User's
Manual

EXA PH

Model PH400G
Intelligent Outdoor pH Converter

IM 12B7C1-02E

vigilantplant.®

YOKOGAWA
Yokogawa Electric Corporation

IM 12B7C1-02E
6th Edition

INTRODUCTION

The intelligent outdoor pH Converter (Model PH400G) is a converter with a pH sensor diagnosis function. This converter can configure any measurement system to satisfy a wide range of applications when combined with various pH sensors, as doing so enables highly reliable pH measurement in general solutions, pure water and fermented food.

This instruction manual describes all intelligent outdoor pH converter operations from installation to inspection and maintenance. In order to display and maintain their performance completely, read the instruction manual thoroughly.

Note also that, this instruction manual does not describe each device configuring the "EXA PH Intelligent outdoor pH converter System", so if more information is required, refer to the appropriate instruction manual.

Instruction Manual	IM No.	Equipment descibed
PH8ERP KCl Refillable pH sensor	IM 12B7K1-02E	PH8ERP: KCl Refillable type pH sensor
PH8EFP KCl Filling type pH sensor	IM 12B7J1-01E	PH8EFP: KCl Filling type pH sensor
PH8TBG Terminal box	IM 12B07W01-01E	PH8TBG: Terminal box
PH8HG Guide-pipe	IM 12B7M2-01E	PH8HG: Guide-pipe
PH8HS Submersion type holder	IM 12B07M01-01E	PH8HS, PH8HSF: Submersion type holder (PH8MV, PH8MVF: Solenoid Valve)
PH8HF Flow-through type holder	IM 12B07N01-01E	PH8HF, PH8HFF: Flow-through type holder (PH8MV, PH8MVF: Solenoid Valve)
HH350G Well bucket type holder	IM 19H1B1-01E	HH350G: Well bucket type holder
PB350G Float type holder	IM 19H1E1-01E	PB350G: Float type holder
PB360G Vertical type float holder	IM 19H1E2-01E	PB360G: Vertical type float holder
PUS400G Ultrasonic oscillator	IM 19C1B3-01E	PUS400G: Ultrasonic oscillator : (Non-explosionproof type)
PH8PU1 Cleaning tank/pump	IM 19C1E1-01E	PH8PU1: Cleaning tank/pump assembly
PH8AX Accessory for pH meter	IM 12B07W03-01E	PH8AX: Accessory
PH8EHP pH sensor for pure water	IM 12B7J2-01E	PH8EHP: pH sensor for pure water
PH8HH Holder for pure water	IM 12B07P01-01E	PH8HH : Holder for pure water
Auto Cleaning Type pH Measurement System PH8SM3 Auto Cleaning Unit PH8HS3 Holder	IM 12B7W1-01E	PH8SM3: Auto Cleaning Unit PH8HS3: Holder

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6th Edition: Apr. 2011 (YK)

◆ After-sales Warranty

- Do not modify the product.
- During the warranty period, for repair under warranty carry or send the product to the local sales representative or service office. Yokogawa will replace or repair any damaged parts and return the product to you.
- Before returning a product for repair under warranty, provide us with the model name and serial number and a description of the problem. Any diagrams or data explaining the problem would also be appreciated.
- If we replace the product with a new one, we won't provide you with a repair report.
- Yokogawa warrants the product for the period stated in the pre-purchase quotation. Yokogawa shall conduct defined warranty service based on its standard. When the customer site is located outside of the service area, a fee for dispatching the maintenance engineer will be charged to the customer.
- In the following cases, customer will be charged repair fee regardless of warranty period.
  - Failure of components which are out of scope of warranty stated in instruction manual.
  - Failure caused by usage of software, hardware or auxiliary equipment, which Yokogawa Electric did not supply.
  - Failure due to improper or insufficient maintenance by user.
  - Failure due to modification, misuse or outside-of-specifications operation which Yokogawa does not authorize.
  - Failure due to power supply (voltage, frequency) being outside specifications or abnormal.
  - Failure caused by any usage out of scope of recommended usage.
  - Any damage from fire, earthquake, storms and floods, lightning, disturbances, riots, warfare, radiation and other natural changes.
- Yokogawa does not warrant conformance with the specific application at the user site. Yokogawa will not bear direct/indirect responsibility for damage due to a specific application.
- Yokogawa Electric will not bear responsibility when the user configures the product into systems or resells the product.
- Maintenance service and supplying repair parts will be covered for five years after the production ends. For repair for this product, please contact the nearest sales office described in this instruction manual.

Table of Contents

1. INTELLIGENT OUTDOOR pH CONVERTER SYSTEM

The basic "Intelligent Outdoor pH Converter System" configuration can be roughly divided into general purpose pH measurement system, pH measurement system for high purity water, and pH measurement system for fermentation.

1.1 General Purpose pH Measurement System

1.1.1 Application Examples

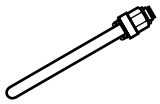
- Water solution pH control in various production processes.
- Water solution pH measurement and recording in water purification plants.
- lndustrial water pH measurement.
- Steel surface treatment process plating line pH measurement and control.
- The pH measurement in fuel gas desulfurizationlwaste gas treatment precesses.
- The pH measurement in factory waste water and drainage treatment precesses.

1.1.2 General Purpose pH Measurement System, Configuration Equipments

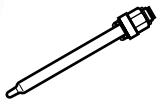
Table 1.1 General purpose pH measurement system, configuration equipments

<table>
<tr>
<th>pH sensor</th>
<th>Holder, Holder with Cleaning System</th>
<th>pH converter</th>
</tr>
<tr>
<td>
KCl refilling type
PH8ERP

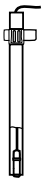

Xerolyte
HA405/HA406/HA485

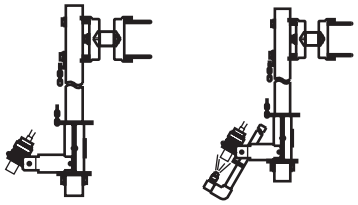

for Chemical
DPA405/DPA406/DPA485


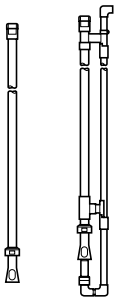
KCl filling type
PH8EFP


Hydrofluoric
Acid-resistive
HF405


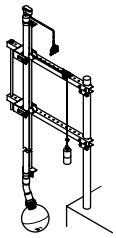
pH/ORP sensor
FU20

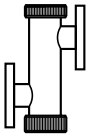
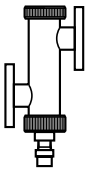
</td>
<td>
Guide Pipe
PH8HG


Suspension Type Holder
HH350G
<No Cleaning> <With Jet Claening>


Submersion Type Holder
PH8HS


Angled Floating Ball Holder
PB350G


Vertical Floating Ball Holder
PB360G


Flow type Holder
PH8HF



No Cleaning
Ultrasonic Cleaning
Jet Cleaning
Brush Cleaning
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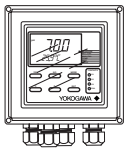
4-wire pH Converter
PH400G

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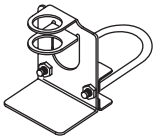
Accessories
PH8AX
Sensor Stand


Calibration Reagent
and KCl solution

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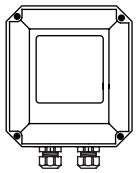
Cleaning Devices
Ultrasonic Oscillator
PUS400G

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Table1-1E.eps

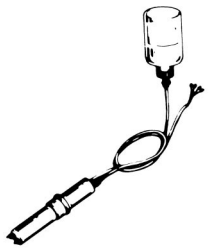
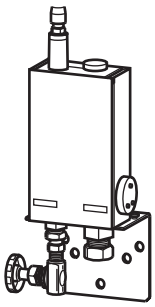
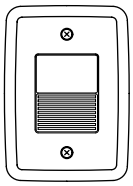
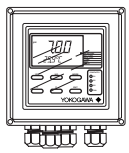
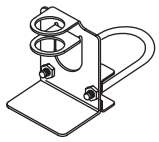
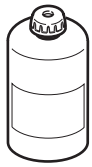
1.2 pH Measurement System for High Purity Water

1.2.1 Application Examples

Drum water pH measurement of general purpose and thermal power generation boiler

1.2.2 pH Measurement System for High Purity Water, Configuration Equipments

Table 1.2 pH measurement system for high purity water, configuration equipment

pH Sensor	Holder	Terminal Box	pH Converter	PH8AX Accessory
For high purity water PH8EHP 	Holder for high purity water PH8HH 	Terminal box PH8TBG 	Intelligent outdoor pH converter PH400G 	Sensor stand  Calibration Reagent and KCl 

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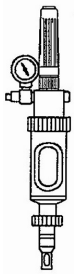
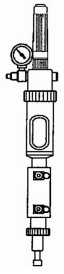
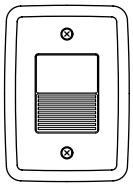
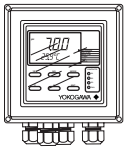
1.3 Fermentation pH Measurement System

1.3.1 Application Examples

Medium in fermentation tank

1.3.2 Fermentation pH Measurement System, Configuration Equipments

Table 1.3 Fermentation pH measurement system, configuration equipment

pH Sensor		Terminal Box	pH converter
Fermentation pH sensor Y/465 	Fermentation pH sensor (Removable type) Y/465 	Terminal box PH8TBG 	Intelligent outdoor pH converter PH400G 

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1.4 Restriction Based on pH sensors

To achieve high-level functions and stability, as a rule, the intelligent outdoor pH converter is to be combined with a general-use type (PH8EFP/PH8ERP), high purity water type (PH8EHP), or (Y/465).

Other combination than the above is possible such as pH sensors (PH8EFG/PH8ERG / PH8EHG). There are pH sensors that can be combined other than the above.

However, in these cases, non-standard and specially ordered PH400G intelligent outdoor pH converter is required. Further, in these combinations, functions and characteristic are slightly different from standard measurement system. Refer to Table 1.1 "Characteristic Comparison Table". The temperature sensor setting of the pH converter is also to be changed corresponding to the sensor to be used as Pt1000 Ω which is selected as its setting during factory calibration before shipment.

(1) When PHΣ pH sensor (PH8EFG/PH8ERG/PH8EHG) is used:
Temperature sensor of 5.1 kΩ is incorporated in PHΣ pH sensor. Prior to operation, select "5.1 kΩ" using service code 02 and make one-point temperature calibration at room temperature.
Note: One-point temperature calibration is also required when the pH sensor is replaced.

(2) When fermentation type pH sensor (Y/465) is used:
Fermentation type pH sensor (Y/465) is not equipped with a temperature sensor. When operating, set a temperature at TEMP (temperature parameter setting mode) on operation level, referring to 6.1.3.

(3) When other pH sensor is used:
Other usable pH sensors, enabling the pH converter to compensate temperature automatically, are limited to pH sensors having built-in 350 Ω or 5.1 kΩ , or 6.8 kΩ temperature sensor. Prior to operation, select a suitable temperature sensor using service code 02 and make one-point temperature calibration at room temperature.

Prior to operation, select a suitable temperature sensor using service code 02 and make one-point temperature calibration at room temperature.

Note: One-point temperature calibration is also required when the pH sensor is replaced.

Table 1.4 Characteristic Comparison Table (1/2)

Combined pH sensor	Temperature sensor incorporated in pH sensor	Temperature coefficient of temperature sensor	Process temperature measurement error *	Temperature compensation error
(EXA PH) PH8EFP PH8ERP	Pt1000 Ω (1000 Ω at 0°C)	———	———	———
(PHΣ) PH8EFG PH8ERG	5.1 kΩ (5.1 kΩ at 25°C)	0.360 %/°C	7.5°C max at 100°C 2.5°C max at 50°C	0.19pH at pH14 0.08pH at pH10 (100°C)
———	350 Ω (350 Ω at 25°C)	0.335 %/°C	———	———
———	5.1 kΩ (5.1 kΩ at 25°C)	0.360 %/°C	———	———
———	6.8 kΩ (6.8 kΩ at 25°C)	0.360 %/°C	———	———

*: When one-point calibration is made at 25 °C

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Table 1.5 Characteristic Comparison Table (2/2)

Combined pH sensor	(EXA PH) PH8EFP PH8ERP	(PHΣ) PH8EFG PH8ERG
Temperature sensor	Pt1000 Ω	5.1 kΩ
Process temperature measurement error*		7.5°C maximum at 100°C 2.5°C maximum at 50°C
Calibration error		0.02pH
Temperature compensation error		0.19pH at pH14 0.08pH at pH10 (100°C)
Temperature display	○	△
mA Output	○	○
mV Output	○	○
e.m.f. display	○	○
Asymmetric potential	○	○
Slope display	○	○
RE impedance display	○	○
Response time display	○	○
Automatic calibration	○	○
Manual calibration	○	○
Automatic temperature compensation	○	△
Manual temperature compensation	○	○
Standard temperature conversion	○	△
AUTO cleaning	○	○
GE self diagnosis	○	○
RE self diagnosis	○	○
Half value width check	○	○
Response time check	○	○

T1-5E.eps

*: When one-point calibration is made at 25 °C

○, △: Executable function (△:Indicates accuracy is worse than that of Pt1000Ω)

2. SPECIFICATION

The Model PH400G Intelligent Outdoor pH Converter is used when configuring the "EXA PH Intelligent Outdoor pH Converter System".

<Features>

- Various kinds of built-in alarm contact output functions make control appropriate for each applicable system.
- Electrode characteristic deterioration can be automatically checked during automatic calibration using buffer solutions. Thus, the electrode replacement period, which has so far relied on intuition can be determined.
- Operation panel is very easy to use. Daily maintenance can be performed keeping the case closed, eliminating insulation deterioration due to humidity intrusion, etc.

2.1 Standard Specification and Reference Performance

Measuring Range

pH : - 2 to15 pH
Temperature : -10 to 130 ℃

Display Method:

Digital display

Display Range

pH : -2 to 15 pH
Temperature : -10 to 130 ℃

Output Signal (pH or temperature can be freely set.)

4 to 20 mA DC : isolated transmission output, Max. load 600 Ω
0 to 1 V DC : isolated transmission output, Minimum load 1 kΩ

(However, the above current (4 to 20 mA) output signal and the voltage (0 to 1 V) output signal are not isolated from each other.)

Output Signal Range

pH : Freely adjustable to any desired range of 1 pH span or greater (set at 0 to14 pH when shipped).

Temperature : Freely settable to any desired range of 50 ℃ span or greater (set to 0 to 100℃ when shipped).

Contact Output

・Contact output function that can be set

Contact	Function	
S1	Setting (free selectable)	Operation (free selectable)
	OFF, low limit, high limit, HOLD	ON/OFF, Proportional duty pulses *1 Proportional frequency pulses *2
S2	OFF, low limit, high limit, HOLD	Ditto
S3	OFF, low limit, high limit, HOLD, Cleaning timer, Hi - Hi limit, Lo - Lo limit	Ditto
FAIL	Failure	ON/OFF

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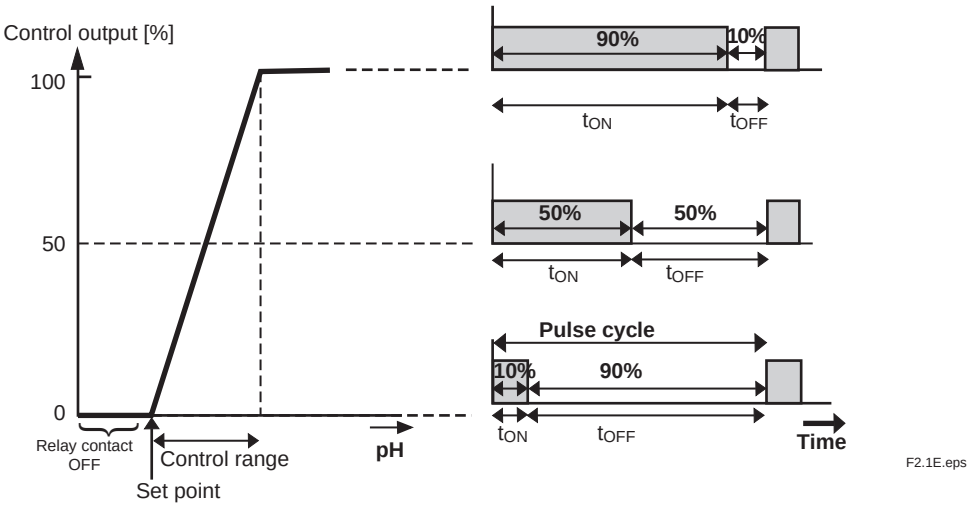
(*1) and (*2) are effective when the low high limit contact output is to be used.

(*1) Proportional duty pulse



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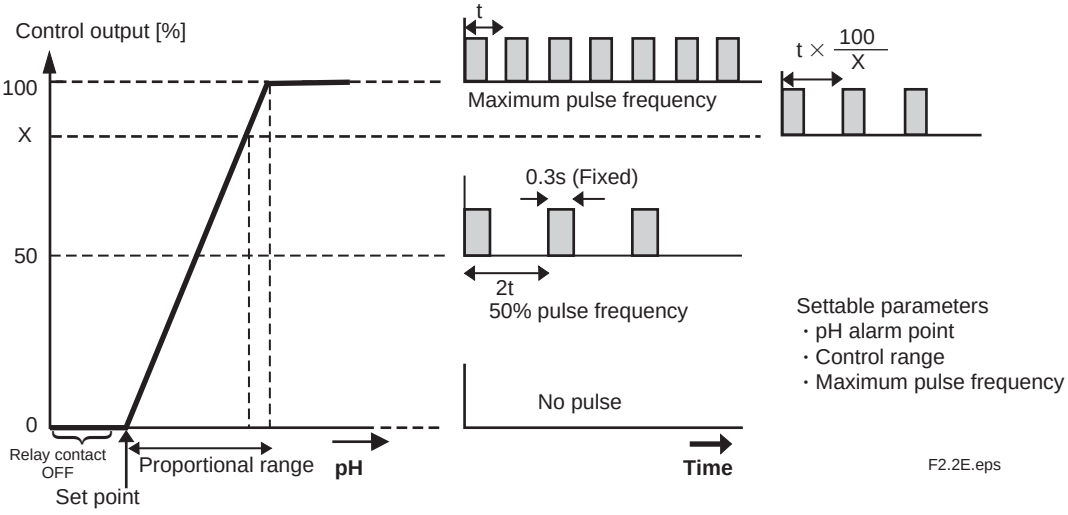
(*2) Proportional frequency pulse example of high limit alarm (control) output



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Contact ON/OFF

S1, S2, S3

		Power	
		ON	OFF
Action	ON	Closed	Open
	OFF	Open	

FAIL

		Power	
		ON	OFF
Action	ON	Closed	Closed
	OFF	Open	

T2.2E.EPS

When closed, each indicator lamp is lit corresponding to each contact status.

·Contact Type: Relay contact output (dry contact)

·Contact Rating:
250 V AC, 2 A, Max. 100 VA
220 V DC, 2 A, Max. 50 W

Contact Input: Dry contact for manual start for automatic cleaning

Ambient Temperature: -10 to 55 °C

Storage Temperature: -30 to 70 °C

Ambient Humidity: 10 to 90% RH

Construction: Watertight complying with JIS C0920 equivalent to NEMA 4 waterproof construction

Material:

Case ; Aluminum alloy casting

Cover and window ; Polycarbonate

Finish : Baked polyurethane resin coating

Colors:

Cover ; Deep sea moss green (Munsell 0.6GY3.1/2.0)

Case ; Frosty white (Munsell 2.5Y8.4/1.2)

Mounting:

Pipe mounting, wall mounting or rack mounting, Panel mounting

Power Supply Voltage:

88 to 132 V AC, 50 / 60 Hz
176 to 264 V AC, 50/60 Hz

Power Consumption:

Approx. 8.5 VA

Electrical Connection:

pH sensor: Watertight plastic gland equivalent to JIS A8 attached to pH sensor side, ϕ13.5 hole

Others: Watertight plastic gland equivalent to JIS A15 (for cable OD. 9 to 12 mm) attached, ϕ21 hole

Weight:

Body : Approx. 2.5 kg
Mounting bracket : Approx. 0.4 kg

Dimensions:

144 (W) x 144 (H) x 135 (D) mm

Function Specifications

Input Impedance: 10^{12} Ω or more

Tip

Use a electrode with solution earth electrode because of differential amplifier (that uses two high impedance amplifiers).

Asymmetry Potential Adjustable Range: pH 7 ± 2 pH

Slope Adjusting Range: Adjustable in the range from 70 % to 110 % of the theoretical value.

Automatic Temperature Compensation Range:

-10 to 130 °C (manual compensation is also available)

Reference Temperature Conversion Coefficient (Reference Temperature 25°C):
On shipment : 0
Adjustable range : -1.00 to 1.00 pH / 10°C

Conversion to the reference temperature is used only for high-purity water or when the measured solution temperature coefficient is known.

Standard Performance (performance when combined with a pH sensor)

Repeatability : 0.05 pH (electrode submerged 3 times in the same buffer solution)

Response Time: 10 sec (90 % response, using pH sensor and buffer solution both at temperature equilibrium at 20 °C, with adequate agitation)

Accuracy: ±0.1 pH (using KCl filling type pH sensor or high-purity water pH sensor)

±0.15 pH (using KCl refillable pH sensor)

Temperature Repeatability: 1 °C

Operating Functions

Display:

3-1/2 digit digital display (data display)
Six digit alphanumerics (message or data display)

Display function:

pH value, Temperature value, mA output, mV output, Reference electrode impedance, The e.m.f. slope, Asymmetry potential, mV (e.m.f.), 90% response time, Error display (at error occurrence), Hold display (when holding), Manual temperature compensation display (in manual temperature compensation setting), Interactive message, Key operation requesting display

Functions that can be set or executed at operation level:

One-touch calibration (Buffer selection is manual but indication stability check is automatic.), Measurement of electrode 90 % response time, Manual calibration, Selection of message area display contents, Temperature coefficient setting, Auto / manual temperature compensation selection, Manual temperature setting, Hold set / reset

Functions that can be set or executed at setting level:

pH value setting for contacts (S1, S2, and S3),
Output range setting (mA and mV outputs)

Hold parameter setting : Hold provided / no selection,
Selection of holding either the value immediately before or the preset value,
Preset value setting (mA and mV outputs)

Cleaning parameter setting : Auto / manual cleaning selection, Manual cleaning start / stop selection, Automatic cleaning ON / OFF selection
Cleaning period : Setting range 0.1 to 36 hours
Relaxation time : Setting range 0.1 to 10 min
Cleaning time : Setting range 0.1 to 10 mim

Functions that can be set or executed at service level:

°C / °F selection

Use / no use of conversion to reference temperature

Temperature sensor selection

Checking item setting (asymmetry potential, e.m.f. slope, reference electrode impedance)

Setting of reference electrode impedance high limit value

Setting of response time high limit value

One-point temperature calibration

Electrode type selection (glass electrode or antimony electrode)

Error reset

pH display value selection (0.1 pH / 0.01 pH)

Half value recovery time check ON / OFF

Half value recovery time setting (0.1 to 10 min)

Burn-up or burn-down ON/OFF

Response stabilization judging parameter setting

Auto-return (approx. 60 min) ON/OFF

pH buffer solution temperature characteristics setting

Temperature sensor cable length correction

Output signal selection

4 to 20mA DC	OFF, pH Temperature
0 to 1V DC	OFF, pH Temperature

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Contact (S1, S2, or S3) output selection

Setting of contact output delay time (0.1 to 20 sec) and hysteresis (0.01 pH to 0.2 pH)

Setting of proportional duty pulse contact output period (5 to 100 sec)

Setting of maximum frequency (50 to 120 pulses /min) at the proportional frequency pulse contact output

Control range (0 to 10 pH)

Details of failure detection by self-diagnosis function:

Response time error during calibration (time until pH value is settled)

Asymmetry potential failure

e.m.f. slope failure

Temperature range failure

pH range failure

Glass electrode impedance failure (measured solution must be 50 mS/cm or more, and temperature 60 °C or less)

Reference electrode impedance failure (measured solution must be 50 mS/cm or more)

Half value recovery time failure

90% response time failure

Calibrating solution temperature failure

2.2 Model and Codes

Model	Suffix Code	Option Code	Description
PH400G	·····	·····	4-wire pH Converter
Power Supply	-1 ·····	·····	100/110 V AC, 50/60 Hz
	-2 ·····	·····	200/220 V AC, 50/60 Hz
Language for warning, etc	-J ···	·····	Japanese
	-E ···	·····	English
———	A ··	·····	Always A
———	*B	·····	Style B
Options	Mounting hardware	/U	Pipe, wall mounting bracket (stainless steel)
		/PM	Panel mounting bracket (stainless steel)
	Hood	/H3	Awning hood (carbon steel)
		/H4	Awning hood (stainless steel)
		/X1	Baked epoxy resin
	Tag plate	/SCT	Stainless steel tag plate
	Conduit Adapter	/AFTG	G1/2
		/ANSI	1/2 NPT
		/SPS	Teflon coated SUS steel screws

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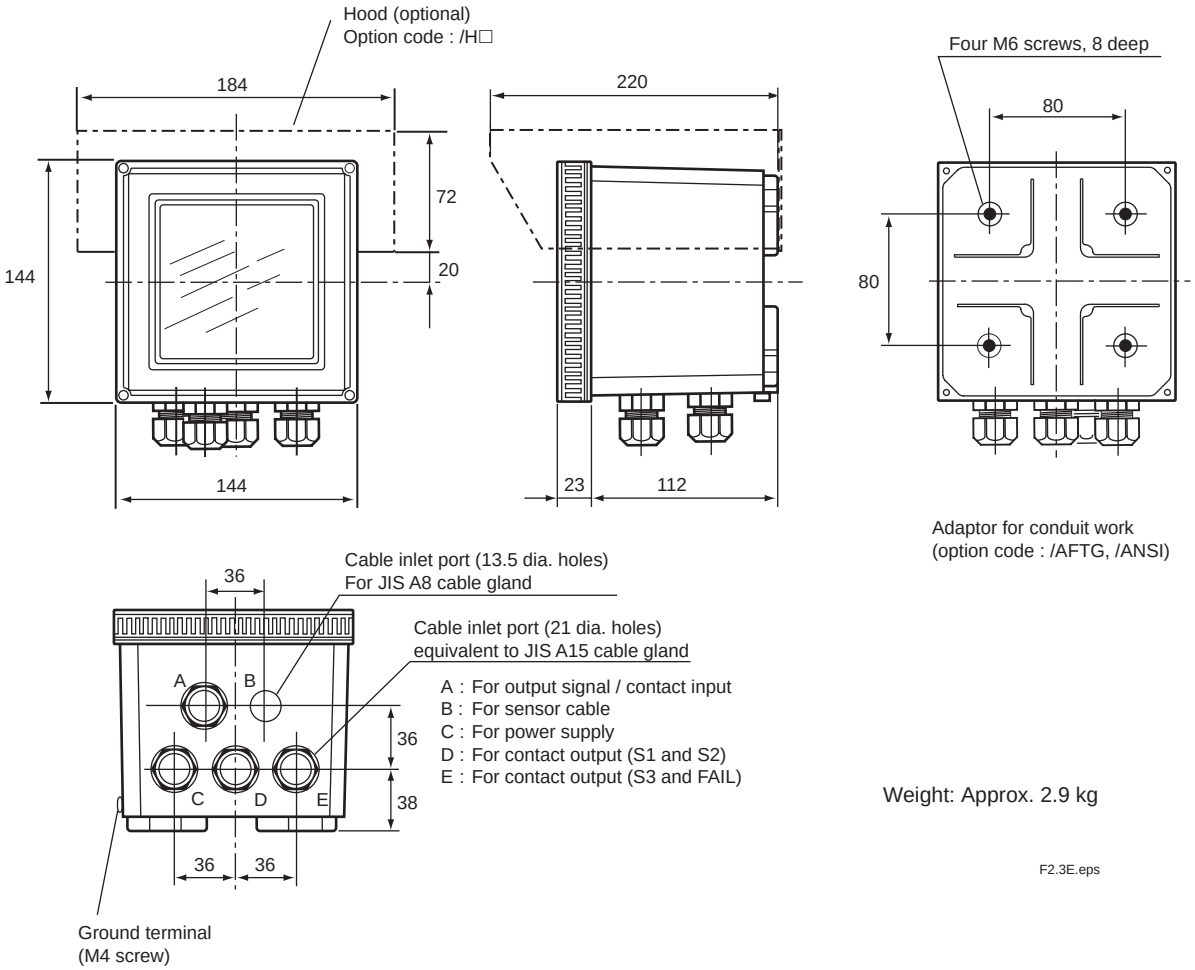
2.3 Dimensional Outline Drawing

· PH400G pH Converter

Unit: mm



Weight: Approx. 2.9 kg

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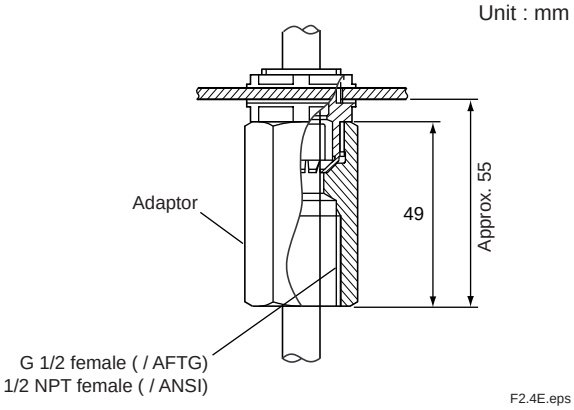
· Adaptor for conduit work (option code: /AFTG, /ANSI)

Unit : mm



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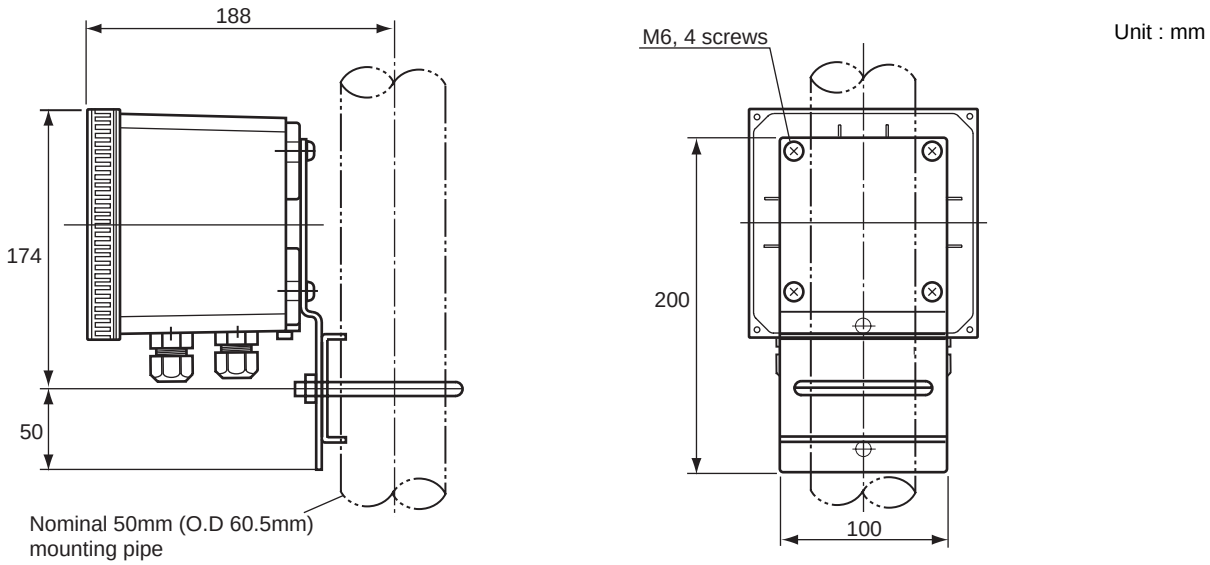
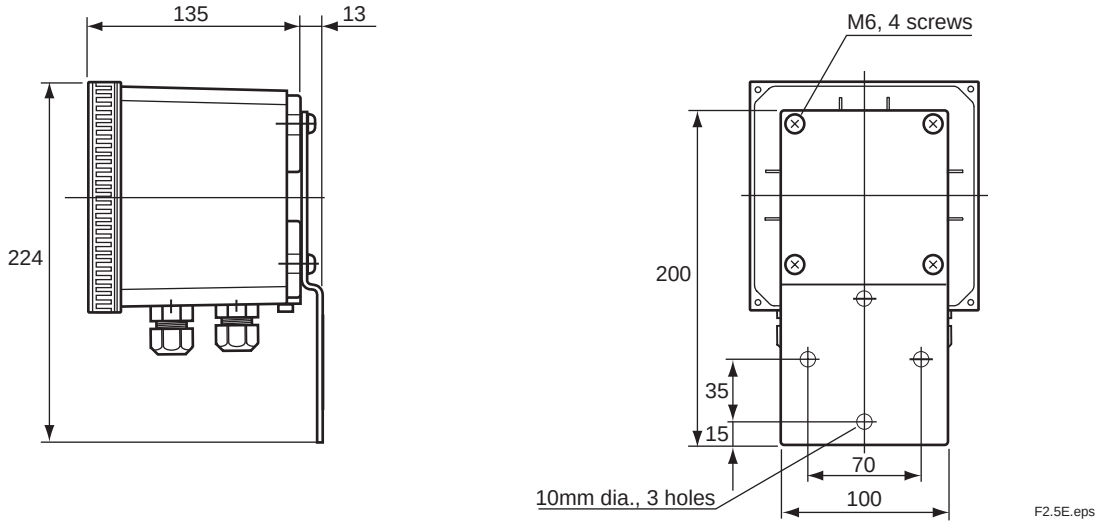
· Pipe Mounting Bracket / Wall Mounting Bracket (option code :/U)

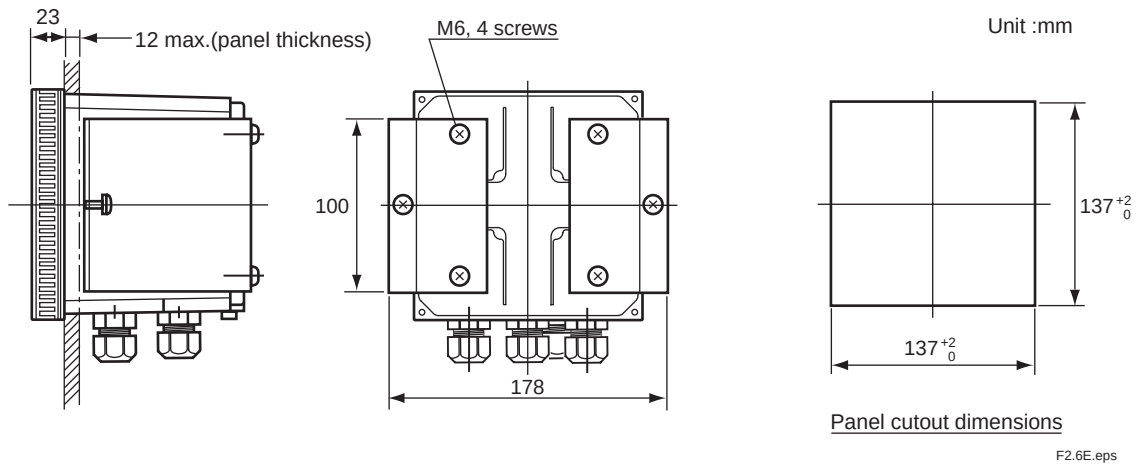
•Example of bracket used for pipe mounting



•Example of bracket used for wall mounting



· Panel Mounting Bracket (option code : /PM)



3. INSTALLATION AND WIRING

3.1 Installation

3.1.1 Unpacking and Specification Check

The intelligent outdoor pH converter is carefully packed after strict inspection at the factory so as to prevent damage during transportation.

Carefully handle the converter during unpacking, and when it has been unpacked, check it visually to confirm that there is no damage. Also, see if the converter is as ordered by checking it against the description on the nameplate.

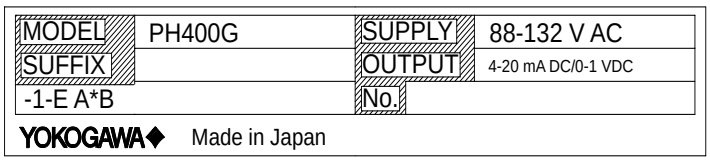


Figure 3.1 Nameplate Indication Example

3.1.2 Installation Location

Although the intelligent outdoor pH converter is of waterproof construction, install it as much as possible where:

・Corrosive gas concentrations are low,
・Mechanical vibration is low.
・At ambient temperature and where temperature change is small.
・A humidity of between 45 and 85% RH is maintained.
(Extremely high or low humidity is bad for the converter.)

Also, if the temperature inside the converter is likely to exceed the operation limit due to exposure to direct sunlight, it is recommended that a hood (Optional) be installed.

3.1.3 Preparation for Installation

[Incorporation of Separate Attachments]

Optional parts specified with the option codes (hood, mounting bracket, adaptor for conduit connection, etc.) are delivered as separate attachments. To avoid losing these parts, it is recommended that you attach them before installation,

[Installation Provisions]

Make provisions to fix the PH400G intelligent outdoor pH converter so that it is installed in a position for easy operation.

(1) Pipe Mounting
The PH400G is fixed to a stanchion (pipe) with a U-bolt. Provide a rigid vertical pipe with an OD of 60.5 mm (a horizontal pipe is also acceptable).

(2) Wall Mounting
Fix the PH400G with three M8 bolts (not supplied), Carry out drilling on the mounting surface as shown in Figure 3.2.

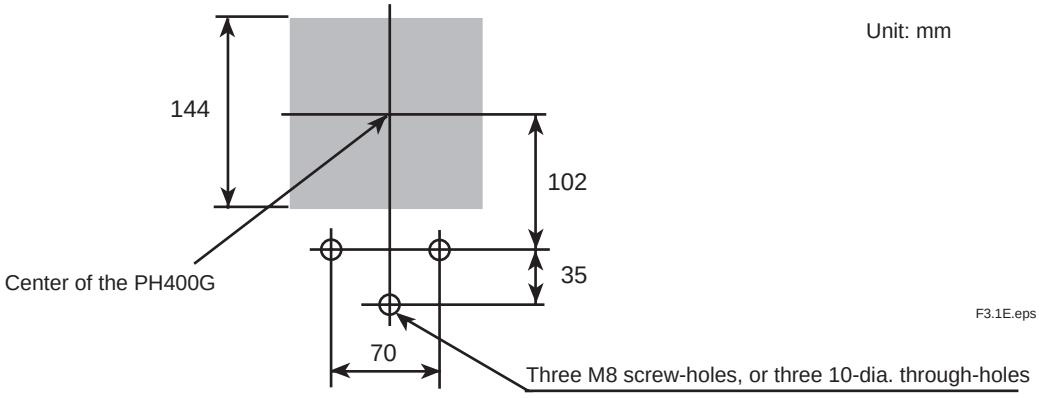


Figure 3.2 Drilling for Wall Mounting

(3) Panel Mounting
Make a panel cutout as shown in Figure 3.3 in the mounting position.

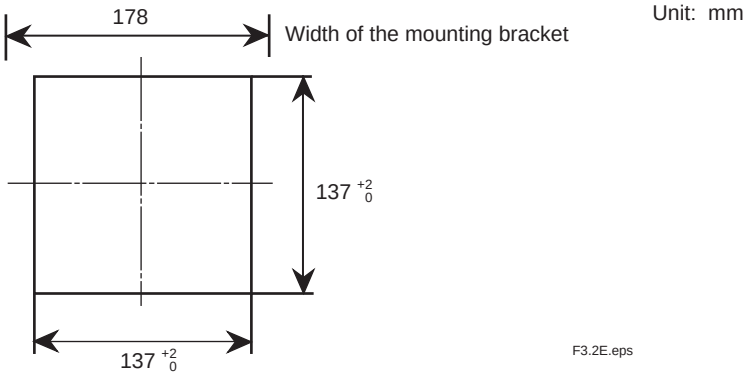
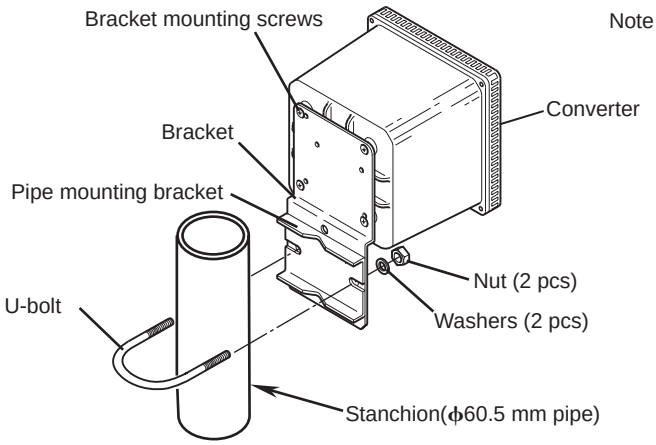


Figure 3.3 Cutout for Panel Mounting

3.1.4 Converter Mounting

(1) Pipe Mounting

Figure 3.4 shows the pipe mounting bracket and the mounting procedure.



Note : If a hood (see 2.3) is to be attached, fix it making use of the two upper bracket mounting screws.

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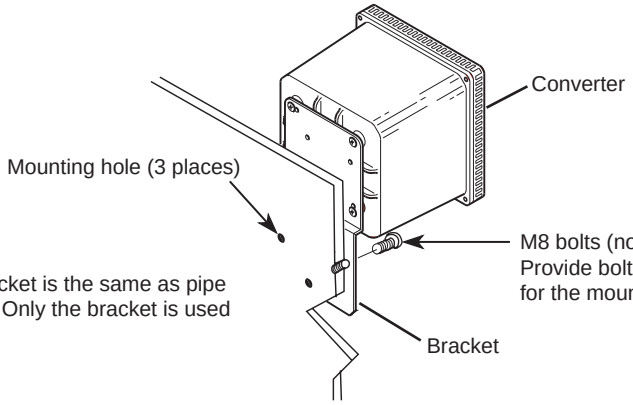
Figure 3.4 Pipe Mounting Procedure

(2) Wall Mounting

Figure 3.5 illustrates the wall mounting procedure.



Note:
Wall mounting bracket is the same as pipe mounting bracket. Only the bracket is used for wall mounting.

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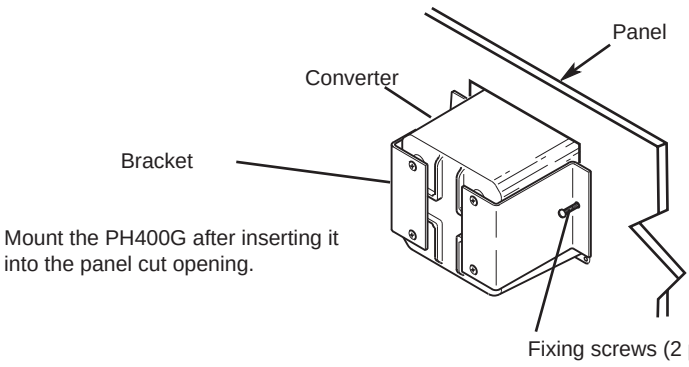
Figure 3.5 Wall Mounting Procedure

(3) Panel Mounting

Figure 3.6 illustrates the panel mounting procedure.



Mount the PH400G after inserting it into the panel cut opening.

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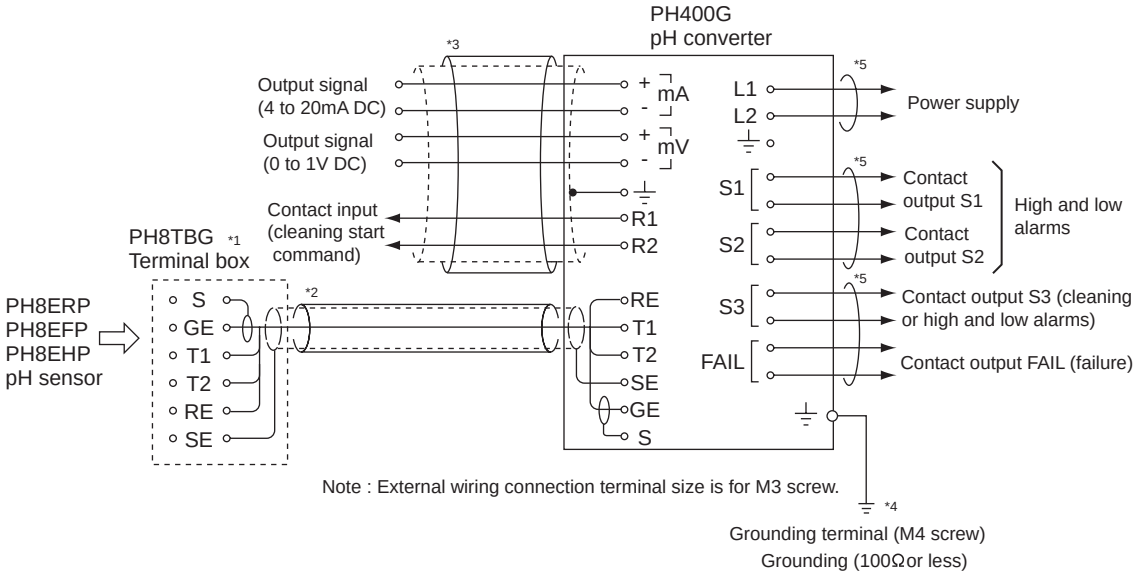
Figure 3.6 Panel Mounting Procedure

3.2 Wiring

3.2.1 Outline of Wiring

Wiring to be connected to the intelligent outdoor pH converter

(1) Wiring for power supply
(2) Wiring for contact outputs (S1, S2)-if necessary
(3) Wiring for contact outputs (S3, FAIL)-if necessary
(4) Wiring for output signal and for remote contact input
(5) Wiring for pH sensor
(6) Wiring for grounding



*1: Terminal box is used only where pH converter is installed some distance from pH sensor (ordinary not needed).
*2: This cable is specified in the option code for the PH8TBG.
*3: Use only shielded cable with an outside diameter of 9 to 12 mm.
*4: Be sure to ground pH converter case grounding terminal (grounding resistance; 100Ωor less).
Only when the above grounding is impossible, ground at power cable side. But be sure to avoid two point-grounding.
*5: Be sure to use cable with the outside diameter of 9 to 12 mm.

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Figure 3.7 Cables to be Connected to Intelligent Outdoor pH Converter

The pH converter has five lead-in inlets for cables as shown in Figure 3.8.

Wiring is to be done using one cable each for each wiring channel.

CAUTION

On the unused lead-in inlets for cables, do not fail to put cable glands with blank plugs.

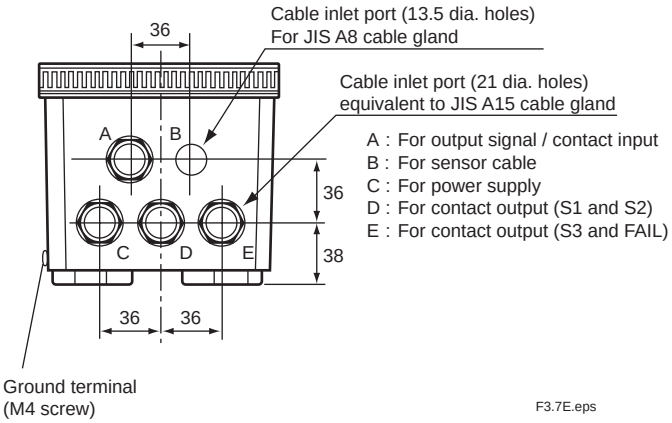

Figure 3.8 Intelligent Outdoor pH Converter Lead-In lnlets for Cables

The outline of wiring is as shown below.

(1) Loosen the 4 screws on the pH converter front, and remove the case cover.
(2) Pull the knob located near the bottom on the right and open the inner part of the converter.
(3) Loosen one screw in the middle, remove the shield plate covering the terminals for power circuit and contact output.
(4) Connect the power circuit and contact output cables to the terminals.
(5) Restore the removed shield plate (at the above step(3)) to the previous place.
(6) Connect the sensor, output signal and remote contact input cables to the terminals.
(7) Fasten the pH converter case cover after wiring is finished. Exercise care to fasten it tightly so as to keep moisture out.

3.2.2 Wiring for Power Circuit

A power cable is to be wired for supplying power with adequate voltage and frequency conforming to the specifications to the intelligent outdoor pH converter.

Use a 2-conductor cable with a finished O.D. of 9 to 12 mm to connect the power circuit with terminals L1 and L2 of the pH converter.

It is recommended to provide a 2-pole switch in the power line, because the converter is not equipped with power switch.

The power cable is connected to the converter according to the procedure shown below.

(1) Treat the cable end. First strip the insulation covering off the cable to approx. 40 mm from each end. And then fasten solderless terminal lugs suitable for M3 screws to the uncovered part.
(2) Connect the cable to each terminal. First remove the cap of cable gland, body of cable gland, nut and retaining nail, and pass the cable through them. And then lead the cable into the converter and connect each conductor to the proper terminal without fail. When a conduit is used to protect the cable, replace the cap of cable gland with an adapter. Conduit connection is shown in Figure 3.9.
(3) Fasten the cap of cable gland, packing and retaining nail into the cable gland planted in the converter. Exercise care to firmly secure the cap of cable gland (or adapter) to prevent moisture intrusion into the case.

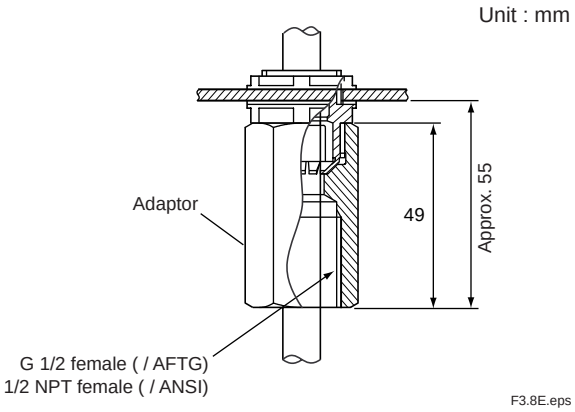

Figure 3.9 Conduit Connection Adapter

3.2.3 Wiring for Contact Output

Contact output cables are to be wired to output optional contact signals such as abnormal, hold, upper/lower limit alarm, etc. from the pH converter. Use a cable with a finished O.D. of 9 to 12mm (select suitable conductor numbers for the number of contact outputs to be used).

Contact rating for the contact output relay is shown in Table 3.1 below. Equipment and devices to be connected must meet the ratings shown in Table 3.1.

Table 3.1 Contact Rating of the Contact Output Relay

	DC	AC
Maximum allowable voltage	220V	250V
Maximum allowable current	2A	2A
Maximum allowable power	50W	100VA

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Connect each conductor of the cable to terminals S1, S2, S3 (optionally settable contact output) and FAIL (Abnormal contact output). The connection procedure is to follow the statement in 3.2.2.

3.2.4 Wiring for Output Signal and Remote Contact Input

This wiring is for transmitting 4 to 20 mA DC/ 0 to 1 V DC output signals to receiving instruments such as recorders, or for using remote contact input to the pH converter. Use a shielded cable with a finished O.D. of ϕ 9 mm to ϕ 12 mm (select a shielded cable of 2, 4, or 6 conductors depending on the numbers of signals to be used).

Connect the cable to the intelligent outdoor pH converter following the procedure described below,

(1) Treat the cable end.
Strip the insulation covering off the cable to approx. 40 mm from each end, cut the uncovered shield at its root, solder a grounding lead at this point, and then protect the soldered part by wrapping it with insulation tape. Note that the opposite shield end of the cable (on the receiving side such as recorder etc.) is to be connected nowhere.
Next, have the leadwire cut to be of the same length as the conductors and fasten a solderless terminal suitable for M3 screw to each end of the lead wire and the conductors,

(2) Connect the cable to each terminal.
First remove the cable packing gland, packing and retaining nail, and pass the cable through them. And then lead the cable in the converter and connect each conductor to the proper terminal without fail.
When a conduit is used to protect the cable, replace the cable packing gland with an adapter. Conduit connection is shown in Figure 3.9.

(3) Fasten the cable packing gland, packing and retaining nail into the cable gland planted in the converter. Exercise care to firmly secure the packing gland (or adapter) to prevent moisture intrusion into the case.

3.2.5 Sensor Cable Connection

This sub-section describes how to connect a pH sensor cable directly to the intelligent outdoor pH converter. When the cable is to be connected to a terminal box, refer to the separately prepared instruction manual "PH8TBG Terminal Box (IM 12B07W01-01E)".

When pH sensors other than EXA PH pH sensors are used, connect the sensor cable conforming to the wiring procedure described here (unless specified instrument manuals for the sensor are prepared),

(1) Lead the sensor cable in the converter and connect to each terminal. The inlet for the sensor cable is the cable gland on the right viewed from the front of the converter. Remove the nut from the cable gland and pass the cable through the wiring hole in the in the converter case.
After inserting the cable in the nut, confirm the markings on each cable lug. Connect each wire to the corresponding terminal.

(2) Install the cable gland to the wiring hole. With the cable gland inserted in the wiring hole, tighten the gland nut. See Figure 3.10. After securing the gland nut, install the gland packing to keep out moisture. Do not apply excessive force to it, as the packing may be damaged.

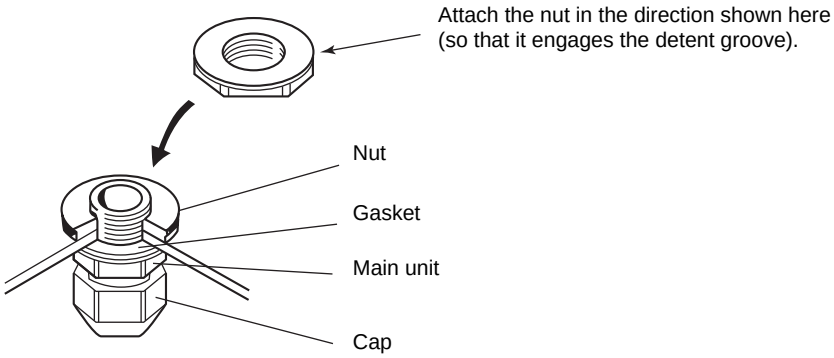


Figure 3.10 Sensor Cable Connection

3.2.6 Wiring to Terminal Box

Terminal Box is used only when the intelligent outdoor pH converter is installed at a distance exceeding 5 m (up to 20 m max,) away from a pH sensor.

In this case, special cables attached to Terminal Box are used for connecting Terminal Box to the intelligent outdoor pH converter.

The wiring procedure for connecting pH sensors to Terminal Box requires referral to another instruction manual : "PH8TBG Terminal Box (IM 12B07W01-01E)".

Cable connection should be in accordance with the procedure described in 3.2.5.

3.2.7 Grounding Conductor Connection

Use a sufficiently thick conductor (nominal cross section : 2 mm^2 or more) for grounding use and ground the grounding terminal at the lower part of the intelligent outdoor pH converter case (ground to earth, grounding resistance : 100 Ω or less). Refer to Figure 3.11 below.

In addition, confirm that the connection is made by inserting the conductor between the screw head and washer.

CAUTION

If the grounding terminal on the pH converter case cannot be used, connect the grounding conductor to another terminal (M4 screw) inside the converter and make grounding on the power circuit side, using a 3-conductor (or 2-conductor) shielded cable for power supply.

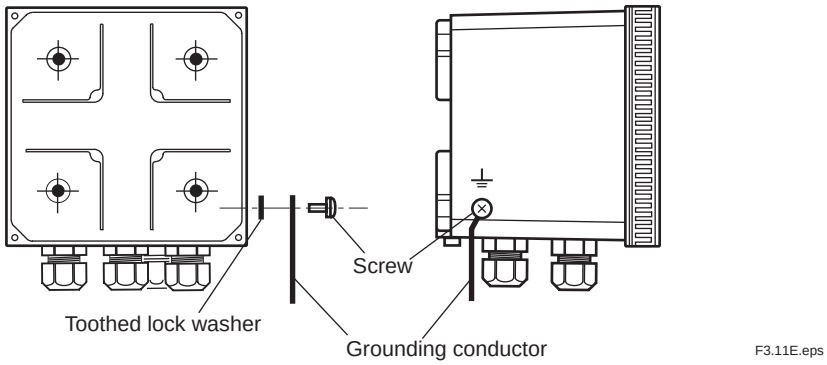


Figure 3.11 Grounding Conductor Connection Procedure

4. FUNCTIONAL DESCRIPTION

4.1 Name of Each Section

Figures 4.1 and 4.2 show the functional description of the intelligent outdoor pH converter.

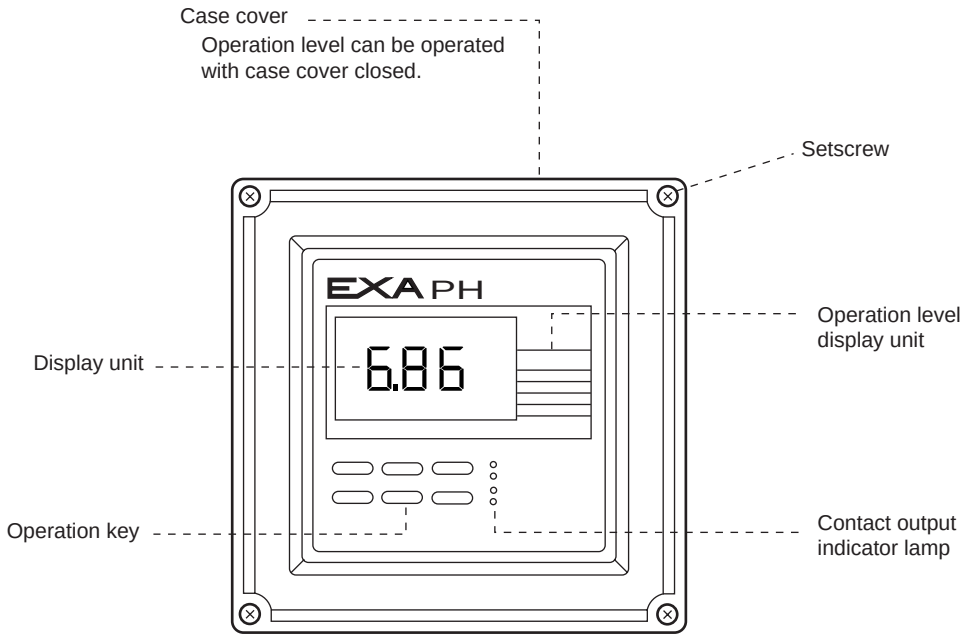


Figure 4.1 Functional Description of Intelligent Outdoor pH Converter (with the Cover Closed)

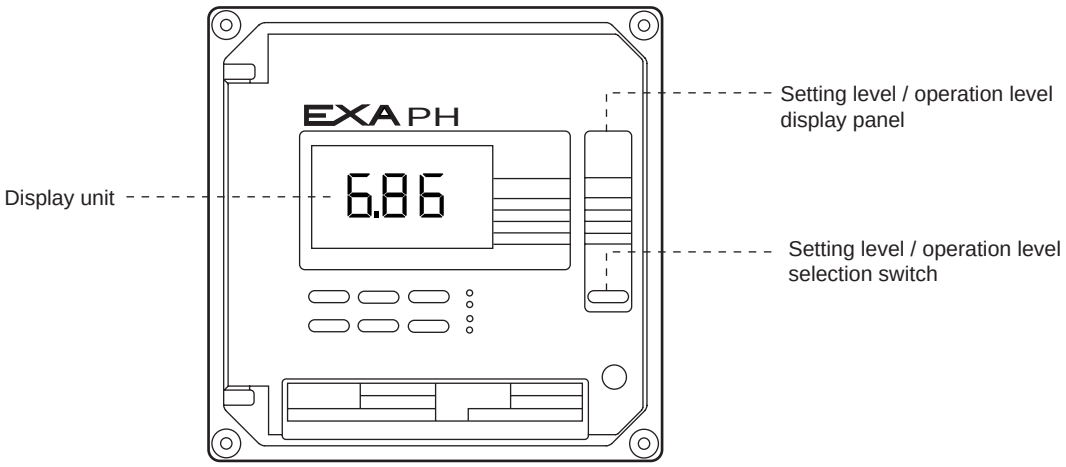
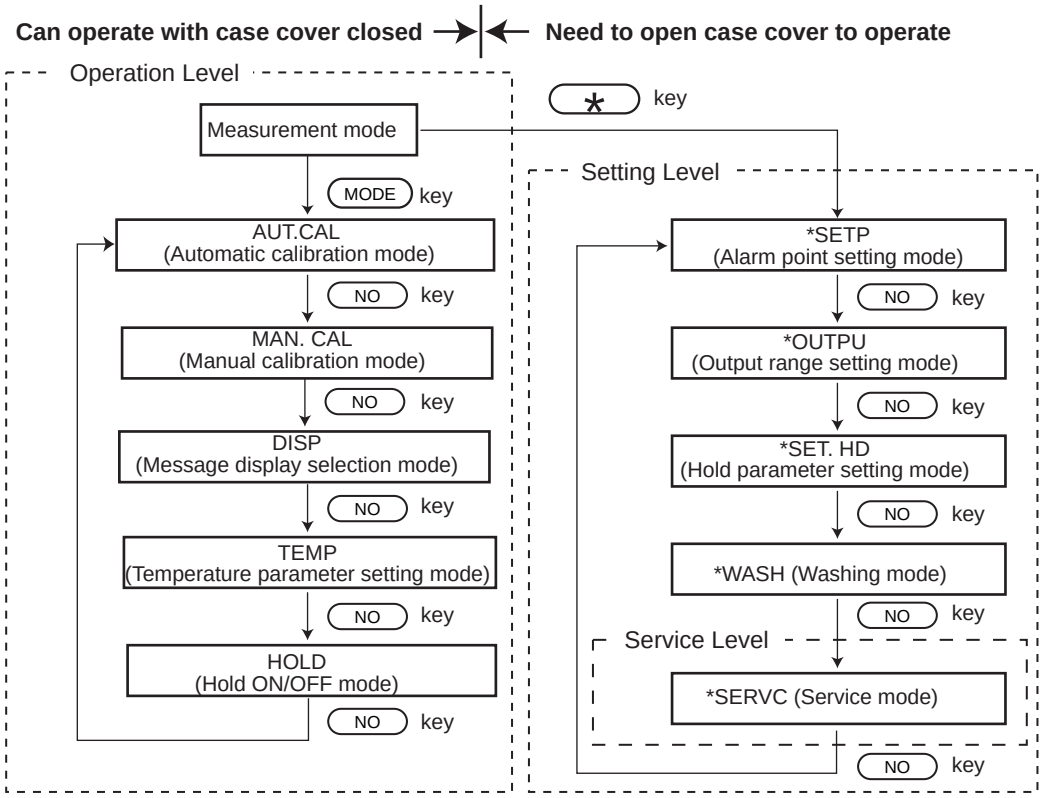


Figure 4.2 Functional Description of Intelligent Outdoor pH Converter (with the Cover Open)

4.2 Intelligent Outdoor pH Converter Operation



·Select desired mode and press YES key.
·The MODE key is also used as a "Cancel and Return to Measurement Mode" escape key.

PH400G Status Transition Diagram

The intelligent outdoor pH converter operation is determined by the following three handling levels.

(1) Operation level
ln the daily inspection and maintenance operation level, it can be operated with the cover closed, while function selection and data setting are done in the setting and service levels.
(2) Setting level
(3) Service level
These levels are functions which are not usually used and are masked with a cover. Remove the cover to change these functions.

These three levels are composed of several modes respectively.

4.2.1 Mode Details in the Operation Level

The MODE key is used to enter and exit the operation level. In the operation level, the following modes are available.

(1) ► MEASURE (Measurement mode):
pH display and auxiliary display.

(2) ► AUT. CAL (Automatic calibration mode):
Automatic (one-touch) calibration, and selection of standard solutions pH4, pH7 or pH9.

(3) ► MAN. CAL (Manual calibration mode):
Manual calibration and standard solution pH value setting.

(4) ► DISP (Message display selection mode):
Selection of message area display details

Temperature / mA (current) output / mV (voltage) output / e.m.f/Asym / Slope / Reference electrode impedance/90% response time

(5) ► TEMP (Temperature parameter setting mode):
Automatic temperature compensation / manual temperature compensation selection, manual temperature setting, temperature coefficient setting at the time of conversion to the reference temperature (25 °C)

(6) ► HOLD (Hold mode):
Hold ON/OFF selection.

CAUTION

If *HLD OFF is set in the setting level, it is impossible to enter the hold mode.

4.2.2 Mode Details in the Setting Level

The ⟨*⟩ key enables entry to the setting level, while the ⟨MODE⟩ (sometimes the ⟨*⟩ key also is effective) enables exit from the same level. In the setting level, the following modes are included.

(1) ► *SETP (Alarm point setting mode):
pH value alarm point setting for contact output (S1, S2, S3)

(2) ► *OUTPU (Output range setting mode):
Range setting (setting of pH value or temperature for mA output and mV output)

(3) ► *SET. HD (hold parameter setting mode):
Hold ON/OFF selection, output selection (value just before hold/fixed value) at HOLD, and fixed value setting

(4) ► *WASH (Washing mode):
Automatic washing/Manual washing selection, automatic washing ON/OFF selection, and washing cycle, washing time, and relaxation time setting

4.2.3 Mode Details in the Service Level

The ⟨*⟩ key enables entry to the service level, while the ⟨MODE⟩ (sometimes the ⟨*⟩ key also is effective) enables exit from the same level. In the service level, the service mode for setting various kinds of data is included which consists of the codes shown below.

(1) ► *SERVC (Service mode)
<Code>

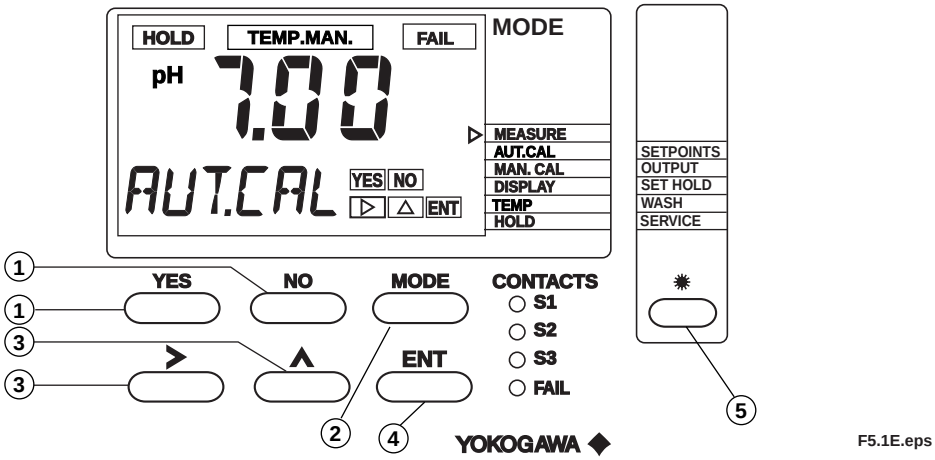
01	* TEMP	: Selection of reference temperature conversion ON/ OFF and °C/ °F
02	* T.SENS	: RTD selection for temperature compensation Pt1000 Ω/ 5.1 kΩ/ 350 Ω/6.8 kΩ
	* TP.ADJ	: One-point-temperature calibration

03	* CHECK	: Selection of asymmetry potential ON/ OFF, Slope ON/ OFF, and glass electrode impedance ON/ OFF.
	* IMP. LT	: Reference electrode impedance upper limit setting
04	* DISP	: Selection of display digit 0.01/ 0.1
05	* BURN	: ON/OFF selection on burn up or burn down
06	* Δ T. SEC	: Discrimination parameter Δt setting during automatic calibration.
	* Δ PH	: Discrimination parameter ΔpH setting during automatic calibration
07	* RET.	: Auto return ON/ OFF selection
08	* BUF.	: pH-temperature characteristics input during automatic calibration (for pH7 when shipped)
09	* BUF.	: pH-temperature characteristics input during automatic calibration (for pH4 when shipped)
10	* BUF.	: pH-temperature characteristics input during automatic calibration (for pH9 when shipped)
11	* CABLE	: Selection of temperature sensor cable length compensation of 5 m/3 m/others.
		Note: To be used when Pt1000 Ω is selected in service code 02.
	* LNGTH	: Temperature sensor cable length setting.
12	* mA. COD	: 4 to 20 mA output selection on OFF/ pH value/ Temperature.
13	* mV. COD	: 0 to 1 V output selection on OFF/ pH value/ Temperature.
14	* S1	: Contact output S1 function selection (OFF/ lower limit/ upper limit/ hold)and output method selection. (status contact output/ proportional duty pulse contact output/ proportional frequency contact output)
15	* S2	: Contact output S2 function selection (OFF/ lower limit/ upper limit/ hold) and output method selection. (status contact output/ proportional duty pulse contact output/ proportional frequency pulse contact output)
16	* S3	: Contact output S3 function selection (OFF/ lower limit/ upper limit/ hold/ washing/ high-high limit or low-low limit) and output method selection. (status contact output/proportional duty pulse contact output/ proportional frequency pulse contact output)
17	* D.TIME	: Contact output delay time setting,
	* HYST.	: Contact output hysteresis (pH) setting.
18	* RANGE	: Range setting of proportional duty pulse contact output or proportional frequency pulse contact output.
19	* PER.	: Proportional duty pulse contact output cycle setting.
20	* FREQ.	: Proportional frequency pulse contact output maximum frequency setting.
21	* HT.CHK	: Selection of half-value recovery time check ON/OFF when washing is completed.
	* HT.min	: Half-value recovery time setting when washing is completed.
22	* Sb. SEN	: Glass electrode/antimony electrode selection.
23	REL x.x	: Software version No. display.
24	* RES. LT	: Measurement of 90% response time of sensor
25	* Err. OF	: Error reset.

5. OPERATION AND DISPLAY

All key-operations on the intelligent pH converter are performed on an interactive basis, and thus each operation is easily carried out in accordance with messages, mode pointer, and the operation key indicator.

5.1 Operation Key



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① YES NO :Used when replying YES/NO to a message.

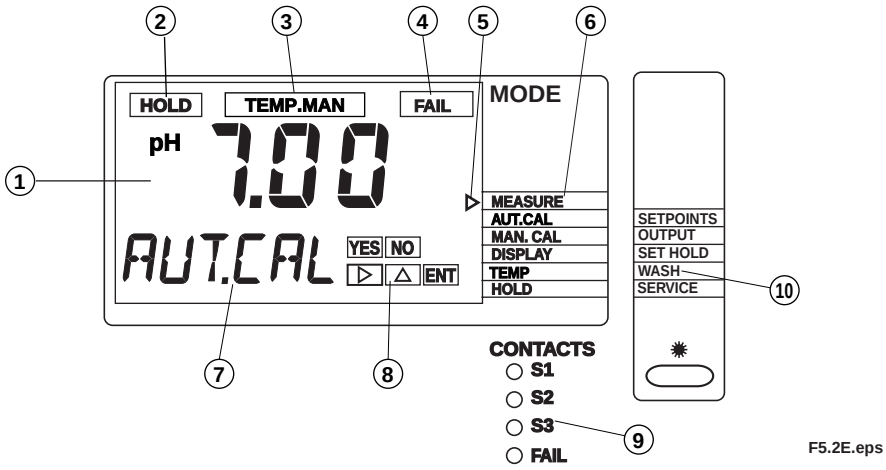
② MODE :Used when the mode is selected.

③ > ∧ :Used when data setting is made.

④ ENT :Set an input value when pressed this key.

⑤ ✳ :Used when seitching between setting level and measurement level is desired.

5.2 Display Details



① Data area: Displays measured data, set data, etc.

② HOLD: Displayed during hold.

③ TEMP. MAN: Displayed during manual temperature compensation.

④ FAIL: Displayed when trouble occurs.

⑤ Mode pointer: Indicates the mode selected. When this pointer lights up, it indicates that the mode has been selected. When the pointer flashes, this indicates that a different mode has been selected.

⑥ Mode in operation level

⑦ Message area : Displays a message necessary for data other than pH measured value and interactive operation.

Note : When ∗ is displayed at the head of a message, this indicates that the level is the setting/ service level.

⑧ Operation key indicator: Indicates the key to be pressed for operation.

⑨ Contact output lamps: Lit when each contact output works or abnormality occurs.

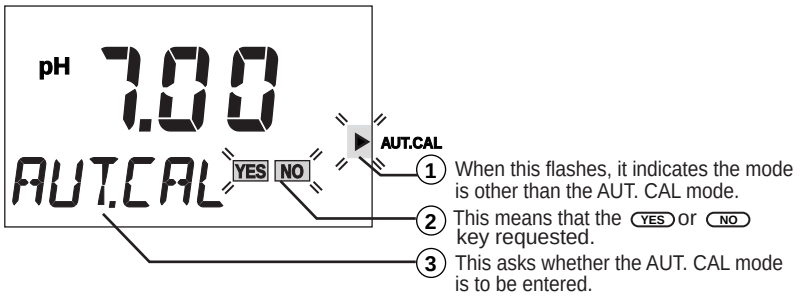
⑩ Mode in setting level/ service level.

5.3 Basic Operation

5.3.1 Operation When the YES and NO Displays Flash

When YES and NO flash on the operation key indication (as in example ②), press the YES or NO key to respond to the message (example ③).

(Example)

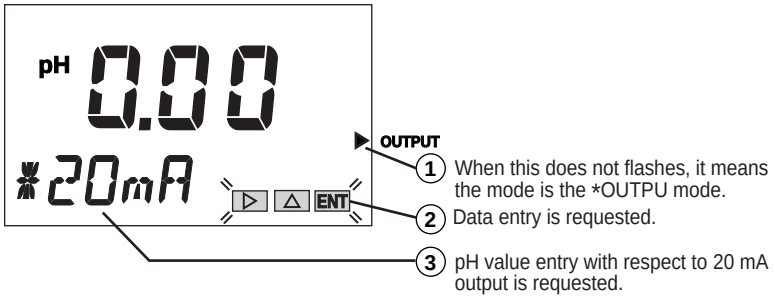


F5.3E.eps

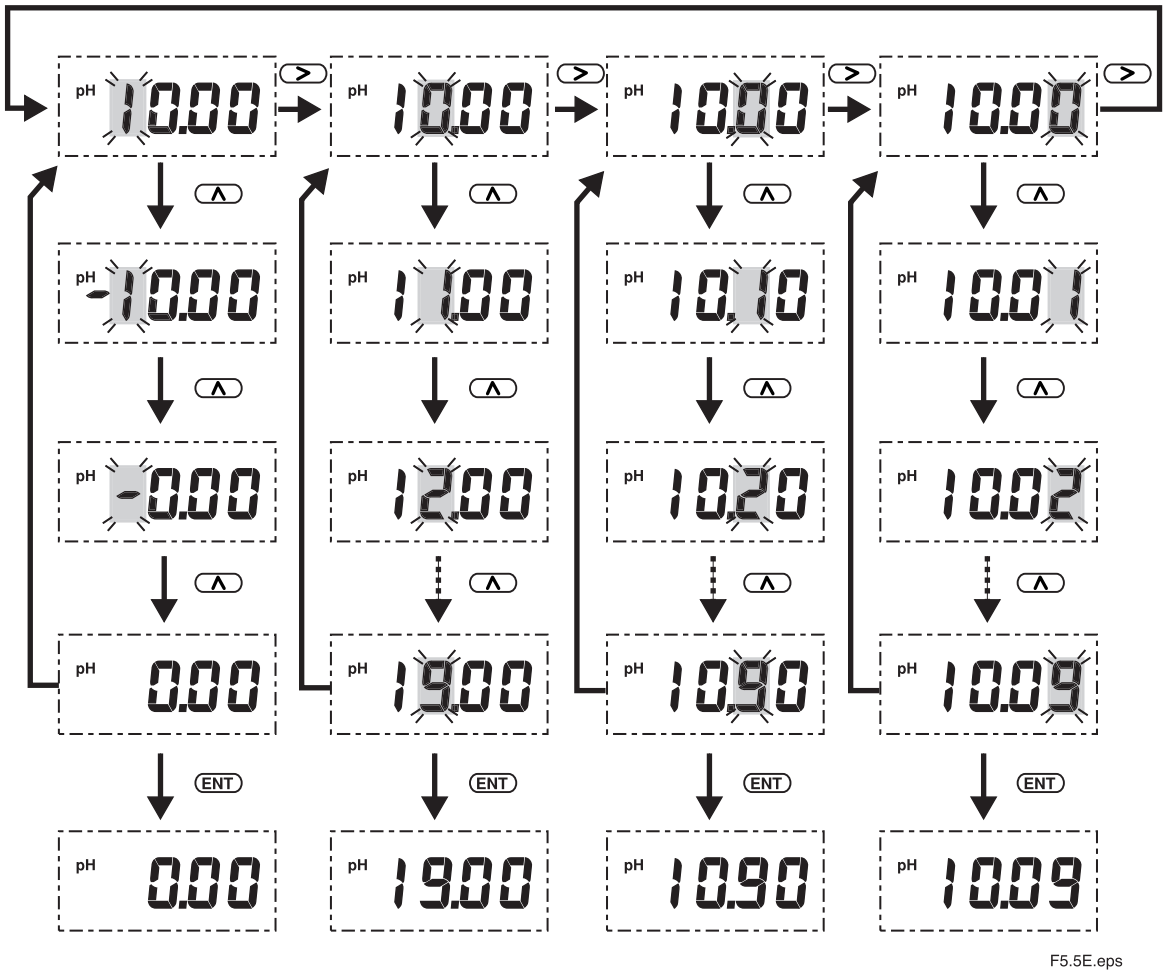
5.3.2 Operation When the ▷ , △ and ENT Displays Flash

When ▷, △ and ENT flash on the operator key indicator, it means that data entry for the message displayed in the message area is requested. Move the digit in the data area by pressing the > key, increment the flashing digit by pressing the ∧ key, and then press the ENT key to set it.

(Example)



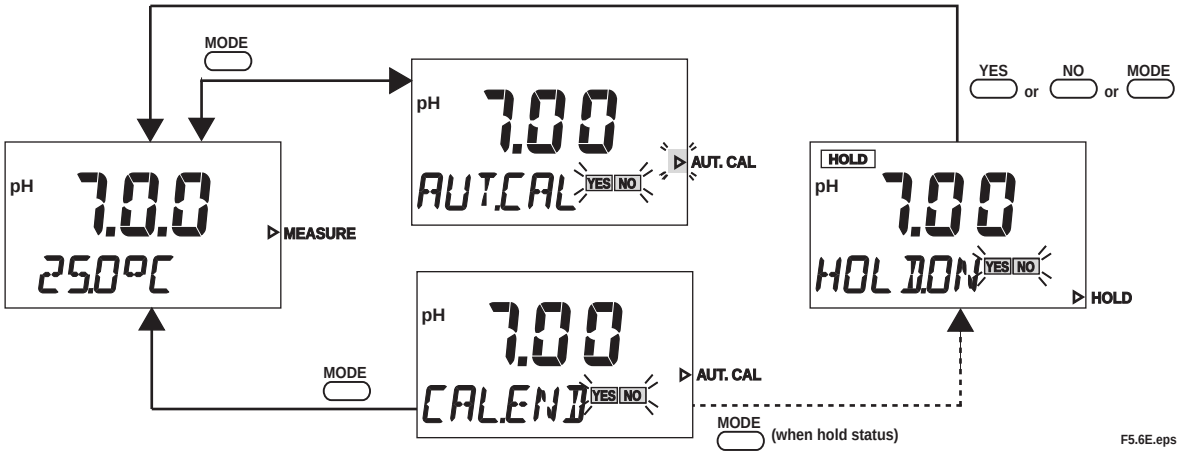
F5.4E.eps



5.3.3 Mode Selection Operations at the Operation Level

Press the MODE key when entering another mode from the measurement mode or returning to the latter from the former. If in the hold status (HOLD is lit), first enter the hold mode and then return to the measurement mode.

(Example)



5.3.4 Switching Operation to Setting Level

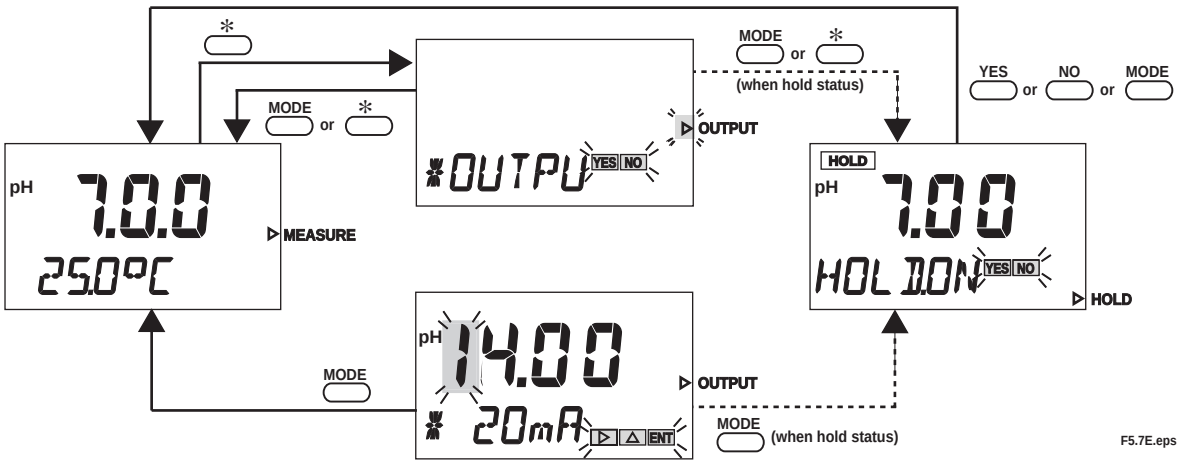
Loosen the 4 screws and remove the case cover from the intelligent pH converter. Press (*) key to change to the setting level.

When returning to the measurement mode in the operation level from the setting level, press the (MODE) key.

The (*) key also is effective when any one of *SETP, *OUTPU, *SET.HD, *WASH is displayed in the message area.

However if in the hold status when returning to the measurement mode, return via the hold mode as direct return to the measurement mode is not possible.

(Example)



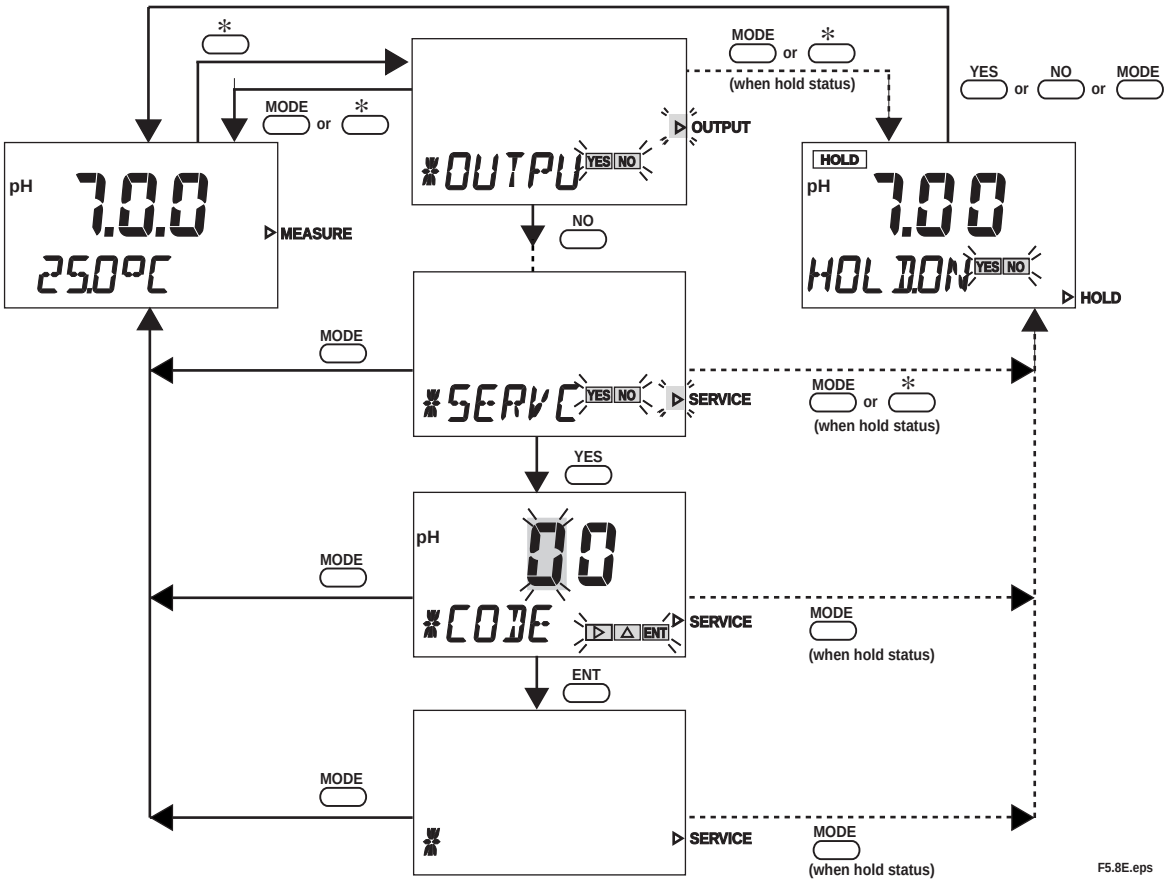
5.3.5 Switching Operation to Service Level

First switch to the setting level using ✻ key. Then, using NO key select *SERVC, and press YES key to enter the service mode.

Press MODE key when returning from the service level to the measurement mode in the operation level. ✻ key also is effective when *SERVC is displayed in the message area.

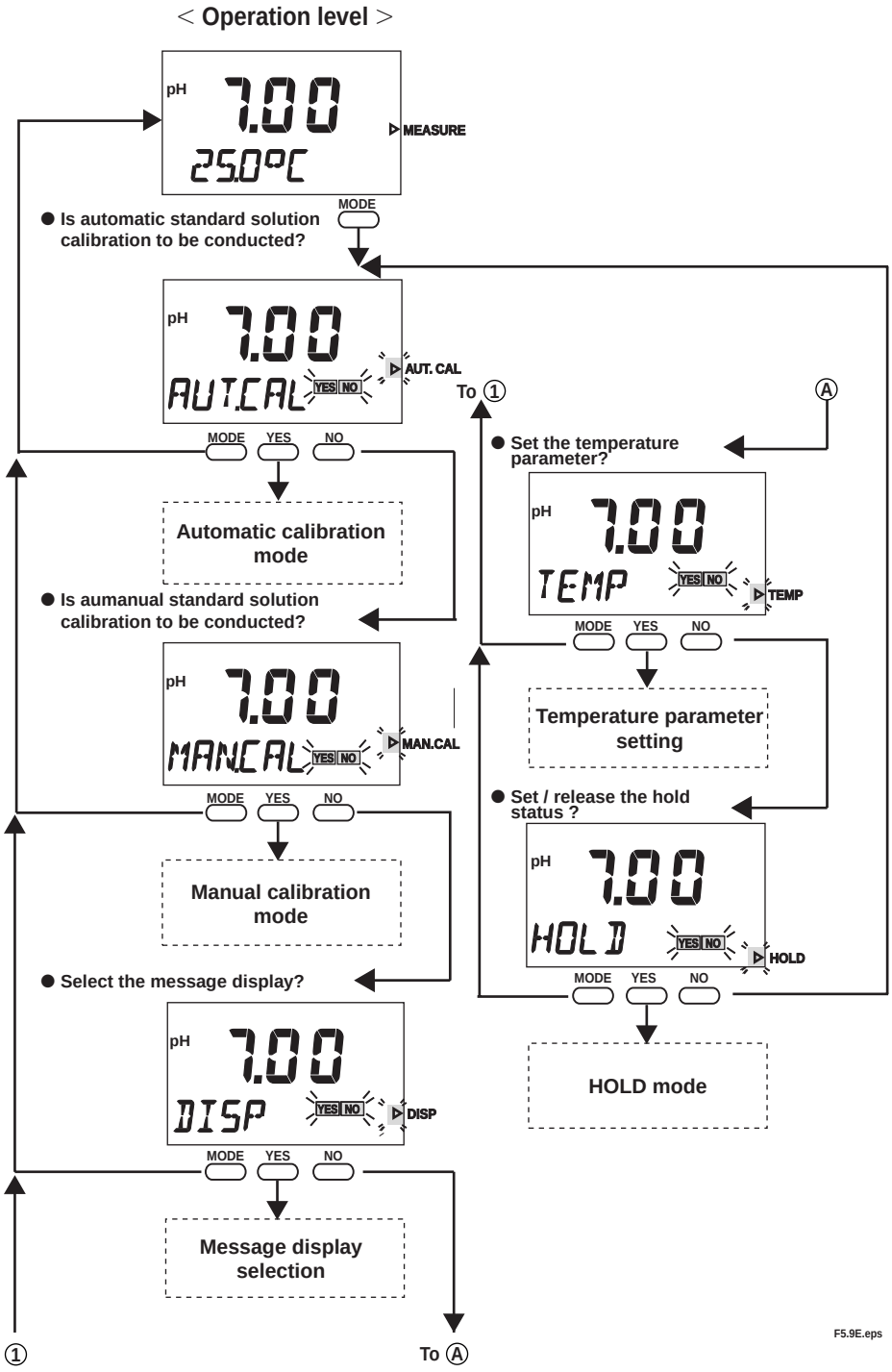
If in the hold mode when returning to the measurement mode, return via the hold mode as switching to the measurement mode is not available.

(Example)



5.4 Level and Mode Selection Procedures

5.4.1 Mode Selection in the Operation Level



(1) MEASURE (Measurement mode)

pH display and message display (any one of temperature, mA output, mV output, e.m.f, asymmetry potential, e.m.f. slope, reference electrode impedance, and 90% response time) are performed.

(2) AUT.CAL (Automatic calibration mode)

① Using YES NO key, select a value for buffer solution calibration; pH7, pH4 or pH9.

② When selected, data display flashes and automatic calibration is performed.

③ When finished, the message display turns to CAL.END.
If one point calibration is required, press the YES key to finish the calibration.
In the case of two point calibration, press the NO key to do a second calibration.

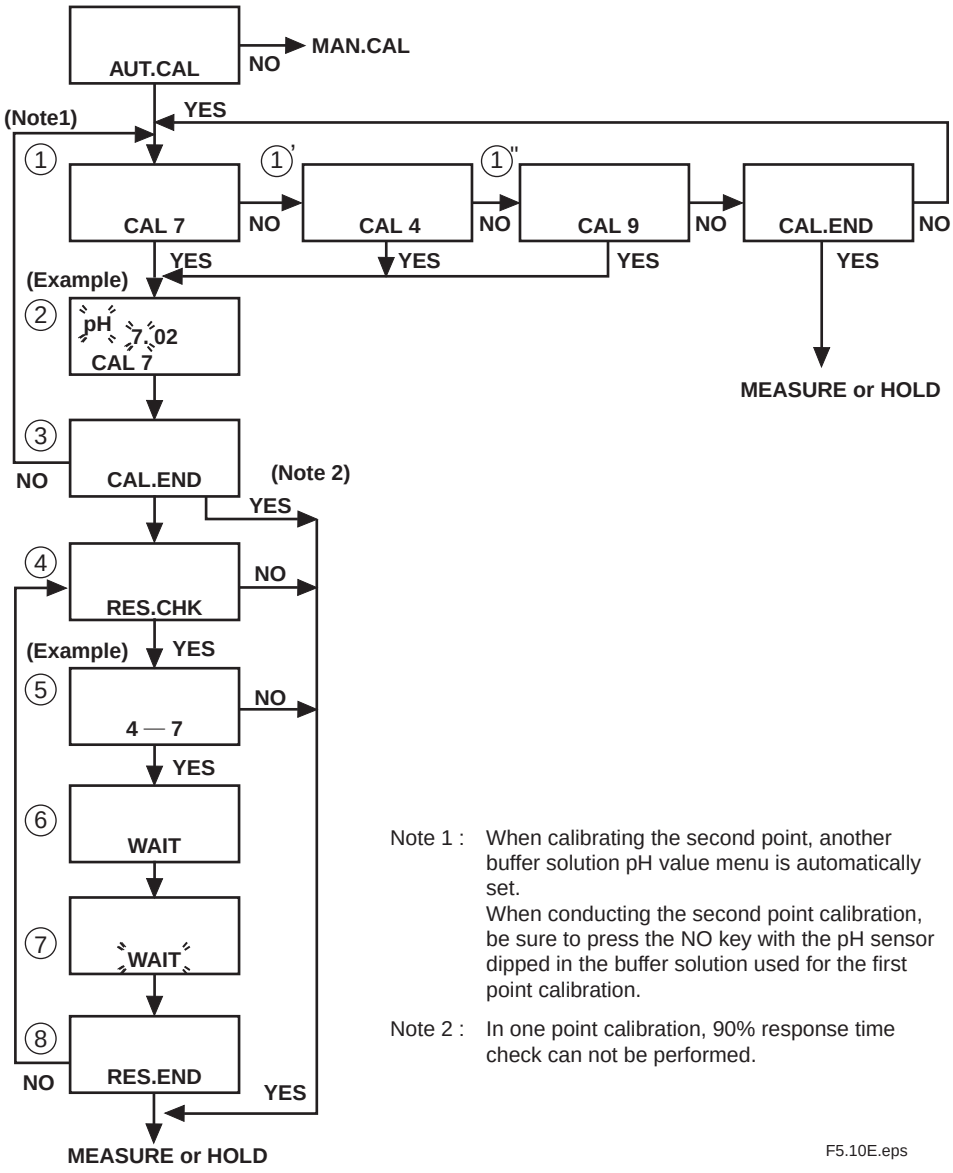
④ After finishing two point calibration, press YES key to proceed to the 90% response time check.

⑤ pH values of the first and second buffer solutions to be used for 90% response time check are displayed.

⑥ Remove the pH sensor from the first buffer solution.

⑦ As soon as the pH sensor is dipped into the second buffer solution, start measuring the response time.

⑧ When finished, RES.END is displayed.



Note 1 : When calibrating the second point, another buffer solution pH value menu is automatically set.
When conducting the second point calibration, be sure to press the NO key with the pH sensor dipped in the buffer solution used for the first point calibration.

Note 2 : In one point calibration, 90% response time check can not be performed.

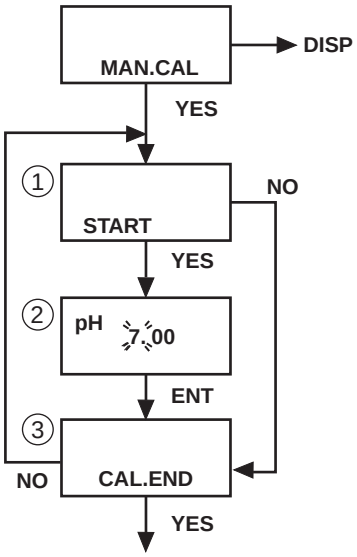
F5.10E.eps

(3) MAN.CAL(Manual calibration mode)

① When START display is ON, press YES key to enable manual calibration.

② Set a pH value using > and ∧ key, and enter it by pressing ENT key to perform calibration.

③ When CAL.END is displayed, press the YES key to end (WAIT is displayed for two to three seconds).
When two point calibration is required, press the NO key.



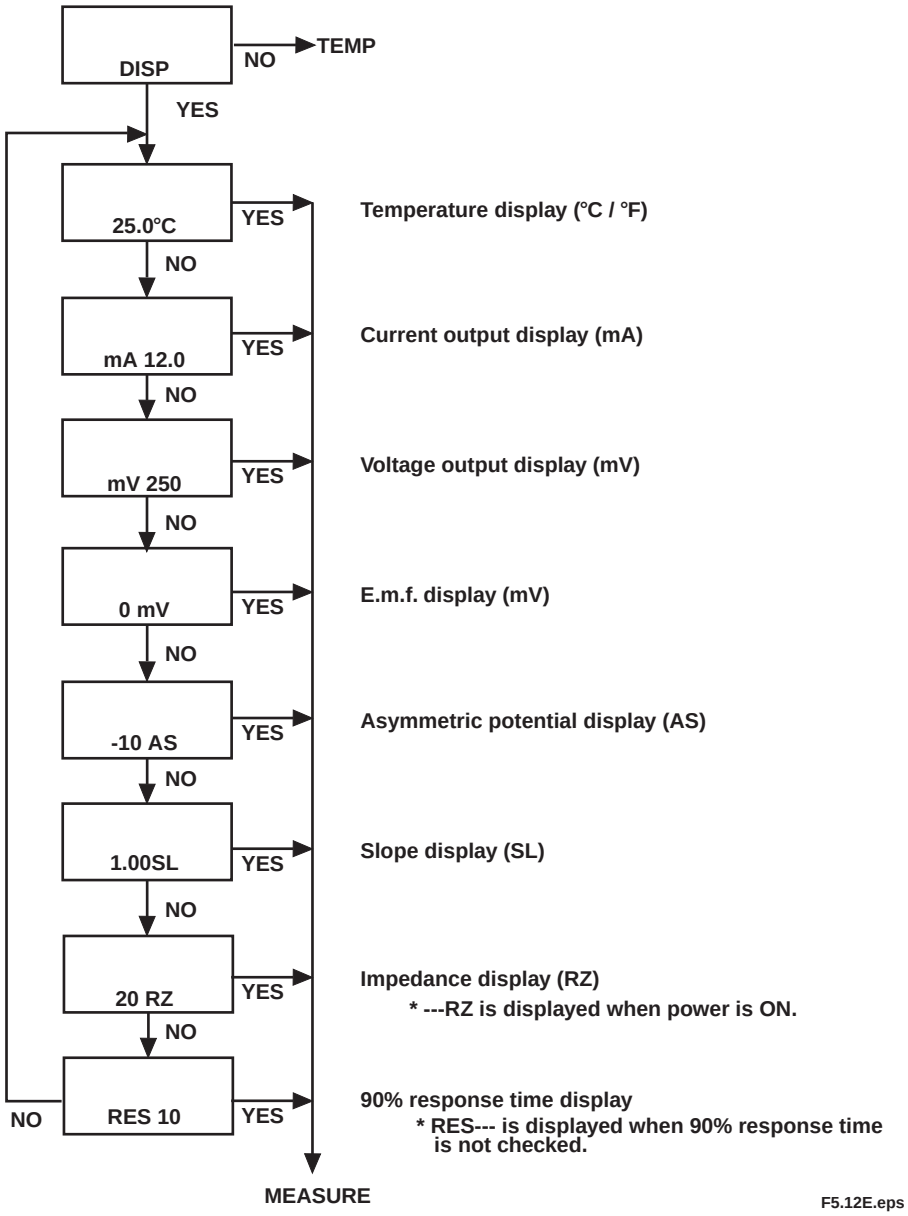
After WHAT is displayed,
MEASURE or HOLD is displayed.

F5.11E.eps

(4) DISP (Message display selection mode)

Press the MODE key, then the YES and NO keys to select DISP.

Temperature (°C/ °F), current output (mA), voltage output (mV), display e.m.f (mV), asymmetric potential (AS), slope (SL), impedance (RZ) and 90% response time(RES) can be displayed.

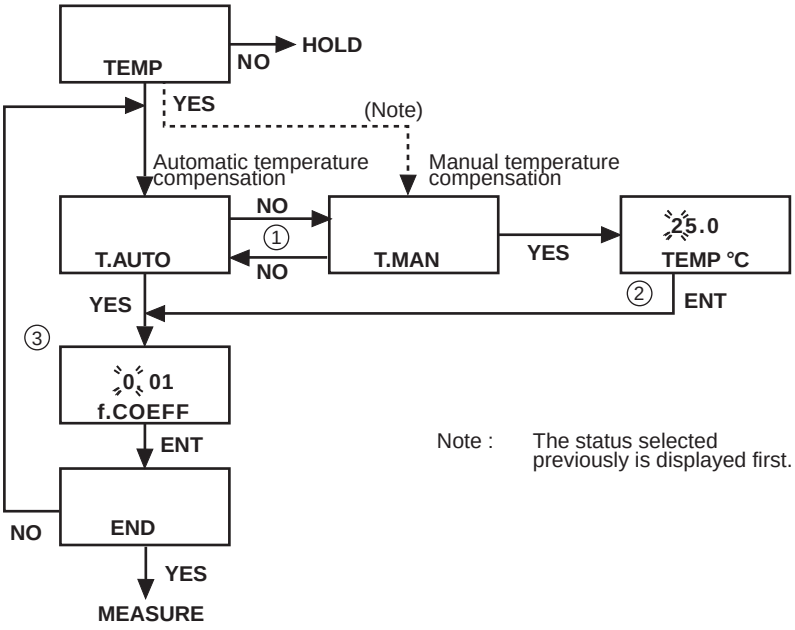


(5) TEMP(Temperature parameter setting mode)

① Select either automatic temperature compensation or manual temperature compensation.

② When manual temperature compensation is selected, measure the buffer solution temperature and set the value.

③ Set the temperature coefficient at the time of conversion to the reference temperature (25 °C). However, if conversion function to the reference temperature is set to OFF in service code 01, ignore this step.

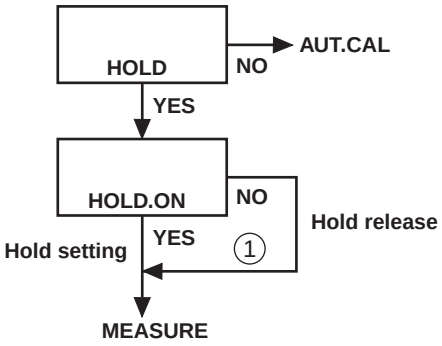


F5.13E.eps

(6) HOLD (hold ON/OFF mode)

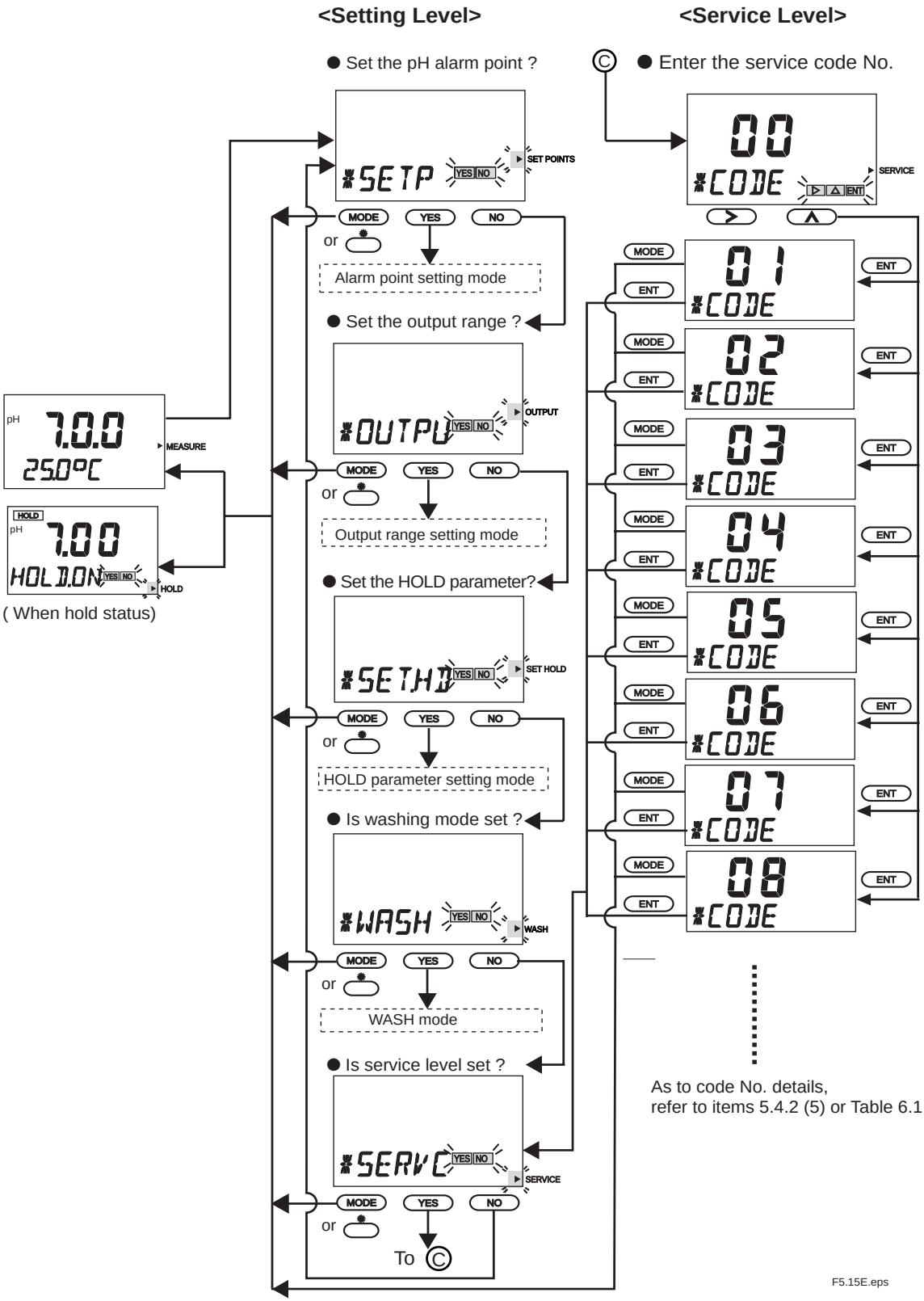
When HOLD.ON is displayed, select either setting or release. Press the YES key to set and the NO key to release. If the MODE key is pressed during HOLD.ON display, the NO key is deemed to have been pressed. When HOLD is set or during the hold status, HOLD is displayed.

Note: HOLD mode is skipped unless *HLD.ON is set at the hold parameter setting mode in the setting level.



F5.14E.eps

5.4.2 Mode and Setting Item Selection in the Setting / Service level



(1) *SETP (Alarm point setting mode)

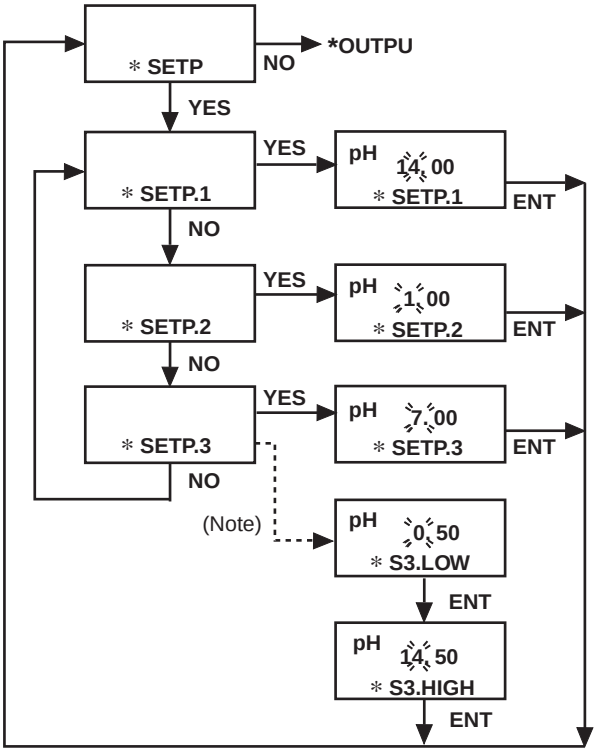
Only when at least one upper or lower limit alarm (high-high limit or low-low limit alarm is included in the case of S3) of S1, S2 or S3 contact output is set in service code 14, 15, 16, is the corresponding alarm point set in pH values.

When the contact output is not set for alarming, this mode is skipped.

① Set alarm point of contact S1

② Set alarm point of contact S2

③ Set alarm point of contact S3



F5.16E.eps

Note:
Set each high-high (low-low) alarm point respectiveiy only when contact S3 is set for high-high (low-low) alarm in the service code 16.

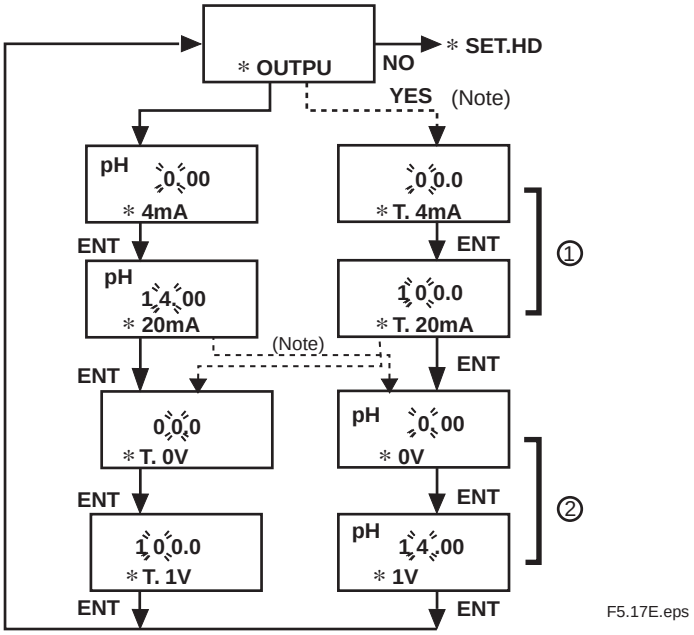
(2) *OUTPU (output range setting mode)

Press the (*) key to enter setting level, then the (∧), (ENT) keys to select *OUTPU.

Set a pH value (1pH span or more) or a temperature value (50 °C or more span) corresponding to 4 to 20 mA output and 0 to 1V output. Selection of either pH value or temperature-matching mA output and mV output is set in the service code 12. 13. If mA output and mV output are set to OFF, this mode is skipped.

① Set the pH value or temperature at 4 mA and 20 mA for mA output.

② Set the pH value or temperature at 0 V and 1 V for mV output.



Note: The menu automatically appears according to the setting in the service level.

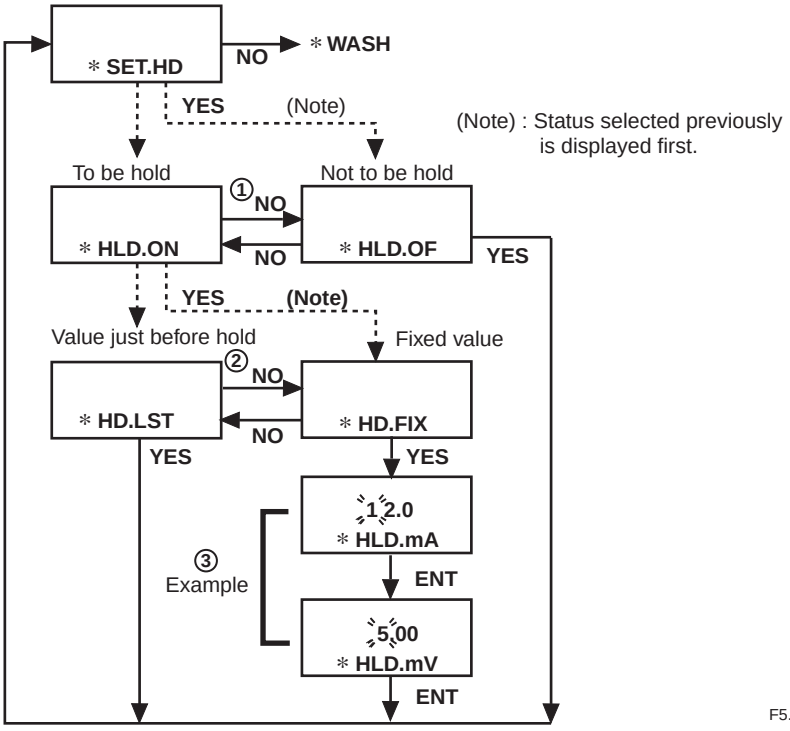
(3) *SET. HD (Hold parameter setting mode)

Set parameter for mA output and mV output hold.

① Select Hold ON/OFF (*HLD.ON or *HLD.OF). If *HLD.ON is selected, output is hold (output is in the hold status) when the automatic calibration mode or manual calibration mode is started in the operation level. When the setting level or service level is initiated, or automatic washing is being performed the output holds automatically and shifts to the hold status. Hold mode in the operation level holds the output manually. If *HLD.OF is selected, the output will not be held.

② When *HLD.ON is selected, set the value just before hold (*HD.LST) or the preset value (*HD. FIX) as the hold output value.

③ As a preset value, set mA output (*HLD.mA) and mV output (*HLD. mV). If mA output or mV output is left OFF in the service level, the preset value will be ineffective for the OFF output.



F5.18E.eps

(4) *WASH (Washing mode)

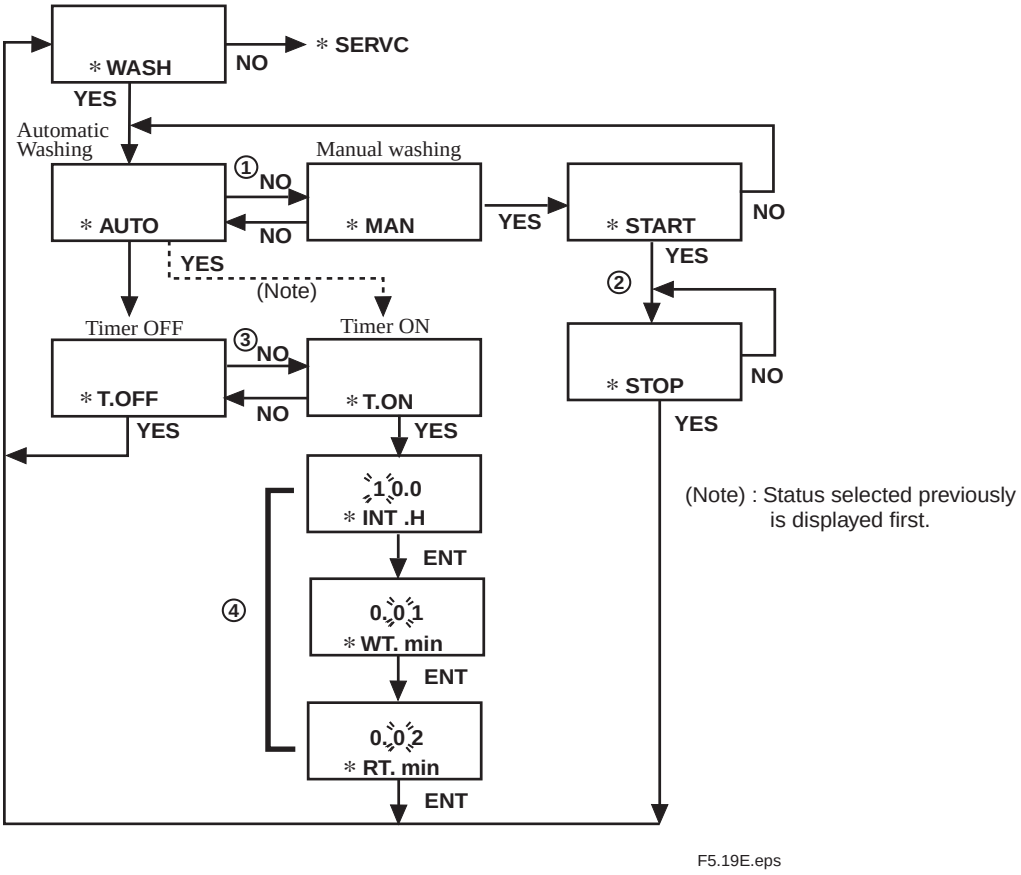
Only when S3 contact out is set "WASH" in the service code 16, this mode is effective. In other settings, the washing mode is skipped.

① Select either automatic washing or manual washing.

② Manual washing starts with *START (YES) and stops with *STOP (NO) .

③ In automatic washing, the timer function can be OFF (*T.OFF).

④ When the timer function is set ON (*T.ON), set the washing cycle *INT.H (in hours), washing time *WT. min (in minutes), and relaxation time *RT. min (in minutes).



F5.19E.eps

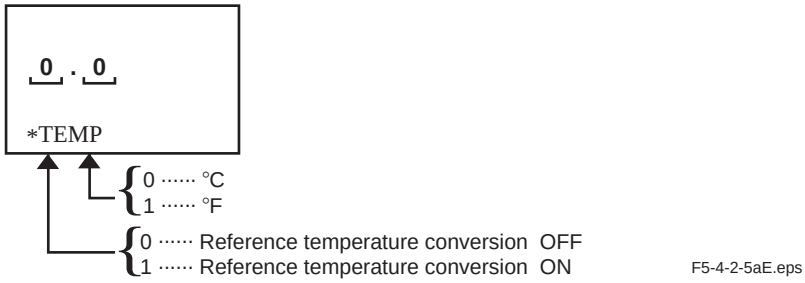
(5) *SERVC (service mode)

Service mode in the service level is composed of the following code. Enter the code No. needed to set the various parameters by pressing (>) ,(∧) ,and (ENT) keys.

CAUTION

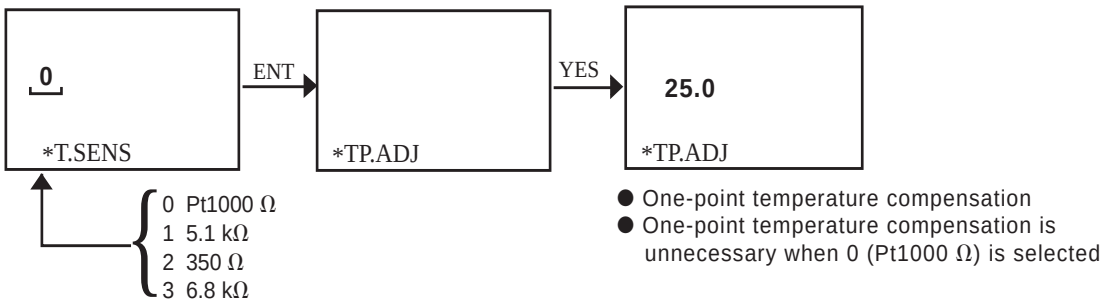
Never enter a code No. other than 01 to 25. If entered by mistake, press the (MODE) key immediately, as entering a code No. other than 01 to 25 may cause a malfunction.

● **01 *TEMP**



F5-4-2-5aE.eps

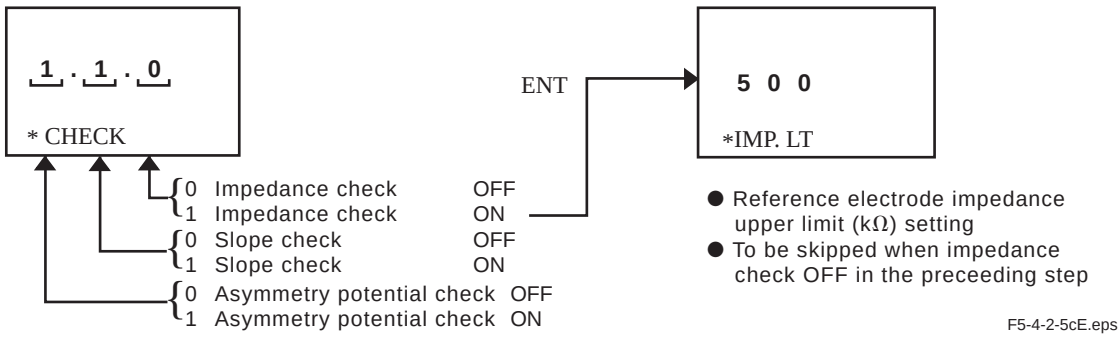
● **02 *T.SENS**



F5-4-2-5bE.eps

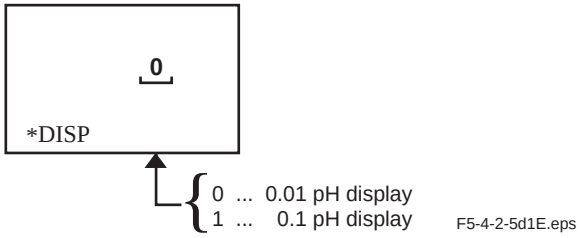
● To be used when selecting a temperature sensor for temperature.

● **03 *CHECK**

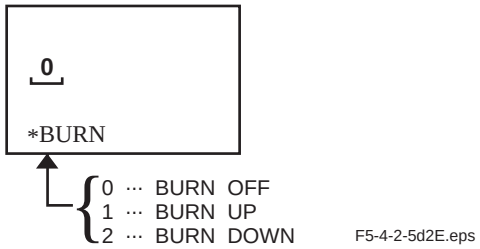


F5-4-2-5cE.eps

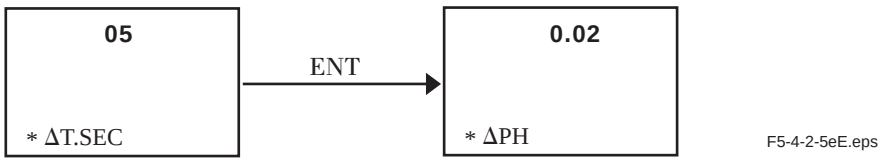
● 04 *DISP



● 05 *BURN



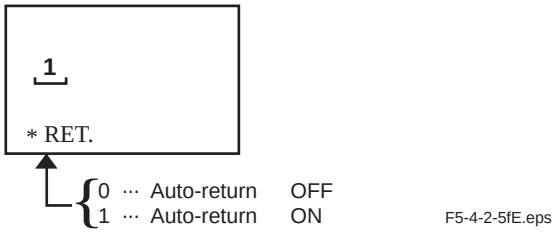
● 06 *ΔT.SEC



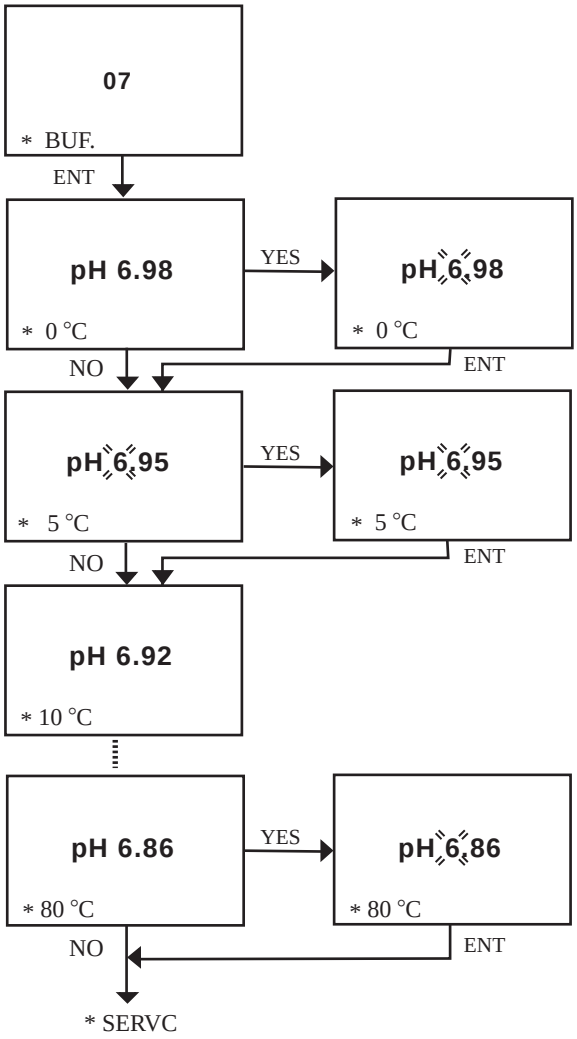
● Judging parameter (time Δt) setting for automatic calibration

● Judging parameter (ΔpH) setting for automatic calibration

● 07 *RET.



● 08 *BUF.

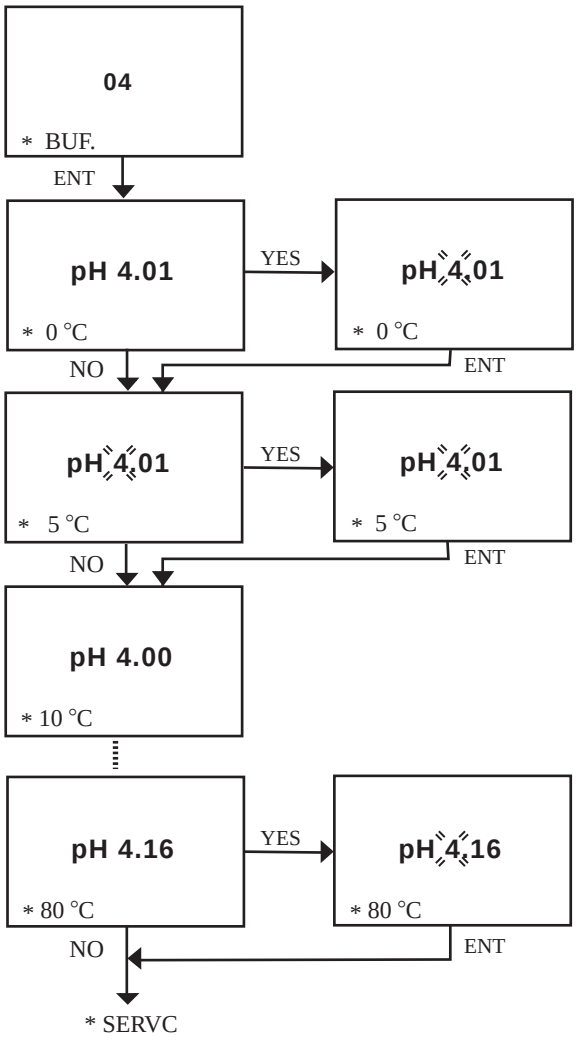


F5-4-2-5gE.eps

- pH value temperature characteristic(0 to 80 °C, in 5 °C steps) setting when automatically calibrated (can be entered into 3 tables totally using code 08, 09 or 10).

(Note): pH value to be entered is 0 to 14, which is equivalent to the value marked by ① in the figure of the previous item 5.4.1 (2). pH7 temperature characteristics (JIS Z8802) are input when shipped.

● 09 *BUF.

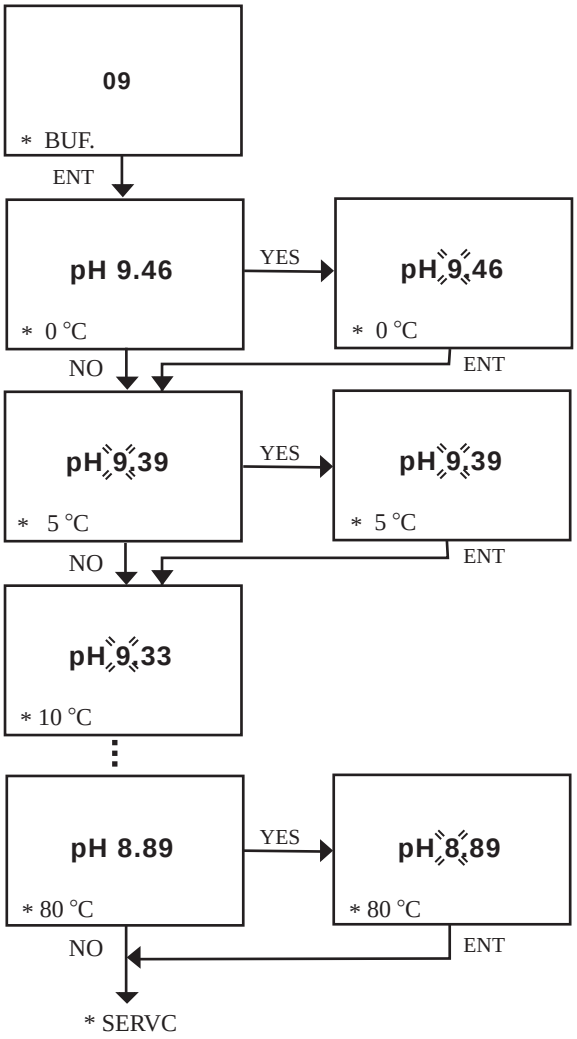


F5-4-2-5hE.eps

- pH value temperature characteristic (0 to 80 °C, in 5 °C steps) setting when automatically calibrated (can be entered into 3 tables totally using code 08, 09 or 10).

(Note): pH value to be entered is 0 to 14, which is equivalent to the value marked by ① in the figure of the previous item 5.4.1 (2). pH4 temperature characteristics (JIS Z8802) are input when shipped.

● 10 *BUF.

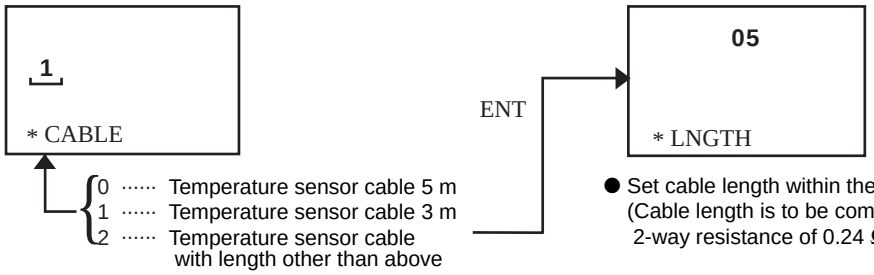


● pH value temperature characteristic (0 to 80 °C, in 5 °C steps) setting when automatically calibrated (can be entered into 3 tables totally using code 08, 09 or 10).

(Note): pH value to be entered is 0 to 14, which is equivalent to the value marked by ① in the figure of the previous item 5.4.1 (2). pH9 temperature characteristics (JIS Z8802) are input when shipped.

F5-4-2-5iE.eps

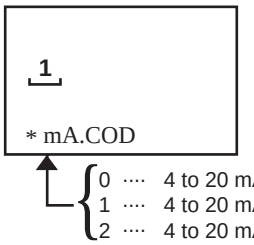
● 11 *CABLE



● Set cable length within the range of 5 to 50 m (Cable length is to be compensated based on 2-way resistance of 0.24 Ω per meter.)

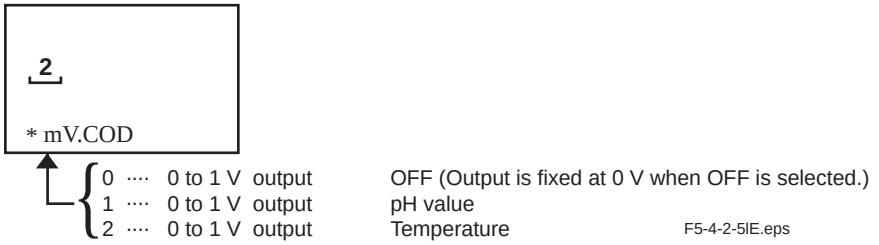
F5-4-2-5jE.eps

● 12 *mA.COD

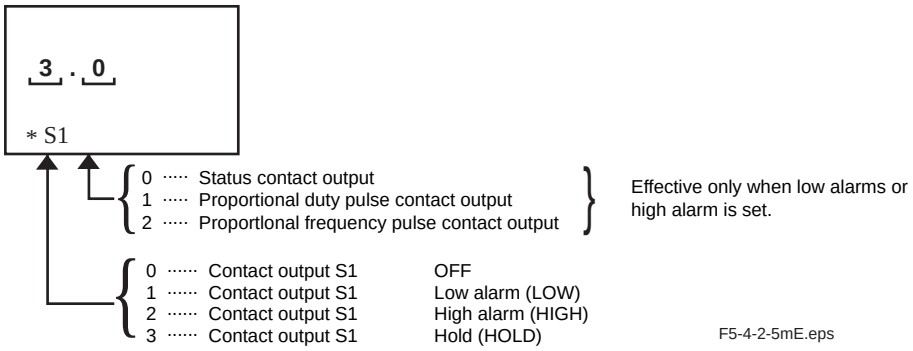


0 ···· 4 to 20 mA output	OFF (Output is fixed at 3.6 mA when OFF is selected.)	
1 ···· 4 to 20 mA output	pH value	
2 ···· 4 to 20 mA output	Temperature	F5-4-2-5kE.eps

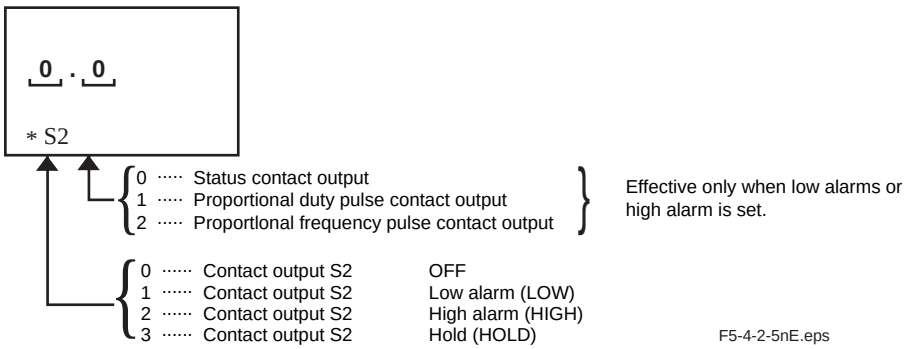
● 13 *mV.COD



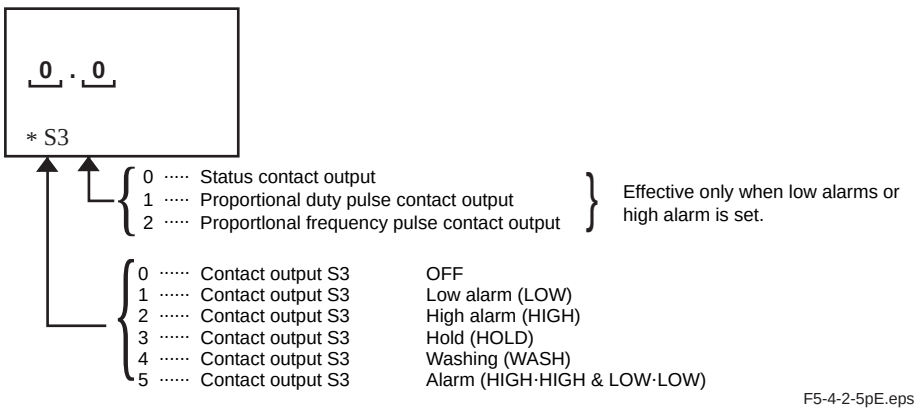
● 14 *S1



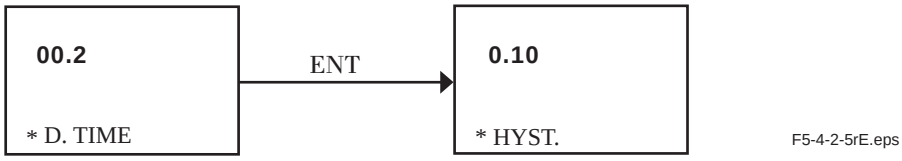
● 15 *S2



● 16 *S3



● **17 *D.TIME**

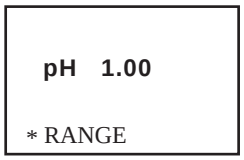


F5-4-2-5rE.eps

● Contact output delay time (sec) setting

● Contact output hysteresis (pH value) setting

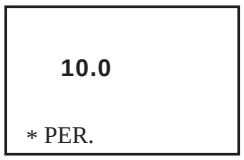
● **18 *RANGE**



● Control range (of pH) setting in proportional duty pulse contact output and proportional frequency pulse contact output

F5-4-2-5sE.eps

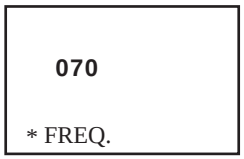
● **19 *PER.**



● Proportional duty pulse contact output cycle (sec) setting

F5-4-2-5tE.eps

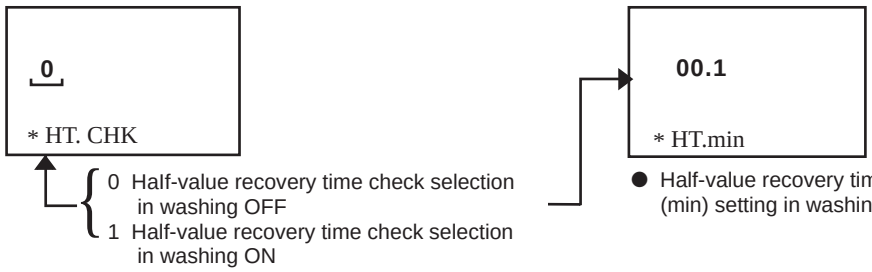
● **20 *FREQ.**



● Proportional frequency pulse contact output maximurn frequency (pulse/min) setting

F5-4-2-5uE.eps

● **21 *HT.CHK**

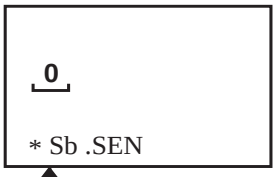


0 Half-value recovery time check selection in washing OFF
1 Half-value recovery time check selection in washing ON

● Half-value recovery time (min) setting in washing

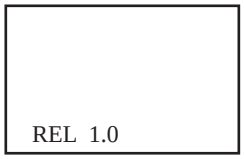
F5-4-2-5vE.eps

● 22 *Sb.SEN



{ 0 ..... Glass electrode selection
1 ..... Antimony electrode selection
(Code No.03 is skipped when antimony electrode is selected.) F5-4-2-5wE.eps

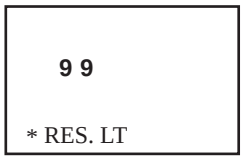
● 23 REL x.x



(Example)

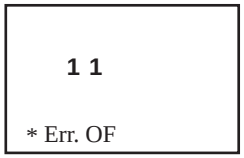
● Software version No. display F5-4-2-5xE.eps

● 24 * RES.LT



● 90% response time upper limit (sec) setting F5-4-2-5yE.eps

● 25 *Err .OF



(Example)

● Error reset (If a specific error occurs, it can be reset using this code otherwise this code will be skipped.) F5-4-2-5zE.eps

6. OPERATION

6.1 Operation Preparation

6.1.1 Wiring Inspection

Confirm if all the wiring throughout the system is properly connected (Refer to section 3.2).

When a ultrasonic oscillator is used, refer to the relevant instruction manual for wiring procedure. Also set the commands and data necessary for steady-state operation in the operation level.

6.1.2 Intelligent Outdoor pH Converter Operation

The intelligent outdoor pH converter is operated by turning the power ON. Supply power meeting the specifications. (It is clearly indicated on the nameplate.)

6.1.3 Data Setting

First set various data in the setting and service level so that operating conditions suitable for each individual process pH control are achieved. First set the service level data, then the setting level data, and finally the operation level data. Do not fail to keep the setting order.

Table 6.1 shows the setting item selection range and the status set at the time of shipment.

Tip

For key operation and display, refer to chapter 5 "Operation and Display ".

Table 6.1 Setting Items List (Set-value and setting range prior to shipment) (No. 1)

	Setting item		Initial value (prior to shipment)	Selection and setting Range
Operation level	**DISP (Message display selection mode)**			
	● Message area display detail selection		Temperature display	Process temperature, mA current, mV current, e.m.f., asymmetric potential, slope, reference electrode impedance, 90% response time
	TEMP (temperature parameter setting mode)			
	● Automatic/manual temperature compensation selection		Automatic (T. AUTO)	Automatic (T. AUTO), Manual (T. MAN)
	● Manual temperature setting		25.0 [°C]	-10.0 to 130.0 (°C)
	● Temperature coefficient setting (converted to reference temperature 25 °C)		0.00 [(pH/ °C)x10]	- 1.00 to 1.00 [(pH/ °C)x10]
Setting level	***SETP(Alarm point setting mode)**			
	● Contact output S1 alarm point		14.00 [pH]	-2.00 to 15.00 [pH]
	● Contact output S2 alarm point		1.00 [pH]	-2.00 to 15.00 [pH]
	● Contact output S3 alarm point		7.00 [pH]	-2.00 to 15.00 [pH]
	● Contact output S3 alarm point setting when high-high alarm or low-low alarm is set.	low-low	0.50 [pH]	-2.00 to 15.00 [pH]
		high-high	14.50 [pH]	-2.00 to 15.00 [pH]
	***OUTPU (output range setting mode)**			
	● pH value or temperature setting corresponding to 4 mA transmission output		0.00 [pH]	-2.00 to 15.00 [pH] or -10.0 to 130.0 [°C]
	● pH value or temperature setting corresponding to 20 mA transmission output		14.00 [p H]	-2.00 to 15.00 [pH] or -10.0 to 130.0 [°C]
	● pH value or temperature setting corresponding to 0 mV transmission output		0.0 [°C]	-2.00 to 15.00 [pH] or -10.0 to 130.0 [°C]
	● pH value or temperature setting corresponding to 1000 mV transmission output		100 [°C]	-2.00 to 15.00 [pH] or -10.0 to 130.0 [°C]
	***SET.HD (hold parameter setting mode)**			
	● Selection of ON / OFF at transmission output hold		ON (*HLD.ON)	ON (*HLD.ON) OFF (*HLD.OF)
	● Hold output value selection		Value just before hold (*HD.LST)	Value just before hold (*HD. LST), Fixed value (*HD. FIX)
	● Fixed value (*HD. FIX) setting	mA output (*HLD.mA)	12.0 [mA]	4.0 to 20.5 [mA]
		mV output (*HLD.mV)	500 [mV]	0 to 1025 [mV]
	***WASH (washing mode)**			
	● Automatic/manual washing selection		Automatic (*AUTO)	Autotmatic (*AUTO), Manual (*MAN)
	● Automatic washing ON/OFF selection		Automatic washing OFF (*T.OFF)	Automatic washing OFF (*T.OFF), Automatic washing ON (*T.ON)
	● Washing Interval setting (*INT. H)		10.0 [hour]	0.1 to 36.0 [hour]
	● Washing time setting (* WT. min)		0.1 [min]	0.1 to 10.0 [min]
	● Relaxation time setting (*RT. min)		0.2 [min]	0.1 to 10.0 [min]

T6.1E-1.eps

Table 6.1 Setting Items List (Set-value and setting range prior to shipment) (No.2)

	Setting item	Initial value (prior to shipment)	Selection and setting Range
Service level	**Code No. 01 (*TEMP)**		
	● Reference temperature conversion ON/OFF selection	OFF (0)	OFF (0), ON (1)
	● Temperature unit selection	°C (0)	°C (0), °F (1)
	Code No. 02 (*T. SENS)		
	● Temperature Sensor selection	Pt 1000 Ω (0)	Pt1000Ω (0), 5.1kΩ (1), 350 Ω (2), 6.8 kΩ (3)
	Code No. 03 (*CHECK, *IMP. LT)		
	● Asymmetric potential check ON/OFF selection	ON (1)	OFF (0), ON (1)
	● Slope check ON/OFF selection	ON (1)	OFF (0), ON (1)
	● Impedance check ON/OFF selection	OFF (0)	OFF (0), ON (1)
	● Reference electrode impedance high limit setting	500 [kΩ]	50 to 1999 [kΩ]
	Code No. 04 (*DISP)		
	● pH value display digit selection	0.01 pH display (0)	0.01 pH display (0), 0.1 pH display (1)
	Code No. 05 (*BURN)		
	● Output signal overflow OFF/UP/DOWN selection	OFF (0)	OFF (0), UP (1), DOWN (2)
	Code No. 06 (* ΔT. SEC, * ΔPH)		
	● Judging parameter(time Δt) setting (at the time of automatic calibration)	5 [s]	5 to 30 [s]
	● Judging parameter(time ΔpH) setting (at the time of automatic calibration)	0.02 [pH]	0.01 to 1.00 [pH]
	Code No. 07 (*RET.)		
	● Auto-return ON/OFF selection	ON (1)	OFF (0), ON (1)
	Code No. 08 (* BUF.)		
	● pH value temperature characteristics input (at the time of automatic calibration)	Temperature characte-ristics at pH 7 according to JIS	Temperature characteristics input in every 5 °C step over the range of 0 to 80 °C
	Code No. 09 (* BUF.)		
	● pH value temperature characteristics input (at the time of automatic calibration)	Temperature characte-ristics at pH 4 according to JIS	Temperature characteristics input in every 5 °C step over the range of 0 to 80 °C
	Code No. 10 (* BUF.)		
	● pH value temperature characteristics input (at the time of automatic calibration)	Temperature characte-ristics at pH 9 according to JIS	Temperature characteristics input in every 5 °C step over the range of 0 to 80 °C
	Code No. 11 (* CABLE, *LNGTH)		
	● Temperature sensor cable length compensation selection	5 m (0)	5 m (0), 3 m (1), Others (2)
	● Temperature sensor cable length compensation setting	5 [m]	5 to 50 [m]
	Code No. 12 (* mA.COD)		
	● 4 to 20 mA output selection	pH value (1)	OFF (0), pH value (1), Temperature (2)
	Code No. 13 (* mV.COD)		
	● 0 to 1 V output selection	Temperature (2)	OFF (0), pH value (1), Temperature (2)
	Code No. 14 (* S1)		
	● Contact output S1 Selection (types)	Hold (3)	OFF (0),Low (1), High (2), Hold (3)
	● Contact output S1 selection (Output form)	Status contact output (0)	Status contact output (0), Proportional duty pulse contact output (1), Proportional frequency pulse contact output (2)

T6.1E.-2eps

Table 6.1 Setting Items List (Set-value and setting range prior to shipment (No.3)

	Setting item	Initial value (prior to shipment)	Selection and setting Range
Service level	**Code No. 15 (* S2)**		
	● Contact output S2 Selection (types)	OFF (0)	OFF (0),Low (1), High (2), Hold (3)
	● Contact output S2 selection (Output form)	Status contact output (0)	Status contact output (0), Proportional duty pulse contact output (1), Proportional frequency pulse contact output (2)
	Code No. 16 (* S3)		
	● Contact output S3 Selection (types)	OFF (0)	OFF (0), Low (1), High (2), Hold (3), Washing (4), High-high Low-low (5)
	● Contact output S3 selection (Output form)	Status contact output (0)	Status contact output (0), Proportional duty pulse contact output (1), Proportional frequency pulse contact output (2)
	Code No. 17 (* D.TIME, *HYST.)		
	● Contact output delay time setting	0.2 [s]	0.1 to 20.0 [s]
	● Contact output hysteresis setting	0.10 [pH]	0.01 to 0.20 [pH]
	Code No. 18 (* RANGE)		
	● Control range setting in proportional duty pulse contact output and proportional frequency pulse contact output	1.00 [pH]	0.00 to 10.00 [pH]
	Code No.19 (* PER.)		
	● Proportional duty pulse contact output pulse cycle setting	10 .0 [s]	5.0 to 100.0 [s]
	Code No. 20 (* FREQ.)		
	● Proportional frequency pulse contact output maximum frequency setting	70 [pulse/min]	50 to 120 [pulse/min]
	Code No. 21(* HT.CHK, * HT.min)		
	● Half-value recovery time check selection in washing	OFF(0)	OFF (0), ON (1)
	● Half-value recovery time setting in washing	0.1 [min]	0.1 to 10.0 [min]
	Code No. 22 (* Sb.SEN)		
	● Glass electrode or antimony electrode selection	Glass electrode (0)	Glass electrode (0), Antimony electrode (1)
	Code No. 23 (REL x.x)		
	● Software version No. display	———	———
	Code No. 24 (*RES. LT)		
	● 90% response time upper limit setting	99 [s]	1 to 99 [s]
	Code No. 25 (*Err. OF)		
	● Error reset	———	———

T6.1E.-3eps

(1) Setting at the operation level

(a) AUT. CAL (automatic calibration mode) and MAN. CAL (manual calibration mode)

No setting is required for AUT.CAL (automatic calibration mode) and MAN.CAL (manual calibration mode), in which calibration using buffer solutions is made.
Also refer to "7. Calibration" for details.

(b) DISP (message display selection mode)

Select the display detail on the message area in steady-state operation (measurement mode) from the following items :
When shipped, the measured solution temperature display (℃) is set.

- The measured solution temperature (℃/ ℉)
  The measured solution temperature is displayed. But the set temperature is displayed when manual temperature compensation is set in TEMP (temperature parameter setting mode).
- mA output display (mA)
  The output signal value (mA) being transmitted currently is displayed.
- mV output display (mV)
  The output signal value (mV) being transmitted currently is displayed,
- e.m.f. display (mV)
  The current pH sensor glass electrode e.m.f (mV) is displayed.
- Asymmetry potential display (AS)
  The current asymmetry potential (for e.m.f. at pH7) is displayed.
- e.m.f. slope display (SL)
  Ratio of the current slope compared with the theoretical slope (electric potential gradient).
- Reference electrode impedance display (RZ)
  The current reference electrode impedance is displayed in a resistance value (kV)

  Note1: ---RZ display appears for some time after power ON.

  Note2: 0 RZ is displayed for pH sensors to which solution earth is not applied, such as fermentation pH sensors.

- 90% response time display (RES)
  90% response time is displayed when pH sensor 90% response time is checked in AUT.CAL (automatic calibration mode).

  Note: RES-- is displayed when 90% response time is not yet checked.

(c) TEMP(Temperature parameter setting mode)

● **Automatic temperature compensation/Manual temperature compensation selection**

Set T.AUTO when automatic temperature compensation is performed, i.e., when a pH sensor equipped with RTD is used. Set T.MAN when manual temperature compensation is performed or a pH sensor not having RTD is used. Then TEMP. MAN is displayed.
Set T. MAN for pH sensors not equipped with RTD such as fermentation pH sensor (Y/ 465). At the time of shipment, T. AUTO (automatic temperature compensation) is set.

● **Manual temperature setting (when T.MAN is selected)**

Measure the process temperature and set it when manual temperature compensation setting is selected. The setting range is from -10.0 °C to 130.0 °C. 25 °C is set at the time of shipment.

● **Temperature coefficient (T.COEFF) setting at the time of conversion to reference temperature**

This is settable only when conversion to reference temperature is set to 1 (ON) at service code 01. If turned to 0 (OFF), this menu will be skipped.
For conversion to reference temperature (reference temperature : 25 °C), set the coefficient between -1.00 and 1.00 [(pH/ °C) ×10]. The coefficient is set 0.00 ((pH/ °C)×10] at the time of shipment. Calculate the solution temperature coefficient using the following equation by measuring the pH values of a measured constant-solute concentration liquid at different temperatures. That is, the temperature coefficient to be entered in the pH converter is the value expressed in [ΔpH/ ΔT]×10. This value matches the pH value which varies in proportion to the measured solution temperature change of 10 °C.

$$\frac{\Delta pH}{\Delta T} \times 10 = \frac{\text{(pH value at the higher temp.)} - \text{(pH value at the lower temp.)}}{\text{(the higher temp.)} - \text{(the lower temp.)}} \times 10$$
$$= \text{Temp. coefficient } \alpha \text{ [(pH / °C)}\times 10\text{]}$$

Equation 6-1E.eps

For example, if the pH value is 9.20 at 20.0 °C, and pH 8.92 at 30.0 °C, the temperature coefficient will be as calculated below.

$$\alpha = \frac{8.92\ [pH] - 9.20\ [pH]}{30.0\ [°C] - 20.0\ [°C]} \times 10 = -0.28\ [(pH / °C)\times 10]$$

Equation 6-1E.eps

Besides the pH value displayed in the data area when conversion to reference temperature is performed is as shown below using the set temperature coefficient α.

(Displayed pH value) = (Measured pH value) − α × (T-25)/10

Note : pH measurement of measured solution (pure water) is impossible with an ordinary pH meter as the liquid easily absorbs CO_2 gas and therefore, is inappropriate as a means of measuring pH value by sampling the liquid. Therefore, it is necessary to measure pH in the actual process. However, the disadvantage of this measurement is that it is impossible to determine whether changes in pH are caused by a change isolate density or process temperature. Therefore, when measuring, pay a close attention to the above.

Although the actual measurement procedure varies with individual process conditions, refer to the following example as guidance.

(Example)

When liquid density has stabilized, change the measured process temperature by turning the sample line cooler ON and OFF. Measure pH value and process temperature after the process temperature has completely stabilized. Then, obtain the temperature coefficient from the above equation.

(d) HOLD (Hold mode)

When *HLD. ON is selected in *SET.HD (Hold parameter setting mode) in the setting level, manual hold or release on mA or mV output is enabled.

To hold output, press the YES key on the HOLD. ON display to enter into the hold status (then HOLD is displayed)

To release hold, press the NO key. At the time of pressing MODE key, NO key is deemed to have been pressed.

The value set in *SET.HD (Hold parameter setting mode) will be the hold value.

Note: This hold mode will be skipped if *HLD.OF is set in *SET. HD (Hold parameter setting mode).

(2)Setting at the setting level

(a) *SETP (Alarm point setting mode)

When an upper alarm (HIGH) or a lower alarm (LOW) (high-high or low-low alarm is included in the case of S3) is set as the contact output function of S1, S2 & S3 contact outputs at service code 14, 15 & 16, enter the corresponding alarm points in all values. If these functions are not selected for each contact output S1, S2 or S3, this alarm setting mode will be skipped. Moreover, in the alarm setting mode menu other than necessary one is not displayed.

●Contact output S1 alarm point setting
Set the alarm point ranging from -2.00 to 15.00 [pH]. 14.00 [pH] is set at the time of shipment.

●Contact output S2 alarm point setting
Set the alarm point ranging from -2.00 to 15.00 [pH]. 1.00 [pH] is set at the time of shipment.

●Contact output S3 alarm point setting
Set the alarm point ranging from -2.00 to 15.00 [pH]. 7.00 [pH] is set at the time of shipment. If high-high or low-low alarm is selected, however, low-low alarm point will be 0.50 [pH] and high-high alarm will be 14.50 [pH] when shipped.

(b)*OUTPU (Output range setting mode)

Set the pH value or temperature corresponding to 4 to 20 mA output or 0 to 1 V output. If both service code 12 and 13 are set to 0 (OFF), the output range setting mode will be skipped. Also, menu other than the necessary one is not displayed even within the output range setting mode.

●Output range setting corresponding to 4 to 20 mA output
Set the pH value or temperature corresponding to 4 to 20 mA output. Set pH values or temperatures at transmission output 4 mA and 20 mA within the range of - 2.00 to 15.00 [pH] or -10.0 to 130.0 °C. The span is to be 1.00 [pH] or more or 50.0 [°C] or more. At the time or shipment, the output range is set 0.00 to 14.00 [pH] corresponding to 4 to 20 mA output.

●Output range setting corresponding to 0 to 1 V output
Set pH values or temperatures at transmission output 0 mV and 1V within the range of -2.00 to 15.00 [pH] or -10.0 to 130.0 °C. The span is to be 1.00 [pH] or more or 50.0 [°C] or more. At the time of shipment, the output range is set to 0.00 to 100.0 [°C] corresponding to 0 to 1 V output.

(c)*SET. HD(Hold parameter setting mode)

Set each parameter on mA output and mV output hold

●Transmission output hold ON/OFF selection

Select *HLD. OF when transmission output hold is unnecessary. Select *HLD. ON when transmission output hold is necessary for maintenance etc. Once *HLD.ON selected, on entering the automatic calibration mode or manual calibration mode in the operation level, on performing automatic washing, or ON pressing ⊂*⊃ to enter the setting level, the transmission output is automatically held and enters into the hold status where [HOLD] lamp is lit.

Moreover the hold mode in the operation level enables manual transmission output hold. *HLD.ON is set at the time of shipment.

Note: The hold mode in the operation level is skipped if *HLD.OF is selected in the setting level.

●Hold output value selection (when *HLD.ON is selected)

Select *HD.LST when the hold output value is set at the output value just before hold. Select *HD. FIX when the hold output value is set at the preset value.

*HD.LST is set at the time of shipment.

●The preset value setting (when *HD.FIX is selected)

The preset value is set as follows :
mA output(*HLD. mA) : Selectable between 4.0 and 20.5 [mA]
mV output (*HLD. mV) : Selectable between 0 and 1025 [mV]

If mA or mV output is set OFF at the service mode, the preset value set here will be ineffective for the set OFF transmission output. The newly entered value will be effective after the time of re-entry into the hold status. The value is set at 12.0 [mA] and 500 [mV] at the time of shipment.

(d) *WASH (Washing mode)

Only when contact output S3 is set at "washing (WASH)" in the service mode, does this washing mode work. Otherwise this mode is skipped. In this mode each parameter on washing is set.

● **Automatic/ Manual washing selection**

Select *AUTO when automatic selection is selected to set each parameter on the washing timer. Press the NO key to select *MAN when Manual washing is required. In performing manual washing press the YES key at *START display to start the washing operation and press the YES key once again at *STOP display to stop the washing operation.

● **Automatic washing (washing timer) ON/OFF selection**

When automatic washing (the washing timer) is not used, always select *T.OFF. Select *T. ON only when the washing timer is used. Set the washing cycle t_{INT}, the washing time t_W, relaxation time t_R as shown in Figure 6.1 when *T. ON is selected. At the time of shipment *T. OFF is set.

WASH (flashing) is displayed in the message area when automatic washing is performed (contact output S3 is working) or during relaxation time. At that time, if MODE key is pressed, the operation in action will be cancelled.

Note 1: In Automatic/ Manual washing, the operation keeps working even if abnormal condition occurs and FAIL lamp is lit during the washing operation.

Note 2: Even in the abnormal condition the automatic washing and the manual washing operation is also usable.

Note 3: If the pH converter is in other mode than the measurement mode when the washing timer has counted the washing cycle t_{INT} to start automatic washing operation, the washing operation will not be carried out.

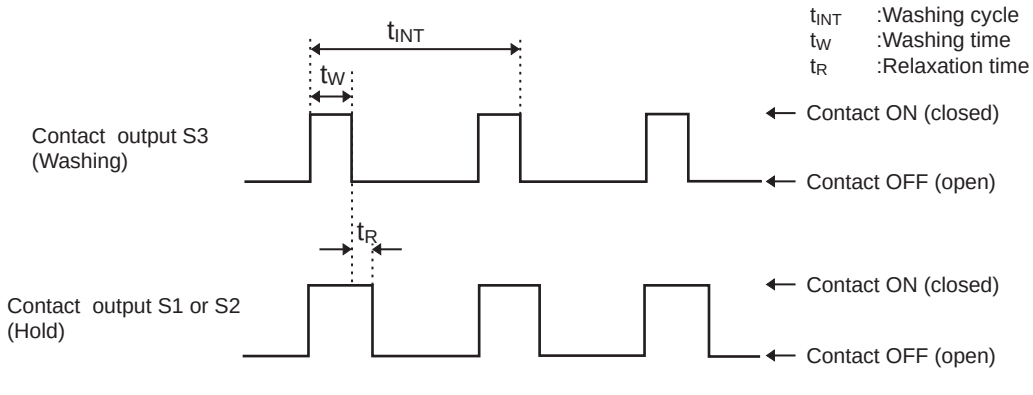


Figure 6.1 Contact Output when Washing Timer is used (Contact Output at the Time of Automatic Washing)

● **Washing cycle setting (when *T.ON is selected)**

Set the washing cycle (*INT.H) between 0.1 (hour) and 36.0 (hour).
0.0 (hour) is set at the time of shipment.

● **Washing time setting (when *T.ON is selected)**

Set the washing time (*WT.min) between 0.1 (min) and 10.0 (min).
0.1 (min) is set at the time of shipment.

● **Relaxation time setting (when *T.ON is selected)**

The relaxation time is to be set considering the time during which pH value fluctuation affected by washing liquid is stabilized after the washing operation is finished. Usually, as shown in Figure 6.1, the washing output contact is used with the hold output contact, and the hold output contact shifts from ON (closed) to OFF (open) after having passed this relaxation time counted from the time of the washing operation finish. Set the relaxation time (*RT. min) between 0.1 [min] and 10.0 [min]. 0.2 [min] is set at the time of shipment.

<Remote contact input >

The washing timer is driven by using the pH converter remote contact input when *AUTO and *T. ON are selected to perform automatic washing. R1 and R2 terminals on the pH converter terminal board are used for the remote contact input. In the following description, call "ON" when short-circuited between R1 and R2 and call "OFF" when opened between R1 and R2.

When automatic washing is performed with the washing cycle t_{INT} set at *INT. H as shown in Figure 6.2, the status between R1 and R2 becomes ON before the next washing begins, and the pH converter regards it as a manual start signal from outside and starts automatic washing after 0.25 sec. At that time the washing timer is non-reset. However, "ON" status between R1 and R2 must continue for more than 0.25 sec. just after the "OFF" status has continued for more than 0.25 sec. Otherwise the pH converter does not regard it as the manual start signal.

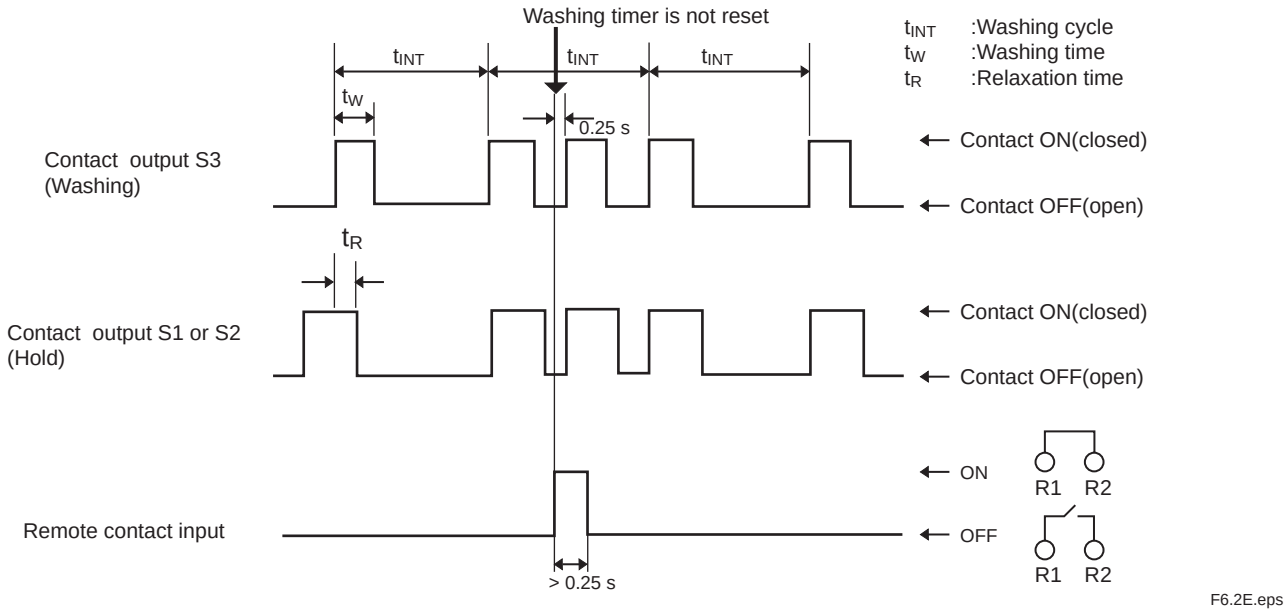


Figure 6.2 Contact Output when Washing Timer is Used (Contact Output with Remote Contact Input at the Time of Automatic Washing)

Note 1: Remote contact input is acceptable only when the pH converter is in the measurement mode and *AUTO and *T.ON is selected at the washing mode.

Note 2: In the same as the usual automatic washing, the automatic washing operation initiated by the remote contact input can be cancelled by pressing (MODE) key during the washing or relaxation time period. The washing operation initiated by the remote contact input continues working even if entered during abnormal status and the [FAIL] lamp is lit during the washing operation.

Note 3: Even if in the abnormal status ([FAIL] lamp is lit), the pH converter accepts the remote contact input.

(3) Setting in the service level

Enter code No. and set each parameter in the service level.

(a) Code 01: Temperature unit and conversion to reference temperature selection (*TEMP)

● Temperature unit (°C/ °F) selection

Set 0 when using °C as the temperature unit, and set 1 when using °F.
0 is set at the time of shipment.

● Conversion to reference temperature ON/OFF

Set 0 (OFF) unless otherwise required. At the time of shipment, 0 (OFF) is also set. When constituting a high purity water pH measuring system or conversion to reference temperature is required based on the definite measured process temperature coefficient, set 1 (ON). If 1 (ON) is set, conversion to reference temperature is automatically calculated from the set temperature coefficient with the reference temperature of 25 °C at TEMP (temperature parameter setting mode) in the operation level.

(b) Code 02: Selection of RTD for temperature compensation, and one-point temperature calibration (*T.SENS)

Select the type of the temperature sensor for pH electrode temperature compensation. At the time of shipment, "Pt1000 Ω " (RTD) is set enabling combination with EXA PH general use pH sensor PH8EFP KCl filling type, PH8ERP KCl refillable type or EXA PH high purity water pH sensor PH8EHP.

Select 1 (5.1 kΩ) when using pH pH sensor (PH8EFG, PH8ERG, PH8EHG), 2 (350 Ω) when using D602 pH sensor or 350 Ω RTD, or 3 (6.8 kΩ) when using 6.8 kΩ RTD. However, note that sensors other than those having the RTD temperature coefficient shown in Table 1.4 must not be used.
Make one-point temperature calibration at the process temperature normally operated without fail. When the type of the temperature sensor is selected, then perform the one-point temperature calibration at the process temperature normally operated.
However, only if 0 (Pt1000 Ω) is selected, can one-point temperature calibration be omitted,
The one-point temperature calibration procedure is as follows.

(1) Press (YES) key at *TP. ADJ display.
(2) Pour city water or the like into a fairly large container and dip the pH sensor to be calibrated into it.
(3) After confirming that the process temperature is sufficiently stabilized, read out the process temperature using the thermometer.
(4) Enter the above temperature reading using the (YES) key after setting using the (>), (∧) keys,

(c) Code 03: ON/OFF selection of Asymmentry potenial, Slope, Impedance each function (*CHECK)

Select use/no-use of each pH sensor self-diagnostic function check item.

Note : If 1 (antimony electrode) is set at service code 22, this code will be skipped.

● Asymmetry potential check ON/OFF selection

Set 1 if asymmetry potential (e.m.f. at pH7) confirmation is required when the buffer solution is used for calibration. Set 0 if it is not required. When the asymmetry potential exceeds the range ±120 mV as a result of calibration using buffer solution after 1 (asymmetry potential check ON) is set, FAIL display appears. 1 (ON) is set at the time of shipment.

● Slope check ON/OFF selection

Set 1 when the slope (electric potential gradient) confirmation is required when the calibration is performed using buffer solution. Set 0 when the slope check is not required. When the slope exceeds the range 70 to 110% of the theoretical value as a result of calibration using buffer solution after 1 (ON) is set, FAIL display appears. 1 (ON) is set at the time of shipment.

● Impedance check ON/OFF selection

Use or no-use of glass and reference electrode impedance checks under normal measurement (measurement mode) is selected. Set 1 when impedance check is required, and otherwise set 0.

When the glass electrode is damaged, disconnected or the reference electrode impedance exceeds the set value (arbitrarily set value) after 1 (ON) is set, FAIL display appears.

Note 1: Set the impedance check OFF when the measured solution conductivity is less than 50 μS/cm.

Note 2: When a pH sensor without solution earth, such as the fermentation pH sensor (Y/465), is used, impedance cannot be measured correctly. Set the impedance check OFF without fail.

Note 3: If the process temperature exceeds 60 °C, no impedance check on the glass electrode will be conducted, even if the impedance check ON is set.

● Reference electrode impedance upper limit setting (when impedance check 1 (ON) is set)

Set the reference electrode impedance upper limit in the range of 50 [kΩ] to 1999 [kΩ]. It is set at 500 [kΩ] at the time of shipment.

Note: Reference electrode impedance varies with application, Therefore the reference electrode impedance upper limit is required to be set for each application after having observed the impedance change with time.

(d) Code 04: pH value display digit selection (*DISP)

Select the pH value digit displayed in the data area. When displaying 0.01 (2 decimal places), set 0, and when displaying 0.1 (1 decimal place), set 1.
0 (2 decimal places) is set at the time of shipment.

Note : Even if the pH value display digit is set at 1 (1 decimal place), the pH value in the mode where data-settings are required, such as MAN.CAL. (manual calibra tion mode) and *OUTPU (output range setting mode), is displayed down to 0.01 (2 decimal places).

(e) Code 05: Output signal burn up/burn down/OFF selection (*BURN)

Select the transmission output signal status at the time of abnormality (FAIL display) occurrence.

If 1 (burn up) is selected, mA output will be 22 mA and mV output will be 1100 mV when abnormality occurs. If 2 (burn down) is selected, mA output will be 3.6 mA and mV output will be 0 mV. 0 (OFF) is set at the time of shipment.

Note1: When mA output OFF is set at service code 12 or mV output OFF is set at service code 13, the transmission output signal set to OFF always turns to a constant value and burn up/down is not performed.

Note2: When burn down is selected for mV output (0 to 1000 mV), the lowest output range limit value and the burn down value are the same (0 mV). Thus use caution.

(f) Code 06: Automatic calibration determination parameter setting (*ΔT.SEC, *ΔPH)

Set the parameter (time ΔT and pH value change allowance ΔpH) by determining whether the pH value measured is stabilized when the buffer solution is calibrated. If the pH value varies exceeding the ± ΔpH range for ΔT sec. after elapse of 3 minutes, an error message issues. (This time FAIL display does not appear. Refer to item 7.4 for details.)

● **ΔT (time) setting**

Set the stability check time between 5 [sec] and 30 [sec]. 5[sec] is set at the time of shipment.

● **ΔpH (pH value change allowance) setting**

Set the pH value change allowance between 0.01 [pH] and 1.00 [pH]. 0.02 [pH] is set at the time of shipment.

(g) Code 07: Auto-return ON/OFF selection (*RET.)

Auto-return function enables the pH converter to return automatically to the measurement mode (or in some cases the hold mode) when the pH converter is left without any key operation in a mode other than measurement mode. Auto-return time is approx. 60 minutes.
1 (ON) is set at the time of shipment.

(h) Code 08: pH value temperature characteristics setting at the time of automatic calibration (*BUF.)

pH value temperature characteristic at the time of automatic calibration is settable every 5 ℃ ranging from 0 ℃ to 80 ℃. At the time of shipment, pH value temperature characteristic for pH7 buffer solution is set. (Refer to Table 7.1)

(i) Code 09: pH value temperature characteristics entry at the time of automatic calibration (*BUF.)

pH value temperature characteristic at the time of automatic calibration is settable every 5 ℃ ranging from 0 ℃ to 80 ℃. At the time of shipment, pH value temperature characteristic for pH4 buffer solution is set. (Refer to Table 7.1)

(j) Code 10: pH value temperature characteristic entry at the time of automatic calibration (*BUF.)

pH value temperature characteristic at the time of automatic calibration is settable every 5 ℃ ranging from 0 ℃ to 80 ℃. At the time of shipment, pH value temperature characteristic for pH9 buffer solution is set (Refer to Table 7.1)

(k) Code 11: Temperature sensor cable length compensation selection and setting (*CABLE, *LENGTH)

Set the temperature sensor cable length to improve temperature measurement accuracy. Only when 0 (Pt1000 Ω) is selected at service code 02, can one-point temperature calibration be omitted and the temperature sensor used by setting only sensor cable length. This cable length compensation is to be made based on 0.24 (Ω) per 1 m of cable length (two-way).

● **Temperature sensor cable length selection**

When Pt 1000 Ω is selected, set 0 if the temperature sensor cable length is 5 m, set 1 if it is 3 m and set 2 in other cases. 0 (5 m) is set at the time of shipment.

● **Temperature sensor cable length setting**

When 2 (other length) is selected, the temperature sensor cable length is settable between 5 m and 50 m. 5 [m] is set at the time of shipment.

(l) Code 12: 4 to 20 mA output type selection (*mA.COD)

Select 0 when 4 to 20 mA output is turned to OFF, select 1 when it represents pH value, and select 2 when it represents temperature. When 0 (OFF) is selected, the output holds the fixed value (3.6 mA) even if the pH converter shifts to the hold status or abnormality occurs and the FAIL lamp is lit. 1 (pH value) is set at the time of shipment.

(m) Code 13: 0 to 1000 mV output type selection (*mV.COD)

Select 0 when 0 to 1000 mV output is turned to OFF, select 1 when it represents pH value, and select 2 when it represents temperature. When 0 (OFF) is selected, the output holds the fixed value (0 mV) even if the converter shifts to the hold status or abnormality occurs and the FAIL lamp is lit. 2 (temperature) is set at the time of shipment.

(n) Code 14: Contact output S1 function selection and output method (*S1)

● **Contact output function selection**

Select 0 when contact output S1 is turned to OFF, select 1 when it is used as lower limit alarm (LOW), select 2 when it is used as upper limit alarm (HIGH), and select 3 when it is used as hold (HOLD). When contact output S1 is not used, select 0 (OFF) without fail. 0 (OFF) is set at the time of shipment.

● **Contact output method selection**

Select 0 when contact output S1 method is status contact output, select 1 when it is proportional duty pulse contact output, and select 2 when it is proportional frequency pulse contact output. 0 (status contact output) is set at the time of shipment.

Note 1: Status contact output

Status contact output is a general output method which closes (ON) the contact output when the value exceeds the alarm point, hold status occurs or marks relay contact output during washing operation. Otherwise, opens (OFF) the contact output. (Refer to Figure 6.3)

The pH converter has the relay contact output of S1, S2, S3 and FAIL, but the FAIL relay contact output is always status output contact.

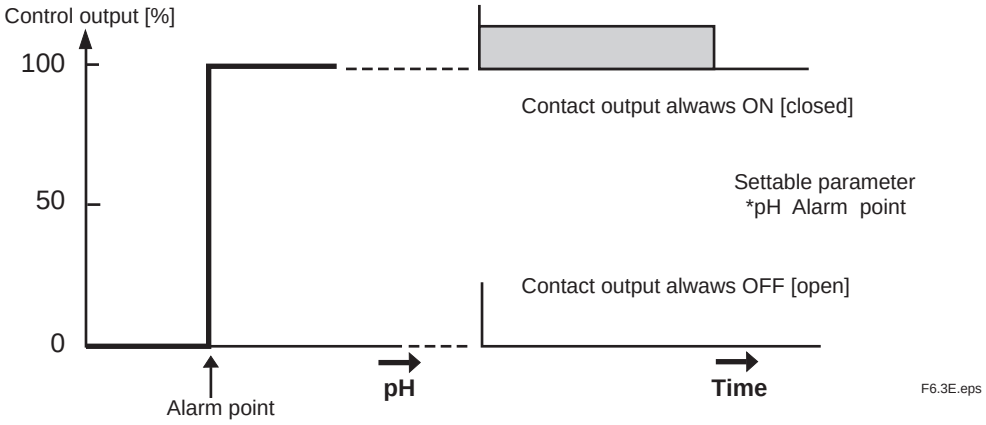


Figure 6.3 Example of Status Contact Output (in the case of upper limit alarm)

Note 2: Proportional duty pulse contact output

Proportional duty pulse contact output is an output method which sets ON/OFF action by controlling relay contact output duty ratio in proportion to the pH value change within the set control range. This proportional duty pulse contact output function is effective only when the lower limit alarm (LOW) or the upper limit alarm (HIGH) is selected. An example is shown in Figure 6.4. When the pH value is lower than the alarm point, the relay contact is always OFF (open). As the pH value increases and reaches the alarm point the relay contact starts ON/OFF action with the set duty ratio of 0.1 : 0.9 pulse cycle as shown in Figure 6.4 (α).

As the pH value increases more and reaches the pH value which is obtained by adding 50% of the set control range to the alarm point, it takes ON/OFF action with a 0.5 : 0.5 ratio as shown in Figure 6.4 (β). As the pH value increases even further to reach or exceed the value which is obtained by adding 100% of the set control range to the alarm point, it takes ON/OFF action with a 0.9 : 0.1 ratio as shown in Figure 6.4 (γ).

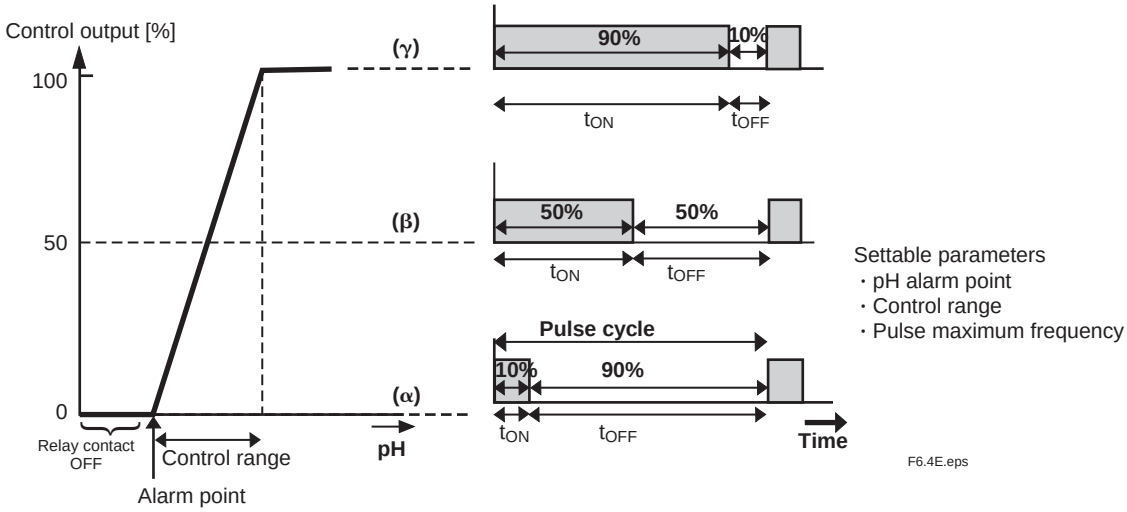


Figure 6.4 An Example of Proportional Duty Pulse Contact Output(in the Case of Upper Limit Alarm)

Note 3: Proportional frequency pulse contact output

Proportional frequency pulse contact output is an output method which performs ON/OFF action by controlling relay contact output fixed pulse (0.3 sec.) occurrence time (t), or occurrence frequency (1/t), in proportion to the pH value change within the set control range.

This proportional frequency pulse contact output function is effective only when the lower limit 1 alarm (LOW) or the upper limit alarm (HIGH) is selected.

An example is shown in Figure 6.5. As (α) in the figure shows, while the pH-value is below the alarm point, the relay contact is always OFF (open). As the pH value increases to reach or exceed the value which is obtained by adding 100% of the set control range to the alarm point, a fixed pulse occurs with the cycle(t) in proportion to the maximum frequency of the set pulse(1/t) as (β) shows. The relay contact is ON (closed) for 0.3 sec during the fixed pulse occurrence. The fixed pulse cycle within the set control range is given below as shown in Figure 6.5.

$$t \times (100/x) \quad (0 < x \leqq 100\%)$$

Here pH value is expressed in x% or control range (0 to 100%) starting from the alarm point. (Refer to Figure 6.5)

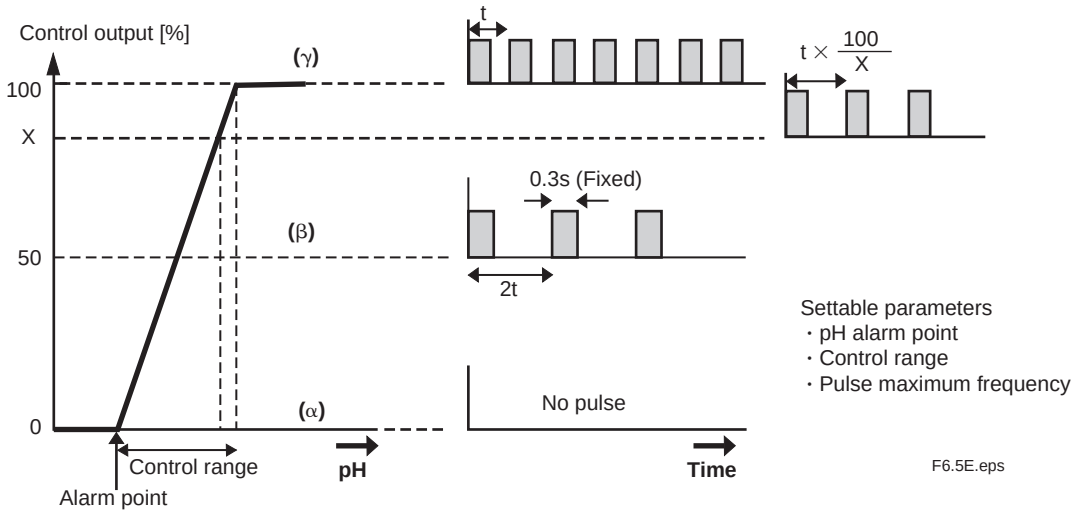


Figure 6.5 An Example of Proportional Frequency Pulse Contact Output (in the Case of Upper Limit Alarm)

Note 4: When using relay contact output (S1, S2, S3, FAIL), be sure to use them within the contact rating allowance.

Note 5: If the pH converter is in hold status (HOLD lamp lit.) or in abnormality occurrence (FAIL lamp lit) when the upper alarm(HIGH) or lower alarm (LOW) (in the case of S3, includes high-high or low-low alarm) is selected as the relay contact output (S1, S2, S3) function, these contact outputs will be temporarily ineffective, whichever contact output method is selected.

(o) Code 15: Contact output S2 function selection (*S2)

● Contact output function selection

Select 0 when contact output S2 is turned to OFF, select 1 when lower alarm (LOW) is required, select 2 when upper alarm (HIGH) is required and select 3 when hold (HOLD) is required. Set 0 (OFF) without fail when contact output S2 is not used. 0 (OFF) is set at the time of shipment.

● **Contact output method selection**

Select 0 when contact output S2 output method is status contact output, select 1 when it is proportional duty pulse contact output and select 2 when it is proportional frequency pulse contact output.

0 (status contact output) is set at the time of shipment.

(p) Code 16: Contact output S2 function selection (*S3)

● **Contact output function selection**

Select 0 when contact output S3 is turned to OFF, select 1 when lower alarm (LOW) is required, select 2 when upper alarm (HIGH) is required, select 3 when hold (HOLD) is required, select 4 when washing (WASH) is required, and select 5 when high-high alarm (HIGH.HIGH) or low-low alarm (LOW.LOW) is required. Set 0 (OFF) without fail when contact output S3 is not used. 0 (OFF) is set at the time of shipment.

● **Contact output method selection**

Select 0 when contact output S3 output method is status contact output, select 1 when it is proportional duty pulse contact output and select 2 when it is proportional frequency pulse contact output.

0 (status contact output) is selected at the time of shipment.

(q) Code 17: Contact output delay time and contact output hysteresis setting (*D.TIME,*HYST)

Set the delay time and hysteresis when upper limit alarm (HIGH) or lower limit alarm (LOW) (high-high and low-low alarm (HIGH.HIGH & LOW.LOW) are included for S3) is selected as a contact output function of S1, S2 or S3, and status contact output is set as a contact output method. An example is shown in Figure 6.6.

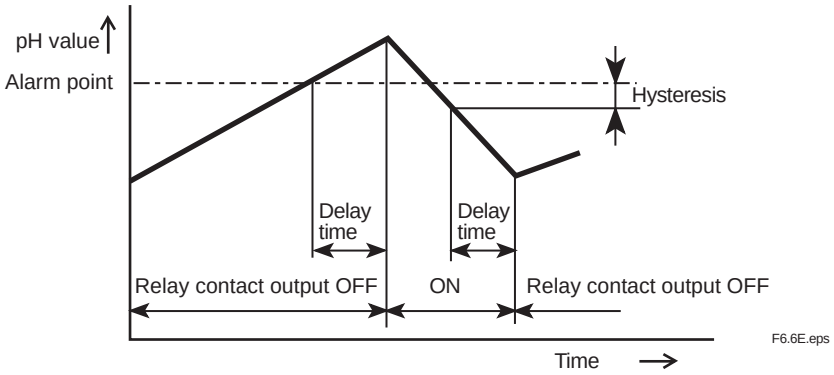


Figure 6.6 Delay Time and Hysteresis in Status Contact Output (in Case of Upper Limit Alarm)

● **Delay time setting**

Set the delay time between 0.1 [sec] and 20.0 [sec].

0.2 [sec] is set at the time of shipment.

● **Hysteresis setting**

Set the hysteresis between 0.01 [pH] and 0.20 [pH].

0.10 [pH] is set at the time of shipment.

(r) Code 18: Control range setting in proportional duty pulse contact output and proportional frequency pulse contact output (*RANGE)

Set the control range between 0.00 [pH] and 10.00 [pH] when proportional duty pulse contact output or proportional frequency pulse contact output is set as a contact output function (Refer to Figure 6.4 & Figure 6.5). 1.00 [pH] is set at the time of shipment.

(s) Code 19: Pulse cycle setting in proportional duty pulse contact output (*PER.)

Set the pulse cycle between 5.0 [sec] and 100.0 [sec] when proportional duty pulse contact output is set as a contact output function (Refer to Figure 6.4). 10.0 [sec] is set at the time of shipment.

(t) Code 20: Maximum frequency setting in proportional frequency pulse contact output (*FREQ.)

The fixed pulse occurrence cycle within the control range varies in proportion to the pH value as shown in Figure 6.5 when proportional frequency pulse contact output is set as a contact output function. It is used to set the fixed pulse occurrence cycle at 100% of the control range, or maximum frequency. But actually for convenience enter in terms of pulse number per minute. The setting range is from 50 [pulse/min] to 120 [pulse/min]. 70 [pulse/ min] is set at the time of shipment.

(u) Code 21: Half-value recovery time check ON/OFF selection and half-value recovery time setting after washing (*HT.CHK)

Half-value recovery time in washing pH sensor is the time needed for the pH value to recover to the intermediate value ((A+B)/2) between the pH value before washing (A) and the pH value during washing (B) from the time point when the washing is complete as shown in Figure 6.7. When half-value recovery time check is performed, confirm whether the pH value recovers to the intermediate ((A+B)/2) after having passed t_{half}, If it does not reach ((A+B)/2), an error (Err.11) occurs and FAIL display is lit.

Note: Confirm this half-value recovery time check only when washing liquid pH value differs widely from the measured solution pH value, such as chemical or acid cleaning, etc.

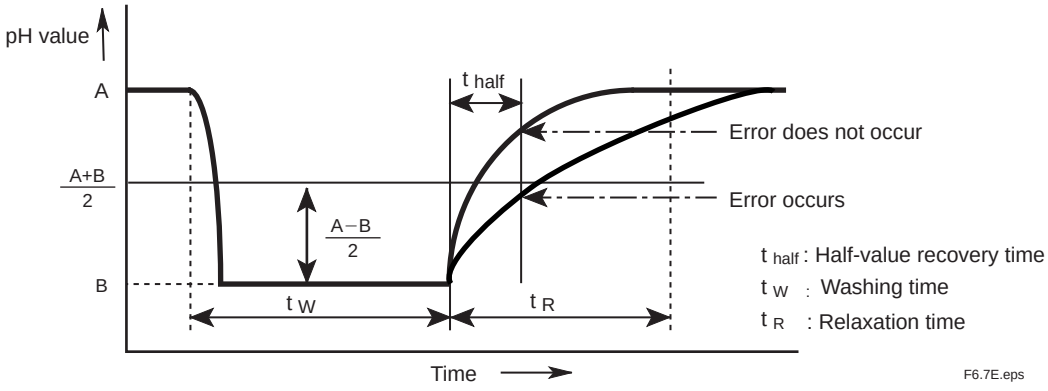


Figure 6.7 Half-Value Recovery Time after Washing

● **Half-value recovery time check selection after washing**

Set 1 when the half-value recovery time check is required in the washing the pH sensor; otherwise set 0. 0 (OFF) is set at the time of shipment.

● **Half-value recovery time setting after washing**

The half-value recovery time to be checked is settable between 0.1 [min] and 10.0 [min]. 0.1 [min] is set at the time of shipment.

(v) Code 22: Glass electrode or antimony electrode selection (*Sb.SEN)

Set 0 when using glass electrode as pH measuring electrode. Set 1 when using antimony electrode. 0 (glass electrode) is set at the time of shipment. Turn to 1 if antimony electrode is used.

Note: When antimony electrode is set, asymmetry potential check and slope check are not performed, i.e., service code 03 is skipped.

(w) Code 23: Software version No. display (REL x.x)

The software version No. currently being used is displayed and can be confirmed.

(x) Code 24: 90% response time upper limit value setting (*RES.LT)

Set 90% response time upper limit value between 1 [sec] and 99 [sec]. If exceeding the alarm point, FAIL display is lit entering into abnormal status. Refer to item 7.3 for details. 99 [sec] is set at the time of shipment.

(y) Code 25: Error reset (*Err.OF)

The error Err.11 can be cancelled and the abnormal status is released.

Note: This code will be skipped if an error does not occur.

6.1.4 Calibration Using Buffer Solutions

Each glass electrode has its own slightly different e.m.f. Thus be sure to conduct calibration using buffer solution AUT.CAL (automatic calibration mode) or MAN.CAL (manual calibration mode) before entering into steady-state operation. The e.m.f. of a glass electrode also changes gradually as it soils or as its own deterioration proceeds. Therefore the calibration using buffer solution must be performed

Therefore the calibration using buffer solution must be performed periodically and within a sufficient cycle to ensure that measuring errors do not exceed the tolerances. Also, refer to "7. Calibration" for calibration procedure using buffer solution.

6.1.5 Reserve Tank Pressurization

This applies when a pH sensor with a medium pressure reserve tank built into the flow through holder is used.

Pay attention to the following when setting reserve tank air pressure.

(1) Make sure that the measured solution doesn't flow backward in the reserve tank.
(2) KCl solution consumption should be as small as possible.

For details, see "reserve tank pressurization" in the pH sensor instruction manual.

6.1.6 Solution Characteristic and Submerged Sensor Status Inspections

Prior to starting steady-state operation, re-check the holder installation status along with the following.

(1) The solution characteristic during measurement should satisfy the conditions required by the pH sensor and holder specifications.
(2) When an immersion sensor guide and submersion holders are used, the sensor tip should always be immersed in the measured solution, even if the liquid level changes.

In addition, confirm the following points.

(1) Solution temperature

The PH8EFP KCl filling type pH sensor can be used with measured solution between -5 and 105 ℃ only when the sensor tip is immersed, (for the PH8ERP KCl refillable type pH sensor : -5 to 80 ℃), or between -5 and 80 ℃ when the section down to the sensor cable is immersed. Note, however, that maximum solution temperature is restricted by holder type, wetted part material and measured pressure.

- Maximum measured temperature is 50 ℃ when sensor suspension a guide holder made of hard chloride vinyl resin is used.
- The maximum solution temperature is 80 ℃ when the polypropylene resin sensor suspension guide holder is used.
- The maximum solution temperature is 100 ℃ or allowable maximum sensor operating temperature whichever is smaller, when the polypropylene resin submersion type holder is used.
- When the SUS316 flow-through type holder is used, maximum measured solution temperature corresponds to the maximum sensor limitation temperature
- When the polypropylene flow-through type holder is used, measured solution temperature is up to 80 ℃ at measured solution pressure of up to 100 kPa. It should be reduced in steps of 2 ℃ every time the pressure increases by 10 kPa.
- If a washing device is attached to the holder, the maximum measured solution temperature is 80 ℃.
- When the PH8EHP pH sensor for high-purity water is used, take into account the fact that measured process temperature in the PH8HH pure water holder becomes less than 50 ℃.

(2) Solution pressure

- When using the sensor suspension guide holder or submersion type holder, measured solution pressure is atmospheric. When the PH8ERP KCl refillable type pH sensor built into the flow-through type holder is used, pressure can be increased up to 200 kPa.
- When a general purpose pH sensor with a reserve tank is used with the sensor built into the flow-through type holder, pressure can be increased up to 10 kPa, but as a rule it should be atmospheric.
- Maximum solution pressure when general purpose a pH sensor with a reserve tank is used with the sensor built into the flow-through holder is 500 kPa. However, when a polypropylene resin holder is used, the pressure is restricted to that lower than 500 kPa in accordance with measured process temperature and ambient temperature. Also, measured solution pressure should be less than the air pressure at which the reserve tank is pressurized.

● When pH measurement is conducted using the holder for high-purity water, the pressure shown be atmospheric in the holder.

(3) Sensor immersion depth

When even the sensor cable is immersed in the measured solution, as happens when the sensor is installed on the sensor. suspension guide holder, sensor immersion depth is limited to 3 m.

(4) Measured Solution flow velocity

Flow velocity at a measured point when the submersion sensor guide holder and submersion holder are used is as a rule, limited to up to 2m/s. Also avoid remarkable turbulence flow and pulsation flow.

(5) Measured Solution flow rate

Measured solution flow rate passing through the flow-through holder should be between 3 to 11 l/min. When the holder for high-purity water is used, set the relationship between measured solution flow rate and conductivity as shown in Figure 6.8.

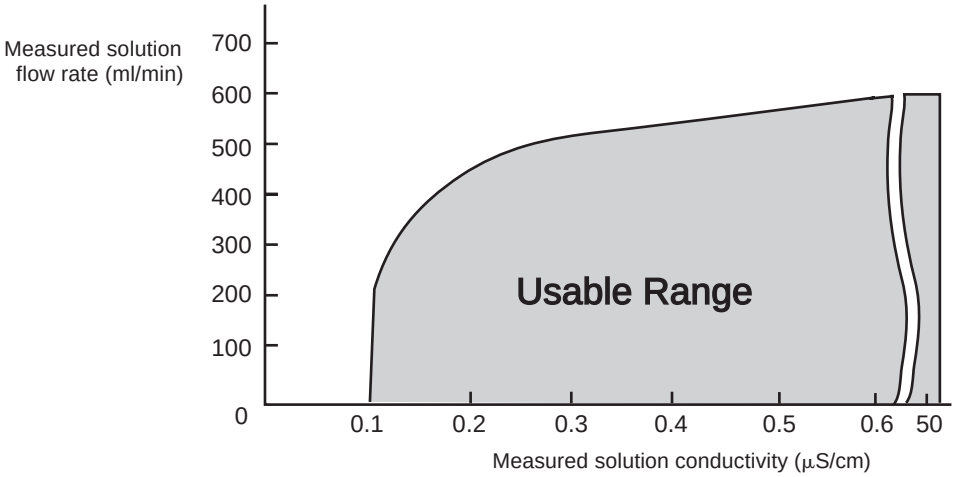


Figure 6.8 Measured Solution Conductivity and Flow Rate when High Purity Water Sensor is Used

6.1.7 Ultrasonic Oscillator

This applies when ultrasonic cleaning is done. First made sure that the power supply satisfies the ultrasonic oscillator specification, then turn the power switch on.

6.1.8 Cleaning Utility Supply

This applies when brush or jet water cleaning is done. During cleaning, be sure to supply cleaning water or air to the cleaning device at the specified pressure.

6.1.9 System Trial Operation

After having confirmed that the intelligent outdoor pH converter is operating normally, observe the operation status for a while to see if there are any problems.

6.2 Steady State Operation

For data display, manual temperature setting and buffer solution calibration in the operation level, it is not necessary to operate this instrument other than when charging the set value in the setting and service levels.

Maintain good operation by carrying out the daily maintenance inspection described in chapter "8. Maintenance".

When an error display appears, a contact signal at abnormality occurrence is output and/or the signal overscales, check the cause in accordance with " 9. Troubleshooting", then take the appropriate steps immediately.

6.3 Operation Suspension and Re-open

Data set to this instrument is reserved even with the power turned off. Also, there is no limitation on power-off timing.

When suspending operation, stop supplying power to this instrument. If power is supplied to re-start this instrument, the instrument starts from the initial operation by resetting the status at operation stop. Therefore, if automatic cleaning is to be down, do it after the lapse of cleaning time.

7. CALIBRATION

It is normal for the pH sensor e.m.f. characteristic to differ from the reference value due to manufacturing dispersion and secular changes. This is especially the ease if the sensor has been used once, as the characteristic widely differs with operating conditions, even after a short period of time. Therefore, it is necessary to make correction on the electric circuit to ensure that the correct pH value is indicated.

The pH converter calibration using buffer solution is performed in the following two modes:

(1) AUT.CAL (automatic calibration mode)...Calibrates using buffer solutions of pH4, pH7 and pH9.
(2) MAN.CAL (manual calibration mode).... Calibrates using buffer solutions other than the above.

There are 2-types of calibration. One is two-point calibration (asymmetry potential and slope adjustment) using 2 kinds of buffer solution ; the other is one-point calibration (asymmetry adjustment only) using one kind of buffer solution. The latter (one-point calibration) is a simplified calibration method usable when measuring a solution showing almost the same pH value as the buffer solution used for calibration. Accordingly, two-point calibration is to be performed normally.

Be careful of the following points regarding calibration using buffer solution.

(1) Use the buffer solution showing the correct pH value. If it becomes degraded and its actual pH value is changed, correct calibration is not possible.
(2) If the buffer solution temperature changes, the measured value is not stabilized. Keep the buffer solution temperature constant during calibration.
(3) Do not switch operation between AUT. CAL (automatic calibration mode) and MAN. CAL (manual calibration mode) unless otherwise required, as the data value obtained from calibration might be altered by such switching.
(4) A pH sensor not equipped with RTD for temperature compensation, such as fermentation pH sensor, is required to measure the buffer solution temperature and the data entered into the pH converter.
(5) When using antimony electrode, keep the temperature of the buffer solution and the measured solution equal, because the pH converter does not make temperature compensation and correct calibration becomes impossible if the temperatures of both differ.

7.1 Automatic Calibration Using Buffer Solution

This instrument executes calibration automatically on the basis of the buffer solution data shown in Table 7.1 if any of the buffer solution values (pH4, pH7 and pH9) are selected in the automatic calibration (AUT. CAL) mode.

Table 7.1 Buffer Solution for pH Calibration vs. Temperature Characteristic (JIS Z8802)

Temperature (°C)	Buffer solution		
	pH4 (Phthalic acid base)	pH7 (Neutral phosphate base)	pH9 (Boric acid base)
0	4.01	6.98	9.46
5	4.01	6.95	9.39
10	4.00	6.92	9.33
15	4.00	6.90	9.27
20	4.00	6.88	9.22
25	4.01	6.86	9.18
30	4.01	6.85	9.14
35	4.02	6.84	9.10
40	4.03	6.84	9.07
45	4.04	6.83	9.04
50	4.06	6.83	9.01
55	4.08	6.84	8.99
60	4.10	6.84	8.96
70	4.12	6.85	8.93
80	4.16	6.86	8.89
90	4.20	6.88	8.85
95	4.23	6.89	8.83

T7-1E.EPS

7.1.1 Preparation

Prepare pH4 buffer solution (Note 1), pH7 buffer solution, two clean approx. 200 ml containers and pH sensor washing water such as high purity water. Also, in automatic calibration using buffer solution at manual temperature compensation, prepare a thermometer to measure buffer solution temperature,

Note: More accurate measured values can be obtained for sensors used for alkalic solution measurement if calibration is done with a buffer solution or pH9 instead of pH4. For 1-point calibration, prepare either of these buffer solutions. Buffer solution is included in optional accessory PH8AX. When powder is used, dissolve one pack in pure water so that the total solution volume becomes 500 ml.

When a sensor stand (for PH8EFP or PH8ERP sensor) is delivered, mount it on a pipe (50 mm nominal O.D.) as shown in Figure 7.1.

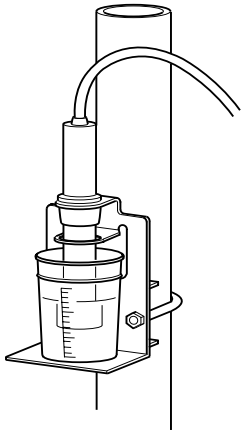


Figure 7.1 Example of Using Sensor Stand

7.1.2 Procedure for Automatic Calibration using Buffer Solution When Temperature is Automatically Compensated

(1) First press (MODE) key at the measurement mode.
Then "AUT.CAL [YES] [NO] " is displayed in the message area. Press (YES) key to go to AUT.CAL (automatic calibration mode), and [HOLD] is displayed in the display holding the transmission output.

Note: If *HLD. OF is selected in the setting level *SET.HD (hold parameter setting mode), the transmission output will not be held.

(2) At this time point, remove the pH sensor from the installation condition for operation.

(3) Clean the removed pH sensor tip using water and wipe away any water drops.

(4) Pour approx. 50 to 100 ml of the buffer solution for the first calibration into the container.

(5) Dip the pH sensor tip into the buffer solution in the container.

(6) "CAL7 [YES] [NO] " is displayed in the message area. Press (YES) key if the buffer solution for calibration is pH7 buffer solution. Otherwise press (NO) key to reach the same pH value display as the buffer solution used for calibration ; on confirming the right pH value display, press (YES) key.

Note: By pressing (NO) key, the display in the message area changes in following order ; "CAL7" → "CAL4" → " CAL9" → "CAL.END"→ "CAL7 ".

(7) At this time point, the pH value in the display flashes to detect automatically the measured pH value stability. When the pH value display stops flashing, the first automatic one-point calibration is performed and the calibration pH value is displayed. Then "CAL. END [YES] [NO] " is displayed to show that the first point calibration is completed.

Note: The measured pH value stability automatic detection determination parameter is settable at service code 06.

(8) Press (YES) key to finish calibration when one-point calibration is required; press (NO) key to enter into the second calibration when two-point calibration is required.

(9) Pour approx. 50 to 100 ml of the buffer solution for the second calibration into the container.

(10) Clean the pH sensor tip using water and wipe away any water drops.

(11) Dip the pH sensor tip into the buffer solution for the second calibration.

(12) "CAL4 [YES] [NO] " is displayed in the message area if the first buffer solution is for pH7. "CAL7 [YES] [NO] " will be displayed if the first buffer solution is not for pH7. Press (YES) key if the buffer solution for calibration has the same pH value as the value displayed in the message area. Otherwise press (NO) key to reach the same pH value display as the buffer solution used for calibration ; press (YES) key. In the same way as the first calibration when the measured pH value is detected to be stabilized, "CAL. END [YES] [NO] " is displayed to show that the second calibration is completed. Now two-point calibration has been performed.

Note: When an error occurs during calibration, error No. is displayed in the message area. But, even if abnormal events on automatic calibration may occur during calibration, [FAIL] display (abnormal status) is not invoked. In this case, take action referring to "7.4 Remedies When an Error Occurs During Calibration using Buffer Solution".

(13) Press (YES) key to finish the buffer solution calibration. Then "RES. CHK [YES] [NO] " is displayed to query whether the pH sensor 90% response time check is required or not. Press (NO) key to exit AUT.CAL(automatic calibration mode); press (YES) key to move forward if a pH sensor 90% response time check is required. For this method, refer to "7.3 90% Response Time Check".
(14) Return the pH sensor to the installation condition for operation.
(15) "HOLD.ON [YES] [NO] " is displayed in the message area. Press (NO) key to release the transmission signal hold status and return to the measurement status (measurement mode).

Note 1: If (YES) key is pressed, the converter returns to the measurement mode holding the transmission signal.

Note 2: If *HLD.OF is selected in the setting level *SET.HD (hold parameter setting mode), "HOLD.ON [YES] [NO] " is not displayed in the message area and the converter returns automatically to the measurement mode directly without passing the hold mode.

7.1.3 Procedure for Automatic Calibration using Buffer Solution When Temperature is Manually Compensated

(1) First select hold mode and press (YES) key on "HOLD.ON [YES] [NO] " display to hold transmission output.
Note 1: This operation is unnecessary if transmission output hold is not required.

Note 2: If *HLD.OF is selected in the setting level *SET.HD (hold parameter setting mode), the hold mode will be skipped and unavailable.

(2) At this time point, remove the pH sensor from the installation condition for operation.
(3) Clean the removed pH sensor tip using water and wipe away any water drops.
(4) Pour approx. 50 to 100 ml of buffer solution for the first calibration into the container.
(5) Dip the pH sensor tip into the buffer solution in the container.
(6) Measure the buffer solution temperature using a thermometer.
(7) Next select TEMP (temperature parameter setting mode) and press (YES) key on the "T.MAN [YES] [NO]" display to set the measured temperature.
(8) After these operations are over, select AUT.CAL (automatic calibration mode).
(9) "CAL7 [YES] [NO] " is displayed in the message area. Press (YES) key if the buffer solution for calibration is pH7 buffer solution; otherwise (for pH4 or pH9 solution) press (NO) key to get the same pH value display as the buffer solution used for calibration and eventually press (YES) key after reaching the right pH value display.

Note: By pressing (NO) key, the display in the message area changes in the following order; "CAL7"→"CAL4"→"CAL9"→"CAL.END"→"CAL7".

(10) At this time point, pH value in the display flashes to detect automatically the measured pH value stability. When the pH value is detected to be stabilized, the pH value flashing stops and the first point automatic calibration is performed and the calibrated pH value is displayed. Then "CAL. END [YES] [NO] " is displayed to show that the first point calibration is completed.
Note: The measured pH value stability automatic detection discrimination parameter is settable at service code 06.

(11) Press (YES) key to finish calibration when one-point calibration is required ; press (NO) key to enter into the second calibration when two-point calibration is required.

(12) Pour approx. 50 to 100 ml of the buffer solution for the second calibration into the container.
(13) Clean the pH sensor tip using water and wipe away any water drops.
(14) Dip the pH sensor tip into the buffer solution for the second calibration.
(15) "CAL4 YES NO " is displayed in the message area if the first buffer solution is for pH7. If the first buffer solution is not for pH7, "CAL7 YES NO "will be displayed. Press YES key if the buffer solution for calibration has the same pH value as that displayed in the message area. Otherwise press NO key to reach the same pH value display as the buffer solution used for calibration ; press YES key after reaching the right selection. In the same way as the first calibration, when the measured pH value is detected to be stabilized, "CAL.END YES NO" is displayed to show that the second calibration is completed.

Note: When an error occurs during calibration, an error No. is displayed in the message area. But, even if abnormal events on automatic calibration may occur during calibration, FAIL display (abnormal status) is not invoked. In this case, take action referring to "7.4 Remedies When an Error Occurs During Calibration Using Buffer Solution".

(16) Press YES key to finish the calibration using buffer solution. Then "RES. CHK YES NO " is displayed to query whether the pH sensor 90% response time check is required or not. Press NO key to exit AUT. CAL(automatic calibration mode); press YES to move forward if a pH sensor 90% response time check is required. For this method, refer to "7.3 90% Response Check".
(17) Return the pH sensor to the installation condition for operation (measurement mode).
(18) "HOLD.ON YES NO " is displayed in the message area. Press NO key to release the transmission signal hold status and return to the measurement status (measurement mode).

Note 1: If YES key is pressed, the converter returns to the measurement mode holding the transmission output.

Note 2: If *HLD.OF is selected in the setting level *SET.HD (hold parameter setting mode), "HOLD.ON YES NO" is not displayed in the message area and the converter returns automatically to the measurement mode directly without passing the hold mode.

Note 3: Remember to make manual temperature setting of the measured solution when the buffer solution calibration is completed.

7.2 Manual Calibration using Buffer Solution

Select MAN. CAL (manual calibration mode) when using buffer solution other than pH4, pH7 and/or pH9 buffer solution.

Note: It is possible to perform manual calibration using pH4, pH7 and pH9 buffer solution, but, normally automatic calibration is recommended in the case of using these buffer solutions, because of much easier operation.

7.2.1 Preparation

Prepare two kinds of buffer solution, two approx. 200 ml clean containers and cleaning water for pH sensor such as high purity water. Also prepare a thermometer to measure buffer solution temperature for manual calibration using buffer solution when temperature is to be compensated manually.

7.2.2 Procedure for Manual Calibration using Buffer Solution When Temperature is Automatically Compensated

(1) First press (MODE) key in measurement mode and select MAN.CAL (manual calibration mode) using (YES) (NO) key. [HOLD] is displayed on the display and the transmission output is held.

Note: If *HLD.OF is selected in the setting level *SET.HD (hold parameter setting mode), the transmission output will not be held.

(2) At this time point, remove the pH sensor from the installation condition for operation.

(3) Clean the removed pH sensor tip using water and wipe away any water drops.

(4) Pour approx.50 to 100 ml of buffer solution for the first calibration into the container.

(5) Dip the pH sensor tip into the buffer solution in the container.

(6) " START [YES] [NO] " is displayed in the message area to request calibration start. After confirming that the pH value displayed in the display is stabilized sufficiently, press (YES) key.

Note: In manual calibration mode, automatic pH value stability detection is not performed and the pH sensor e.m.f. at the moment, when (YES) key is pressed, is calibrated.

(7) The buffer solution temperature is displayed in the message area and " [▷] [△] [ENT] " flashes to request pH value data setting. Set the pH value using (>) (∧) key and enter it using (ENT) key.

(8) When (ENT) key is pressed, the first calibration is over, performing one-point calibration. "CAL.END [YES] [NO] " is displayed in the message area. Press (YES) key to complete calibration if one-point calibration is required, press (NO) key if two-point calibration is required.

(9) Pour approx. 50 to 100 ml of buffer solution for the second calibration into the container.

(10) Wash the removed pH sensor tip using water and wipe away any water drops. Then perform the same operation as the first calibration following steps (5) through (7) above.

(11) When ENT key is pressed, the second calibration is completed, performing two-point calibration. "CAL.END YES NO " is displayed in the message area. Press YES key to finish the calibration using buffer solutions.

Note: When an abnormal event occurs during calibration, an error No. is displayed in the message area. However, even if an abnormal event on manual calibration may occur during calibration, FAIL display (abnormal status) is not invoked. In this case, take action referring to "7.4 Remedies When an Error Occurs During Calibration Using Buffer Solution".

(12) Return the pH sensor to the installation condition for operation.

(13) "HOLD.ON YES NO " is displayed in the message area. Press NO key to release the transmission output hold status and return to the measurement status (measurement mode).

Note 1: If YES key is pressed, the converter returns to the measurement mode holding the transmission output.

Note 2: If *HLD.OF is selected in the setting level *SET.HD (hold parameter setting mode), "HOLD.ON YES NO " is not displayed in the message area and the converter returns automatically to the measurement mode directly without passing the hold mode.

7.2.3 Procedure for Manual Calibration using Buffer Solution When Temperature is Manually Compensated

(1) First select the hold mode to display "HOLD.ON [YES] [NO]". Press (YES) key to hold the transmission output. [HOLD] is displayed on the display and the transmission output is held.

Note 1: This operation is unnecessary when holding transmission output is not required.

Note 2: If *HLD.OF is selected in the setting level *SET.HD (hold parameter setting mode), the hold mode will be skipped and be unavailable.

(2) At this time point, remove the pH sensor from the installation condition for operation.

(3) Wash the removed pH sensor tip using water and wipe away any water drops.

(4) Pour approx. 50 to 100 ml of buffer solution for the first calibration into the container.

(5) Dip the pH sensor tip into the buffer solution in the container.

(6) Measure the buffer solution temperature using a thermometer.

(7) Next select TEMP (temperature parameter setting mode) and press (YES) key on the "T.MAN [YES] [NO]" display to set the measured temperature.

(8) After these operations are over, press (MODE) key and select MAN.CAL (manual calibration mode) using (YES), (NO) key.

(9) "START [YES] [NO]" is displayed in the message area to prompt calibration start. Press (YES) key after confirming that the pH value displayed on the display is stabilized sufficiently.

Note: The automatic pH value stability detection is not made in the manual calibration mode, so the pH sensor e.m.f. at the moment when (YES) key is pressed is the calibration object.

(10) The buffer solution temperature is displayed in the message area and "[▷] [△] [ENT]" flashes to request pH value data setting. Set the pH value using (>) and (∧) keys and enter it using (ENT) key.

(11) When (ENT) key is pressed, the first calibration is completed, performing one-point calibration. "CAL.END [YES] [NO]" is displayed in the message area. Press (YES) key to finish calibration if one-point calibration is required ; press (NO) key if two- point calibration is required.

(12) Pour approx. 50 to 100 ml of buffer solution for the second calibration into the container.

(13) Wash the removed pH sensor tip using water and wipe away any water drops. Then perform the same operation as the first calibration following steps (9) through (10) above.

(14) When (ENT) key is pressed, the second calibration is completed, performing two-point calibration. "CAL.END [YES] [NO]" is displayed in the message area. Press (YES) key to finish the calibration using buffer solutions.

Note: When an abnormal event occurs, an error No. is displayed in the message area. However, even if an abnormal event on manual calibration may occur during calibration, [FAIL] display (abnormal status) is not invoked. In this case, take action referring to "7.4 Remedies When an Error Occurs During Calibration using Buffer Solution".

(15) Return the pH sensor to the installation condition for operation.

(16) "HOLD.ON YES NO" is displayed in the message area. Press NO key to release the transmission output hold status and return to the measurement status (measurement mode).

Note 1: If YES key is pressed, the converter returns to the measurement mode holding the transmission output.

Note 2: If *HLD.OF is selected in the setting level *SET.HD (hold parameter setting mode), "HOLD.ON YES NO" is not displayed in the message area and the converter returns automatically to the measurement mode directly without passing the hold mode.

Note 3: Remember to set the measured process temperature manually after the calibration using buffer solution is completed.

7.3 90% Response Time Check

90% response time check aims at determining the degree of the pH sensor aging deterioration by measuring the pH sensor 90% response time using two kinds of buffer solution (to be referred to as A and B hereinafter) in AUT. CAL (automatic calibration mode). The 90% response time herein called is to be defined as the time required for the pH value to change from 100% to 90% of the full span (A-B) shown in Figure 7.2 below.

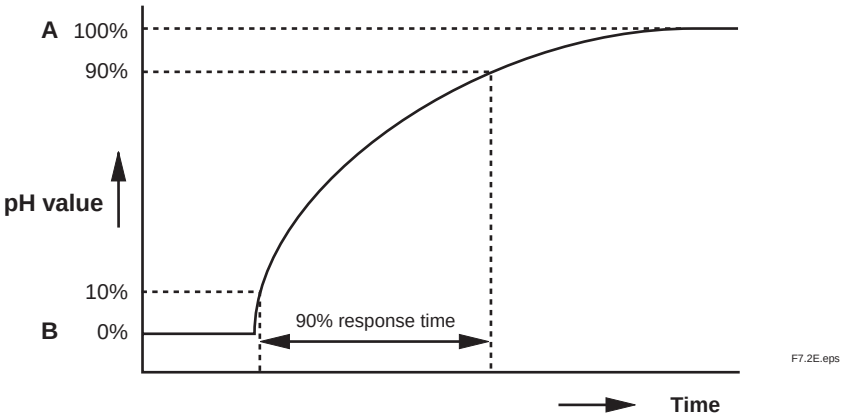


Figure 7.2 90% Response Time

This 90% response time check can be performed using the same two type of buffer solution only after two-point calibration is performed using two types of buffer solution among pH4, pH7 and pH9 buffer solutions in AUT. CAL (automatic calibration mode).

Note 1: Abnormal status (FAIL lamp is lit) will be invoked if the 90% response time exceeds the value set by the service code 24.

Note 2: The latest 90% response time check result can be viewed in DISP (message display selection mode). However, "RES.--" will be displayed if 90% response time check is not performed.

7.3.1 90% Response Time Check Procedure

Perform the following operations as soon as the two-point calibration described in "7.1.2 Procedure for Automatic Calibration using Buffer Solution When Temperature is Automatically Compensated" or "7.1.3 Procedure for Automatic Calibration using Buffer Solution When Temperature is Manually Compensated" is finished.

(1) "CAL.END [YES] [NO] " is displayed. Press (YES) key to finish the second buffer solution calibration thus ending two-point calibration. Then "RES. CHK [YES] [NO]" is displayed in the message area. Press (YES) key to perform the pH sensor 90% response time check.
(2) If the first buffer solution used for the two-point calibration is A and the second one is B, "B−A [YES] [NO]" will be displayed in the message area, indicating to measure 90% response time when the pH sensor is moved from buffer solution B to A. Press (NO) key to exit AUT. CAL (automatic calibration mode) when 90% response time check is cancelled.
(3) Press (YES) key to invoke "WAIT" display in the message area, with the pH converter waiting for the pH sensor to be moved from the buffer solution B to A. Accordingly, remove the pH sensor from the buffer solution B used for the second calibration and dip the sensor immediately into the buffer solution A used for the first calibration without cleaning the pH sensor tip.
(4) 90% response time measurement start automatically and the response time is counted in seconds in the data area while the "WAIT" display flashes in the message area.
(5) As the measured pH value reaches the specified buffer solution pH value, counting automatically stops and "RES.END [YES] [NO]" is displayed in the message area.
(6) Press (NO) key to perform 90% response time check once again ; press (YES) key to complete it.
(7) Return the pH sensor to the installation condition for operation, if (YES) key is pressed.
(8) "HOLD.ON [YES] [NO]" is displayed in the message area. Press (NO) key to return the converter to the measurement status (measurement mode) to release the transmission output hold status.

Note 1: If (YES) key is pressed, the converter returns to the measurement mode holding the transmission output.

Note 2: If *HLD.OF is selected in the setting level *SET.HD (hold parameter setting mode), "HOLD.ON [YES] [NO]" is not displayed in the message area and the converter returns automatically to the measurement mode directly without passing the hold mode.

Note 3: When the two-point calibration is performed according to "7.1.3 Procedure for Automatic Calibration using Buffer Solution When Temperature is Manually Compensated" and further, the 90% response time check is implemented, be sure to manually set the measured process temperature after checking is completed.

7.4 Remedies When an Error Occurs During Calibration Using Buffer Solution

Errors that occur during calibration operations using buffer solution are shown in Table 7.2 below.

Table 7.2 Errors Occurring during Calibration Operation using Buffer Solution

Error No.	Error detail	AUT.CAL (Automatic calibration mode)	MAN.CAL (Manual calibration mode)
Err. 0	Abnormal buffer solution temperature	○	—
Err. 1	Abnormal stability	○	—
Err. 2	Abnormal asymmetric potential	○	○
Err. 3	Abnormal slope	○	○
Err. 19	Input data setting out of range	—	○

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When these errors occur, each error is displayed in the message area. However, FAIL lamp is not lit even if an error occurs during the calibration operations using buffer solution. Accordingly, the contact output for FAIL does not operate.

When an error occurs, take the following measures.

(1) If with the error display, YES NO lamps flash, press YES or NO key to perform recalibration and confirm whether the error is reproduced or not.
(2) Remove the cause of the error referring to "9. TROUBLESHOOTING" if the error is reproduced during the recalibration.

Note: If the converter is returned to the measuring mode without removing the cause of the error, the pH value reflects the calibration data before entering into the calibration using buffer solution. That is, the calibration data is not updated when an abnormal event occurs.

8. MAINTENANCE

8.1 Periodic Maintenance

8.1.1 Electrode Washing

Stains on the pH sensor glass membrane and/or liquid junction may cause measured-value instability and drift and reduce response speed. Therefore, it is essential that the electrode be washed periodically as part of regular maintenance.

However, when the pH sensor is used and automatic continuous (for ultrasonic cleaning) or intermittent (cleaning with a water jet or brush) washing is done, most stains are removed. Therefore, usually it is not necessary to perform manual washing in addition to the above automatic washing. Even if acid washing becomes necessary to remove chemical stains caused by metal attachments, the maintenance man-hours required are very small compared with if no automatic washing is done.

For the actual washing procedure, see item "Maintenance of IM for pH sensor".

8.1.2 Calibration

pH sensor e.m.f. varies with electrode deterioration and staining of the electrode both of which may cause measurement error. Therefore, do calibration using buffer solution periodically to maintain accurate pH measurement.

Calibration intervals vary widely with operating conditions. At the initial stage of operation, do calibration once a week to gather data to be used in determining calibration intervals.

Note : For calibration execution procedure using buffer solution see "7. CALIBRATION ".

8.1.3 Refilling the pH Sensor with KCl Solution

When the PH8EFP KCl refillable type pH Sensor or PH8EHP pH sensor for high-purity water is used, refill it with KCl solution if the reserve tank gets empty. Also, when the fermentation pH sensor is used, pour the solution directly into the electrode if the inner solution level has fallen when viewed through the holder window.

For the KCl solution top up procedure, see item Maintenance of IM for the relevant pH sensor.

8.2 Inspection and Maintenance to Prevent Trouble

8.2.1 Inspection of Intelligent pH Converter Drying Status

If the GE terminal is not isolated with a resistance value of more than 10^{12} Ω, an abnormal measured-value may be displayed.

Once or twice a year, check to see if the inside of the intelligent outdoor pH converter is wet, as moisture may cause insulation resistance deterioration. When closing the front cover after inspection, check to see if there is any dust on the gasket sealing surface.

Note : However, the front cover should not be removed frequently.

8.2.2 Inspection of Intelligent pH Converter Window

Wipe any stains off the intelligent pH converter window (polycarbonate weather-proofed sheet) with soft paper such as tissue paper, etc. When the window is badly stained, neutral detergent may be used, but not organic solvent. If stains and scratches greatly kinder key operation and display checking, replace the window. (Part No. : K9313DW)

8.2.3 Wetted Part Sealing O-ring Inspection

When the KCl refillable type pH sensor is used, wetted part sealing O-rings are used at the glass electrode, liquid junction and sensor installation section when the sensor is installed on the immersion holder or flow-through holder. They are also used for the fermentation pH sensor at the holder electrode contact and fermentator holder insertion holes.

Check to see if the O-ring sealing characteristic has deteriorated. Note, however, that frequent O-ring checks may damage the O-ring sealing characteristic.

Note 1 : As a rule, use the replacement O-ring recommended by us.

Note 2 : When inspecting KCl refillable type pH sensors the glass electrode O-ring, do not wet the mounting hold.

Note 3 : It is recommended that the seal O-ring be replaced at fixed intervals. Pay close attention to this, especially when measured solution is strongly influenced by faulty O-ring seals (for example, when the fermentation pH sensor is used, the medium in the fermentation process may be greatly influenced).

8.2.4 Ultrasonic Washing Element Corrosion Inspection

This applies when the holder with as ultrasonic washing device (refillable KCl pH sensor) is used. Ultrasonic washing element material is selected so as to resist corrosion by the measured solution, but sometimes corrosion may occur. If this happens, the element should be replaced before the measured solution penetrates into the ultrasonic washing element.

8.2.5 Inspections of the KCl Reserve Tank and KCl Solution Refilling Tube

These apply when the KCl refillable type pH sensor or pH sensor for high-purity water is used. If the KCl solution leaks because of cracks in the reserve tank or damage to the KCl solution refilling tube, grounding connections will be made at two points. This may cause unstable readings or measurement errors. Periodically check the reserve tank for cracks and the KCl solution refilling tube for damage or deterioration to ensure that no leakage of KCl solutions occurs. It is recommended that the reserve tank or refilling tube be replaced with a new one if the potential for leakage, damage, or deterioration exists.

9. TROUBLESHOOTING

9.1 Error Display

The pH converter indicates an error (error No. flashes) in the message area when it detects an abnormal event, and at the same time FAIL is displayed.

As FAIL display is associated with the contact output for FAIL, the contact output for FAIL is turned ON to show that the converter is abnormal as soon as FAIL is lit. Also mA output and mV output can vary at the time of abnormal status (when FAIL is lit) by setting the service code 05 to burn-up or burn-down.

Exceptionally, however, when an error occurs during the calibration operation using buffer solution or the input data are improper (Err.17 and Err.19), error display only is presented.

Note 1: Even if the converter is in abnormal status, it is possible to transfer from the measurement mode to other mode. Also error display can be observed only in the measurement mode.

Note 2: In the case of simultaneous multierror occurrence, the error Nos. display in sequence.

Note 3: If upper limit alarm, lower limit alarm, high-high or low-low alarm is selected to be used as the contact output function, this contact output is temporarily inoperative at the time of the abnormal status (when FAIL is lit) as well as the time of the hold status (when HOLD is lit).

Error No. and its error details are shown in Table 9.1 .

Table 9.1 Error No. and its detail

Error No.	Abnormality details
Err. 0	Buffer solution temperature range (0 to 80 °C) out of range during automatic calibration
Err. 1	Stability insufficient during automatic calibration using buffer solution (when not stabilized in three minutes)
Err. 2	Asymmetry potential out of range (when exceeding ±120 mV range)
Err. 3	E.m.f. slope out of range (when exceeding 70 to 110% of theoretical value)
Err. 4	Glass electrode impedance failure (LOW : broken glass electrode etc.)
Err. 5	Glass electrode impedance failure (HIGH :glass electrode lead wire disconnection, etc.)
Err. 6	Reference electrode impedance failure (when exceeding the set upper limit)
Err. 7	Temperature measuring range out of range (when exceeding 140 °C)
Err. 8	Temperature measuring range out of range (when lower than -20 °C)
Err. 9	pH value measuring range out of range (when exceeding pH -2 to 15 range)
Err. 10	EEPROM abnormal (in writing to data holding IC)
Err. 11	Half-value recovery time abnormal during automatic washing (when exceeding the setpoint)
Err. 16	90% response time abnormal (when exceeding the upper limit setpoint)
Err. 17	mA output or mV output range setting failure (when the range is set to a narrower span than 1 pH or 50 °C)
Err. 19	Input data setting range abnormal
Err. 20	Initial adjustment value abnormal

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9.2 Remedis

When an error occurs, check the error No. and take the following measures in each case. The error No. display will not be erased until the cause of the error is removed.

9.2.1 "Err. 0" (Buffer Solution Temperature Range out of Range during Automatic Calibration)

"Err. 0" status is for the error message displayed when the buffer solution temperature exceeds the 0 to 80 °C range during the automatic calibration using buffer solution. Then the calibration data are not updated.

Press (YES) or (NO) key to perform automatic calibration using buffer solution once again using buffer solution the temperature of which is within the 0 to 80 °C range.

9.2.2 "Err. 1" (Stability Insufficient during Automatic Calibration)

"Err. 1" is displayed when a pH value is not stabilized in three minutes during automatic calibration. Then the calibration data are not updated. First check if there is any attached soiling or the performance does not recover after acid cleaning. Also check if the judging parameter ΔT and ΔpH, set forth at the service code 06, are proper. If no problem is found, in principle replace the glass electrode or liquid junction with a new one, because the error may be caused by electrode response performance deterioration.

9.2.3 "Err. 2" (Asymmetry Potential out of Range)

"Err. 2" stands for an error when the asymmetry potential exceeds the $\pm$120 mV range as a result of asymmetry potential check in computation during the calibration using buffer solution. Then the calibration data are not updated.

First check if there is any attached soiling and/or if normal status is recovered after acid cleaning. Also consider whether the buffer solution used for the calibration is old and degraded beyond the pH value allowance. Or if it might be attributed to improper manual pH value input in the manual calibration mode.
If the error is displayed again even during the recalibration using buffer solution after acid cleaning, the glass electrode or the liquid junction must be replaced.

Note: Asymmetry potential check is performed when asymmetry potential check ON is set at the service code 03.

9.2.4 "Err. 3" (E.m.f. Slope out of Range)

"Err. 3" stands for an error when the e.m.f. slope exceeds 70 to 110% range of the theoretical value as a result of e.m.f. slope check during the calibration using buffer solution. Then the calibration data are not updated.
First check if there is any attached soiling and/or if normal status is recovered after acid cleaning. Also consider whether the buffer solution used for the calibration is old and degraded beyond the pH value allowance. Or if it might be attributed to the improper manual pH value input in the manual calibration mode.
If the error message is displayed again even during the re-calibration using buffer solution after acid cleaning, the glass electrode or the liquid junction must be replaced.

Note: The slope check is performed when slope check ON is set at the service code 03.

9.2.5 "Err. 4" (Glass Electrode Impedance Failure:LOW)

"Err. 4" stands for an error when the glass electrode impedance shows an abnormally low value as a result of impedance check. The error is mainly caused by the glass electrode breakage. Check the glass electrode and replace it when broken.

Note: The glass electrode impedance check is performed when impedance check ON is set at the service code03 ; however, if the measured solution exceeds 60 °C, the glass electrode impedance check is not conducted even if impedance check is ON.

9.2.6 "Err. 5"(Glass Electrode Impedance Failure: HIGH)

"Err. 5" stands for an error when the glass electrode impedance shows an abnormally high value as a result of impedance check.
The error is mainly caused by a shortage of measured solution which keeps the electrode away from the measured solution surface or a disconnected glass electrode lead wire. Check both possibilities and replace the glass electrode if the lead wire is disconnected.

Note: The glass electrode impedance check is performed when the impedance check ON is set at the service code03 ; however, if the measured solution temperature exceeds 60 °C, the glass electrode impedance check is not conducted even if impedance check is ON.

9.2.7 "Err. 6" (Reference Electrode Impedance Failure)

"Err. 6" stands for an error when the reference electrode impedance exceeds the upper limit setpoint at the service code03 as a result of impedance check. The error is mainly caused by clogging in the liquid junction ; check if the clogging is removed by cleaning ; replace the liquid junction if it is unrecoverable. In addition, confirm whether or not the upper limit value is properly set.

Note: The liquid junction impedance check is performed when impedance check ON is set at the service code 03.

9.2.8 "Err. 7" (Temperature Mearuring Range out of Range: HIGH)

"Err. 7" stands for an error when the measured solution temperature exceeds 140 °C. Keep the measured solution temperature below 140 °C. If the error display is not cleared even after the solution temperature falls lower than 140 °C, check the pH sensor cable connection to verify an RTD failure. In this case, replace the pH sensor.

9.2.9 "Err. 8" (Temperature Measuring Range out of Range: LOW)

"Err. 8" stands for an error when the measured solution temperature falls below -20 °C. Keep the solution temperature above -20 °C. If the error display is not cleared even after the solution temperature rises to exceed -20 °C, an RTD failure is very probable. If failed, replace the pH sensor.

9.2.10 "Err. 9" (pH value Measuring Range out of Range)

"Err. 9" stands for an error when the measured solution pH value exceeds -2 to 15 pH range. Usually the error is caused by sensor system problems rather than actual measured solution pH value ; therefore check the sensor after confirming that no soiling or moisture is adhering to the sensor cable connecting part to cause insulation deterioration.

9.2.11 "Err. 10" (EEPROM Abnormal)

"Err. 10" stands for an error when a writing error to the data holding IC is detected. "Err. 10" is caused by the intelligent outdoor pH converter failure, contact Yokogawa Service Office or the Yokogawa Sales Office Representative.

9.2.12 "Err. 11" (Half-value Recovery Time Abnormal)

"Err. 11" stands for an error when the limit time set at the service code 21 is exceeded as a result of half-value recovery time check during automatic washing. First confirm if the set time limit is proper. Also observe if the glass/reference electrode is contaminated. If the error display is not cleared even after checking the half-value recovery time once again using acid-cleaned glass/reference electrode, replace the glass electrode or the liquid junction because of their possible deterioration.

Note: The half-value recovery time check is performed when half-value recovery time check ON is set at the service code 21.

9.2.13 "Err. 16" (90% Response Time Abnormal)

"Err. 16" stands for an error when the set limit time is exceeded as a result of 90% response time check. First check if the glass/reference electrode is contaminated. If the error display is not cleared even after checking the 90% response time once again using acid-cleaned glass/reference electrode, replace the glass electrode or the liquid junction because of their possible deterioration.

9.2.14 "Err. 17" (mA Output or mV Output Range Setting Failure)

"Err. 17" stands for an error when the range of 4 to 20 mA output or 0 to 1 V output is set with a narrower range span than 1 pH or 50 °C at the setting level *OUTPU (output setting mode).

When this error No. is displayed, data updating is not conducted. Press (YES) key or (NO) key to clear this error display: re-enter the proper span wider than 1 [pH] or 50 [°C].

9.2.15 "Err. 19" (Input Data Setting Range Abnormal)

"Err. 19" stands for an error when the set values exceed the settable range in setting the data in the operation level, setting level or service level. When this error No. is displayed, data updating is not conducted. Press (YES) key or (NO) key to clear the error display ; re-enter the proper set values.

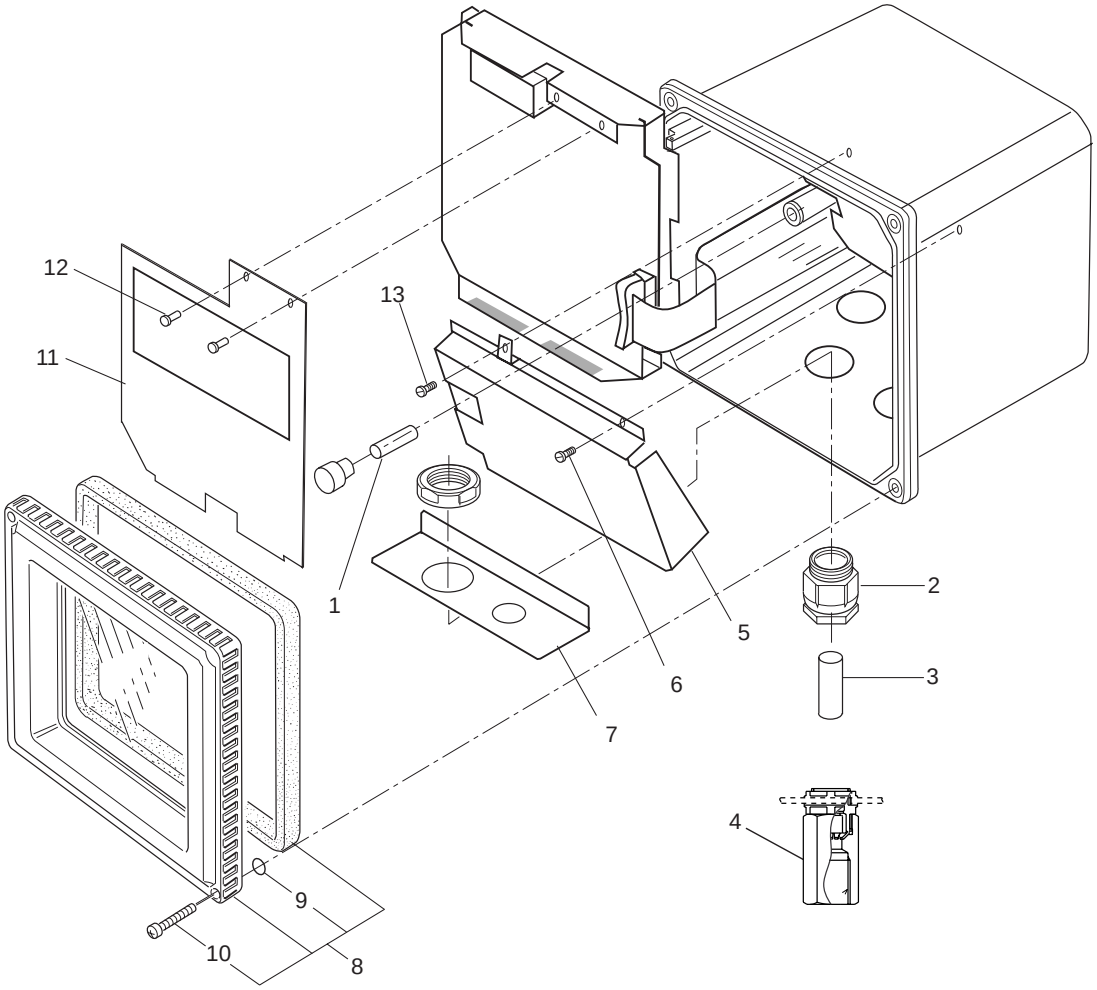
9.2.16 "Err. 20" (Initial Adjustment Value Abnormal)

"Err. 20" stands for an error when an abnormality of the basic set value adjusted in the pH converter fabrication is detected. Contact Yokogawa Service Office or the Yokogawa Sales Office Representative.

Customer Maintenance Parts List

EXA PH

Model PH400G
Intelligent Outdoor pH Converter



Item	Part No.	Qty	Description
1	A1103EF	1	Fuse (100mATime Lag Fuse)
2	B1002JZ	4	Cable Gland
3	K9334CN	3	Insert
4	K9141TX	4	Fitting (for Option Code: /AFTG)
	K9311KQ	4	Adapter (for Option Code: /ANSI)
5	K9313BK	1	Bracket
6	Y9405LU	1	Screw
7	K9313BL	1	Shield
8	K9313DW	1	Cover Assembly
9	K9221US	4	O-Ring
10	Y9420LU	4	Screw
11	K9313BM	1	Plate
12	L9813UT	1	Rivet
13	K9313DX	1	Screw

YOKOGAWA
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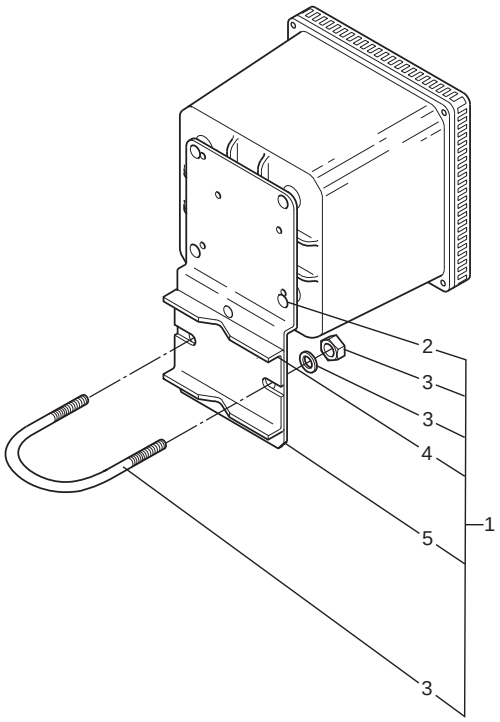
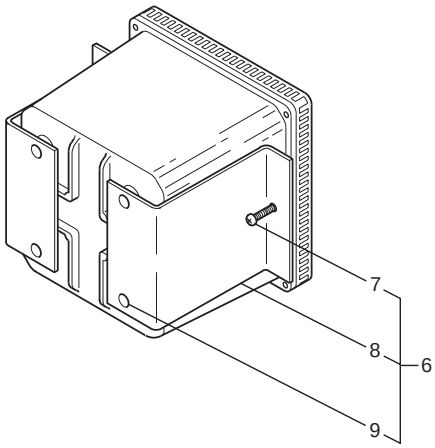
CMPL 12B7C1-02E
1st Edition : Apr. 1992 (YK)
3rd Edition : Mar. 2011 (YK)

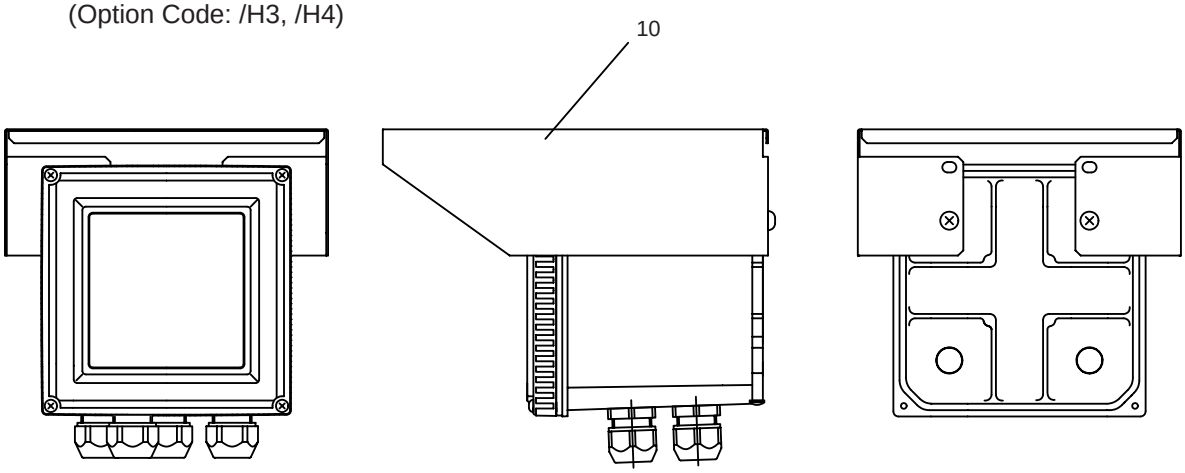
Pipe/Wall Mounting Hardware
(Option Code : /U)



Panel Mounting Hardware
(Option Code : /PM)



Sun Protection Cover
(Option Code: /H3, /H4)



Item	Part No.	Qty	Description
1	K9171SS	1	Mounting Set (/U)
2	Y9608KU	4	Screw
3	D0117XL-A	1	U-Bolt Assembly
4	K9171SY	1	Plate
5	K9171SX	1	Bracket
6	K9171ST	1	Mounting Set (/PM)
7	Y9520LU	2	Screw
8	K9171SW	2	Bracket
9	Y9608KU	4	Screw
10	——		Sun Protection Cover
	K9664CA	1	Cabon steel (/H3)
	K9664CC	1	Stailess steel (/H4)

Revision Record

Manual Title : Model PH400G Intelligent Outdoor pH Converter
Manual Number : IM 12B7C1-02E

Edition	Date	Remark (s)
1st	1992	Newly published
2nd		
3rd	Sep. 1995	
4th	July. 2006	IM Style & Format is renewed. Revised and Corrected all over. ("After sales warranty" added, etc.)
5th	Aug. 2007	p.i, Revisions of IM No. to be refered; p.2-7, Additions of option code /H3 and /H4 for awning hood, deletion of /H; p.2-8, Revisions of PH400G external dimensions for /H3 and /H4 awning hood; p.3-3, Revisions of Figure 3.4; p.8-2, Caution for KCl solution leakage of reserve tank added to 8.2.5 Inspections of the KCl Reserve Tank and KCl Solution Refilling Tube.
6th	Apr. 2011	Over all revised.

User's Manual

Model PH400G
Intelligent Outdoor pH Converter

Supplement

Thank you for selecting our Model PH400G Intelligent Outdoor pH Converter.
The Instruction Manual IM 12B7C1-02E 6th edition supplied with this product has been amended as follows, please make a note in your copy.

On p.2-6, Additions of accessories.
On p.6-9, Some revisions of Figure 6.1
On p.6-10, Some revisions of Figure 6.2

YOKOGAWA
Yokogawa Electric Corporation

IM 12B7C1-02E
6th Edition

Details of failure detection by self-diagnosis function:

Response time error during calibration (time until pH value is settled)

Asymmetry potential failure

e.m.f. slope failure

Temperature range failure

pH range failure

Glass electrode impedance failure (measured solution must be 50 mS/cm or more, and temperature 60 °C or less)

Reference electrode impedance failure (measured solution must be 50 mS/cm or more)

Half value recovery time failure

90% response time failure

Calibrating solution temperature failure

2.2 Model and Codes

Model	Suffix Code	Option Code	Description
PH400G	·····	·····	4-wire pH Converter
Power Supply	-1 ·····	·····	100/110 V AC, 50/60 Hz
	-2 ·····	·····	200/220 V AC, 50/60 Hz
Language for warning, etc	-J ·····	·····	Japanese
	-E ·····	·····	English
———	A ·····	·····	Always A
———	*B ·····	·····	Style B
Options	Mounting hardware	/U	Pipe, wall mounting bracket (stainless steel)
		/PM	Panel mounting bracket (stainless steel)
	Hood	/H3	Awning hood (carbon steel)
		/H4	Awning hood (stainless steel)
		/X1	Baked epoxy resin
	Tag plate	/SCT	Stainless steel tag plate
	Conduit Adapter	/AFTG	G1/2
		/ANSI	1/2 NPT
		/SPS	Teflon coated SUS steel screws

T2.4E.eps

Accessories

Item	Part Number	Remarks
Label for contact signals	K9313PC	For display on the operation panel
Spare fuse	K9313PS	0.1 A (for either a 100V or 200V power line)
Pipe/wall mounting bracket	K9171SS	Attached when option code "/U" is specified
Panel mounting bracket	K9171ST	Attached when option code "/PM" is specified
Shading hood	K9664CA	Attached when option code "/H3" is specified
Shading hood	K9664CC	Attached when option code "/H4" is specified
Tag plate	Y9412NP	Attached when option code "/SCT" is specified
Conduit adpter	Y9313PN	Attached when option code "/AFTG" is specified
Conduit adpter	Y9313PW	Attached when option code "/ANSI" is specified

T2.5E.eps

(d) *WASH (Washing mode)

Only when contact output S3 is set at "washing (WASH)" in the service mode, does this washing mode work. Otherwise this mode is skipped. In this mode each parameter on washing is set.

● **Automatic/ Manual washing selection**

Select *AUTO when automatic selection is selected to set each parameter on the washing timer. Press the NO key to select *MAN when Manual washing is required. In performing manual washing press the YES key at *START display to start the washing operation and press the YES key once again at *STOP display to stop the washing operation.

● **Automatic washing (washing timer) ON/OFF selection**

When automatic washing (the washing timer) is not used, always select *T.OFF. Select *T. ON only when the washing timer is used. Set the washing cycle t_{INT}, the washing time t_W, relaxation time t_R as shown in Figure 6.1 when *T. ON is selected. At the time of shipment *T. OFF is set.

WASH (flashing) is displayed in the message area when automatic washing is performed (contact output S3 is working) or during relaxation time. At that time, if MODE key is pressed, the operation in action will be cancelled.

Note 1: In Automatic/ Manual washing, the operation keeps working even if abnormal condition occurs and FAIL lamp is lit during the washing operation.

Note 2: Even in the abnormal condition the automatic washing and the manual washing operation is also usable.

Note 3: If the pH converter is in other mode than the measurement mode when the washing timer has counted the washing cycle t_{INT} to start automatic washing operation, the washing operation will not be carried out.

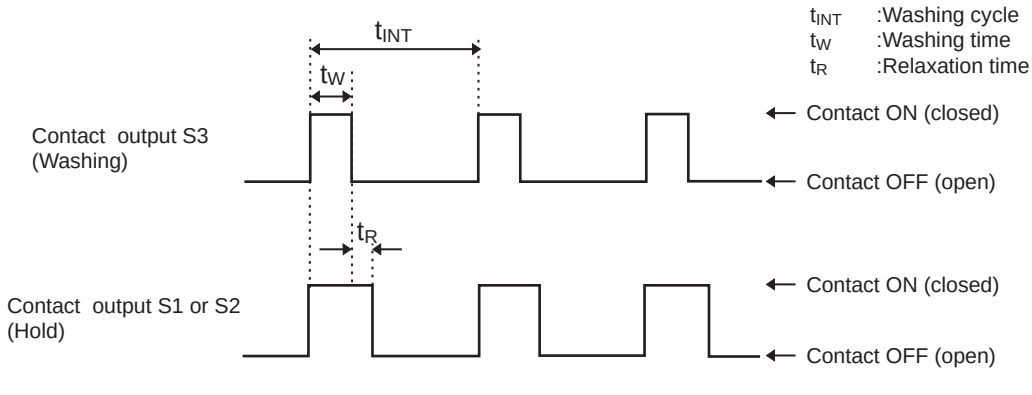


Figure 6.1 Contact Output when Washing Timer is used (Contact Output at the Time of Automatic Washing)

● **Washing cycle setting (when *T.ON is selected)**

Set the washing cycle (*INT.H) between 0.1 (hour) and 36.0 (hour).
0.0 (hour) is set at the time of shipment.

● **Washing time setting (when *T.ON is selected)**

Set the washing time (*WT.min) between 0.1 (min) and 10.0 (min).
0.1 (min) is set at the time of shipment.

● **Relaxation time setting (when *T.ON is selected)**

The relaxation time is to be set considering the time during which pH value fluctuation affected by washing liquid is stabilized after the washing operation is finished. Usually, as shown in Figure 6.1, the washing output contact is used with the hold output contact, and the hold output contact shifts from ON (closed) to OFF (open) after having passed this relaxation time counted from the time of the washing operation finish. Set the relaxation time (*RT. min) between 0.1 [min] and 10.0 [min]. 0.2 [min] is set at the time of shipment.

<Remote contact input >

The washing timer is driven by using the pH converter remote contact input when *AUTO and *T. ON are selected to perform automatic washing. R1 and R2 terminals on the pH converter terminal board are used for the remote contact input. In the following description, call "ON" when short-circuited between R1 and R2 and call "OFF" when opened between R1 and R2.

When automatic washing is performed with the washing cycle t_{INT} set at *INT. H as shown in Figure 6.2, the status between R1 and R2 becomes ON before the next washing begins, and the pH converter regards it as a manual start signal from outside and starts automatic washing after 0.25 sec. At that time the washing timer is non-reset. However, "ON" status between R1 and R2 must continue for more than 0.25 sec. just after the "OFF" status has continued for more than 0.25 sec. Otherwise the pH converter does not regard it as the manual start signal.

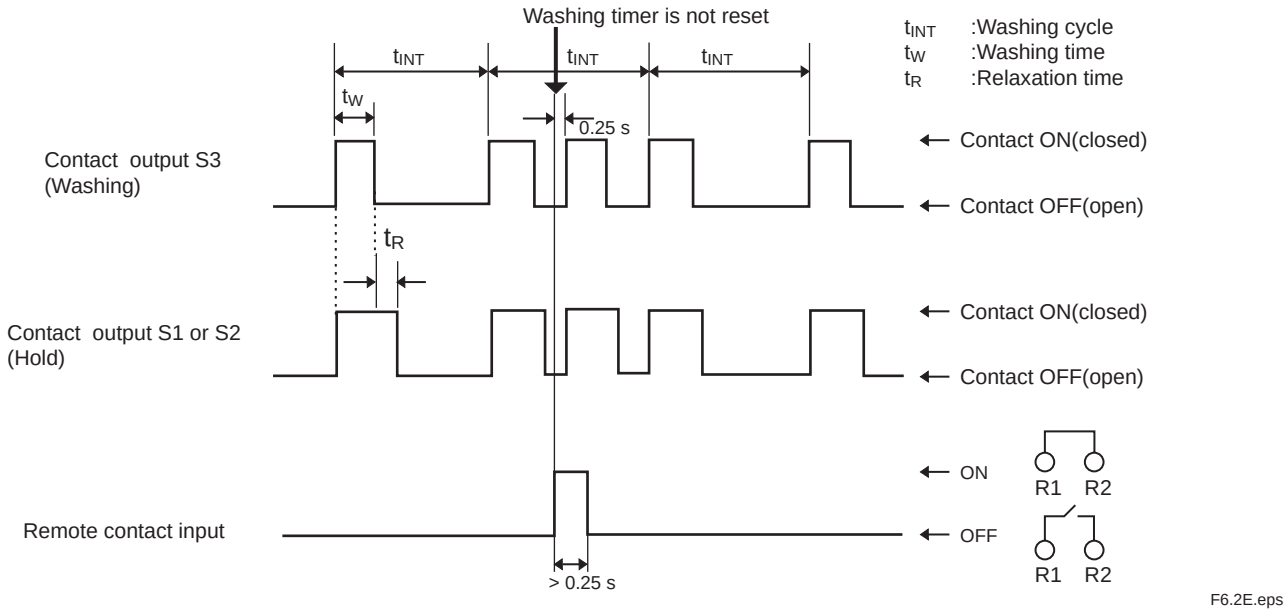


Figure 6.2 Contact Output when Washing Timer is Used (Contact Output with Remote Contact Input at the Time of Automatic Washing)

Note 1: Remote contact input is acceptable only when the pH converter is in the measurement mode and *AUTO and *T.ON is selected at the washing mode.

Note 2: In the same as the usual automatic washing, the automatic washing operation initiated by the remote contact input can be cancelled by pressing (MODE) key during the washing or relaxation time period. The washing operation initiated by the remote contact input continues working even if entered during abnormal status and the [FAIL] lamp is lit during the washing operation.

Note 3: Even if in the abnormal status ([FAIL] lamp is lit), the pH converter accepts the remote contact input.