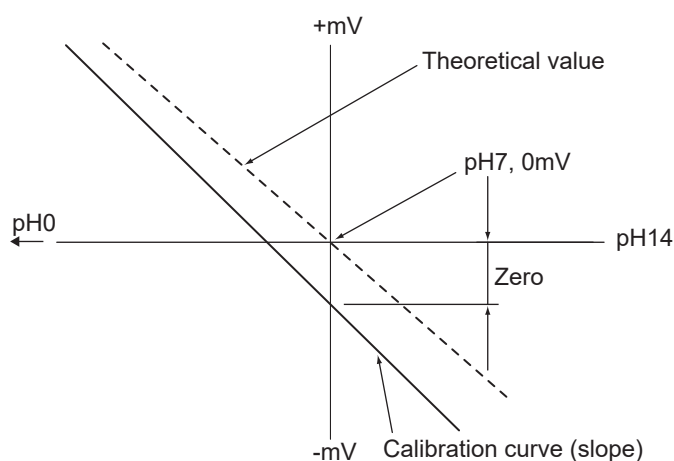


Figure 2.3 Zero/Slope

● ITP

ITP represents a pH value where the output of the sensor does not change with temperature. For further information, see 3.3.1 Cal. set pH

● pH/ORP_Sensor

Represents the electromotive force of the sensor.

● Impedance 1

For a PH sensor, "Impedance" shows electrical resistance of the glass membrane electrode. The FLXA402 checks the impedance to know damage of the electrode.

For an ORP sensor, "Impedance" shows electrical resistance of metal electrode. The FLXA402 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 impedance is set to "Low", the measured impedance value is displayed.

If Impedance measurement(A) is set to "Disabled", "----" is displayed. You can change the setting of Impedance measurement (A) only when PH sensor module is in use.

To change the setting, go to Sensor menu > Wellness settings > Impedance settings > Impedance measure (A) See 3.4.1 for the details.

● 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. Therefore, it must be kept clean and filled with conductive electrolyte. Otherwise the measurement will suffer from instability, drift and measuring errors.

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 Impedance is set to "Low", the measured impedance value is displayed.

If Impedance measurement(A) is set to "Disabled", "----" is displayed. You can change the setting of Impedance measurement (A) only when PH sensor module is in use. To change the setting, go to Sensor menu > Wellness settings > Impedance settings > Impedance measure (A). See 3.4.1 for the details.

■ Sensor wellness

Sensor wellness shows the soundness of a sensor. The larger number of ■ appears in each gauge, the more sound the parameter concerned is. 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."

When analog sensor module is in use, if Impedance measurement (A) is set to "Disabled", "----" is displayed, even if Impedance wellness is "Enabled".

For Sensor wellness, go to Sensor menu > Configure sensor > Wellness settings

See 3.4 for the details.

When a sensor or an electrode is exchanged or replaced, sensor wellness data should be reset. Use Reset wellness in Sensor menu.  See 2.3.

■ SENCOM Sensor status

The status of the sensor is displayed.

● Max temp. exposed

Displays the maximum temperature, which is automatically updated every time a higher temperature is measured.

● High pH total time/Low pH total time

Displays the total time during which the pH value remains above the upper pH limit or below the lower pH limit.

Up to 10 years (87600 hours) can be counted, after which the time is no longer updated.

To set the parameters of High/Low pH value, go to Sensor menu > Configure sensor > Wellness settings > Define Sencom status

● Sterilization

Displays the number of times the temperature remains above the preset value for at least the prescribed time period (min.).

Go to Sensor menu > Configure sensor > Wellness settings > Define SENCOM status

An example of sterilization

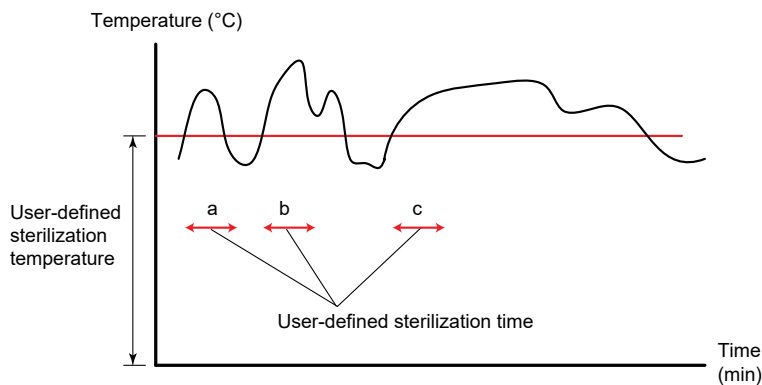


Figure 2.4 Sterilization

- a: does not count, because the length of time that the temperature exceeds the sterilization temperature is shorter than the length of sterilization time.
- b: counts, because the length of time that the temperature exceeds the sterilization temperature is longer than the length of sterilization time.
- c: counts, because the length of time that the temperature exceeds the sterilization temperature is longer than the length of sterilization time.

If the temperature exceeds the sterilization temperature longer than the length of sterilization time consecutively, the event counts as one.

The last time when the event counts is displayed as a last sterilization date/time.

Counter indicates a maximum of 9999. After the counter reaches the maximum, if the requirements to count is satisfied, the data of last sterilization date and time is updated.

● High temp 1 total, Last date of High temp1, High temp 2 total

To define the temperature of “High temp 1” and “High temp 2”, go to Sensor menu > Configure sensor > Wellness settings > Define Sencom status

The total length of time that the measured temperature exceeds the defined High temp 1 or High temp 2.

Displays the total time during which the temperature remains over the high temperature 1 or 2.

The last date and time (the end of high-temperature condition) is displayed as the “last date.” “Up to 10 years (87600 hours) can be counted. Even after that, the “last date” is updated if the event meets the conditions.

■ Predict. maintenance

● Last calibrated at

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 at

Date when the calibration must be done next according to the settings of the calibration interval. To set the calibration intervals, go to Sensor menu > Calibration settings > Limits and timing > Calib. interval

● 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 the figure below, 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.

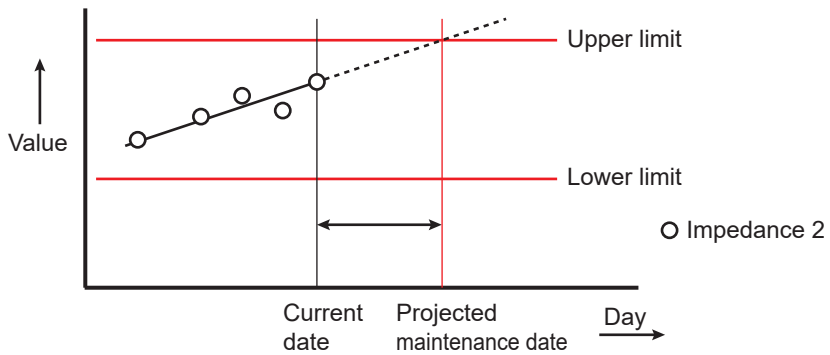


Figure 2.5 Projected maintenance

The status shows the certainty of the projected maintenance date in terms of the correlation coefficient R. Table 2.1, Table 2.2 shows pattern of the projected maintenance date, status.

Table 2.1 Display pattern of the projected maintenance date

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

- - : not predictable due to insufficient data

Table Display pattern of the status

Status	(- - - -)	(Poor)	Reasonable)	(Excellent)
Criteria	($R < 0.50$)	($0.50 \leq R < 0.70$)	($0.70 \leq R < 0.85$)	($0.85 \leq R < 1.00$)

● 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 Impedance 2 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 Impedance 2 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

This screen enables operators to check the module Serial No., Hardware Rev, Software Rev.

When SENCOM SA is used, you can check the serial number, Hardware Rev., Software Rev. ID chip information (Sensor Model code , Serial No.) of the ID chip installed in the sensor.

When SENCOM SA is used:

Execute the proper procedure to reflect correct cal. info and ID CHIP info (Model code, Serial No.) of sensor when sensor or SA11+sensor (SA11 with sensor connected) is replaced. See "10.1 Installation of SA11" in SA11 Smart Adapter IM 12A06S01-00EN-P for more details.

■ Converter log, Sensor log

Same display as on the converter "Detail".

See 3.1 in [IM 12A01F01-03EN](#) Operation of Converter.

2.2 Calibration

Sensor menu > Calibration . See Chapter 4.



Figure 2.6 Calibration selection

If you have a password, a prompt dialog box appears to input your password. After the password is verified, the page shifts to Calibration.

For password, see 5.4 in [IM 12A01F01-03EN](#) Operation of Converter.

2.3 Reset wellness

Sensor menu > Reset wellness 

A dialog box appears to ask if you want to reset sensor wellness data.

Yes: the wellness is reset

No: the reset will not take place. The page returns to Sensor menu.



Figure 2.7 Reset wellness and dialog

If you created a password, a prompt dialog box appears to input your password. After the password is verified, a dialog appears to confirm if you want to reset.

For password, see 5.4 in [IM 12A01F01-03EN](#) Operation of Converter.

2.4 Reset

Sensor menu > Reset 

The screen jumps to Load PH config. File screen, where you can reset parameters of analog sensor module, SENCOM SA.

While Wash is in progress, “Reset” is invalid. Even if you tap the icon, you will not jump to the sensor reset screen.



Figure 2.8 Reset in sensor menu

In the box of File name, name of defined sensor config. file to load is displayed, after sensors connected are automatically detected. You cannot change the file name.

If you tap “Execute”, the loading starts. When the loading ends, you will return to Sensor menu.

If you create a password, a prompt dialog box appears to enter the password. After the password is verified, Sensor reset screen appears.

For password, see 5.4 in [IM 12A01F01-03EN](#) Operation of Converter.

If you go to Sensor reset screen, mA output becomes HOLD, and contact output keeps the current status.

2.5 Sensor settings

Sensor menu > Setting  > Sensor setting

When Wash is in progress, the character row is displayed in color. You cannot move to Sensor settings.

For further information on sensor settings, read chapter 3.



Figure 2.9 Sensor setting

If you create a password, a prompt dialog box appears to enter the password. After the password is verified, Sensor setting is displayed.

For password, see 5.4 in [IM 12A01F01-03EN](#) Operation of Converter.

If you go to Sensor setting, the mA output becomes HOLD, and contact output keeps the current status.

3. Sensor setting

When you configure each setting, fill in User setting table we provide, and keep it in safe place.

Download the user setting table from our website below.

<http://www.yokogawa.com/an/flxa402/download/>



Configure sensor setting

Go to Main screen > Sensor menu > Sensor setting

You can confirm or edit the setting. When you go to Sensor setting, mA output becomes HOLD, and contact output keeps the current status.



Figure 3.1 Sensor menu to Sensor setting

To know how to confirm or edit the settings with parameters, refer [IM 12A01F01-03EN](#) Operation of Converter.

In the parameter list of Sensor setting, parameters with (A) or (S) represent (A) for Analog sensor module, (S) for exclusively SENCOM SA.

You cannot configure parameters which do not apply to the sensors to be used.

NOTE

As for some parameters, you don't need to configure parameter, because when SENCOM SA is connected, the data stored in ID chip is read automatically. Even when you edit some parameter setting, if you insert/remove sensors or power on/off SENCOM SA, the original data stored in ID chip installed in the sensor is read automatically and the originally stored parameter will not be overwritten.

We recommend that you should not change setting when SENCOM SA is connected.

When you configure sensor setting and save the data, a dialog box appears to notify the operation is in progress. If you succeed the configuration, you will return to parameter list, and if fail, a fail dialog appears.

NOTE

When setting parameters, FLXA402 features parameter reviewing function, which secures the parameter accuracy by network communication.

You might find the end of a value you set edited. This does not affect any measurement or arithmetic.

3.1 Configure sensor

Configure the setting of SENCOM SA and sensors, which connects to FLXA402.

3.1.1 Sensor type (A)

Select sensor type from the following 3 types.

When SENCOM SA is in use, the sensor type is automatically detected, thus you don't need to set it.

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 ORP 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 the best results, connect a liquid earth to terminal 14. For details of the wiring connections, see 2.6.1. [IM 12A01F01-02EN](#) Installation and Wiring

If there is no liquid earth, the sensor diagnostic function is disabled. Go to

Sensor menu > Configure sensor > Wellness setting > Impedance settings > Impedance measure (A), and set "Impedance measure (A)" to "Disabled".

If SENCOM SA is in use, make all related alarms not occur.

Converter menu > Settings > Converter settings > Error settings > set "Impedance1 too high/low", "Impedance 2 too high/low" to "Off".

NOTE

When ORP is specified as "Sensor type" and no ORP sensor has any temperature element, set both of "Temperature too high/low" in "Error configuration" to Off so that no related error is caused.

See 4.7 in [IM 12A01F01-03EN](#) Operation of Converter.

Without temperature input, the measurement is not displayed, because it is regarded as a sensor fault. Go to

Sensor menu > Configure sensor > Measure setting > Temp. compensation > Compensation Set Compensation to Manual and set Manual temperature to the process temperature.

3.1.2 Temperature settings

■ Temp. element (A)

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

If SENCOM SA is in use, you don't need to configure the setting of the temperature element, because it is detected automatically.

3.1.3 Others

■ MODBUS address (S)

You can change MODBUS address only when SENCOM SA is in use.

After changing MODBUS address, you need to change the configuration of the converter that connects to the system. To change the converter setting, go to

Converter menu > Converter setting > Advanced settings > MODBUS settings > MODBUS address (S). See 4.6.1 in [IM 12A01F01-03EN](#) Operation of Converter.

We recommend keeping the initial setting (1), not changing the setting unless you conduct multiple-sensor measurement.

NOTE

After you insert/remove SENCOM SA, the change of Modbus address(S) is available

3.2 Measure setting

Set parameters for measurement.

3.2.1 Temperature settings

■ Unit

Displays the unit for temperature, but you cannot change the setting here.

To change the setting, go to

Converter menu > Setting > Advanced setting > Other

3.2.2 Temp compensation

■ Compensation

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

Methods: Automatic, Manual, External input

Automatic: when a temperature element is used,

Manual: when a manually set temperature is used.

External input: when mA input to the converter is used. Go to
Converter menu > Converter setting > mA input setting (Ad) >
Temperature

The setting must be matched to the specification of the device to use as
an external input.

NOTE

When Manual is selected on the Temperature compensation, a process temperature should be set in the "Manual temp." Home/Main screen displays the temperature you set here.

■ Manual temp.

When you select Manual, you must enter process temperature.

■ Reference temp.

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

NOTE

Reference temperature here is used by the method "TC" or "NEN6411" as a way of temperature compensation.

If the method of temperature compensation is Matrix, Raw value is converted to the one at the standard temperature by using the "Tref" value which is programmed in Matrix.

3.2.3 pH

■ Method (pH)

Select a temperature compensation method for pH measurement. "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".

■ Temp. coeff

● Temp. coef (TC pH)

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 ($\Delta\text{pH}/\Delta T$). Adjust the value between -0.1 to 0.1 pH/°C. In combination with the reference temperature setting, a linear compensation function is obtained, which is suitable for all kinds of chemical solutions.

■ Matrix

● Temp. range, Solution 1 to Solution 5

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, go to

Measure setting > Temp. ranges > Reference temp. pH > Method (pH)

Select "None".

■ 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.

3.2.4 ORP

■ Method (ORP)

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.

Select from among "ORP1 (no compensation)", "ORP1(TC)", "ORP2 (no comp.)", "ORP2 (TC)", when you select "ORP" at "Sensor type". ORP1 and ORP2 result same value.

When you select "pH + ORP" at "Sensor type", the following definition is given.

ORP1: Metal electrode (terminal 14) and reference electrode (terminal 13)

ORP2: Metal electrode (terminal 14) and glass electrode (terminal 15)

Select an electrode that suits the application.

■ Temp.coeff

● Temp. coeff (TC ORP1/2)

See Method (ORP) above.

3.2.5 High/Low alarm setting

Alarms from sensors are sorted out to "Device fail", "Device status", "Measure alarm", "Sensor status". Setup High/Low alarm setting of main measurement value on Measure alarm.

For details on alarms, see 4.7 in [IM 12A01F01-03EN](#) Operation of converter.

Parameter	Alarm description	Setting range	Default
Temp. warning high limit	Temperature too high	-30.0~140.0[°C]	140.0[°C]
Temp. warning low limit	Temperature too low	-30.0~140.0[°C]	-30.0[°C]
pH warning high limit	pH too high	-2.0~16.0[pH]	16.00[pH]
pH warning low limit	pH too low	-2.0~16.0[pH]	-2.00[pH]
ORP warning high limit	ORP too high	-1500~1500[mV]	1500[mV]
ORP warning low limit	ORP too low	-1500~1500[mV]	-1500[mV]
rH warning high limit	rH too high	0.0~100.0[rH]	100.0[rH]
rH warning low limit	rH too low	0.0~100.0[rH]	0.0[rH]

3.3 Calibration settings

3.3.1 Cal. set pH

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 3.2 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 25°C.

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 25°C.

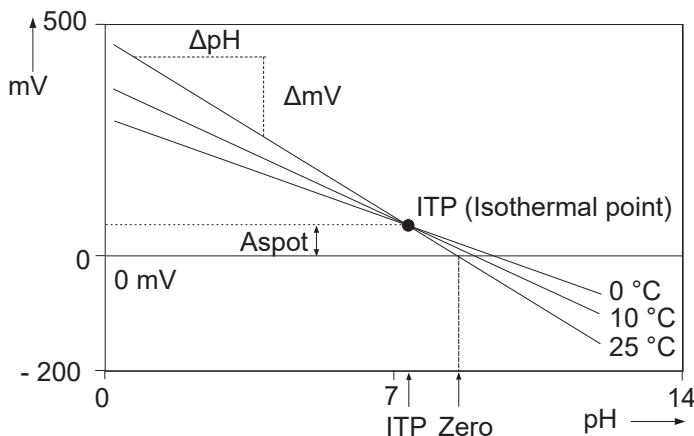


Figure 3.2 Calibration parameter

■ Unit

● Zero unit/Slope unit

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 limit

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 limit

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.

■ Buffers (select set)

● Buffers (select set), Free programmable, Buffer table

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.

There are three types of user programmable buffers. 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.

■ 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 always necessary to enter this data. In most cases, the FLXA402 automatically does this while performing calibration. Direct input is used when special electrode systems are used or the calibration in the process environment is not possible.

3.3.2 Cal. set ORP/rH

■ Limits and timing

● Zero high/low limit

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.

● Zero 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.

■ Zero/Slope (ORP1/2)

● Zero Slope

You can enter directly Zero, Slope for ORP1, ORP2 respectively.

3.3.3 Cal. Set others

- **Step range (pH)/(ORP)/(rH)**

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 measured 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 measured 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.

3.3.4 Cal. set temperature

- **Temp.offset**

You can enter directly Temp. offset value here.

Input the temperature-corrected offset value based on the next equation.

$$Y = A - (B - C)$$

where Y = Temp.offset

A = actual value

B = displayed temperature value

C = current temperature offset

Note

- Check A(actual value) on other devices.
- B is a value displayed on FLXA402 process.
- C (current temperature offset) is confirmed on Temp. offset screen.

When SA11 Smart Adapter is used with FLXA402, the following equation applies.

$$Y = (B + C) - A$$

where Y, B, C, A represent all the same as above mentioned.

NOTE

Use this function when a calibration is disabled.

You don't need to input directly Temp. offset when temp. offset is revised by calibration.

3.4 Wellness settings

This screen is used to set items relating to sensor diagnostics displayed on the Sensor wellness. Gauges are displayed for only parameters that have been enabled in Wellness settings.

*Parameters set to Disable are provided with a bar display.

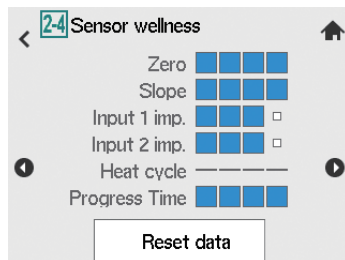


Figure 3.3 Sensor wellness

The setting parameters include “Impedance settings” “Impedance 1”, “Impedance 2”, “Progress Time”, “Heat cycle”.

When input impedance is set “High” (section 4.4.2), “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 as follows:

Progress time: “Progress time”, and “BAD Limit”.

Heat cycle: “Heat cycle temperature”, “Heat cycle time”, “BAD Limit”.

3.4.1 Impedance settings

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

When SENCOM SA is in use, you don't need to configure the setting, because data of ID chip built in a sensor is detected and Impedance setting is determined automatically.

- **Impedance measure (A)**

Set Impedance measure to “Enabled” or “Disabled”.

When SENCOM SA is in use, Impedance measurement runs whatever the setting is.

■ Impedance 1/2

● Impedance 1/2, High limit, Low limit, FINE”

“Impedance1” represents the “glass membrane impedance” of a pH sensor. For ORP sensor, it represents “metal electrode impedance.”

“Impedance2” represents “reference impedance.”

If you select “Input impedance: Low”, you will move to the Input impedance screen, where you can set the high and low limits.

The FLXA402 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 (Impedance1: high) and reference (Impedance2: 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.

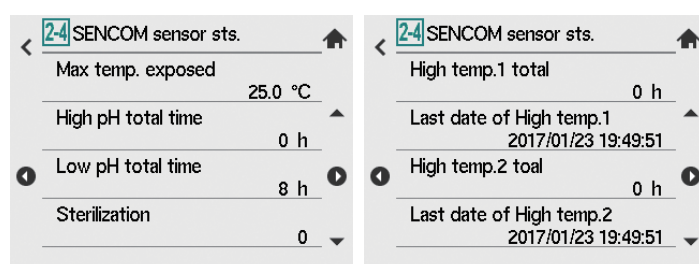
A sensor without a liquid earth cannot measure impedance. All settings on the Error configuration screen should be set to Off so that no “Impedance 1 too high” or “Impedance 2 too high” error is generated.

When analog sensor module is in use, set “Impedance (A)” “Disabled. When SENCOM SA is in use, set all to “Off” to avoid the error showing Impedance 1/2 too high/low.

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.

3.4.2 Define SENCOM status



The parameters are Sterilized temp., Sterilized time, High temp.1, High temp.2, Low pH value, and High pH value. For details see 2.1 Detail

4. Calibration pH/ORP

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

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



Figure 4.1 Sensor menu to Calibration

Choose the item to be calibrated, configure the calibration settings, then perform calibration.

- *: If Favorite calibration is set, you will directly go to the defined calibration.
 To set Favorite calibration go to
 Converter menu > Display setting > Display > Favorite Calibration

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

The item to be calibrated is determined according to the settings made in the Configure sensor > Sensor type (A).

Calibration of "pH", "ORP", "rH" can be monitored on the calibration trend, while their measurement is being transitioned.



Figure 4.2 Sample of Calibration trend

If FLXA402 detects any sensor fault such as damage on temperature element, no calibration is implemented.

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 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 CO₂ 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.

4.1 pH Calibration

There are “pH Manual”, “pH Auto”, “Sample Cal.”.

To “pH Manual”, and “pH Auto”, you can program “Favorite Calibration”.

“Favorite Calibration” leads you directly to your programmed calibration, by tapping  on Home/Main screen.

To program “Favorite Calibration”, go to

Converter menu > Setting > Display setting

(Section 4.5.1 in [IM 12A01F01-03EN](#) Operation of Converter)

4.1.1 pH Manual

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 measures pH value, temperature influence, and stability.

Select the calibration type from among [zero (1pt)], [zero/slope], [zero/slope/ITP(3pt)], and [zero/slope1, 2 (3pt)].

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.

● Zero (1 pt)

This calibration type is one-point calibration.

One-point calibration performs the zero adjustment only.

● Zero/slope (2 pts)

This calibration type is two-point calibration.

Two-point calibration performs the zero and slope adjustments.

● Zero/slope/ITP(3 pts)

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

If ITP is not 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 1st and 3rd buffer solutions should be 20°C or higher
- The temperature difference between the 2nd and 3rd buffer solutions should be 20°C or higher
- 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.

$$\text{pH}_{3\text{cal}} = \text{ITP} - \frac{\left(\frac{t_3 - t_1}{t_2 - t_1} (273.15 + t_2)(\text{ITP} - \text{pH}_2) + \left(1 - \frac{t_3 - t_1}{t_2 - t_1} \right) \times (273.15 + t_1)(\text{ITP} - \text{pH}_1) \right)}{(273.15 + t_3)}$$

pH_n: pH value of n-th buffer solution

T_n: Temperature of n-th buffer solution (°C)

ITP: ITP value displayed in calibration settings (see section 4.2.4)

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} ± 1.

● Zero/slope1, 2(3 pts)

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 20°C or less.
- The temperature difference between the 2nd and 3rd buffer solutions should be 20°C or less.

4.1.2 Automatic Calibration

Calibration can easily be performed by following the calibration menus.

Sensor menu > Configure sensor > Cal. set pH > Buffers (select set) > Select Buffer

At “Select Buffer”, select a buffer to use from among “NIST/DIN 19266”, “DIN 19267”, “US”, “Free programmable”.

If you select “Free programmable”, a user defined buffer, the 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 (1 pt)], [zero/slope (2 pts)], [zero/slope/ITP(3 pts)], and [zero/slope1, 2(3 pts)].

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.

- **Zero (1 pt)**

Select the solution that works with the “buffer solution” selected in “Select Buffer”.

Perform calibration by following the prompts on the screen.

- **Zero/slope (2 pts)**

Calibration is performed in the sequence of the sequence selection menu (Table 5.1) of the solution that works with the “buffer solution” selected in “Select Buffer”

Perform calibration by following the prompts on the screen.

Table 4.1 Selection of Buffer Solution in 2-point calibration

Buffer settings	Buffer sequence selection menus
NIST/DIN19266	pH1.7→pH4.0
	pH1.7→pH6.9
	pH4.0→pH6.9
	pH1.7→pH9.2
	pH4.0→pH9.2
	pH6.9→pH9.2
	pH4.0→pH1.7
	pH6.9→pH1.7
	pH6.9→pH4.0
	pH9.2→pH1.7
	pH9.2→pH4.0
	pH9.2→pH6.9
DIN19267	pH4.7→pH6.8
	pH4.7→pH9.2
	pH6.8→pH9.2
	pH6.8→pH4.7
	pH9.2→pH4.7
	pH9.2→pH6.8
US	pH4.0→pH7.0
	pH4.0→pH10.0
	pH7.0→pH10.0
	pH7.0→pH4.0
	pH10.0→pH7.0
	pH10.0→pH4.0
Free Programmable	Table 1→Table 2
	Table 1→Table 3
	Table 2→Table 3
	Table 2→Table 1
	Table 3→Table 1
	Table 3→Table 2

● Zero/slope/ITP (3 pts)

Calibration is performed in the sequence of the sequence selection menu (Table 5.1) 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 25°C).
- The temperature of the 1st and 3rd buffer solutions is at least 20°C or higher
- The temperature of the 2nd and 3rd buffer solutions is at least 20°C or higher.

● Zero/slope1, 2 (3 pts)

Calibration is performed in the sequence of the sequence selection menu (Table 5.1) 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 themselves 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 20°C or less.
- The temperature difference between the 2nd and 3rd buffer solutions should be 20°C or less.

Table.4.2 Selection of Buffer Solution in 3-point calibration

Buffer settings	Buffer sequence selection menus
NIST/DIN19266	pH1.7→pH6.9→pH9.2
	pH4.0→pH6.9→pH9.2
	pH9.2→pH6.9→pH1.7
	pH9.2→pH6.9→pH4.0
DIN19267	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
Free Programmable	table1→table2→table3
	table3→table2→table1

4.1.3 Sample Cal.

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. After the sample value is obtained, when you change the zero (asymmetric), do not update the data or calibration with the last-obtained sample value. If you perform sample calibration, re-take the sample value.

4.2 Cal. set ORP/rH

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.

4.3 Temperature Cal.

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.

Appendix 1 For pH/ORP

■ Buffer tables

The following tables show the details of the buffer solutions selectable in Calibration settings of pH (Section 4.2.4) (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 which are selectable in Temperature compensation (Section 4.2.3).

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

● How to input user-defined value

As shown in Table 6, input values in Martix

Table 6 Matrix sample of user-defined value (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.

Reference temperature is to be set in this matrix when user-defined matrix is used. The default is 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, verify that there is no error. Check if the matrix is consistently incremental or decremental and has left no blank.

When the matrix is not filled appropriately and an error is found when you store the data, the parameter list will not be affected.

■ 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.

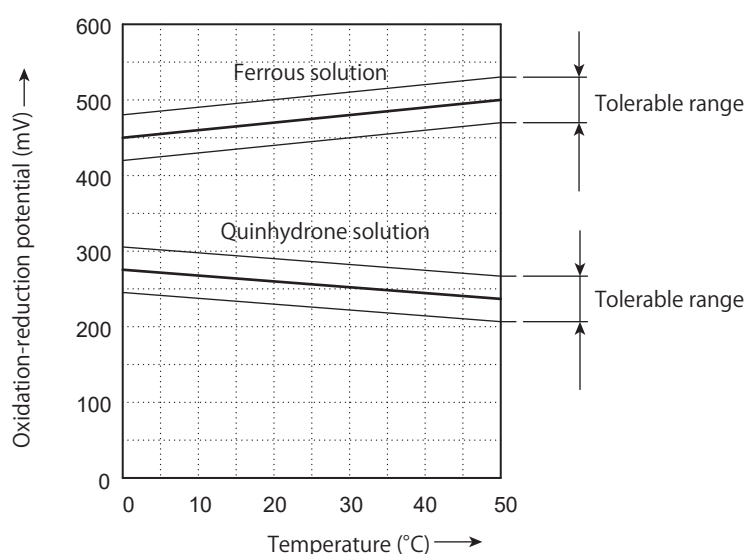


Figure 1 Oxidation-Reduction Potential given by Checking Solution
(Reference electrode: 3.3 mol KCl - AgCl)

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