User's Manual

FLXA202 / FLXA21 2-Wire Analyzer Operation of DO

IM 12A01A03-34EN

YOKOGAWA
Yokogawa Electric Corporation

IM 12A01A03-34EN
1st 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
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 (This 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

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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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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 dissolved oxygen (DO) 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 (This manual)	IM 12A01A03-01EN
FLXA202 FLXA21	-D1	Operation of DO	IM 12A01A03-34EN

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FLXA202 / FLXA21
2-Wire Analyzer
Operation of DO

IM 12A01A03-34EN 1st Edition

CONTENTS

1. OPERATION OF DO (Dissolved Oxygen)

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

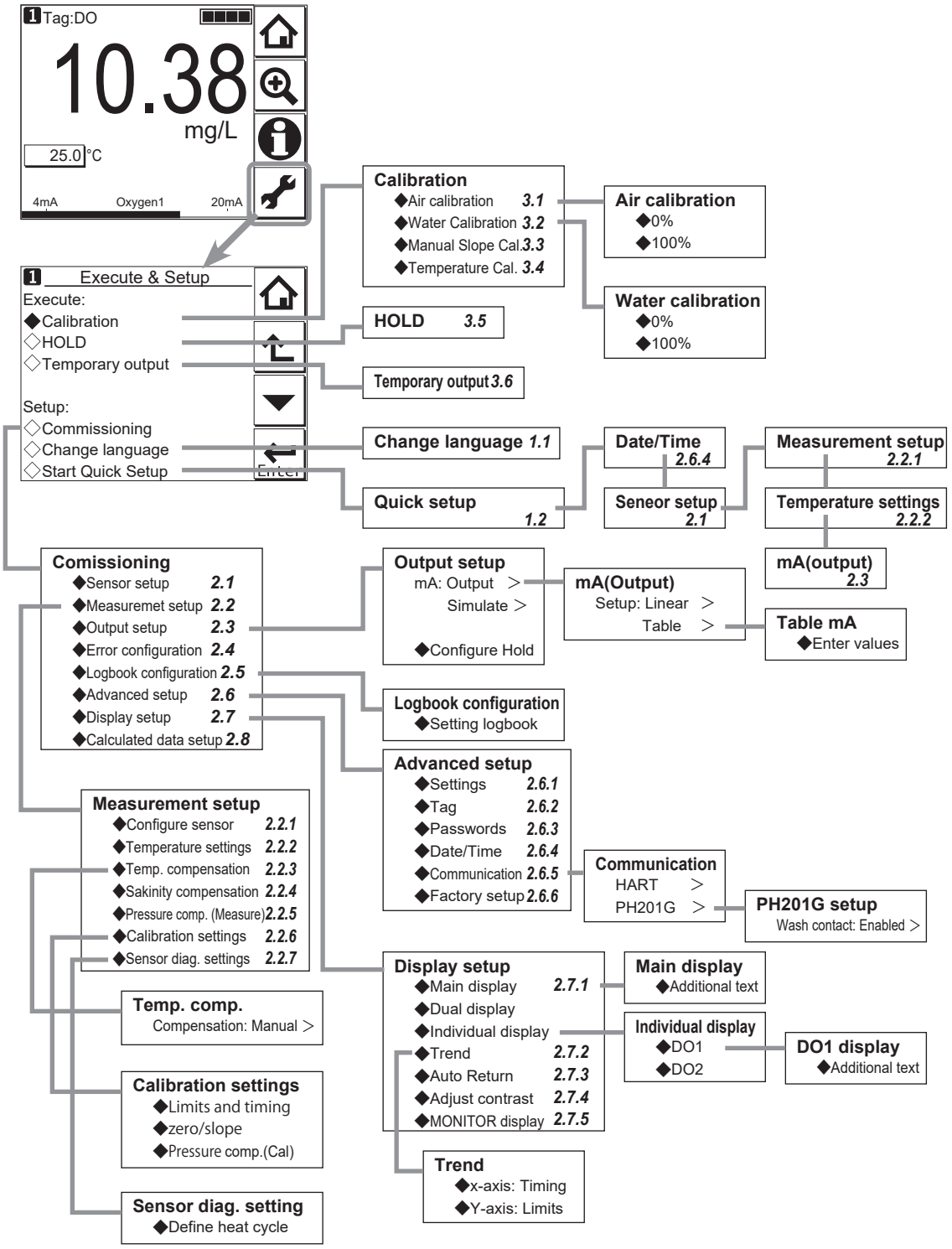


Figure 1.1 Menu structure of DO (the number after the item refers to the relevant section)

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

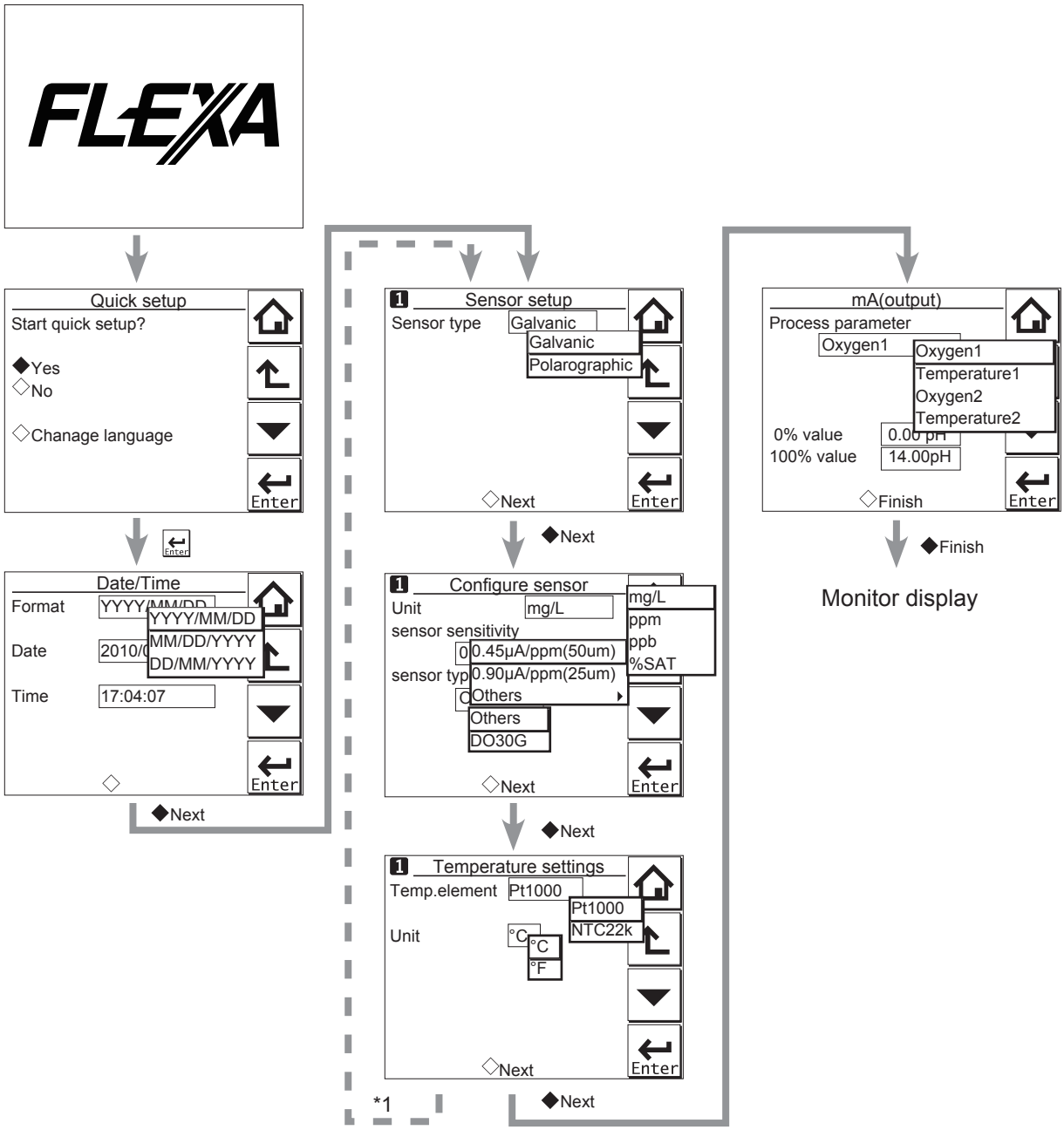
The Quick setup screen is used to set up the basic items you want to set up first, such as the date/time and sensor settings. The detailed settings are described in 2. COMMISSIONING OF DO (Dissolved Oxygen).

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: 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, see 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

Configure sensor

On this screen, select the units and set the sensor sensitivity. If Polarograph is selected for the sensor type, the polarograph application voltage can also be set. For details, see 2.2.1 Sensor setup

For DO30G, set the sensor type to “DO30G”. The Available KOH parameter on the detail display will be enabled.

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 an appropriate process parameter from among those displayed and set it. If it is necessary to improve the resolution, set it to a value suitable for the relevant 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.

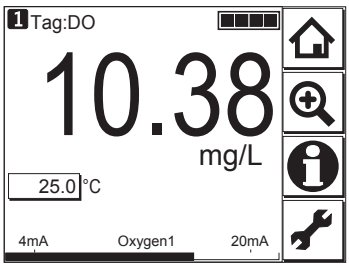


Figure 1.3 Example of main display

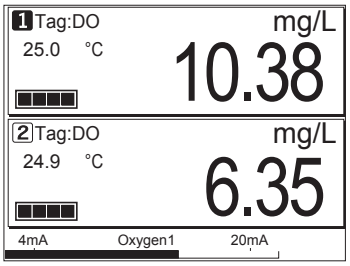


Figure 1.4 Example of home display

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)). In the default condition, the 1st display item is oxygen, 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.

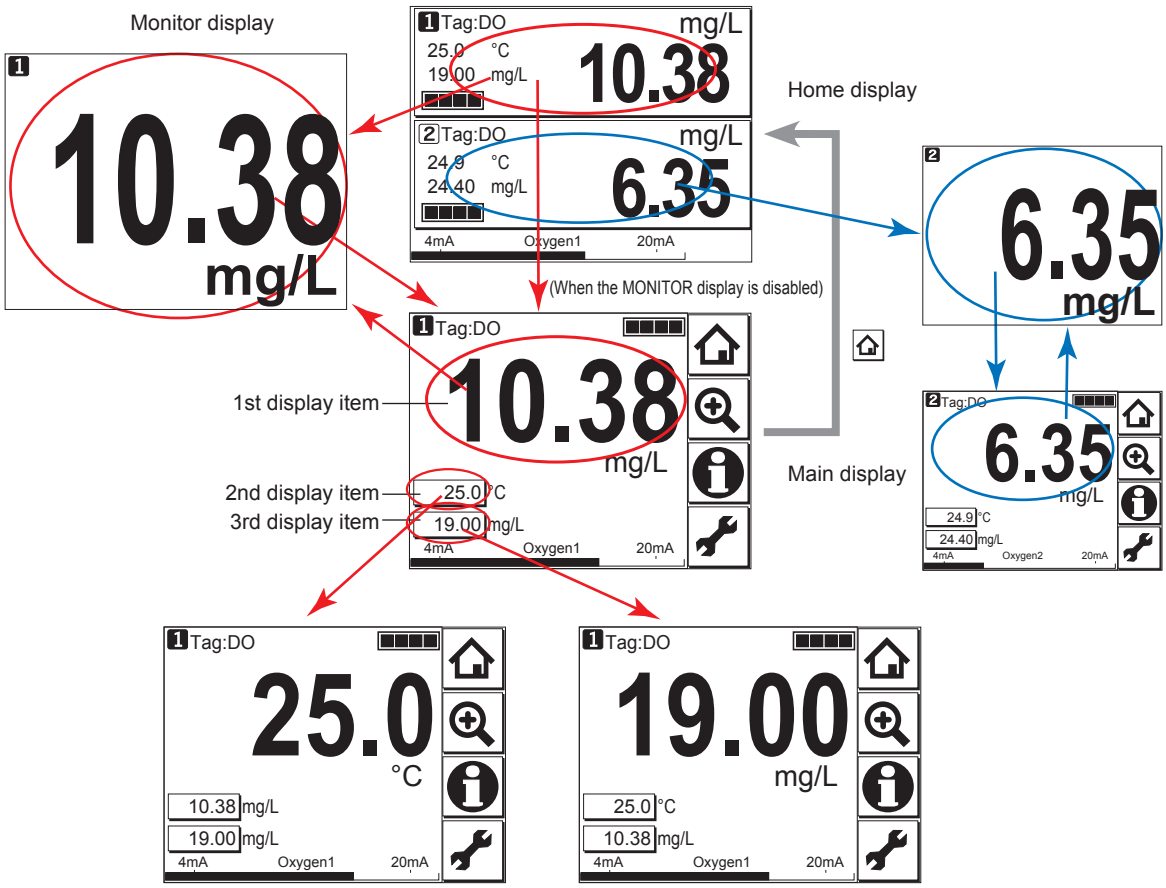
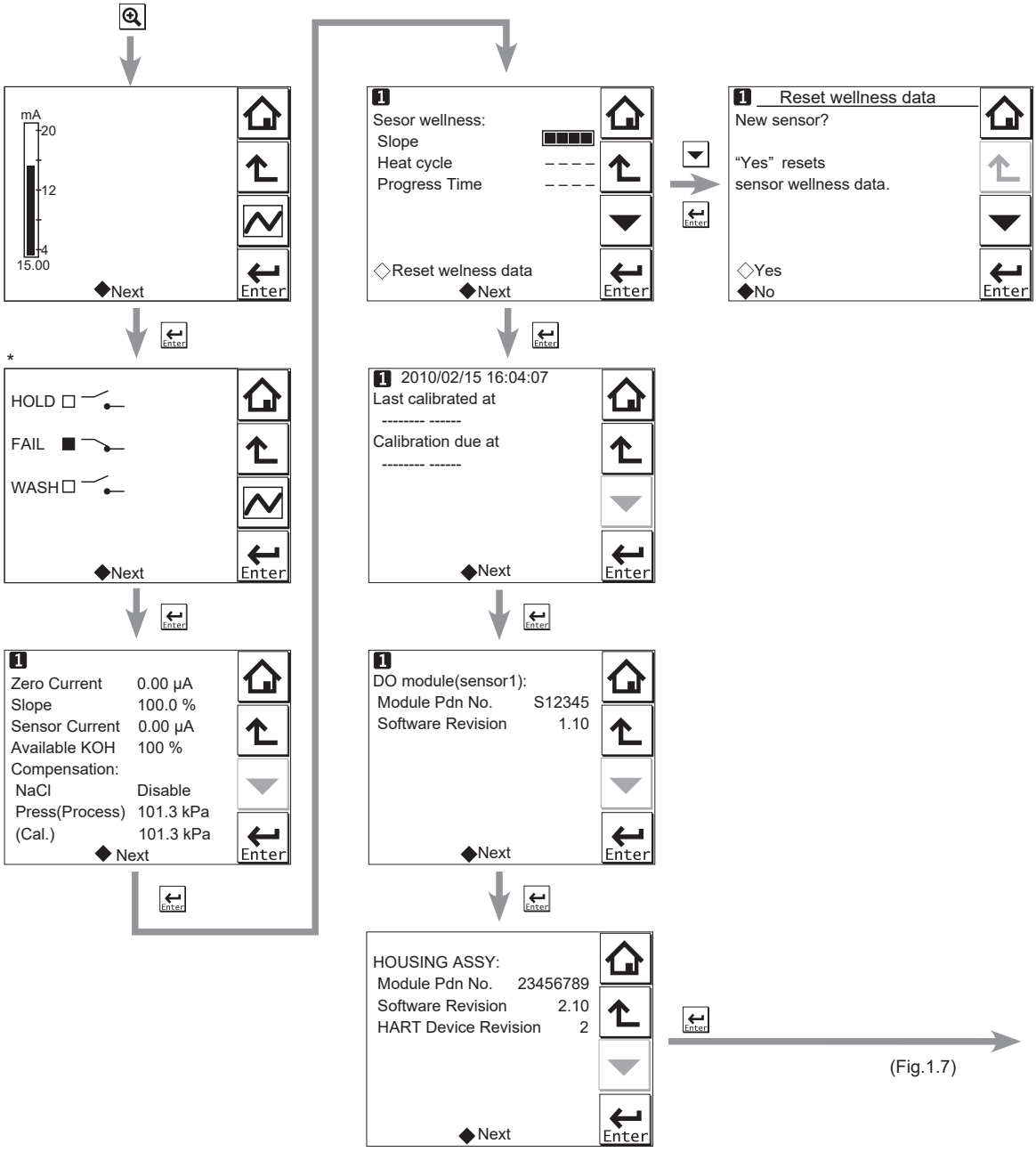


Figure 1.5 Change display

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 2.3 Output setup.

Contact status

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

Zero Current

= The offset value of a calibrated sensor. This is the offset of the sensor and sensor circuit in the zero oxygen condition.

Slope

This parameter indicates the sensitivity of the sensor after calibration. It is indicated as a percentage of the reference sensitivity based on the selection of the sensor or that has been entered.

Sensor Current

= The raw output of the sensor before it is calibrated and temperature compensated.

Available KOH

When the sensor type under Configure sensor is set to “DO30G”, a number is displayed. When set to “Others”, a bar (----) is displayed.

This parameter indicates the amount of available KOH remaining in the sensor. This amount is calculated and displayed by totalizing the amount of KOH consumed by dissolved oxygen measurements.

When replacing the solution in the sensor, calibration should be made to reset (clear) diagnostic sensor data.

Compensation

For compensation of measured value, salinity compensation and pressure compensation are available. To use pressure compensation, enter the pressure level directly.

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 diag. settings.

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

When a sensor or a membrane 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 the Figure 1.7.)

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.

DO 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.

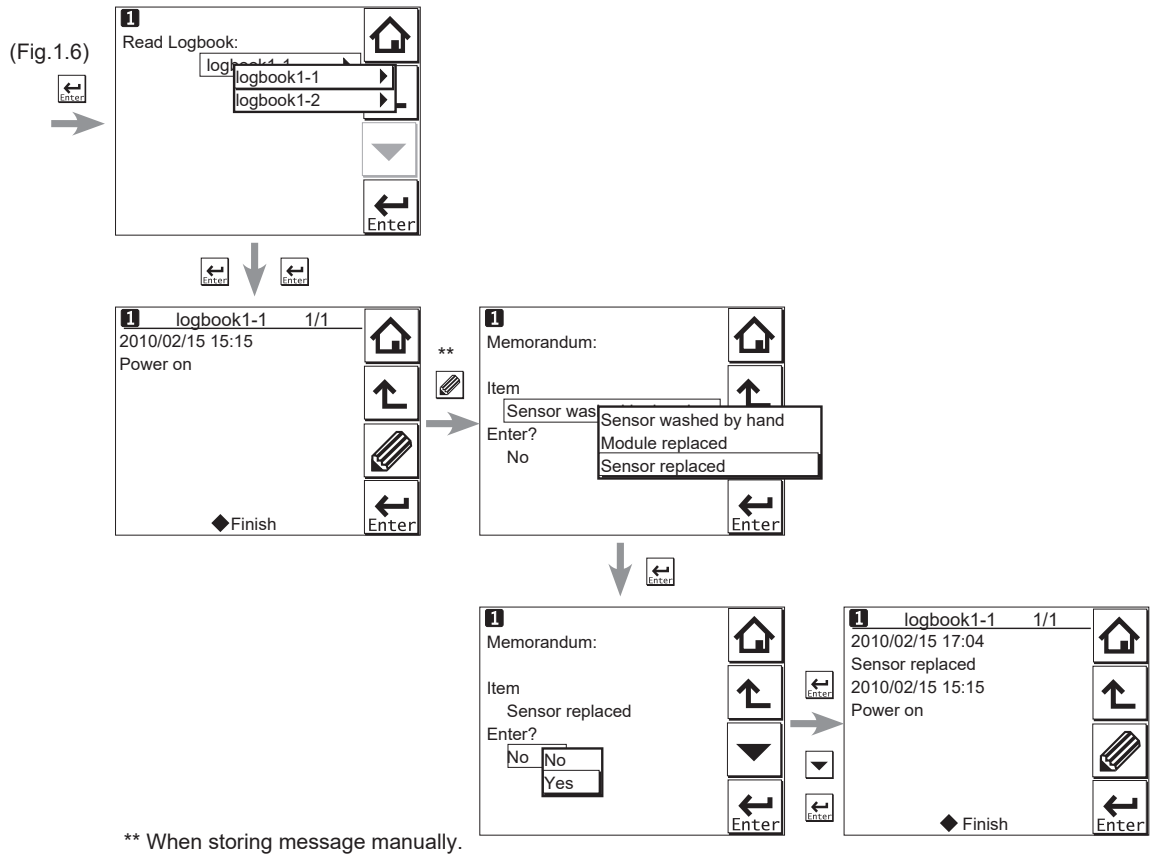
In addition to this storing, following three messages can be manually stored in the logbook;

"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.)

(Fig.1.6)



** When storing message manually.

Figure 1.7 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 Display setup).

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.

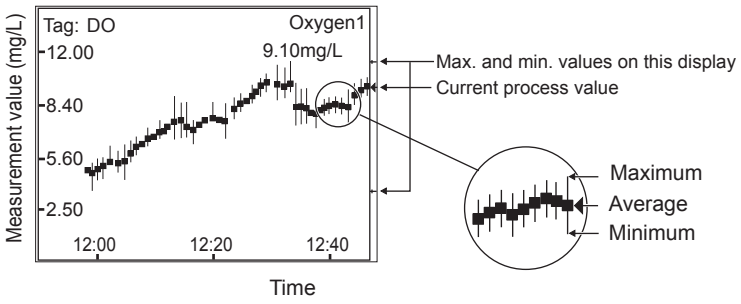


Figure 1.8 Trend screen

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.

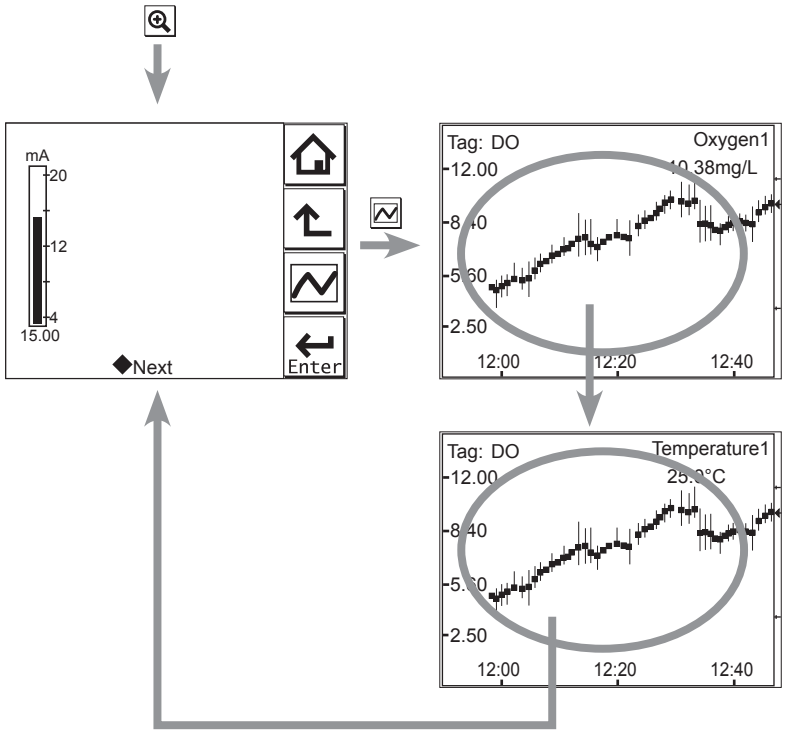


Figure 1.9 Trend graphics

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 2.6.3 Passwords

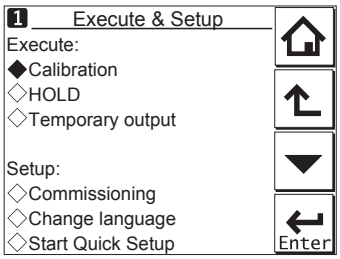


Figure 1.10 Execute & Setup

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 chapter 3. CALIBRATION OF DO (Dissolved Oxygen), and for commissioning, read 2. COMMISSIONING OF DO (Dissolved Oxygen).

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2. COMMISSIONING OF DO (Dissolved Oxygen)

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

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

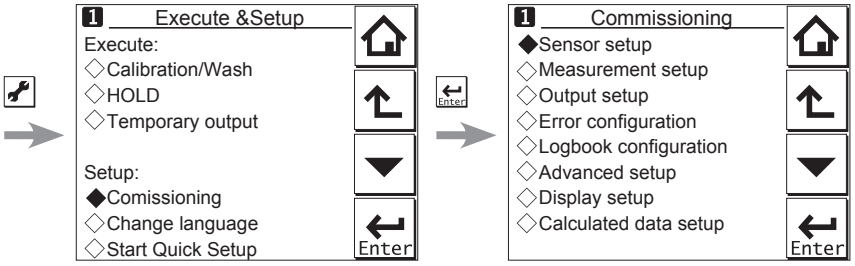


Figure 2.1 Example of the commissioning screen (for two modules)

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 DO” 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 DO” 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
Measurement setup	Configure sensor	Unit			2.2.1
		Sensor sensitivity			
		Polarization Voltage			
	Temperature settings	Temp. element			2.2.2
	Temp. compensation				2.2.3
	Salinity compensation				2.2.4
	Pressure comp. (Measure)				2.2.5
	Calibration settings				2.2.6
	Sensor diag. settings				2.2.7
Output setup	mA				2.3
		Output	Process parameter		
			Setup		
			Linear	0 % value	
				100 % value	
			Table		
			Burn		
			Damping time		
		Simulate	Simulation perc.		
	Configure Hold				
Error configuration					2.4
Logbook configuration					2.5
Advanced setup	Settings				2.6.1
	Tag				2.6.2
	Passwords				2.6.3
	Date/Time				2.6.4
	Communication				2.6.5
		HART			
		PH201G			
	Factory setup				2.6.6
Display setup	Main display (Dual display, Individual display)				2.7.1
	Trend				2.7.2
	Auto Return				2.7.3
	Adjust contrast				2.7.4
	MONITOR display				2.7.5
Calculated data setup	Function				2.8

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 Reference material

2.1 Sensor setup

Select the sensor type that is used from among "Galvanic" and "Polarographic."

The sensor type suitable for the actually connected sensor should be selected.

2.2 Measurement setup

In this section, set up various parameters relating to measurements.

Measurements are performed based on the measurement parameter setup.

If “Polarographic” is selected for “Sensor type” in the Sensor setup screen, the polarographic application voltage can be set.

2.2.1 Sensor setup

Select a unit for sensors from mg/L, ppm, ppb, and %SAT. Select a value for sensor sensitivity from 0.45 µA/ppm (50 µm), 0.90 µA/ppm (25 µm), and other. If you select “other,” enter an appropriate value.

2.2.2 Temperature settings

Select the temperature element used for compensation from among Pt1000 and NTC22k. 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

Select “Manual” or “Automatic” for the temperature compensation type.

Select “Automatic” if the temperature sensor’s measured value is used or “Manual” if no temperature sensor 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.

2.2.4 Salinity compensation

This function is used to measure sample water containing salt such as sea water.

The dissolved oxygen in a solution is affected by salinity. Therefore, to conduct accurate measurements, it is necessary to compensate the influence of the salinity of the sample solution. To make salinity compensation, select “Enabled” for “Compensation.”

Calculate the saturated concentration value from the salinity and temperature of the actual sample water based on Table 1 Solubility of oxygen in water as a function of temperature and salinity and enter the value.

2.2.5 Pressure comp. (Measure)

Dissolved oxygen concentration changes depending on changes in the process pressure or air pressure. To compensate this, enter a value of pressure (air pressure).

See Table 2 Solubility of oxygen in water as a function of temperature and pressure and Table 3 Variation of atmospheric pressure with respect to altitude in the Appendix Reference material.

2.2.6 Calibration settings

In “Calibration settings,” set the high and low limits of Zero/Slope and set up parameters relating to stabilization performed during calibration.

- **Limits and timing**

Zero High/Low

Set the high and low limits of Zero. 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. 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.

Stabilization time

During calibration, the stability of the measurement is constantly monitored. When variations of the value are within a value set in Step Range over this stabilization time set here, the value is regarded as being stable. If the value does not stabilize within 60 minutes, calibration is aborted.

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.

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.

Zero current values can be set only when the setting of “Zero Calibration” is “Enabled.”

- **Pressure comp. (Cal.)**

You can enter the pressure level directly.

- **Zero Calibration**

If zero calibration is required, select “Enabled” for this parameter. The default value is “Disabled.” When this feature is enabled, “Zero current values” can be set in zero settings.

NOTE

When the zero calibration is set to “disabled” after performing the calibration, the result of the calibration turns invalid (default).

2.2.7 Sensor diag. 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 Progress time and Heat cycle. 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

For the available process parameters, see Table 2.2.

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, Oxygen1 or Diff-Oxygen1) 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)

Table 2.2 List of Process Parameters

Number of sensors	Process Parameters
1	Oxygen1 (2)
	Temperature1 (2)
2	Oxygen1
	Temperature1
	Oxygen2
	Temperature2
	Calculated*1
	Redundant*2

*1: Refer to 2.8 Calculated data setup.
*2: Refer to the <Redundant system> below.

Calculated data and Redundant system are available when two modules are installed on the instrument.

<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.

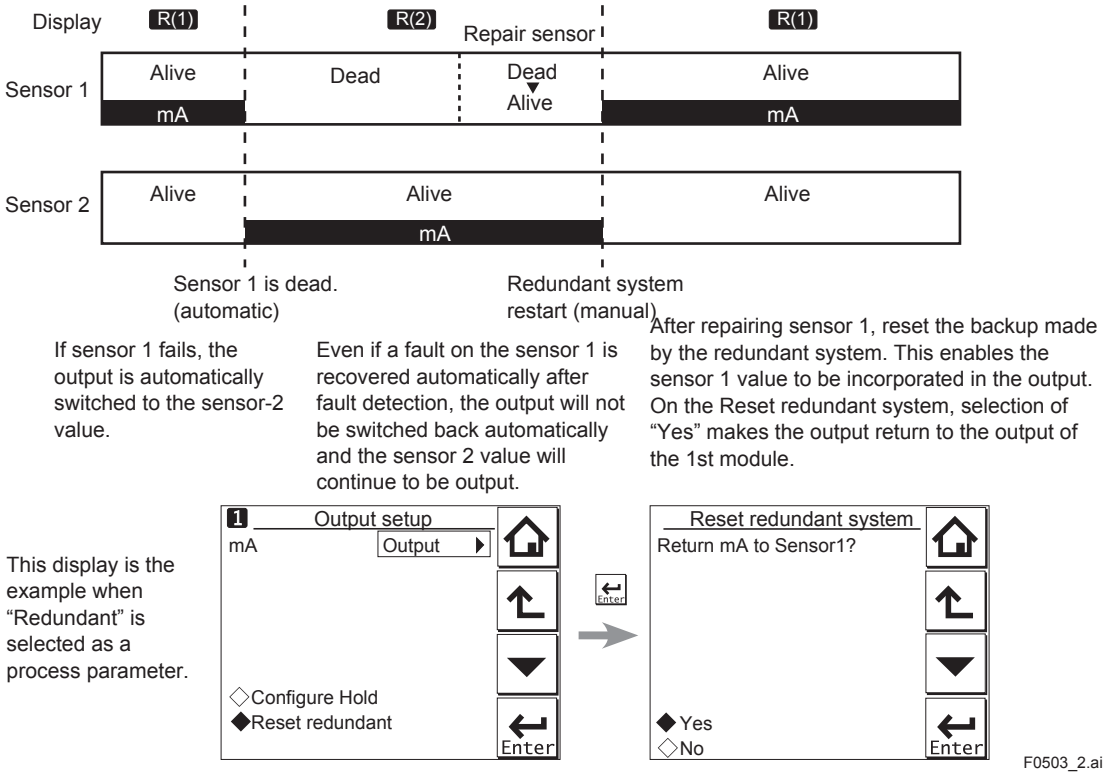


Figure 2.2 Redundant system

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. For the default values, see Table 2.3)

Table 2.3 Table of Default Values

%	0.000	5.000	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00
Oxygen (mg/L)	0.00	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00
Oxygen (ppm)	0.00	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00
Oxygen (ppb)	0.0	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0	45.0	50.0
Oxygen (%sat)	0.0	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0	45.0	50.0
Temperature (°C)	0.0	2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	25.5	25.0

%	55.00	60.00	65.00	70.00	75.00	80.00	85.00	90.00	95.00	100.0
Oxygen (mg/L)	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00
Oxygen (ppm)	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00	20.00
Oxygen (ppb)	55.0	60.0	65.0	70.0	75.0	80.0	85.0	90.0	95.0	100.0
Oxygen (%sat)	55.0	60.0	65.0	70.0	75.0	80.0	85.0	90.0	95.0	100.0
Temperature (°C)	27.5	30.0	32.5	35.0	37.5	40.0	42.5	45.0	47.5	50.0

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. (No fixed output is produced.)

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 to3.5 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 1/2 and 2/2 screens.

Table 2.4 Error configuration

Display item	Description	Default
DO too high	Input is over 50 µA (galvanic) or 1200 nA (polarographic).	Warn.
DO too low	Input is below −0.05 µA (galvanic) or −1.2 nA (polarographic).	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.
Sensor membrane	Sensor membrane is damaged.	Off
Calib. time exceeded	Calibration time exceeds the calibration interval (see Section 2.2.6).	Off

CAUTION

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

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 DO or FLXA21-DO. 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. See2.4 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.

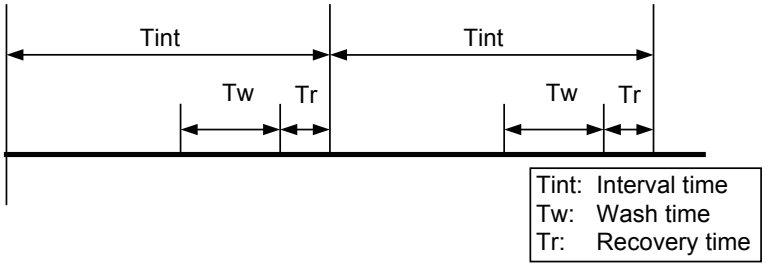
Manual wash: Select “Disabled” or “Enabled.”
When this item is enabled, a wash cycle can be activated manually. On the Calibration/Wash screen, press the “Start manual wash cycle” to perform a manual wash.

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.

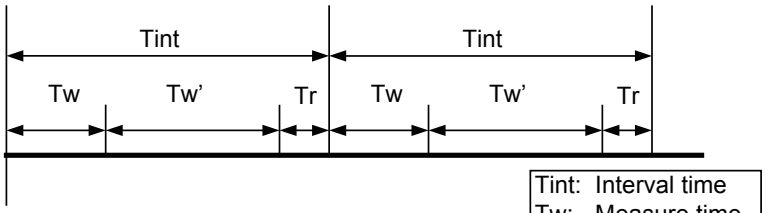
Continuous wash: Select “Disabled” or “Enabled.”
A continuous wash cycle is started at the instant when this item is enabled.

In a continuous wash, the “Measure time” and “Interval time” are reversed (see Figure 2.3).

When a continuous wash is disabled



When a continuous wash is enabled



F050605_2.ai

Figure 2.3

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.

2.7.1 Main display (Dual display, Individual display)

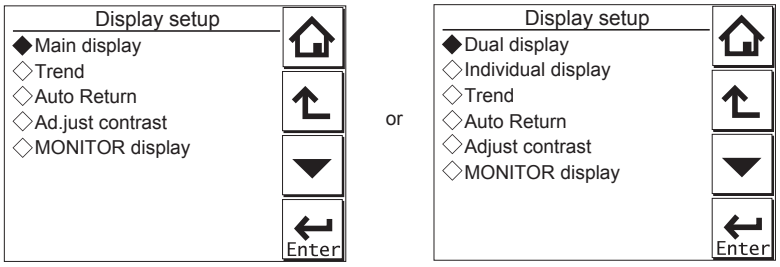


Figure 2.4 Display setup screens for a single module (left) and two modules (right)

- **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 “DO1 display” or “DO2 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 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)

3. CALIBRATION OF DO (Dissolved Oxygen)

Calibrate dissolved oxygen sensors after installing or replacing them, cleaning the membrane, or replacing the electrolyte solution.

Air, water, and manual calibrations are available.

Air calibration is the most common and easiest method. Water calibration is more accurate. Manual calibration uses manually analyzed sample water and adjusts the sensor to the value.

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)

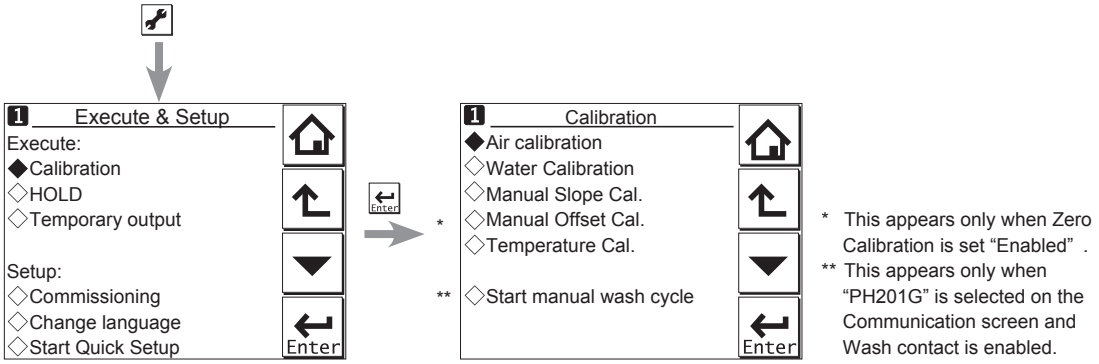


Figure 3.1 Calibration

The calibration items include “Air calibration,” “Water Calibration,” “Manual Slope Cal,” and “Temperature Cal.”

When Zero Calibration is set “Enabled” (see 2.2.6 Calibration settings), “Manual Offset Cal.” is available.

Press  to select “Execute: Calibration,” choose the calibration object, and configure the calibration to perform it. Calibration is made stepwise; follow the prompts displayed on the screen to carry it out.

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

NOTE

While “CHECKING STABILITY…” is indicated, the instrument automatically checks the stability of the measurement (input value). If the stability is not confirmed within 60 min, an error is issued and the procedure is aborted. Change the parameters in the stabilization time and step range as necessary (see 2.2.6 Calibration settings), and then recalibrate the sensor.

NOTE

When a sensor or a membrane 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 1.9.)

3.1 Air calibration

Span calibration in the ambient atmosphere is the most common and easiest method.

Although setting the Zero Calibration to “Enabled” allows 2-point calibration of Zero (0%) and Span (100%), only span calibration is generally performed. For zero calibration, see the next section.

Set the sensor in the maintenance mode. Wash off any stain on the membrane and use a soft tissue to wipe off any remaining water from the membrane.

Leave the sensor in an environment without temperature fluctuation or air flow for about 10 minutes, such as in an empty container. After confirming that the reading is stable, calibrate the sensor.

3.2 Water calibration

Water calibration is a method of calibrating dissolved oxygen analyzers in a laboratory. Accurate results can be obtained if the span calibration is performed carefully in air-saturated water.

Although setting the Zero Calibration to “Enabled” allows 2-point calibration of Zero (0%) and Span (100%), the reading must have been stable before performing zero calibration. Therefore, zero calibration takes a relatively long time.

Conduct water calibration in fresh water. For zero calibration in salt water, perform it by manual calibration.

Set the sensor in the maintenance mode. Wash off any stain on the membrane and use a soft tissue to wipe off any remaining water from the membrane.

- **Air-saturated water**

Pour water (without salt content) into a beaker or other container, and place it on a magnetic stirrer or other agitator. Put a stirring bar in it and agitate the water, and send air from a pump (bubbling). It takes 15 to 30 minutes until the water is fully saturated. Then put the sensor in this water which is still agitated and bubbling, and calibrate it. Keep the sensor at least 3 cm above the bottom of the beaker to prevent the membrane from directly contacting the air bubbles.

- **Water for zero calibration**

Zero calibration takes a long time and normally there is no need to perform it. A clean sensor does not have a zero current and thus does not require zero calibration.

For the zero calibration water, dissolve 20 to 30 grams of sodium sulfite in 1 liter of desalinated water.

NOTE

Dissolve sodium sulfite in the water and wait until the reading becomes stable before calibrating the sensor. Even a healthy sensor needs 40 to 50 minutes. Leave the sensor in the solution.

3.3 Manual slope calibration

Calibrate the sensitivity of the sensor with a solution of known oxygen concentration.

First, analyze the oxygen concentration of a sample solution and then calibrate the sensor sensitivity to adjust to this value. From the actual measurement of salinity and temperature, obtain the dissolved oxygen concentration by referring to Table 1 Solubility of oxygen in water as a function of temperature and salinity and enter it.

When salinity must be considered, perform the calibration manually.

Note the following:

- Quickly analyze the sample water to prevent the dissolved oxygen concentration or temperature from changing.
- Before analyzing the sample water, analyze the reference with a calibrated laboratory instrument.
- To eliminate any discrepancies, the laboratory instrument must have been calibrated with the same calibration data as specified in ISO 5814.

Confirm that the reading of the instrument is stable and the sensor is clean. If the reading remains unstable, set the sensor in the maintenance mode and wash off any stain on the sensor membrane. Return the sensor to the sample water and leave it until the reading becomes stable.

Salinity compensation

To compensate salinity, select “Enabled” in “Measurement setup” – “Salinity compensation” – “Compensation” (see 2.2.4 Salinity compensation).

Perform calibration by referring to Table 1 Solubility of oxygen in water as a function of temperature and salinity.

Example:

When the atmospheric pressure is 101.325 kPa, the solution temperature is 22.5°C, and the salinity is 30 g/kg (3 wt% seawater equivalent):

(1) Calculate the saturated concentration of desalinated water.

According to Table 1 Solubility of oxygen in water as a function of temperature and salinity the saturated concentration is 8.74 mg/l at 22°C and 8.58 mg/l at 23°C.

The value at 22.5ºC is calculated as follows:

8.74 + (8.58 – 8.74) × (22.5 – 22) = 8.66 mg/l

(2) Compensate the value for salinity.

The compensation value for 30 g/kg salinity at 22.5°C is calculated as follows:

0.0453 + (0.0443 – 0.0453) × (22.5 – 22) = 0.0448 mg/l

0.0448 × 30 = 1.34 mg/l

(3) Calculate the saturated concentration of the solution (for calibration).

The saturated concentration for 30 g/kg salinity at 22.5ºC is calculated as follows:

8.66 – 1.34 = 7.32 mg/l

3.4 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.

3.5 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 ■ Configure Hold

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.

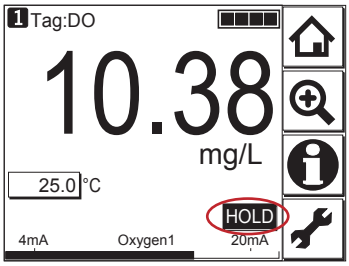


Figure 3.2 Example of the display with the manual hold enabled

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

3.6 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.

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

Dissolved oxygen

Dissolved oxygen means the oxygen dissolved in water.

Its concentration is expressed as the amount of oxygen per unit volume of water (mg/L or ppm).

The solubility of oxygen in water varies depending on water temperature, salinity, atmospheric pressure, etc.

The sensors used in FLXA202/FLXA21 use the membrane electrode method to measure the dissolved oxygen.

Two methods are available: galvanic cell method and polarographic method.

Compensation

There are three compensation methods for FLXA202/FLXA21: temperature compensation, salinity compensation, and process pressure compensation.

Salinity and temperature compensations meet ISO 5814 (see Table 1).

There is no need to change the setting for normal usage.

Use the salinity compensation when measuring a solution containing salt (see 2.2.4 Salinity compensation).

For operation at high altitude, adjust the pressure value for the process pressure compensation (see 2.2.5 Pressure comp. (Measure)

Table 1 Solubility of oxygen in water as a function of temperature and salinity

Temperature (°C)	Solubility of oxygen in water in equilibrium with air at 101.325 kPa (mg/l)	Correction to be subtracted for each degree of salinity expressed in g/kg of total salts (NaCl) in water (mg/l)
0	14.62	0.0875
1	14.22	0.0843
2	13.83	0.0818
3	13.46	0.0789
4	13.11	0.0760
5	12.77	0.0739
6	12.45	0.0714
7	12.14	0.0693
8	11.84	0.0671
9	11.56	0.0650
10	11.29	0.0632
11	11.03	0.0614
12	10.78	0.0593
13	10.54	0.0582
14	10.31	0.0561
15	10.08	0.0545
16	9.87	0.0532
17	9.66	0.0514
18	9.47	0.0500
19	9.28	0.0489
20	9.09	0.0475
21	8.91	0.0464
22	8.74	0.0453
23	8.58	0.0443
24	8.42	0.0432
25	8.26	0.0421
26	8.11	0.0407
27	7.97	0.0400
28	7.83	0.0389
29	7.69	0.0382
30	7.56	0.0371

ISO 5814:1990(E)

Table 2 Solubility of oxygen in water as a function of temperature and pressure

Temperature (°C)	Pressure [kPa (atm) *1]						
	111.5 (1.1)	101.3 (1.0)	91.2 (0.9)	81.1 (0.8)	70.9 (0.7)	60.8 (0.6)	50.7 (0.5)
	Solubility (mg/l)						
0.0	16.09	13.14	11.69	10.21	8.74	8.74	7.27
5.0	14.06	11.48	10.20	8.91	7.62	7.62	6.34
10.0	12.43	10.15	9.00	7.86	6.71	6.71	5.58
15.0	11.10	9.05	8.03	7.01	5.98	5.98	4.96
20.0	10.02	8.14	7.23	6.30	5.37	5.37	4.44
25.0	9.12	7.40	6.56	5.70	4.84	4.84	4.00
30.0	8.35	6.76	5.99	5.19	4.60	4.60	3.62
35.0	7.69	6.22	5.47	4.75	4.01	4.01	3.28
40.0	7.10	5.72	5.03	4.34	3.65	3.65	2.96

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*1: Units at standard barometric pressure (normal atmospheric pressure at sea level): 101.325 kPa = 101.325 kN/m^2 = 1 atm = 760 mmHg

Table 3 Variation of atmospheric pressure with respect to altitude

Altitude (m)	Mean atmospheric pressure (kPa)
0	101.3
100	100.1
200	98.8
300	97.6
400	96.4
500	95.2
600	94.0
700	92.8
800	91.7
900	90.5
1000	89.4
1100	88.3
1200	87.2
1300	86.1
1400	85.0
1500	84.0
1600	82.9
1700	81.9
1800	80.9
1900	79.9
2000	78.9
2100	77.9

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Changing the settings

If any setting is accidentally changed, values to the right of the relevant arrow in Table 4 are all initialized.

Table 4 Parameters that initialize other values

Sensor type ->	Sensor sensitivity
	Calibration settings: Limits and timing: Zero, Slope (low, high)
Output: Process parameter ->	Linear: 0% value, 100% value
	Table
	Communication: HART: PV
Trend Graph Screen ->	Y-axis (low, high)
	Communication: HART
Configure sensor: Unit ->	Trend: Y-axis: Limits: Oxygen (low, high)

Revision Record

- Manual Title : FLXA202 / FLXA21 2-Wire Analyzer Operation of DO
- Manual No. : IM 12A01A03-34EN

Jan. 2021/1st Edition
Newly published (Separate volume from IM 12A01A02-01E)

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